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Araştırma
(Research)

Effects of Calving Age and Calf Sex on Colostrum Composition and Its Changes After Calving in Anatolian Buffaloes*

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Abstract

Objective: This study aims to investigate the changes in colostrum during the first 72 h after birth and to elucidate the impact of calving age and calf sex in Anatolian buffaloes.

Materials and Methods: The study used colostrum samples from 25 newly calved Anatolian buffalos raised under similar farm conditions. The samples were collected at the first milking after calving (T0), 24 h (T24), 48 h (T48), and 72 h (T72) after calving during the summer season. The postpartum period, calving age, and calf sex were considered as non-genetic factors.

Results: The first milking colostrum weight, fat, solids-not-fat (SNF), protein, and lactose content were determined as 2.95±0.21 kg, 7.96±0.45%, 17.5±1.63%, 14.5±1.45% and 2.58±0.24%, respectively. Fat, SNF, and protein were significantly higher at T0. Colostrum weight was the lowest at T0 and T24, gradually increasing at T48 and T72 (P<0.05). Lactose did not change statistically in the postpartum period (P>0.05). The calving age and calf sex did not statically affect colostrum weight, fat, SNF, protein, and lactose content (P>0.05).

Conclusion: In conclusion, the composition of buffalo colostrum showed significant changes in the postpartum period, especially after the first milking. Therefore, providing high-quality colostrum as soon as possible is recommended for calf health.

Keywords: Anatolian buffalo, colostrum, fat, lactose, protein

Anadolu Mandalarında kolostrum bileşimi üzerine malaklama yaşı ve malak cinsiyetinin etkileri ve malaklama sonrası değişimi

Öz

Amaç: Bu çalışmada, Anadolu mandalarında malaklamadan sonraki ilk 72 saatte kolostrumdaki değişimlerin incelenmesi ve malaklama yaşı ile malak cinsiyetinin kolostruma etkisinin ortaya konulması amaçlanmıştır.

Materyal ve Yöntem: Çalışmada benzer çiftlik koşullarında yetiştirilen 25 yeni buzağılamış Anadolu mandasından alınan kolostrum örnekleri kullanıldı. Örnekler yaz mevsimi süresince malaklama sonrası ilk sağım (T0), 24. saat (T24), 48. saat (T48) ve 72. saatte (T72) alınmıştır. Malaklama sonrası dönem, malaklama yaşı ve malak cinsiyeti genetik olmayan faktörler olarak değerlendirilmiştir.

Araştırma Bulguları: İlk sağım kolostrum ağırlığı, yağ, yağsız kuru madde (YKM), protein ve laktoz oranları sırasıyla 2,95±0,21 kg, yağ %7,96±0,45, %17,5±1,63, protein %14,5±1,45 ve %2,58±0,24 olarak belirlenmiştir. Yağ, YKM ve protein T0'da önemli ölçüde daha yüksektir. Kolostrum ağırlığı T0 ve T24'te en düşük, T48 ve T72'de kademeli olarak artmıştır (P<0.05). Laktoz doğum sonrası dönemde istatistiki olarak değişmemiştir (P>0.05). Malaklama yaşı ve malak cinsiyeti kolostrum ağırlığı, yağ, YKM, protein ve laktoz içeriğini istatistiki olarak etkilememiştir (P>0.05).

Sonuç: Sonuç olarak, manda kolostrumunun bileşimi malaklama sonrası dönemde özellikle ilk sağımdan sonra önemli düzeyde değişim göstermiştir.

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Bu nedenle, malak sağlığı için mümkün olan en kısa sürede yüksek kaliteli kolostrum sağlanması önerilir.

Anahtar Kelimeler: Anadolu mandası, kolostrum, yağ, laktoz, protein

Introduction

Calves represent the future of our dairy herds, with males serving as prospective breeding bulls and females fulfilling roles as herd replacements (Abbas et al., 2017). Nonetheless, the substantial economic losses in livestock production stem from neonatal calf morbidity and mortality. Maintaining an optimal level of immunity is paramount in addressing these challenges. The immune status of newborn calves relies on the transfer of immunoglobulins (Ig) from dams to calves through colostrum ingestion and subsequent absorption in the small intestine (Sattar et al., 2003). Since calves are immunodeficient at birth due to the syndesmochorial placenta, which restricts the transfer of maternal immunoglobulins, colostrum feeding becomes instrumental in providing passive protection during early life. The circulating plasma immunoglobulin levels serve as a direct indicator of the calves' immune status (Panigrahi et al., 2005; Abdullahoğlu et al., 2019). The quantity of colostrum consumed, its Ig content, and immediate intake collectively play pivotal roles in calf health (Abd El-Hady et al., 2006).

Colostrum, as the initial postpartum mammary secretion, contains elevated levels of immunoglobulins, proteins, vitamins, and minerals, as well as hormones and growth factors crucial for the neonatal calf's well-being. The intake of colostrum plays a pivotal role in aiding calves in adapting to their new environment while establishing passive immunity. It is effective on the development and functionality of the gastrointestinal system, and as the metabolic and endocrine systems. It also has positive effects on the feeding mechanism of newborn (Abd El-Hady et al., 2006). The quality of colostrum is vital for nutrient absorption, significantly influencing the calf's future performance. Research indicates that calves receiving colostrum exhibit enhanced development of intestinal villi compared to those fed whole milk (Yang et al., 2015). Considering that calves require fat and protein for energy, muscle development, and various essential nutrients concentrated in colostrum, its consumption is critical. Given the newborn calf's limited energy reserves, colostrum, with its higher fat content than milk, becomes indispensable for their survival and health. The absence of colostrum consumption significantly influences the neonates' well-being (Abd El-Hady et al., 2006).

Many neonatal calf diseases are attributed to inadequate colostrum intake and suboptimal colostrum quality. Ruminants acquire maternal antibodies through colostrum ingestion (Tesfaye et al., 2020; Johnson et al., 2022; O'Brien and Dever, 2023). The initial colostrum concentration decreases rapidly in subsequent milkings (Kelly, 2003). Calves deprived of colostrum are vulnerable to various diseases (Panigrahi et al., 2005). Colostrum intake in the first hours of a calf's life not only influences survival and health but also stimulates the maturation and function of the gastrointestinal tract, which is crucial for nutrient absorption and the calf's future performance (Yang et al., 2015; Soufleri et al., 2019).

Survival and daily weight gain in newborns are closely linked to colostrum intake. Ensuring an adequate supply of high-quality colostrum at birth, sufficient milk during suckling, and appropriate post-weaning feeding is crucial for calves' overall well-being and growth (Afzal et al., 2009). However, suboptimal colostrum management and challenges during weaning persist in dairy farms, resulting in approximately 52% mortality in buffalo calves (Pasha, 2013) and reduced weight gain in the first three weeks of life (Donovan et al., 2007). Furthermore, health issues like diarrhea and pneumonia have become more prevalent, impacting both growth and mortality rates (Abd El-Hady et al., 2006; Akkulak and Kul, 2023).

In the transition from colostrum to regular milk, there can be gradual or sudden changes in composition and properties. Understanding the composition and physical attributes of colostrum, as well as subsequent secretions, is crucial for determining the appropriate processing time for such milk and identifying its optimal utilization (Abd El-Fattah et al., 2012).

Numerous investigations have assessed changes in the chemical composition of cow colostrum following parturition; however, limited information is accessible regarding buffaloes in Turkey. Therefore, the objective of this study was to monitor the variations in colostrum composition during the first 72 h after birth and to elucidate the impact of calving age and calf sex in Anatolian buffaloes.

Materials and Methods

The research was performed on Anatolian buffaloes under similar conditions on small-scale farms as part of the National Anatolian Buffalo Development Program conducted by the Ministry of Agriculture and Forestry, General Directorate of Agricultural Research and Policies in the year 2020 in Amasya province. The research material comprised 25 colostrum samples obtained from Anatolian buffaloes and their respective calves.

Colostrum samples were manually collected from each dam, ensuring udder health at calving (first milk) at specific intervals: first milk (T0), 24 h (T24), 48 h (T48), and 72 h (T72) after calving. Individual colostrum samples were obtained from pooling the milk of two right or left quarters while the calf was suckling. Colostrum weights were recorded for each milking session and multiplied by two. Approximately 50 ml of colostrum was collected and stored in sterile milk bottles. Following collection, the colostrum samples were transported to the laboratory and immediately frozen at -20 °C for preservation. Colostrum samples were heated in a water bath to 37 °C, and then analyzed for chemical composition, including fat, solids-not-fat (SNF), protein, and lactose using a LactoStar milk analyzer (Funke-Gerber, Berlin, Germany).

Postpartum time (T0, T24, T48 and T72; n=25), calving age (from 3 to 6; n=11 and 7 to 10 ≤; n=14) and sex of calf (male; n=18 and female; n=7) were used as fixed factors. The following mathematical models on colostrum quality were applied:

$$Y_{ijkl} = \mu + a_i + b_j + c_k + e_{ijkl}$$

Where, Y_{ijkl} = the observations, μ = overall mean, a_i = Effect of ith postpartum time, b_j = Effect of jth calving age, c_k= Effect of kth calf sex, e_{ijkl} = Random error

The results were expressed as Least-squares means (LSM) along with standard errors (SEM). Statistical analyses were conducted using SPSS Version 17.0. The general linear model's procedure was employed for statistical analysis, and the Duncan's Multiple Range Test determined differences between means.

Results and Discussion

The study depicted the variation in buffalo colostrum secretion up to the fourth postpartum milking, as shown in Figure 1. In this study, the amount of first milking colostrum weight, fat, SNF, protein, and lactose were colostrum weight, fat, solids-not-fat (SNF), protein, and lactose content were determined as 2.95±0.21 kg, 7.96±0.45%, 17.5±1.63%, 14.5±1.45%, and 2.58±0.24%, respectively. Comparable total solids content values (23.9%) for colostrum were noted by McGuirk (1989). Abd El-Fattah et al. (2012) indicated that buffalo colostrum at calving had total solids, total protein, and fat content of 26.7%, 13.5%, 11.80%, and 9.59%, respectively. In a study by Abd El-Hady et al. (2006), the reported fat, protein, lactose, and SNF content were 5.38%, 11.8%, 2.85%, and 15.6%, respectively. Arain et al. (2008) reported that the average values for SNF, fat, total protein, and lactose in colostrum were 23.1±0.31%, 5.41±0.21%, 18.8±0.30%, and 2.70±0.05%, respectively. The results of our study indicated that the colostrum concentration within the normal range reported for buffalo milk in various studies. The colostrum composition, distinct from normal milk (Arain et al., 2008), exhibited variations during postpartum milking sessions. The lowest colostrum weight was recorded at T0 and T24, gradually increasing over time at T24 and T48 ($P < 0.05$). Fat, solids-not-fat (SNF), and protein content were significantly influenced by postpartum time ($P < 0.05$), while lactose content remained unaffected. The highest values for fat, SNF, and protein content were observed in colostrum collected at the beginning of lactation (T0) but gradually decreased during T24, T48, and T72. A similar result was obtained in buffaloes by Singh et al. (1993), reporting a decline ($P < 0.05$) in colostral protein and total solids during the fourth milking postpartum. These findings agree with Abd El-Fattah et al. (2012), indicating a gradual decrease in all components during the transition period, except for lactose, which conversely increased. Results are in accordance with Coroian et al. (2013), stating that physicochemical compounds of buffalo colostrum were influenced by postpartum day, with all parameters, except lactose, gradually decreasing during the colostral period. Dry matter and protein exhibited a similar evolution to fat, reaching the lowest values at the end of the colostral period. Lactose showed a gradual increase, peaking on day seven postpartum. Additionally, Abd El-Hady et al. (2006) reported that the highest protein, total solids, and SNF content were in the first postpartum milking, decreasing significantly with subsequent milking sessions. Conversely, fat and lactose were lowest in the first milking and gradually increased ($P < 0.01$) with milking intervals. As the transition period advanced, these components in both colostrum decreased gradually, with the composition approaching that of normal milk on the third day of parturition.

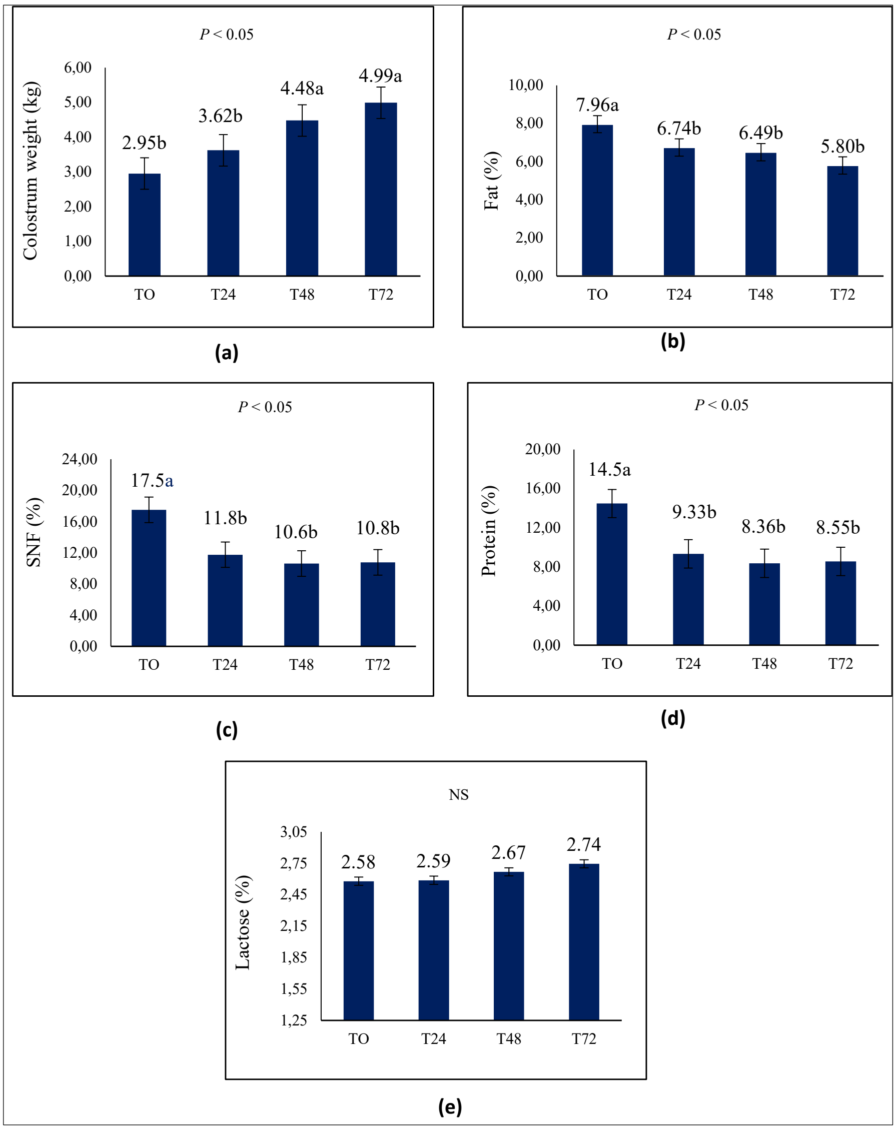

Figure 1. Changes in colostrum weight (a), fat (b), SNF (c), protein (d), and lactose (e) during postpartum time from Anatolian buffaloes. [a,b] Different letters for each parameter was statically different (P < 0.05). NS: not significant ($P > 0.05$)

The notable variations in the total solids content between colostrum and normal milk could be attributed to the heightened antibody levels present in colostrum (Nickerson, 1995). A gradual and significant decrease in the total solids content of colostrum was observed up to the subsequent postpartum milking, which correlated with changes in total protein content, albumin, globulin fraction, and ash (Singh et al., 1982). This decline may be attributed to the initially high level of globular protein in the first milking colostrum, transitioning to lower levels up to the third milking day, leading to colostrum coagulation and/or precipitation (Walstra and Jennes, 1984). However, variations in the coagulation/precipitation time of colostrum were also noted among buffaloes, potentially reflecting individual differences among them (Maher, 2000). Lactose was the sole compound in buffalo colostrum that consistently increased during the first three days of milking (Coroian et al., 2013). It gradually normalized by the seventy-second hour (72 h) of postpartum milking but aligned with the transition period reported by various researchers within 5 to 6 days (Arain et al., 2008).

As seen in Figure 2, the influence of maternal age on the first colostrum weight and its components was not found to be statistically significant. This is consistent with Abd El-Hady et al. (2006), who reported that buffaloes in their first lactation produced the lowest first milking weight (1.45±0.54 kg) compared to older cows.

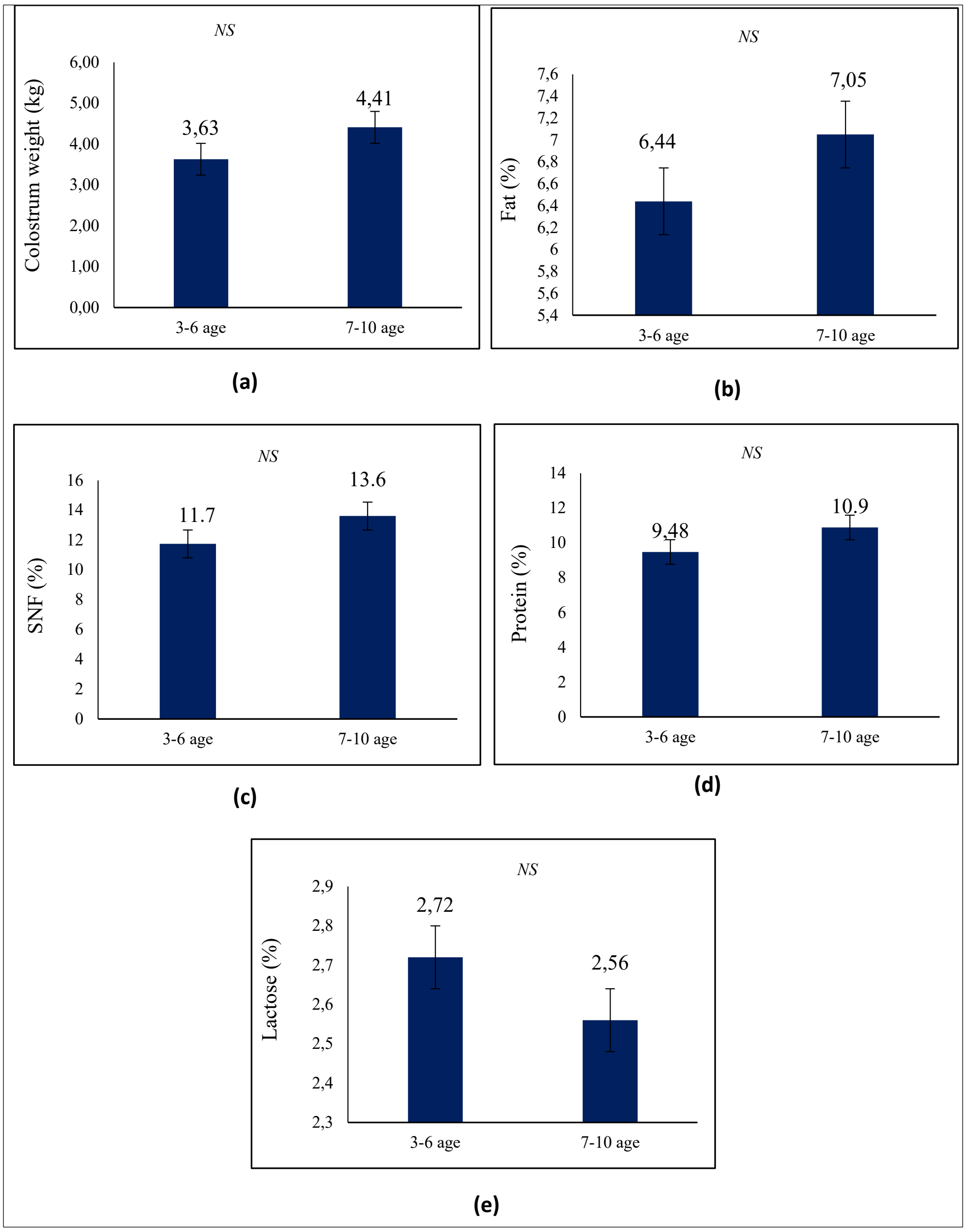

Figure 2. Changes in colostrum weight (a), fat (b), SNF (c), protein (d), and lactose (e) according to calving age from Anatolian buffaloes. NS: not significant ($P > 0.05$)

According to Abd El-Hady et al. (2006), the chemical composition of colostrum exhibited significant differences with parity. First lactation cows displayed higher (P < 0.01) colostral protein and consequently SNF content compared to multiparous cows. However, colostral fat and lactose were lower (P < 0.01) in first lactation cows compared to older cows. Salama et al. (1997) found that colostral protein and total solids were higher in first lactation buffaloes compared with multiparous cows, while fat content was lower in first lactation (5.6%) and increased with parity. Kume and Tanabe (1993) reported that the highest colostral protein was in the third lactation, and the lowest was in the first lactation (P < 0.05). Additionally, Quigley lii et al. (1994) mentioned that colostral protein and fat content were lower in second lactation cows. Generally, in literature studies, the age of the buffalo has been observed to impact colostrum components, and observed significant compositional changes in buffaloes in their later lactations have been noted. However, in our study, the effect of maternal age was observed to be non-significant. These disparities can be attributed to variations in the breeds studied, diverse herd management practices, and differences in sample sizes.

The influence of calf sex on colostrum weight and its composition was determined to be statistically non-significant (P > 0.05), as shown Figure 3. Difficult births may potentially reduce both the quality and quantity of colostrum, consequently diminishing passive immunity in calves. Additionally, cesarean-section births could potentially affect the quantity and quality of mammary gland secretion, potentially even halting its production. Furthermore, the level of difficulty during birth holds significance in relation to the achieved daily weight gains during colostrum feeding periods (Puppel et al., 2019). It can be said that the fact that buffalos generally give birth normally and that difficult births are not observed very often has an effect on the results.

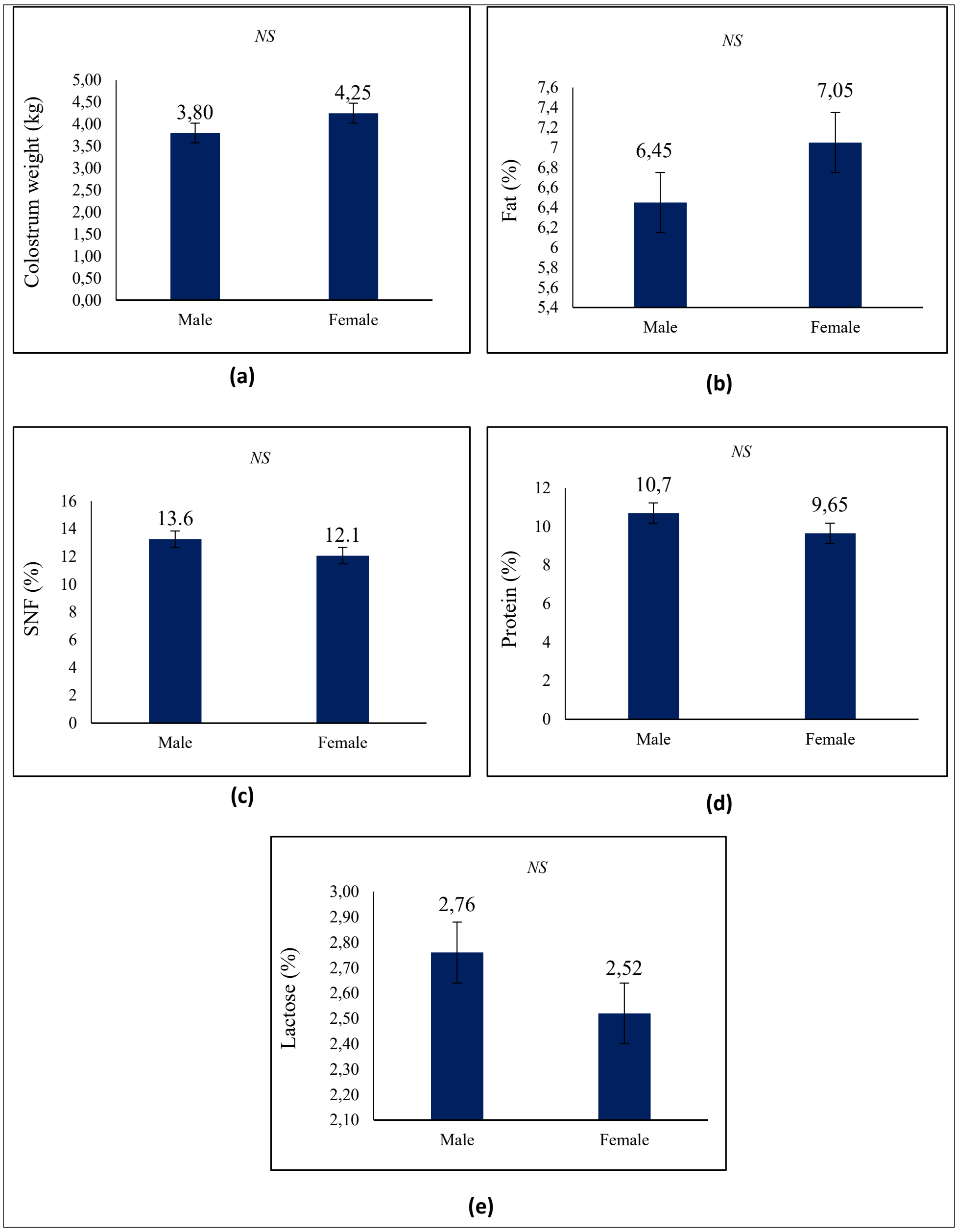

Figure 3. Changes in colostrum weight (a), fat (b), SNF (c), protein (d), and lactose (e) according to calf sex from Anatolian buffaloes. NS: not significant (P>0.05)

Conclusion

The present study revealed that colostrum weight was the highest in the T48 and T72, and the lowest in T0 and T24. The highest fat, SNF, and protein content were in the T0, and then decreased non-significantly as the postpartum time advanced except lactose which conversely increased. Colostrum weight, fat, SNF, protein, and lactose were not significantly affected by calving age and calf sex. In this study, postpartum time was determined as a primary factor influencing the composition of buffalo colostrum. As a result, it is recommended that high-quality colostrum be provided promptly for calf health.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Authors statement of contribution

EK, AŞ and HÇ designed the study. EK and SHA collected the data. SHA carried out the statistical data analysis. EK and HÇ wrote the draft of the manuscript; AŞ and SHA reviewed the manuscript; and EK edited the manuscript. All authors contributed to the article and approved the submitted version.

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