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Research Article

Factors associated with the colostrum quality of dairy cows in the Menemen district of İzmir provience

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ABSTRACT

This study aimed to determine the factors affecting the colostrum quality in dairy farms located in the Menemen district of İzmir province. A total of 61 colostrum samples were collected in the first 6 hours after birth from six dairy farms having more than 100 head. The colostrum obtained from each cow was measured for density using a colostrometer. It was found that 40 of the colostrum samples were of good quality, 16 were of medium quality, and 5 were of poor quality. The current study identified a statistically significant effect of herd size ($P<0.05$) on colostrum quality, with higher quality observed in farms with a herd size of less than 250 head. Parity and calving season did not affect colostrum quality in this study. Simmental cows had better colostrum quality than Holstein and Jersey cows. The specific gravity of Jersey colostrum was lower (-23 g/L) in summer compared to other seasons, whereas that of Simmental was higher. Therefore, it can be concluded that Simmental and Holstein cows are more suitable for profitable dairy farming in this region.

INTRODUCTION

The first week after birth is the most vulnerable time for the calves since the fetal period of pregnancy is in a sterile field (Bıyıklı et al., 2017), and the transfer of immunoglobulins from the cow to the fetus does not occur during this period (Koyun and Karaca, 2018). Mortality rates in calves are the highest during the first week of their life (Svensson et al., 2003). Therefore, the survival of calves during this period depends on colostrum feeding that delivers high amounts of immunoglobulins at the right time (Godden, 2008).

Colostrum production begins in the mammary glands 3-4 weeks before parturition. It contains twice the dry matter, 4.5 times the protein, 1.7 times the fat, and more vitamins and minerals than milk (Lopez and Heinrichs, 2022). Salient feature of colostrum is its high concentration of immunoglobulins, also known as maternal antibodies. These antibodies are developed by the dam throughout her life that provide crucial immunity to the calf during its first week of life. In bovine colostrum, immunoglobulins make up 70 to 80% of the total protein content, whereas they only make up 1-2% of the total protein in normal milk (Kozat, 2019).

Quality of colostrum is dependent on several factors such as the breed, age, parity, feeding management, and dry period length of the dairy cows (Wattiaux, 2006). According to Shearer et al. (1992), cows in first lactation produce lower quality colostrum compared to multiparous cows. Sellers (2001) stated that colostrum quality is affected by feeding management during the dry period. Additionally, Selk (2007) found that cows that were malnourished in the last period of pregnancy experienced a significant decrease in colostrum production.

Environmental conditions can also impact colostrum quality. It was reported that high ambient temperature has a detrimental effect on colostrum quality (Coşkun, 2020). In many regions of Turkey, summer average temperatures are at a level (>25 °C) that may cause stress in dairy cows (Er and Özcan, 2023). Menemen district of İzmir province is situated in one of these regions has many dairy farms. However, no studies have been conducted to investigate the quality of colostrum in this area, considering the high ambient temperature and farm practices. Therefore, this study aimed to assess the factors affecting the colostrum quality in dairy farms located in the Menemen district of İzmir province.

MATERIALS and METHODS

Sampling

The study was conducted in the Menemen district of İzmir

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province between May 2023 and March 2024. In the present study, 61 colostrum samples were collected within the first 6 hours after birth from six dairy farms having herd size more than 100 heads. Table 1 presents the size of the herds from which colostrum was collected in the study, along with the number of colostrum samples collected by season.

Table 1. The herd size and number of colostrum samples collected.

Herds no	Size of herds, heads	Numbers of colostrum samples		
		Summer	Other seasons	Total
1	>500	6	4	10
2	250-500	5	4	9
3	250-500	4	6	10
4	250-500	4	6	10
5	<250	5	6	11
6	250-500	6	5	11
Total		30	31	61

Breed, lactation number, calving season, and diet composition in the dry period were recorded from the herd management system. In addition, 500g feed samples were collected from each farm for three consecutive days and then stored at -20°C to determine the chemical compositions of the ration in the dry period.

The average ambient temperature and relative humidity of the Menemen district of İzmir province for the months of summer were obtained from the General Directorate of Meteorology. The temperature-humidity index (THI) was calculated using the following formula of THI (NWSCR, 1976).

THI = (9/5 × temperature + 32) – (11/20 – 11/20 × Humidity) × (temperature – 26)

Colostrum quality and Chemical analyses

The colostrum obtained from each cow after calving was cooled to 20 °C within the first 24 hours. then it was measured for density using a colostrometer (Kerbl, Germany) according to Kaygısız and Köse, (2007). Based on density, colostrum was classified as good (>1045 g/L), medium (1035-1045 g/L), and low quality (<1035 g/L).

For chemical compositions, samples of TMRs were dried to a constant weight in an air-forced oven at 65 °C for 72h. Dried samples were ground to pass through a 2-mm screen. Dry matter (DM), and crude protein (CP) contents of the samples were analyzed according to AOAC (1990). Neutral detergent fiber (NDF) and acid detergent fiber were assayed according to the methods described by Van Soest et al. (1991.) The ingredients and chemical compositions of the diets are presented in Table 2.

Table 2. The ingredients and chemical compositions of the diets used in farms.

Ingredients	Herds 1	Herds 2	Herds 3	Herds 4	Herds 5	Herds6
Wheat straw	50	45	25	48	50	45
Maize silage	30	20	40	35	30	35
Wheat silage		10				
Concentrate 1	20	15	10	17	20	20
Concentrate 2			25			
Chemical compositions						
Dry matter	68.7	65.5	56.9	61.7	67.1	62.6
Crude protein	9.3	10.1	13.4	9.7	8.8	9.4
NDF	45.0	46.1	33.7	46.9	43.6	46.5

Concentrate 1: Commercial feed for dry period (% 14 crude protein); Commercial 2: Commercial feed for lactatating period (%19 crude protein).

Statistical analyses

The effects of ambient temperature, breed, herd size, lactation number, and calving season on colostrum quality were analyzed using the General Linear Model (GLM) procedures

with Least Squares Mean (LSMS) in SPSS software package (22.0, IBM Corp. Inc., NY, US). Duncan's multiple comparison test was used to compare the differences among the means. P<0.05 was accepted as statistically significant difference among the means.

RESULTS

Figure 1 shows the average records of ambient temperature, relative humidity, and temperature humidity index during the summer season in the study. The minimum and maximum recorded ambient temperatures were 16.6 and 44.1 °C respectively. Relative humidity ranged from 23.4 to 78.1%. Daily average THI was recorded above 70 in summer in the current study.

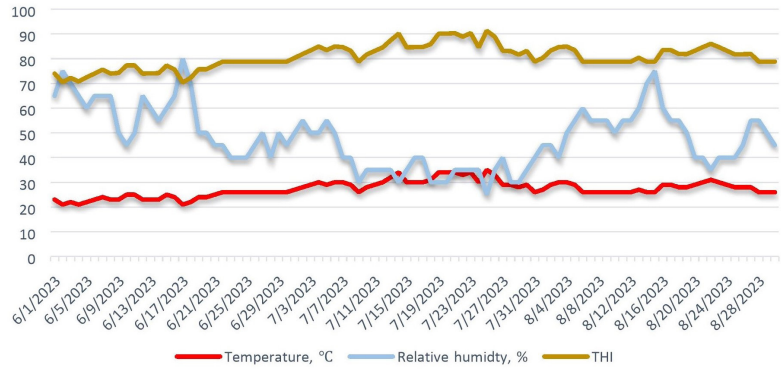

Figure 1. The average records of ambient temperature, relative humidity, and temperature humidity index during the summer season

The quality distribution of colostrum collected during the study is presented in Figure 2. It was found that 40 of the colostrum samples were of good quality, 16 were of medium quality, and 5 were of poor quality.

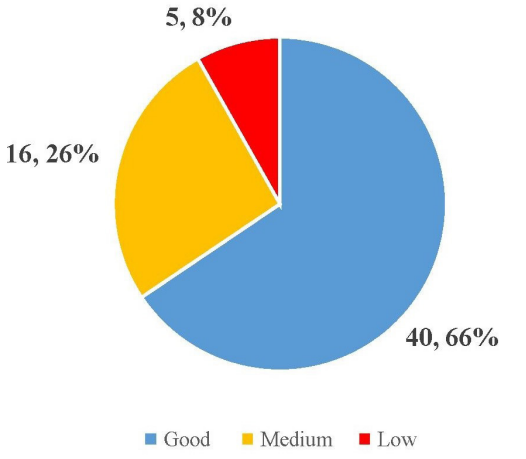

Figure 2. The quality distribution of colostrums collected during the study.

The effects of herd size and parity on the colostrum quality are shown in Table 3. The current study identified a statistically significant effect of herd size (P<0.05) on colostrum quality, with higher quality observed in farms with a herd size of less than 250 head. Meanwhile, parity did not show a notable influence on colostrum quality.

Table 4 shows the effects of calving season and breed on the colostrum quality. In the present study, the colostrum quality was not affected by calving season. However, Simmental cows had better colostrum quality than Holstein and Jersey cows (respectively 1067, 1049, and 1047 g/L) (P<0.05). In addition, we observed an interaction between calving season and breed (P<0.05) (Figure 3). The specific gravity of Jersey colostrum was lower (-33 g/L) in summer compared to other seasons, whereas that of Simmental was higher (15 g/L) (Table 4).

DISCUSSION

Growth and profitability of dairy farms rely on the continuous addition of healthy and young animals to the herd. Sustainable management of dairy farms aims to achieve one calf per cow per year. Therefore, survival and growth performance of newborn calves significantly impact the continuity of the herd. Some critical points such as proper colostrum feeding, and colostrum quality have an important effect on the survival and growth performance of neonatal calves.

The collected colostrums in this study were, in general, good quality (Figure 2). In total, only 8.3% of the colostrum samples in this study contained <1035 g/L specific gravity, which is considered to be an indication of low-quality colostrum (Kaygısız and Köse, 2007). No previous study has investigated the

factors associated with the colostrum quality of dairy cows in İzmir. However, Tatar and Esenbuğa (2022) found that farmers in the Odemis district of İzmir province had sufficient knowledge about animal care and nutrition. Therefore, it can be concluded that the dairy management practices in İzmir province have good results. In addition, the rate of low-quality

Table 3. The effects of herd size, and parity on the colostrum quality.

Item	n	Colostrum specific gravity, g/l			P value
Size of herds, heads		$\overline{X} \pm Sx$	**Minimum**	**Maximum**	
>500	10	1049 ± 5.70^{b}	1038	1061	
250-500	40	1049 ± 2.28^{b}	1043	1054	0.017
<250	11	1067 ± 5.43^{a}	1056	1077	
Number of lactations					
Uniparous	26	1050 ± 3.74	1042	1057	0.436
Multiparous	35	1054 ± 3.22	1047	1060	

->1045 g/l good quality; 1035-1045 g/l; medium quality; <1035 g/l low quality
a, b= Column means within a classification with different superscripts differ ($P < 0.05$).

Table 4. The effects of calving season and breed on the colostrum quality.

Item	n	Colostrum specific gravity, g/l
Calving season		$\overline{X} \pm Sx$
Summer	30	1051 ± 3.4
Other seasons	31	1059 ± 4.1
Breed		
Holstein Friesian	39	1049 ± 2.6^{b}
Jersey	11	1047 ± 4.9^{b}
Simmental	11	1067 ± 5.42^{a}
Summer		
Holstein Friesian	19	1047 ± 3.77
Jersey	6	1032 ± 6.70
Simmental	5	1075 ± 7.34
Other seasons		
Holstein Friesian	20	1052 ± 3.67
Jersey	5	1065 ± 7.34
Simmental	6	1060 ± 6.70
	Calving season	0.131
P value	Breeds	0.007
	Calving season x Breed	0.004

>1045 g/l good quality; 1035-1045 g/l; medium quality; <1035 g/l low quality
a, b=Column means within a classification with different superscripts differ

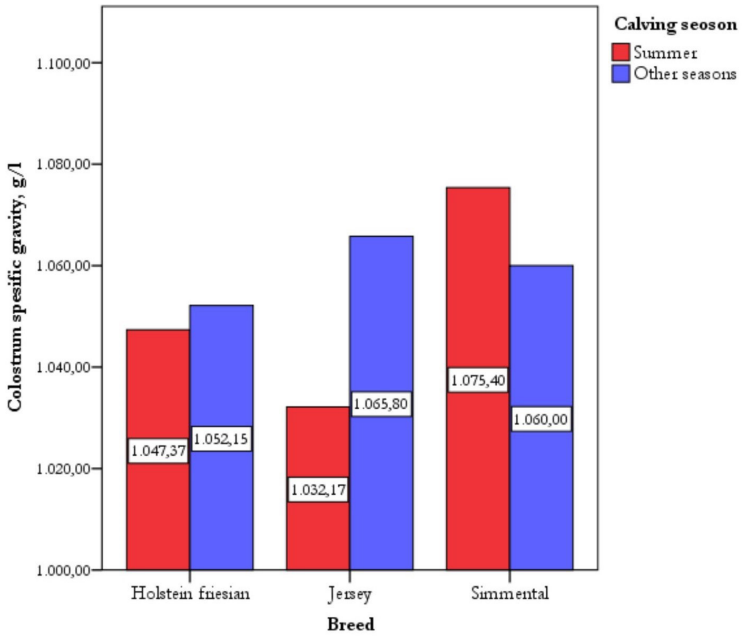

Figure 3. Interaction between calving season and breed for colostrum quality.
->1045 g/l good quality; 1035-1045 g/l; medium quality; <1035 g/l low quality

colostrum was in agreement with the rates reported in other studies; Conneely et al. (2013) reported a rate of 4% in 741 cows, while 13.5% was reported in another study (Göncü and Gökçe, 2015). Contrary to the findings of our study, Shearer et al. (1992) reported that 79.8% of 2045 colostrum samples had low concentrations of Ig (less than 50 mg/mL). As already known, calving interval and colostrum collection is one of the main factors affecting colostrum quality (Kehoe et al., 2011). However, Shearer et al., (1992) collected colostrum samples 12 h after the calving that might have resulted in low quality colostrum.

In the present study, cows produced high quality colostrum (+17.2 g/L specific gravity) when the herd size was above 250 heads (Table 3). There could be two possible reasons for this result. The first one was the breed of the cows which was the Simmental in these herds. As shown in Table 4, Simmental cows produced higher quality colostrum than Holstein and Jersey cows in the current study. The second possible reason was the management of these herds. There is a lack of studies that investigate the effect of herd size on colostrum quality. It can be expected that improved management and nutritional practices, which are more likely to be present in larger herds, would be effective in producing high-quality colostrum (Godden, 2008). However, smaller herds with a higher number of farm workers per 100 dairy cows (+0.6) in the current study might have more effective management.

The parity of cows did not affect colostrum quality (Table 3). Consistent with our findings, Kıyıcı and Sevişoğlu (2022) reported a numerical increase in colostrum quality in multiparous cows. On the other hand, lower colostrum quality in the first lactation was reported in many studies (Erdem and Atasever 2005; Connely et al., 2013). Differences in findings may be associated with environmental conditions. Calving season of multiparous cows in our study occurred primarily during the summer, which may cause stress for dairy cows.

Heat stress is a primary concern for dairy farms in warm regions and it has been reported that the effects of heat stress start to appear in dairy cows when THI is higher than 68 (Collier et al., 2012) or 72 (Armstrong, 1994). Additionally, as colostrum production begins up to 3 weeks before parturition, heat stress during the dry period has a significant impact on colostrum production and quality (Avendaño-Reyes et al., 2023). In the present study, the daily average THI was recorded as above 80 in the summer season. (Figure 1). Therefore, we can say that cows were exposed to heat stress in this period. Although the specific gravity of colostrum was numerically lower in summer (-8 g/L), the calving season did not affect colostrum quality in this study. (Table 4). Thi result contrasts with that of Genç (2015) who reported that cows produced significantly lower quality colostrum in the summer season ($P<0.05$). Although there is a high correlation between colostrum specific gravity and actual Ig concentration, it has been suggested that the scale may not be sufficiently refined to allow the use of Ig concentration as a continuous variable (Shearer et al., 1992). However, Genç (2015) quantified colostrum IgG using an ELISA method, which may provide more accurate results. Furthermore, our results are in line with those of other studies (Morin et al., 2001; Kaygısız and Köse, 2007) that used colostrometers to determine colostrum quality in cows.

In agreement with previous studies (Ontsouka et al., 2003; Kıyıcı and Sevişoğlu; 2022), colostrum quality was affected by breed in our study and Simmental's colostrum quality was higher (+19 g/L) than Holstein and Jersey. In addition, there was a negative correlation between ambient temperature and the specific gravity of Jersey colostrum, whereas there was a

positive correlation for Simmental cows. Heat tolerance, which was reported to be higher in Simmental (Gartner el., 2017a; 2017b) and lower in Jersey (Bianca, 1965), could be a possible explanation of these findings.

CONCLUSION

Findings of the present study indicate that, in general, dairy herds in the Menemen district of İzmir province were well-managed, as only 8.3% of the collected colostrum samples were of low quality. However, management of dairy cows in large herds (>250 heads) was suboptimal. Parity did not affect the colostrum quality in the current study. Due to the use of the similar diets in dairy farms, except for farm 3, and the limited number of colostrum samples, this study does not provide conclusive evidence on the effects of nutritional management on colostrum quality. However, Simmental cows produced higher quality colostrum than Holstein and Jersey cows. Furthermore, Jersey cows were not well adapted to the region and environmental conditions. Therefore, it can be concluded that Simmental and Holstein cows are more suitable for profitable dairy farming in this region.

DECLARATIONS

Ethics Approval

Since the data collected in the study were obtained from routine farm practices, the approval of the ethics committee is not required.

Conflict of Interest

The authors have no relevant financial or non-financial interests to disclose.

Author contribution

Idea, concept and design: OGK, ME

Data collection and analysis: OGK, ME

Drafting of the manuscript: OGK, ME

Critical review: ME

Data Availability

The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

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REFERENCES

AOAC. (1990). Official Methods of Analysis. Association of Official Analytical Chemists, Arlington, VA

Armstrong, D. V., (1994). Heat stress interaction with shade and cooling Journal of Dairy Science, 77:2044–2050. https://doi.org/10.3168/jds.S0022-0302(94)77149-6.

Avendaño-Reyes, L., Macías-Cruz, U., Sánchez-Castro, M. A., Anzures-Olvera, F., Vicente-Pérez, R., Mellado, M., ... & López-Baca, A. (2024). Effects of parity, seasonal heat stress, and colostrum collection time postpartum on colostrum quality of Holstein cattle in an arid region. International Journal of Biometeorology, 68(3), 427-434. https://doi.org/10.1007/s00484-023-02601-5.

Bıyıklı, E., Azkur, A. K., Tonbak, Ş., & Macun, H. C. (2017). Buzağılarda Schmallenberg Virüs Özgül Maternal Antikor Varlığının İzlenmesi. Firat Universitesi Saglik Bilimleri Veteriner Dergisi, 31(3).

Bianca, W. (1965). Section A. Physiology. Cattle in a hot environment. Journal of Dairy Research, 32(3), 291-345.

Collier, R. J., L. W. Hall, S. Rungruang, and R. B. Zimbleman., (2012). Quantifying heat stress and its impact on metabolism and performance. Pages 74–84 in Proc. 23rd Annual Florida Ruminant Nutrition Symposium, Gainesville. University of Florida, Gainesville

Conneely, M., Berry, D. P., Sayers, R., Murphy, J. P., Lorenz, I., Doherty, M. L., & Kennedy, E. (2013). Factors associated with the concentration of immunoglobulin G in the colostrum of dairy cows. Animal, 7(11), 1824-1832. https://doi.org/10.1017/S1751731113001444

Kaygısız, A. ve Köse, M. 2007. Siyah Alaca ineklerde kolostrum kalitesi ve kolostrum kalitesinin buzağı gelişme özelliklerine etkisi. Tarım Bilimleri Dergisi, 13 (4) 321-325.

Coşkun, B. (2020). Kuru Dönemde Bakım ve Beslemenin Buzağı Sağlığı Üzerine Etkiler. T.C. Sanayi ve Teknoloji Bakanlığı. https://www.kalkinmakutuphanesi.gov.tr/assets/upload/dosyalar/buzagi-kayiplarinin-onlenmesinde-buzagi-sagligi-ve-yetistiriciligi-el-kitabi.pdf

Gantner, V., Bobic, T., Gantner, R., Gregic, M., Kuterovac, K., Novakovic, J., & Potocnik, K. (2017). Differences in response to heat stress due to production level and breed of dairy cows. International journal of biometeorology, 61, 1675-1685. https://doi.org/10.1007/s00484-017-1348-7

Er, M., & Cengiz, Ö. (2023). The effects of ration particle size and live yeast supplementation on dairy cows performance under heat stress conditions. Tropical Animal Health and Production, 55(2), 130. https://doi.org/10.1007/s11250-023-03550-2

Erdem, H., & Atasever, S. (2005). Yeni doğan buzağilarda kolostrumun önemi. Anadolu Tarım Bilimleri Dergisi, 20(2), 79-84. https://doi.org/10.7161/anajas.2005.20.2.79-84

Gantner V, Bobic T, Gregic M, Gantner R, Kuterovac K, Potocnik K. (2017). The differences in heat stress resistance due to dairy cattle breed. Mljekarstvo 67(2):112–122 https://doi.org/10.15567/mljekarstvo.2017.0203

Genç, M. (2015). İsviçre esmeri ve siyah alaca sığırlarda bazı çevresel faktörlerin kolostrum kalitesi ve pasif immunite üzerine etkileri. Doktora tezi. T.C. Atatürk Üniversitesi Sağlik Bilimleri Enstitüsü.

Godden, S. (2008). Colostrum management for dairy calves. Veterinary Clinics of North America: Food Animal Practice,

24(1), 19-39. https://doi.org/10.1016/j.cvfa.2007.10.005

Göncü, S., and Gökçe, G. (2015). Çok ve Tek Doğum Yapmış Siyah Alaca İneklerin Kolostrum İçerik Değişimi. Çukurova Üniversitesi Ziraat Fakültesi Dergisi, 30(1), 9-16

Kehoe, S. I., Heinrichs, A. J., Moody, M. L., Jones, C. M., & Long, M. R. (2011). Comparison of immunoglobulin G concentrations in primiparous and multiparous bovine colostrum. The Professional Animal Scientist, 27(3), 176-180. https://doi.org/10.15232/S1080-7446(15)30471-X

Kıyıcı, J. M., & Sevişoğlu, B. (2022). Farklı Sığır Irklarında Kolostrum Kalitesinin Araştırılması. Hayvan Bilimi ve Ürünleri Dergisi, 5(1), 40-47. https://doi.org/10.51970/jasp.1014836

Koyuncu, M., and Karaca, M. (2018). Buzağılarda Yaşama Gücünün Anahtarı; Kolostrum. Hayvansal Üretim, 59(1), 67-78. https://doi.org/10.29185/hayuretim.359971

Kozat, S. (2019). Yenidoğan buzağılarda kolostrum yönetiminin önemi. Atatürk Üniversitesi Veteriner Bilimleri Dergisi, 14(3), 343-353. https://doi.org/10.17094/ataunivbd.541789

Lopez, A. J., and Heinrichs, A. J. (2022). Invited review: The importance of colostrum in the newborn dairy calf. Journal of dairy science. 105, 2733–2749. https://doi.org/10.3168/jds.2020-20114

Morin, D. E., Constable, P. D., Maunsell, F. P., & McCoy, G. C. (2001). Factors associated with colostral specific gravity in dairy cows. Journal of Dairy Science, 84(4), 937-943. https://doi.org/10.3168/jds.S0022-0302(01)74551-1

Ontsouka, C. E., Bruckmaier, R. M., & Blum, J. W. (2003). Fractionized milk composition during removal of colostrum and mature milk. Journal of dairy science, 86(6), 2005-2011. https://doi.org/10.3168/jds.S0022-0302(03)73789-8

Ravagnolo, O., & Misztal, I. (2000). Genetic component of heat stress in dairy cattle, parameter estimation. Journal of dairy science, 83(9), 2126-2130. https://doi.org/10.3168/jds.S0022-0302(00)75095-8

Sellers, R. (2001). A guide to colostrum and colostrum management for dairy calves. Publication of the Bovine Alliance on Management and Nutrition. AFIA, Arlington, VI USA.

Selk, G. E. (2007). Disease Protection for Baby Calves. Oklahoma Cooperative Extension Service.

Shearer, J.H.O., Mohammed, J.S., Brenneman, Tran, T.Q., 1992. Factors Associated With Concentrations Of Immunoglobulins in Colostrum At The First Milking Post-Calving. Preventive Veterinary Medicine. 14 (1-2), 143-154. https://doi.org/10.1016/0167-5877(92)90091-S

SPSS. (2010). SPSS for Windovs, Version 22, Inc. Chicago.

Svensson CK, Lundborg UE, Olsson SO. (2003). Morbidity in Swedish dairy calves from birth to 90 days of age and individual calf-level risk factors for infectious diseases. Preventive Veterinary Medicine. 58: 179-197. https://doi.org/10.1016/S0167-5877(03)00046-1

Tatar, Y. E., and Esenbuğa, N. (2022). İzmir İli Ödemiş İlçesi Sığırcılık İşletmelerinin Sürü Yönetim Tekniklerinin İncelenmesi. Palandöken Journal of Animal Sciences Technology and Economics, 1(1), 16-23.

Wattiaux, M.A. (2006). Heifer Raising Birth to Weaning 28 Importance of Colostrum Feedıng. https://www.infodairy.com/infodairy_upload_files/Cows_heifers_calves/Calves/0188Importance%20of%20colostrum%20feeding-e.pdf

Van Soest, P. V., Robertson, J. B., & Lewis, B. A. (1991). Methods for dietary fiber, neutral detergent fiber, and nonstarch polysaccharides in relation to animal nutrition. Journal of Dairy Science. 74(10), 3583-3597. https://doi.org/10.3168/jds.S0022-0302(91)78551-2