The Effect of Calving Season and Parity on Some Reproductive Performance in Anatolian Buffaloes Reared in Bartın Province

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Article Info	ABSTRACT
	The purpose of this research is to determine the effect of calving season and parity on the reproductive performances of CI (calving interval) and DP (dry period) in Anatolian buffaloes raised under farm conditions in Bartın province of Turkey between 2015 and 2020. For this purpose, 1251 records of 616 Anatolian buffaloes were evaluated to determine CI and DP from the reproductive performances of Anatolian buffaloes. In the analysis of the data obtained in the study, the effects of calving season and parity, which are environmental factors, on DP and CI, which are reproductive parameters, were calculated by the "Least Squares Method". Statistical significance of mean values was determined by analysis of variance, and statistical differences between means were evaluated using the Tukey test. Within the framework of the study, the values of CI and DP, the reproductive characteristics of Anatolian buffaloes, were determined as 423.84 ± 3.06 days and 149.55 ± 2.81 days, respectively. In the work, the effect of parity and calving season on CI and DP was found to be statistically significant. At the same time, high positive phenotypic correlations were found between CI and DP (r: 0.722, $p<0.001$). In this study, the highest reproductive performance in Anatolian buffaloes was obtained in the third and fourth parities, with those calving in the spring season. In the study, it was concluded that taking into consideration the CI and DP factors, which are found to be important and affecting productivity in the selection of breeding animals by breeders will contribute to farm efficiency.

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INTRODUCTION

Buffalo (Bubalus bubalis) is a dairy animal that is raised worldwide, especially in Asia, where 98 percent of the world's buffalo population can be found. India (54.5%), Pakistan (21.3%) and China (13.1%) are home to 88.9 percent of the world's buffalo population (FAO, 2022). The water buffaloes reared in Turkey are descended from Mediterranean buffaloes – a subgroup of river - type buffaloes. Referred to today as Anatolian buffaloes (Cicek et al., 2009), they are raised mostly in the northern, central, western, eastern and southeastern parts of Anatolia (Atasever and Erdem, 2008).

The population of Anatolian buffalo in Turkey had decreased from about 1.2 million head to 84,726 head between 1960s and 2010. Then, the "National Anatolian Buffalo Breeding Project in Farmer Conditions" was launched by the Ministry of Agriculture and Forestry (MoAF) in 2011, which resulted in the number of Anatolian buffalo in Turkey increasing to 161,749 head in 2020 (TURKSTAT, 2023).

Buffalo breeding in Turkey is generally focused on the production of meat and especially milk (quark, yogurt, cheese, ice cream). Foods of animal origin such as meat and milk play an important role in human nutrition (Oyan et al., 2024). Especially recently, there has been an increase in studies showing that whey proteins produced from milk can be used as an important food additive in the nutrition of infants, the elderly and sports (Aktan and Uçar, 2022). Milk yield and reproduction; it is influenced by factors such as age, genotype, season, management and nutrition (Kumar et al., 2017). CI is an indicator of the reproductive status of dairy animals. In cows and buffaloes, the recommended CI is 12-13 months, and if a dairy animal is to be cost-effective, it should have a shorter DP and a shorter CI. In this regard, CI and DP are important economic factors affecting milk productivity in buffaloes (Sanker et al., 2014).

The aim of this research is to define the effects of parity and season on the reproductive performance (CI, DP) of Anatolian buffaloes reared under farm conditions. It is believed that the information obtained from this study will help in the formulation of future breeding plans of Anatolian buffaloes.

MATERIAL AND METHOD

Study Area, Animals and Data Collection

The data were acquired from the "Manda Yıldızı" database (Tekerli, 2019) within the scope of the "Anatolian Buffalo National Breeding Project in Farmer Conditions" supported by the Directorate General of Agricultural Research and Policy (TAGEM). The research data included the pedigree records of 901 head of Anatolian buffalo reared in Bartın province (41° 38' N and 32° 20' E) between 2015 and 2020. In the study, 1251 records of reproductive performance of Anatolian buffaloes that calved between 2015 and 2020 were evaluated. In the region, buffalo husbandry is mostly practiced under pasture conditions. During the grazing season, buffaloes are generally not given supplemental feed, but are provided with small amounts of stock feed (dried alfalfa, straw, silage, etc.) in winter. Buffalo in the herd reproduce by natural mating. Buffalo in the herd reproduce by natural mating. Colostrum is given to newborns to provide passive immunity and contribute to the development of the gastrointestinal tract (Uysal et al., 2024). Milking is done twice a day, morning and evening, by hand for most farmers and by machine for the rest.

In the study, records with a CI of ≥300 and ≤700 days (Koçak et al., 2019) and a DP of ≥30 and ≤300 days (Poudel et al., 2017) were assessed. The findings obtained by Alkoyak and Öz (2020) in a study conducted in the same area were also used. The DP was calculated considering the date on

which the animals were dried off at the end of the ongoing lactation. In line with the prevailing geo-climatic conditions in Turkey, calving seasons are split into four groups; winter (1) (February, January, December), spring (2) (May, April, March), summer (3) (August, July, June), fall (4) (November, October, September). Parity was ranked numerically from 1 to 5.

Statistical Analysis

In this study, the effects of season and parity on reproductive parameters were calculated using the least squares method. Statistical significance of means was determined by analysis of variance, and differences were evaluated using the Tukey test. Due to lack of data in the subgroups, no two- or three-way interaction was assumed between the factors studied. In addition, the phenotypic correlation was determined using the Pearson's method. The general linear model within the Minitab version 18 package and the correlation procedure were used for the analyses (Minitab, 2017).

The following statistical model was used to calculate the effect of season and parity on CI and DP.

$Yi_jkl = \mu + S_i + P_j + H_k + e_{ijkl}$ where;

Y_{ijkl} is the production level of any buffalo (i. season, j. parity, k. observation level of the herd for the characteristic in question)

μ represents the mean (expected),

S_i represents the effect of calving season (i: 1, 2, 3, 4),

P_j represents the effect of parity (j:1, 2, 3, 4)

H_k represents the effect of herd (k: 1- 118 different herds)

e_{ijkl} represents the random error (NID, 0, $\sigma 2$).

RESULTS

Means, standard errors and influential factors for the effect of season and parity on reproductive performance are calculated (Table 1). The number of herds examined (118 herds) is not given in Table 1 because it is too high. The results of the analysis of variance regarding the environmental factors examined in the study are given in Table 2. The effects of calving season and parity on DP and CI were significant ($p<0.01$, $p<0.001$). High positive phenotypic correlations were found between CI and DP (r: 0.722, $p<0.001$)

Table 1

Mean Least Squares (± Se) Of Ci and Dp of Anatolian Buffaloes According to Season and Parity

FACTORS	CI (Days)		DP (Days)	
	n	(Mean±SE)	n	(Mean±SE)
Overall average	1251	423.84±3.06	1251	149.55±2.81
Calving Season		**		**
Winter	195	448.32±5.56[a]	195	164.85±5.10[a]
Spring	282	413.88±4.99[b]	282	142.24±4.58[b]
Summer	436	417.04±4.35[b]	436	150.03±3.99[ab]
fall	338	416.12±4.46[b]	338	141.09±4.09[b]
Parity		*		**
1st	451	436.25±3.73[a]	451	165.22±3.42[a]
2nd	381	423.23±4.01[b]	381	152.21±3.67[b]
3rd	247	417.09±4.93[b]	247	142.22±4.52[b]
4th	172	418.78±5.92[b]	172	138.55±5.43[b]

*:p<0.01; **: p<0.001
a, b: Differences between the means in the same column with different superscripts are significant (p<0.01).

Table 2

Analysis of Variance of Factors Affecting Ci and Dp

Factors	CI			DP	
	D.F	M.S	F-Value	M.S	F-Value
Herd	113	11361	2.62**	7042	1.94**
Calving season	3	47247	10.91**	23285	6.40**
Parity	3	23639	5.46*	38848	10.68**
Error	1131	4330		3638	

M.S: Mean square; D.F: Degrees of freedom; *p<0.01; **p<0.001

Table 3

Phenotypic Correlation (Rp) for Ci and Dp of Anatolian Buffaloes

Traits	CI	DP
CI	-	
DP	0.722**	-

CI: Calving interval; DP: Dry period; **P<0.001

DISCUSSION

In the study, the mean CI found in Anatolian buffaloes (423.84±3.06 days) was similar to the findings of other researches (Alkoyak and Öz, 2020; Alkoyak et al., 2023; Malhado et al., 2013; Soysal et al., 2018), who reported CI's of 411 days in Murrah buffaloes and 411.3 - 426.3 days in Anatolian buffaloes. However, this value is higher than that of Marai et al., (2009) on Egyptian buffaloes (402.6 days). Conversely, there have been many studies (Komori et al., 1994; Tekerli et al., 2001; Thevamanoharan 2002; Hussain et al., 2006; Sanker et al., 2014; Charlini and Sinniah 2015; Nava-Trujillo et al., 2018; Koçak et al., 2019) reporting higher CI's than in this study, such as 453 days in Murrah buffaloes, 450.2–496 days in Nili-Ravi buffaloes and 441.9–450.3 days in Anatolian buffaloes.

In the present study, the effect of calving season on CI was determined to be significant (p<0.001). Consistent with this study, there are studies that reported the effect of calving season on CI to be important in Anatolian buffaloes (Tekerli et al., 2001; Koçak et al., 2019; Alkoyak and Öz 2020; Alkoyak et al., 2023) and Egyptian buffaloes (Marai et al., 2009). In contrast to the present study, the effect of season on CI was not found to be significant in the research of Anatolian buffaloes in İstanbul (Soysal et al., 2018). While in the present study the longest CI for Anatolian buffaloes was observed in animals that calved in winter, the shortest CI was observed in animals that calved in summer, and other studies have obtained similar results (Bashir et al., 2015; Koçak et al., 2019), which supports the results of this study. The fact that the shortest CI was observed in animals that calved in summer could be attributed to the fact that the gestation period of the animal after birth could continue into the fall or winter seasons. In winter and fall, the reduce in day length and the decrease in temperature may lead to an increase in sexual activity in buffaloes. In this work, the effect of parity on CI was significant (p<0.01). Similarly, Soysal et al. (2018), Alkoyak and Öz (2020), and Alkoyak et al. (2023) found that the effect of parity on CI was significant in Anatolian buffaloes, and there are many other studies (Charlini and Sinniah, 2015; Fakruzzaman et al., 2020; Hussain et al, 2006; Marai et al., 2009; Nava-

Trujillo et al., 2018; Sanker et al., 2014) that reported the effect of parity on CI to be significant in buffaloes. In the research, it was observed that CI steadily decreased with increasing parity, and this result was similar to the findings of other studies (Charlini and Sinniah, 2015; Alkoyak and Öz, 2020), which may be attributable to the lower reproduction performance of buffaloes at early parity, and the increase in their performance with increased age. Different from this study, Tekerli et al., (2001) conducted parity to have no significant effect on CI.

In the present study, the mean DP of Anatolian buffaloes was 149.55±2.81 days, which was similar to the DP found in other studies (Marai et al., 2009; Sanker et al., 2014), which were 144.3 days for Nili-Ravi buffaloes and 148.7 days for Egyptian buffaloes. However, there have been studies (Alkoyak et al., 2023; Charlini and Sinniah, 2015; Hussain et al., 2006) that reported longer DP's than those in the present study, such as 179-194.4 days for Nili-Ravi buffaloes and 191.7 days for Anatolian buffaloes. There are also studies (Poudel et al., 2017; Verma and Yadav 1989) reporting shorter DP's than those in the present study, e.g. 110.9 days for crossbred Murrah buffaloes and 120 days for Nili-Ravi buffaloes. However, if a dairy animal is to be cost effective, it must have a shorter DP (Poudel et al., 2017). DP is the necessary resting period between calving and animals normally have low yield during this period. When this period is longer than normal, milk production decreases, which affects the economics of the farm. In this work, the effect of calving season on DP was reported to be significant (p<0.001). Similarly, Alkoyak et al. (2023) and Hussain et al. (2006) found that DP was significantly affected by calving season. On the other hand, Thevamanoharan (2002) found that calving season had no significant effect on DP in Nili-Ravi buffaloes, unlike the present study. Furthermore, the effect of parity on DP was found to be significant (p<0.001). Similarly, there have been studies (Hussain et al., 2006; Sanker et al., 2014; Alkoyak et al., 2023) that reported the effect of parity on DP to be significant, thus supporting the findings of this study. Contrary to the findings of this study, there have been studies (Hussain et al., 2006; Poudel et al., 2017; Fakruzzaman et al., 2020) reporting parity to have insignificant effect on DP. In this work, the highest DP was measured in the first parity, with a steady decrease observed in later parities (Table 1). Similarly, there have been studies (Fakruzzaman et al., 2020) reporting that the longest drying period was observed in buffaloes in the first parity, and a significant decrease in the following parities.

This study also found positive, high and significant correlations (r= 0.722, p<0.001) between the reproductive traits of CI and DP (Table 3), and similarly, there are other studies reporting high and significant phenotypic correlations between these traits (Marai et al., 2009; Galsar et al., 2016; Jakhar et al., 2016). On the other hand, Aziz et al. (2001) reported only moderate phenotypic correlation between CI and DP. In the present study, the investigated environmental factors were found to influence the reproductive traits of CI and DP. Since high and positive phenotypic correlations were observed, it can be concluded that reproductive traits could be improved by better control of the identified environmental factors.

CONCLUSION

It can be concluded that if the Anatolian buffalo breeders take the necessary measures in terms of care, nutrition and herd management, their reproductive performance will increase. The significant correlations between CI and DP indicate that buffalo breeders can improve reproductive traits by ensuring better management conditions in their farms. In this study, the highest reproductive performance of buffaloes was obtained in the third and fourth parity with those calving in spring. It was concluded that taking into account the factors considered important and affecting the yield in the selection of breeding animals and using these factors in the genetic improvement of animals, could contribute significantly to farm productivity.

Ethics Committee Approval

In our study titled "The effect of calving season and parity on some reproductive performance in Anatolian buffaloes raised in Bartin province", no action was taken on the animals and only the data recorded in the breeding project were evaluated. The authors declare that an ethics committee decision is not required.

Authors Contributions

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Sezer Öz, Kürşat Alkoyak and İrfan Güngör. The first draft of the manuscript was written by Kürşat Alkoyak and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Conflict of Interest

The authors declare that they have no conflict of interest.

Sustainable Development Goals (SDG): 12 Responsible Consumption and Production, 15 Life on Land

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