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The Effects of Some Environmental Factors on Colostrum Quality in Anatolian Buffaloes

Anadolu Mandalarında Kolostrum Kalitesi Üzerine Bazı Çevresel Faktörlerin Etkileri

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THE EFFECTS OF SOME ENVIRONMENTAL FACTORS ON COLOSTRUM QUALITY IN ANATOLIAN BUFFALOES

ABSTRACT:

The aim of this study was to determine colostrum quality (specific gravity) and some environmental factors in Anatolian buffaloes reared under similar farm conditions in Amasya province, Turkey. Calving age (from 3 to 6, 7 to 10≤), calving year (2019 and 2020), calving season (winter, spring and summer) and sex of calf were considered as fixed factors on colostrum quality. A total of 44 colostrum samples of Anatolian buffaloes constituted the research material. Colostrum samples were taken from the first colostrum within 2 h after calving at buckets after hand milking and immediately stored at -20°C until analyzed. The colostrum quality was determined using a colostrometer and the colostrum quality was classified as poor quality (red: <1035 g/ml), intermediate quality (yellow: 1035-1045 g/ml) and good quality (green: >1045 g/ml). The mean concentration of IgG in colostrum was affected by calving season (P<0.05). Effects of calving age, calving year and sex of calf on colostrum quality were not significant (P>0.05). The colostrum quality of the total samples was determined in good class (IgG: 1050±1.88 g/ml). In this study, the rations of good, intermediate and poor quality colostrum were determined as 56.8%, 25.0% and 18.2%, respectively. The results showed that Anatolian buffaloes had good quality colostrum, and more studies with a greater sample size are needed to investigate the factors affecting colostrum quality.

Keywords: Anatolian Buffalo, Buffalo Farming, Colostrum Quality, Environmental Factors.

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ANADOLU MANDALARINDA KOLOSTRUM KALİTESİ ÜZERİNE BAZI ÇEVRESEL FAKTÖRLERİN ETKİLERİ

ÖZ:

Bu çalışmanın amacı, Amasya ilinde benzer çiftlik koşullarında yetiştirilen Anadolu mandalarında kolostrum kalitesi (özgül ağırlık) ve bazı çevresel faktörlerin belirlenmesidir. Buzağılama yaşı (3-6, 7-10≤), buzağılama yılı (2019 ve 2020), buzağılama mevsimi (kış, ilkbahar ve yaz) ve buzağının cinsiyeti kolostrum kalitesi üzerinde sabit faktörler olarak dikkate alındı. Anadolu mandalarından toplam 44 kolostrum örneği araştırma materyalini oluşturmuştur. Kolostrum örnekleri elle sağımdan sonra kovalarda buzağılamadan 2 saat sonra ilk kolostrumdan alındı ve analiz edilene kadar hemen -20 °C'de saklandı. Kolostrum kalitesi bir kolostrometre kullanılarak belirlendi. Kolostrum kalitesi kötü kalite (kırmızı: <1035 g/

ml), orta kalite (sarı: 1035-1045 g/ml) ve iyi kalite (yeşil: >1045 g/ml) olarak sınıflandırıldı. Kolostrumdaki ortalama IgG konsantrasyonu malaklama mevsiminden etkilenmiştir (P<0.05). Malaklama yaşı, malaklama yılı ve malak cinsiyetinin kolostrum kalitesine etkisi önemli değildir (P>0.05). Toplam örneklerin kolostrum kalitesi iyi sınıfta (IgG: 1050±1.88 g/ml) belirlendi. Bu çalışmada iyi, orta ve düşük kaliteli kolostrum oranları sırasıyla %56.8, %25.0 ve %18.2 olarak belirlendi. Sonuçlar Anadolu mandalarının kaliteli kolostruma sahip olduğunu göstermiş olup, kolostrum kalitesini etkileyen faktörlerin araştırılması için daha büyük örneklem büyüklüğüne sahip daha fazla çalışmaya ihtiyaç duyulmaktadır.

Anahtar Kelimeler: Anadolu Mandası, Manda Yetiştiriciliği, Kolostrum Kalitesi, Çevresel Faktörler.

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1. INTRODUCTION

Newborn calves need their mother's colostrum because they are born without protective immunoglobulins to protect it against disease (El-Fattah et al., 2012). Maternal colostrum provides them with essential nutrients and bioactive compounds to sustain life. In this respect, a rapid test needs to monitor their immune status. Because calves have relatively limited time before their intestines close. There was a tendency for more susceptible to infectious diseases and higher morbidity and mortality rates, as well as diarrhea and respiratory disease in calves with a failure of passive immunity transfer (Giammarco et al., 2021). Therefore, colostrum for passive immunity transfer is essential for the calf's health and survival during the neonatal period (El-Fattah et al., 2012). Feeding good quality colostrum to newborn calves is essential to ensure their birth weight and production traits.

Colostrum, known as first milk, is a form of milk produced by the mammary after birth and it is thick and yellowish-white fluid. Colostrum, called Liquid Gold (Dang et al., 2009; El-Fattah et al., 2012) is more nutritious and digestible than normal milk. It contains very large amounts of more protein (lactalbumins, lactoglobulins and immunoglobulins), fat, vitamins (A, E, D, B), minerals and lower lactose concentration (Kuralkar and Kuralkar, 2010). Colostrum is relatively rich in immunoglobulins (IgA, IgG, IgM), growth factors (prostaglandins), hormones (insulin, prolactin, thyroid hormones, cortisol), peptides (lactoferrin, transferrin), enzymes, cytokines, acute phase proteins (C1- glycoprotein), nucleotides, polyamines and cell elements than mature bovine milk (Kuralkar and Kuralkar, 2010; El-Fattah et al., 2012). IgG, IgA, and IgM account for approximately 86%, 8%, and 6% of the total immunoglobulin (Ig) (Souza et al., 2020). IgG, which consists of $IgG_{1,}$ IgG_2, IgG_3, and IgG_4 (Wąsowska and Puppel, 2018) is main responsible for passive immunity in the first several months of life of calves (Souza et al., 2020) and IgG_1 makes up for 80% to 90% of the total Ig (Godden et al., 2019).

After birth, as soon as possible and high-quality colostrum is most important to the calf's health and well-being. The adverse consequences of inadequate absorption of IgG by the neonatal calf such as reducing long-term potential growth and productivity, and increased risk of disease and death are well documented (Chaudhary et al., 2017). Feeding poor quality colostrum with a low Ig concentration leads to high mortality and morbidity rates in calves (Usha et al., 2020). For these reasons, early determination of colostrum quality for increased immunity is fundamental for good neonatal management at the farm. Calves suck colostrum within 2 to 3 h after birth, and absorption of Ig declines rapidly after 12 h with a mean gut closure time of 24 h after birth (Lombardi et al., 2001). Therefore, high-quality colostrum within the first 24 h of life is essential in order to develop the calf's health and performance (Giammarco et al., 2021).

There are various factors affecting the colostrum composition and its quality such as parity, maternal age, season, breed, nutritional status and colostral handling factors (El-Fattah et al., 2012). Although much research have been conducted on the factors associated with colostrum quality in cows, information relating to the colostrum quality of buffaloes is limited. The objectives of this study were to determine the colostrum quality and reveal some environmental factors affecting colostrum quality in Anatolian buffaloes.

2. MATERIAL AND METHODS

The study material consisted of 44 colostrum samples taken from Anatolian buffaloes raised under similar conditions in small-scale farms within the scope of the National Anatolian Buffalo Development Program carried out by the Ministry of Agriculture and Forestry, General Directorate of Agricultural Research and Policies in Amasya.

Buffalo husbandry is carried out by small-scale family enterprises and use traditional husbandry methods in Amasya province. Buffaloes raised on these farms were kept in tied-stall barns. Animals were fed twice daily in equal proportions after milking. The buffaloes that graze on the pastures for eight months of the year are taken to the pasture in the morning and the barn in the evening. Buffaloes are taken from the pasture to the barn in November.

Buffalo colostrum samples were taken up to two hours after calving. Colostrum samples were taken in a sterile bottle of approximately 250. Samples were stored at −20 °C until further analysis in the deep freeze. Frozen colostrum samples were firstly thawed in a hot water bath at 37°C and also heated at 20-22 °C in water bath. Colostrum quality was measured by its specific gravity using a colostrum densimeter (Kruuse colostrometer, Langeskov, Denmark) by determining the relationship between the amount of immunoglobulin and specific gravity. The colostrum qual-

ity was determined using a colostrometer and the colostrum quality was classified as poor quality (red: <1035 g/ml), intermediate quality (yellow: 1035-1045 g/ml) and good quality (green: >1045 g/ml).

Calving age (from 3 to 6, 7 to 10≤) calving year (2019 and 2020), calving season (winter, spring and summer) and sex of calf (male and female) were used as fixed factors. The following mathematical models on colostrum quality were applied:

$$Y_{ijklm} = \mu + A_i + Y_j + S_k + C_l + e_{ijklm}$$

Where, Y_{ijklm}= the observations, μ: overall mean, A_i Effect of i^{th} calving age, Y_j = Effect of j^{th} calving year, S_k= Effect of k^{th} calving season, C_l= Effect of l^{th} sex of calf, e_{ijklm}= Random error.

The results were presented as mean ± SEM (standard error of the mean). All data were analyzed using SPSS Version 17.0. Statistical analysis was performed by general linear model's procedure followed by the Duncan test.

3. RESULTS AND DISCUSSION

The results of IgG in buffalo colostrum are shown in Table 1. The concentration of IgG in buffalo colostrum was 1050±1.88 g/ml and it was found as good quality. In this study, 56.8% of colostrum samples with >1045 g/ml were good quality colostrum and the highest. Also, colostrum with 1035-1045 g/ml as being of intermediate quality colostrum was 25.0%. However, 18.2% of colostrum samples were of poor quality (Table 1) and therefore colostrum with a value below 1035 g/ml should not be used for buffalo calves.

Table 1. Frequency for colostrum quality

Quality	n	Frequency (%)
Poor	8	18.2
Intermediate	11	25.0
Good	25	56.8
Mean	44	100.0

Poor: IgG<1035 g/ml), Intermediate: IgG=1035-1045 g/ml, Good: IgG>1045 g/ml

Das and Behera (2015) the colostrum quality was classified as good quality (>50 mg/ml), moderate quality (20-50 mg/ml) and poor quality (<20 mg/ml).

Similar results were published by Arain et al. (2008) for IgG in buffalo colostrum. Similarly, Dang et al. (2009) and Giammarco et al. (2021) reported that the mean IgG in buffalo colostrum was determined as 54.0 mg/ml and 64.9 mg/ml, respectively. Zhang et al. (2001) reported that IgG level in colostrum was found to be high (67.2 mg/ml). Differently, El-Fattah (2012) reported that moderate quality colostrum in buffaloes (36 mg/ml).

As shown in Figure 1, the calving year on IgG was not significant (P>0.05). The concentration of IgG was the highest at 1052±2.39 g/ml in the 2019 year, followed by the 2020 year with values of 1048±3.01 gr/ml, respectively, however, differences were not significant (P>0.05).

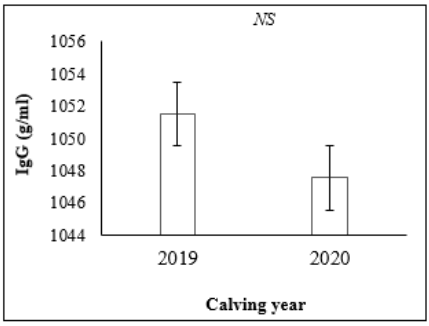

Figure 1. Effect of calving year on IgG
NS: Not significant (P>0.05)
Calving year: 2019 (n=28), 2020 (n=16)

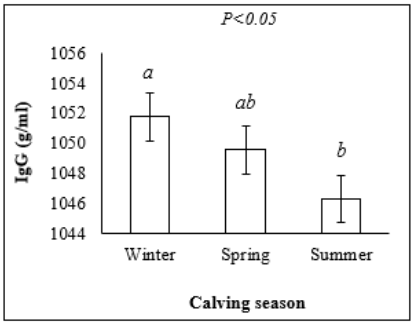

Figure 2. Effect of calving season on IgG
[a,b]: Different letters on the same line indicate statistically significant differences (P<0.05) Calving season: winter (n=21), spring (n=16), summer (n=7)

Calving season had significant effect on IgG (Figure 2). The concentrations of IgG increased in the winter season (1052±2.74 g/ml) and decreased in the summer season (1046±5.34 g/ml), however, there were no significant differences in the spring season (1050±2.98 g/ml). This may be due to deficient immune status of calves in summer compared to other seasons. Similarly, Zarei et al. (2017) reported that the highest colostral IgG concentration in Holstein colostrum was determined during the winter months. The results of present study were in different with those of Agrawal et al. (2015). However, this finding disagrees with the report of Yaylak et al. (2017), who observed that calving season had no effects on major components of Holstein colostrum. This might be related to differences in their secretion patterns in different seasons. Because colostral IgG concentration depends on the action of the immune cells in the udder. Summer season is the stressful conditions including temperature and humid (Zarei et al., 2017). Stress leads to decreasing IgG in summer season.

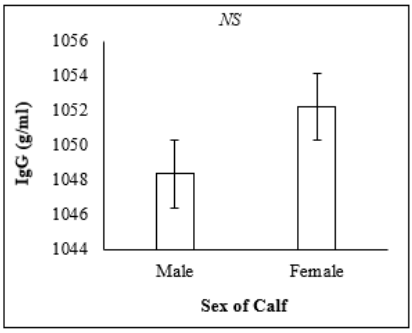

Figure 3. Effect of calving age on IgG
NS: Not significant (P>0.05)
Calving age: 3-6 (n=28), 7-10≤ (n=16)

Figure 4. Effect of sex of calf on IgG
NS: Not significant (P>0.05)
Sex of Calf: Male (n=24), Female (n=20)

In this study, it was found that there was no significant difference between the samples with respect to their IgG with increasing parity, but there was a trend of lower IgG concentration with increasing parity (Figure 3). These results are consistent with the findings reported by Agrawal et al. (2015) though the significant effects of the dam's parity on colostral IgG levels in cows were observed other studies (Tyler et al., 1999; Gulliksen et al., 2008; Kehoe et al., 2011). Similar results were reported by Yaylak et al. (2017) and Zarei et al. (2017) who found no significant differences among parities for IgG in Holstein cows' colostrum. However, the findings of Kehoe et al. (2011) did not confirm the results of the present study and they determined that the effect of parity on mean IgG concentration in colostrum was significant (P<0.001). Researchers reported that older cows produce colostrum with higher amounts of IgG due to their exposure to high level antigens during their life (Zarei et al., 2017). Based on the results of the literature, however, contrary to our findings and support the idea maintained by previous researchers that the colostrum of primiparous cows should not be discarded. In parallel with these findings, Maunsell (2014) stressed that some heifers produce very good quality colostrum and producers should not automatically discard heifer colostrum but should test and keep high quality colostrum from a cow of any parity.

There was no significant difference in the sex of the calf (Figure 4). IgG was higher in the calf's female sex (1052±2.89 g/ml) than in a male (1048±2.45 g/ml). However, these values decreased non-significantly. Similarly, Kaygısız and Köse (2007) and Cabral et al. (2016) reported that the effect of the sex of calf on colostrum quality in Holstein cows was not significant.

4. CONCLUSION

In this study, IgG in colostrum was significantly affected by calving season ($P<0.05$). Effects of calving age, calving year and sex of calf on colostrum quality were not significant ($P>0.05$). The colostrum quality of the investigated animals was evaluated in good quality class. Therefore, higher quality colostrum had been obtained in the winter season, extra colostrum samples those collected in the winter might be stored to serve Anatolian buffalo calves born in the other seasons as a booster. The results showed that Anatolian buffaloes had good quality colostrum and more studies with a greater sample size are needed to investigate the factors affecting colostrum quality.

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Conflict of Interest

The authors declare that there is no conflict of interest.

Ethics

This study does not require ethics committee approval.

Author Contribution Rates

Design of Study: EK (50 %), AŞ (25 %), SHA (25 %)

Data Acquisition: EK (75 %), AŞ (10 %), SHA (15 %)

Data Analysis: EK (40 %), AŞ (20 %), SHA (40 %)

Writing up: EK (75 %), AŞ (10 %), SHA (15 %)

Submission and Revision: EK (80 %), AŞ (5 %), SHA (15 %)

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