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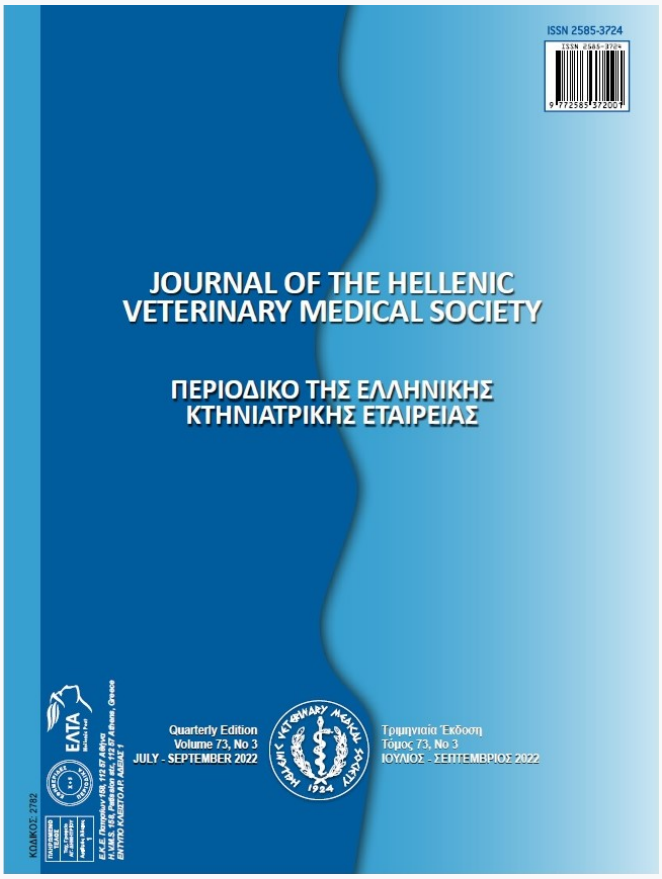

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Research article
Ερευνητικό άρθρο

Environmental factors influencing milk yield and lactation length in Italian Mediterranean buffaloes in Türkiye

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ABSTRACT: This preliminary study was conducted to investigate the impact of the fixed effects of calving season, parity, calving age and service period, on the annual average milk yield and lactation length of the Italian Mediterranean Buffaloes that were milked by rotary milking parlor. For this purpose the data of 347 buffaloes of a dairy farm (with milking parlor) was used. Their annual average milk yield and lactation length were found to be 1587.55 ± 33.82 L and 247.66 ± 4.39 days. It was observed that the prolonged service period had a positive effect on the total milk yield and lactation length. The calving season did not affect the milk yield, but the lactation length was longer in the buffaloes calving in winter months. The service period had a direct effect on the economic profitability, and it was observed that the service period of buffaloes calving in winter was shorter. It was also determined that milk productivity was positively affected due to the increase of calving age and parity, but there were wide variations in the herd. In conclusion, calving age, parity, and service period had a positive effect on the annual average milk yield and lactation length, but, on the other hand, calving season did not affect the annual average milk yield. Further studies on breeding and herd management are required to minimize variations in buffalo herds milked by rotary milking system.

Keywords: buffalo, milk yield, lactation length, milking techniques

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INTRODUCTION

Italian Mediterranean buffaloes, which are included in the river buffalo group show a wide geographical distribution in the Mediterranean countries (Soysal et al., 2016). In Italy, the breed is raised in intensive farming systems and is selected for milk yield, fat and protein (Rosati et al., 2002; Soysal et al., 2016). The Italian Mediterranean buffaloes are raised under various production systems in the Mediterranean countries, thus it is important to investigated the genetic and environmental factors that have impact on milk yield and lactation length.

In terms of their reproductive characteristics, they show seasonal cycles depending on the geographical region (Perera, 2011; Harun-Or-Rashid et al., 2019). This period may vary depending on the breed, habitat, nutrition, climate, and management conditions (Qureshi et al., 1999; Perera, 2011). Buffaloes that calve during their normal calving season resume their cyclical ovarian activity earlier than those calve in other seasons (Baruselli et al., 1997; Ahmad, 2009). Various factors such as calving interval, and service period are considered as important factors affecting the profitability of the commercial enterprise (Ermetin, 2017).

Buffalo farming requires meticulous planning for efficient production. In dairy farming, fertility and milk yield are critical traits in the maintenance of productivity and they interact with various factors (Parlato and Ziccarelli, 2016). Several factors impact on the efficiency of milk production, and although there are several studies investigating the milk production in buffaloes, these are less than the relevant research works on cattle. Furthermore, limited work exists on Italian buffaloes raised in Türkiye. Therefore, more studies that will provide new data on the buffaloes' milk production are necessary.

Rotary milking units can provide serious advantages in breeding farm animals in terms of reducing labor cost, animal management, length of milking, and milking stress (Caria et al., 2011; Jiang et al., 2017). The rotary milking parlor is not widespread in dairy buffalo farms, and thus there is need for further studies to investigate the factors that have impact on milk yield and compare the efficiency of different systems.

This study gives some preliminary results on the factors that influence milk yield and lactation length of the Italian Mediterranean buffalo in a farm in Türkiye that has installed a rotary milking parlor. As mentioned before further studies are required to provide the necessary data that will improve the buffalo milk production sector in Türkiye.

MATERIALS AND METHODS

This research was conducted according to the institutional committee on animal use (2020/480). For this purpose, the farm records constituted of the 347 pure Italian Mediterranean buffaloes bred in a commercial dairy enterprise (Lat: 41°12'25'' N, Long: 28°13'07'' E, Alt: 135 m) in the Silivri district of Istanbul between 2016 and 2018 years were examined. On this farm, animals were housed in a semi-open free-stall barn. Total mixed ration (TMR) feeding was done by taking into account the nutrient requirements of the animals according to the milk yield, pregnancy, and milking days. The feed ingredients included in the ration consisted of corn, barley, sunflower meal, distilled dried grains with solubles, soybean meal, fine bran, alfalfa, oatmeal, wheat straw, vitamin-mineral premix and sodium bicarbonate. There was no facility such as ponds etc. to cool the buffaloes within the farm. Buffaloes in estrus were naturally mated in the ratio of 25/1 male. The newly born buffalo calves were kept in separate calf compartments, after staying with their mother for three days. Milking was performed twice a day in a 40-unit rotary milking unit with an interval of 12 hours. The average milking time was 15 minutes for each animal. The vacuum power of the milking machine was 40 kpa, the pulsation number was 65 cycles/min, and the pulsation rate was 65:35. The automatic massage was applied before milking to help the milk let down. Milk yields were checked monthly, and milking was performed until buffaloes were dried out spontaneously.

By examining the two-year records of the farm, milk yield and lactation length of buffaloes were classified according to calving age, calving season, parity and service period. After classification, average of total milk yield and lactation length of buffaloes examined in each parameter, were calculated (Mean ± SD). Calving seasons of buffaloes were classified into four groups as Winter (December, January, February), Spring (March, April, May), Summer (June, July, August) and Fall (September, October, November) by considering regional climatic conditions (geo-climate). The time between calving and successful conception (service period), was classified in 6 groups, 1 (0-45 days), 2 (46-90 days), 3 (91-150 days), 4 (151-210 days), 5 (211-300 days), and 6 (300 days and above). The parity of buffaloes is listed between 1 and

4, and the 4th included those with four or more parities.

Statistical Analysis

In this study, the sample size was determined by statistical power analysis using G*Power 3.1.9.4 version software program and evaluation of similar studies in the literature. The required minimum sample size for one way ANOVA for one independent variable was calculated as 343, taking the effect size (f) 0.25, type I error (α) 0.05 and power (1-β error) 0.80 (using Cohen guidelines). Similarly, an average of 350 buffaloes had been used in the studies (Chaudry, 1992; Afzal et al., 2007; Şahin and Ulutaş, 2014; Tekerli et al., 2001; Uğurlu et al., 2016) investigating the effects of environmental factors on milk yield and lactation length.

Statistical Package for Social Sciences 17 edition (SPSS 17.0) was used for statistical analysis. The effect of calving season, calving age, parity, and service period on lactation length and total milk yield were evaluated with Analysis of variance (ANOVA) and also posthoc Tukey's multiple tests were used to compare the subgroups of factors that made significant effects (Tekerli et al., 2001). The impacts of some environmental factors on total milk yield and lactation length were calculated by using the following model:

$$Y_{ijklm}=\mu+a_i+b_j+c_k+d_l+e_m+f_{ijklm}$$

Where; Y = the dependent variable (total milk yield, lactation length), μ: the overall mean, a: amount of effect of calving age (i: 3, 4, 5, 6, 7, 8, 9, 10), b: the amount of effect of parity (j: 1, 2, 3, 4), c: the amount of effect of the calving season (k:1, 2, 3, 4), d: the amount of effect of service period (l: 1, 2, 3, 4, 5, 6), e: the amount of effect of year (m: 2016-2017, 2017-2018), f_{ijklm} : error

RESULTS

The effects of calving age, parity, calving season, and service period on annual average milk yield and lactation length and mean values (Mean ± SEM) of this data was presented in Table 1 and was illustrated in Figure 1. When the data was analyzed, it was determined that the average age of first calving age was 37.64 ± 3.19 months.

In the study, the effect of calving age (P<0.05), parity (P<0.01), and service period (P<0.001) on milk yield were found to be significant. The highest milk yield was observed in those who were three years old (1850.79 ± 109.96 L), in primiparous buffaloes (1807.55 ± 67.20 L), and in animals with a service period of 300 days or more (6) (1998.96 ± 93.27 L). While the effect of calving season on milk yield was not statistically significant in the study, higher average values were obtained in buffaloes calving in winter.

The effect of calving age, parity, calving season, and service period on the lactation length was found statistically significant (P<0.001). Among the examined groups, the lactation length was found longer in those who were three years old (319.51 ± 19.09 L), in primiparous buffaloes (308.07 ± 10.92 L), in those calving in summer (286.70 ± 15.53 L), and in those whose service periods in 6th group (316.38 ± 12.63 L), when compared to the values of other groups. Moreover, service period is longer in primiparous buffaloes (average: 4 (151-200 days) than other calving age groups.

DISCUSSION

In the current study, the average milk yield was found to be 1587.55 ± 33.82 L in Italian Mediterranean buffaloes of different ages and different lactation lengths milked by rotary milking parlor (Table 1). Milk yield was higher than other studies investigating the effect of environmental factors on lactation dynamics in Anatolian buffaloes in Türkiye (Tekerli et al., 2001; Şahin and Ulutaş, 2014; Uğurlu et al., 2016; Ermetin, 2017; Soysal et al., 2019). Nevertheless, it was found lower than the values reported by Murrah (2229.87 L), (Pawar et al., 2012), and Nilli Ravi (1831 L) (Afzal et al., 2007) for the buffaloes bred in countries like India and Pakistan, and also than the values reported by Parlato and Ziccarelli (2016) for the Italian Mediterranean buffaloes. It was also found to be lower than the milk yield obtained from the buffaloes grown in semi-intensive conditions in Egypt (Mourad and Rashwan, 2001). Milk yield average may show variance depending on genetic factors (Afzal et al., 2007; Pawar et al., 2012; Soysal et al., 2019), management, feeding, rearing conditions (Mourad and Rashwan, 2001; Uğurlu et al., 2016), and also milking techniques (Caria et al., 2014).

Teat morphology of buffaloes (Sastry et al., 1988; Thomas, 2004) and their temperament (Caria et al., 2014) are different from cow. It is suggested that the rotary milking systems can be more effective in terms of tolerance of prolonged milking times and also in solving problems experienced during milk flow (O'Brien et al., 2012). Thus, more detailed studies can be conducted to investigate the individual variations arising from milking systems in the buffaloes.

Table 1. Descriptive statistics and significance for milk yield and lactation length according to environmental factors

Factor		Lactation milk yield			Lactation length		
	N	X ± Sx	Min	Max	X ± Sx	Min	Max
Total	347	1587.55±33.82	504	3893	247.66±4.39	89	690
Calving age							
3	39	1850.79±109.96 **c**	786	3893	319.51 ± 19.09 **c**	154	690
4	78	1587.83±56.30 **abc**	508	2935	259.28 ± 8.58 **b**	95	458
5	33	1673.78 ± 118.73 **bc**	511	3059	237.93 ± 12.05 **ab**	117	381
6	74	1622.47 ± 85.42 **abc**	620	3601	243.93 ± 8.85 **ab**	115	460
7	42	1599.52 ± 93.36 **abc**	555	3562	232.11 ± 8.52 **ab**	122	355
8	19	1516.63 ± 138.67 **ab**	504	3063	223.84 ± 16.61 **ab**	89	449
9	27	1322.74 ± 106.75 **a**	515	2529	203.33 ± 10.33 **a**	109	296
10	35	1366.88 ± 96.44 **ab**	520	2287	225.77 ± 11.65 **ab**	120	411
P		*			***		
Parity							
1	81	1807.55±67.20 **a**	786	3893	308.07±10,92 **a**	149	690
2	74	1431.47±64.20 **b**	508	2947	230.33±8.54 **b**	95	411
3	109	1569.47±61.69 **b**	516	3601	231.24±5.96 **b**	114	460
4	83	1535.74±71.38 **b**	504	3340	225.72±7.17 **b**	89	401
P		**			***		
Season							
1	124	1602.25 ± 54.14	511	3562	234.87 ± 4.98 **a**	120	566
2	97	1585.02 ± 68.04	508	3893	236.34 ± 10.42 **a**	95	690
3	37	1590.83 ± 91.32	504	2935	286.70 ± 15.53 **b**	89	458
4	89	1568.47 ± 69.95	515	3340	261.59 ± 8.03 **ab**	109	411
P		ns			***		
Year							
2016-2017	161	1618,59 ± 660,46	504	3893	289,78 ± 86,59	95	690
2017-2018	186	1485,89 ± 663,17	515	3601	249,1 ± 85,52	89	566
		***			***		
Service Period *							
1	43	1409.48 ± 80.71 **a**	518	2529	208.02 ± 7.59 **a**	109	297
2	70	1469.84 ± 57.81 **a**	511	2871	223.04 ± 6.10 **ab**	127	458
3	49	1466.38 ± 99.28 **a**	504	3144	227.63 ± 9.34 **ab**	89	389
4	70	1536.57 ± 83.40 **a**	508	3601	244.67 ± 12.29 **c**	95	690
5	63	1651.19 ± 66.49 **a**	853	3340	264.26 ± 8.55 **bc**	149	498
6	52	1998.96 ± 93.27 **b**	723	3893	316.38 ± 12.63 **d**	134	566
P		***			***		

ns: >0.05, ***:** P<0.05, ****:** P<0.01, *****:**P<0.001

a-c: means within a column with different letter are significantly different

* Since this study represents the 2 years data of the farm, this table also includes buffaloes (n=81) which became pregnant again after parturition in the first lactation.

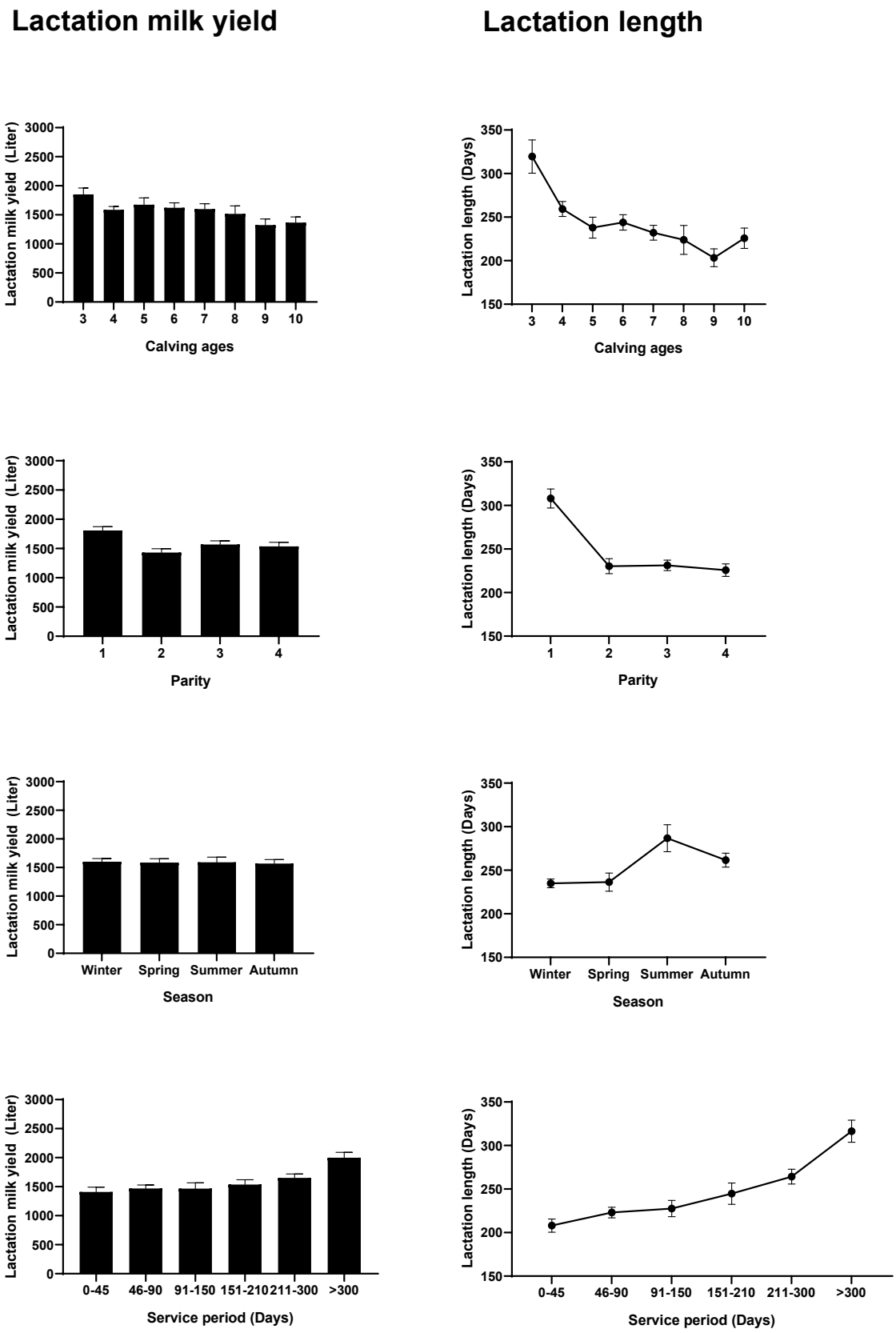

Figure 1. Graphical summary of the effects of some factors on milk yield and lactation length in Italian Mediterranean buffaloes milked by rotary milking parlor

Hormonal changes during pregnancy can cause regression in mammary glands, and eventually, this situation could have adverse effects on milk yield (Qureshi et al., 2007; Khan et al., 2008). When the data was examined, it was seen that the service period was more than 300 days in primiparous animals. Considering the prolongation in conception affected milk yield positively, this situation explained the higher milk yield in primiparous buffaloes. It is thought that the lactation length of primiparous buffaloes is prolonged and they cannot conceive, so the total milk yield increases.

In the current study, as the number of lactations increased in Italian Mediterranean buffaloes (excluding the first parity), the average milk yield increased (Figure 1). These results were compatible with similar studies (Mourad and Rashwan, 2001; Afzal et al., 2007; Uğurlu et al., 2016). However, when the values related to the aging were examined, it was seen that the variations in the herd were quite high, and an increase was seen in milk yield values up to 6 years, and then the decline occurred.

Similar to the present study, it has been reported that the lactation length, service period and calving interval are longer in primiparous buffaloes compared to buffaloes of other calving ages (Cady et al., 1983; Pawar et al., 2012; Thiruvenkadan et al., 2014; Jakhar et al., 2016). In this study, it was observed that the average milk yield in 3-year-old buffaloes was higher than in other calving age groups. On the contrary, Parlato and Ziccarelli (2016) have reported that young buffaloes have lower milk yield and milk yield increases as the parity increases. In this study, there may be different reasons for the higher milk yield and longer lactation period in 3-year-old buffaloes. These reasons may be due to individual differences that cause variation within the herd including body weight, body condition score, gestation period and udder diseases or may be related to farm management (Akçapınar and Özbeyaz, 2021; Qureshi et al., 2007; Khan et al., 2008; Gorelik et al., 2021). In this study, it was also observed that the lactation length and milk yield were higher in buffaloes with a long service period (>300 days). Since there is no competition between fetal development and milk yield in non-pregnant buffaloes, it becomes possible to obtain more milk during the lactation period (Akçapınar and Özbeyaz, 2020). This finding is similar to that reported by some researchers (Nava-Trujillo et al., 2020; Şahin and Ulutaş, 2014), but is inconsistent with other studies (Afzal et al., 2007; Pawar et al., 2012). It is thought that these differences in milk yield and lactation length might be related to buffalo breed and different management and feeding conditions, and also long service period. As some researchers have reported in buffaloes (Khan et al., 2008; Seno et al., 2007) and in cattle (Duru and Tuncel, 2004; Japertiene and Japertas, 2013; Mikolaychik et al., 2021), in this study, it is seen that milk yield and lactation length increase because of elongation in service period. This may be related to the effect of service period on lactation persistence (Kaya and Kaya, 2003).

The buffaloes have dark-colored and thick skins, and the number of sweat glands in their bodies is less than other livestock, and therefore these species can be more affected by heat when compared to other farm animals (Soysal, 2009). In some studies (Mourad and Rashwan, 2001; Pawar et al., 2012; Afzal et al., 2007; Catillo et al., 2002), it was reported that the calving season affected milk yield. The effect of season on milk yield is controversial. Pawar et al. (2012), Catillo et al. (2002), Thiruvenkadan et al. (2014) have reported that buffalo calving in winter, Afzal et al. (2007) reported that buffalo calving in the spring, and Mourad and Rashwan (2001) have reported that buffalo calving in autumn have higher milk yield those that gave birth in other seasons. Although similar results were obtained in our study with Pawar et al. (2012) and Catillo et al. (2002), no statistical significance was found in milk yield depending on the calving season. It is thought that this situation can be related to the breeding conditions, photoperiod, or feeding conditions of the animals.

The average lactation length in Italian Mediterranean buffaloes (247.66 ± 4.39 L) was lower than the values reported for the Murrah buffaloes (Pawar et al., 2012, Harun-Or-Rashid et al., 2019) and Nilli Ravi (Harun-Or-Rashid et al., 2019; Afzal et al., 2007), on the other hand, it was found higher than those reported for Anatolian buffaloes (Şahin and Ulutaş, 2014; Soysal et al., 2019) and the values reported for some native breed buffaloes bred in Bangladesh (Harun-Or-Rashid et al., 2019). It was found similar to the values reported by Soysal et al. (2019) for Italian Mediterranean buffaloes.

In our study, calving age, parity, calving season, and service period were found to be efficient in the lactation length. As some researchers (Chaudhry, 1992; Khan and Chaudhry, 2000), in the current study, the lactation length was found to be higher in

the buffaloes that were in the first lactation. However, although the findings regarding the effect of the season on the lactation length are different from other studies (Afzal et al., 2007; Chaudhry, 1992; Khan and Chaudhry, 2000), it was found similar to the research data of Hussain et al. (2006) only.

CONCLUSION

Based on data from this preliminary study, it was determined that the environmental factors including calving age, parity and service period were efficient on total milk yield but it was seen that season had no effect on it in Italian Mediterranean buffaloes in Türkiye. All of these environmental factors were efficient on the lactation length. In buffalo husbandry in Türkiye, it is recommended to consider the effects of environmental factors on milk yield and lactation length, and to take necessary precautions in farms to prevent the negative effects of environmental factors on yield characteristics in buffalo farms. In addition, there is a requirement for further studies with more comprehensive and rigorous data investigating the effects of environmental factors and different milking systems on lactation yield and dynamics in Italian Mediterranean buffaloes.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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