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EFFECT OF SEASON OF BIRTH ON SEASON OF CALVING AND AGE AT FIRST CALVING IN BUFFALO HEIFERS

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Abstract

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Records for 589 Bulgarian Murrah heifers from the buffalo herd of Agricultural Institute – Shumen, borne within the period 1982-2010, were processed using the software products LSMLMW and MIXMDL (Harvey, 1990) with the aim to study the effect of season of birth on season of calving and age at first calving (AFC). The operational model also included the factors period of birth, season of conception, and period of conception. It was established that the factor season of birth has significant effect on the variation of the trait AFC (P=0.0025), expressed in lower calving age in the heifers borne in summer and autumn. The influence of season of calving on AFC has shown to be more pronounced in the winter-borne heifers, the age of the autumn calvers being significantly lowest; as well as in the spring-borne ones, where the age of the summer calvers is highest. The heifers borne in summer are characterized by the typical for the breed spring-summer seasonality of calving, those borne in spring calve chiefly in spring, while the calvings of those borne in autumn and winter are mostly in summer.

*Key words***:** buffalo heifers, season of birth, season of calving, age of calving

Abbreviations: AFC – age at first calving

Introduction

The water buffalo is a traditional animal for the Bulgarian husbandry and it is subject of increasing interest on European and global scale because of the unique attributes of the beef and dairy products. For the profitability of a buffalo farm, high genetic progress in productivity traits is prerequisite, which is largely dependable on the reproductive efficiency of the animals in the herd (Peeva, 2000).

Except the irregular cyclicity in adult buffalo cows, serious problem in buffalo breeding is the irregularity of onset of puberty and estrus behavior in heifers, chiefly due to the species-specific effect of season because of different trends of pineal photosensitivity and melatonin secretion (Borghese et al., 1995; Kassim et al., 2008; Perera, 2011). In combination with the peculiarities of buffalo reproduction like high incidence of silent heat and low conception rates, this often results in long periods of anestrus, especially in heifers (Sah and Nakao, 2010). In this context, of utmost importance is the season in which the onset of puberty of the heifer occurs and respectively in which she enters the main herd to be naturally serviced or artificially inseminated. The results of the selection on seasonality of reproduction on different buffalo farms in Italy (Seren et al., 1995) are indicative of the existence of relationship between seasonality of calving of the dam and seasonality of first calving of the daughter.

The objective of the present work was to study the effect of season of birth on season of calving and age at first calving in Bulgarian Murrah buffalo heifers.

Material and Methods

The study assigned 589 buffalo heifers from the Bulgarian Murrah breed borne on the farm of Agricultural Institute – Shumen within the period 1982-2010. The trait age at first calving (AFC) was studied.

The software products LSMLMW and MIXMDL (Harvey, 1990) processed the data, the operational model being represented with the equation:

$$Y_{i,q} = \mu + SB_i + YB_j + SC_k + YC_q + e_{i,q},$$

where the mean value of the trait AFC is denoted by μ, and the included fixed effects were season of birth (SB_i j = 1...4),

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period of birth (YB_j, j= 1...6), season of conception (SC_k, k= 1...4), and period of conception (YC_q, q= 1...6). To form the levels of the factors period of birth and period of conception, the set of data was pooled into six separate subsets (j and q) of five consecutive years each. Seasons of birth and conception were formed as follows: spring – from March to May; summer – June-August; autumn – September-November; and winter – December-February.

The whole bulk of data was pooled into four subsets correspondent to the different seasons of birth. For the evaluation of the influence of season of calving on AFC within the different seasons of birth, the data were processed by the conventional statistical procedure.

Results and Discussion

Table 1 represents the analysis of variance of the trait age at first calving (AFC) with included typical environmental factors only. The results indicate that period of birth and period of conception are most pronounced sources of variance (P≤0.001). However, only at a marginal degree of significance, season of conception also affects the reproductive trait (P≤0.05).

Noteworthy is that season of birth is a statistically significant source of the variance of AFC (P=0.0025). The data in Table 2 indicate that the heifers borne in summer and autumn have significantly earlier age at calving – by 69 days compared to those in winter (P≤0.05; P≤0.01) and by 46 than those in spring (P≤0.05). Greatest is the number of animals borne in summer (n=237), to constitute roughly 40% of all studied heifers, which is in keeping with the established in the Bulgarian Murrah buffaloes seasonality of calving (Alexiev et al., 1988; Penchev, 1999; Peeva et al., 2011). Little is the number of heifers that have conceived early (Table 2) – before the main breeding season – which results in lower AFC in the spring and winter calvers, the differences being significant only with regard to the former (P≤0.05). The information in the table shows that 42% of the heifers have conceived in summer, which is associated with the relatively low level of melatonin and hence higher levels of sexual hormones associated with the longer photoperiod in the conditions of different countries (Borghese et al, 1995; Kassim et al., 2008; Perera, 2011).

In Table 3 are presented the data about AFC corresponding to the seasons of calving within the different seasons of birth, as resulted from the conventional statistical process-

Table 1
Analysis of variance of the trait age at first calving

Sources of variance	df	MS	F-test	P
Season of birth	3	136325.18	4.88	0.0025
Period of birth	5	612948.02	21.94	0.0000
Season of conception	3	79906.56	2.86	0.0358
Period of conception	5	723320.95	25.90	0.0000
Remainder	572	27932.97		

Table 2
Effect of the factors season of birth and season of conception on age at first calving

Season	n	LSM	SE	t-test
Season of birth				
Spring	154	1167.5	14.4	1-[2,3]*
Summer	237	1122.0	12.3	2-[4]**
Autumn	115	1121.3	16.7	3-[4]*
Winter	83	1190.9	20.3	
Season of conception				
Spring	117	1124.2	17.3	
Summer	250	1175.1	12.2	1-[2,3]*
Autumn	162	1167.7	13.8	
Winter	60	1134.7	22.6	
Overall LS-mean	589	1150.4	9.4	

Significance of differences: ** – P≤0.01, * – P≤0.05

ing. They show that 443 heifers (75% of all animals assigned) have calved in spring and summer, which is to some extent commensurate with the sooner spring seasonality of calving of the heifers from earlier stage of development of the breed (Alexiev et al., 1988; Peeva et al., 2011). Although this typical seasonality of calving is observed in all four seasons of birth, there are certain differences among them, graphically presented with Figure 1. The buffalo heifers borne in spring have cascade pattern of seasonality of calving, representing certain difference between the percentages of spring (40.9%) and summer (31.8%) calves. When the season of birth is summer, the spring-summer seasonality of calving is most pronounced, the two seasons being represented by practically identical percentages coming to 81.5%. Since this portion of heifers borne in summer is largest, the results are similar to those about all studied animals – with high total calving concentration of 443 animals (75.2%) in spring and summer (Table 3). When the heifers are borne in autumn and winter their calving peak is in summer, the collective percentage of spring-summer calving being 68.7 and 71.1% respectively.

The information in the table also indicates that the heifers borne in winter have calved at latest age (1220.9±24.4 days)

Table 3
Age at first calving (AFC, days) as affected by season of calving within the different seasons of birth

Season of calving		n	x	± Sx	C	Minimum	Maximum	t-test
			Spring borne					
1	Spring	63	1146.4	± 19.2	13.3	1015	1833	
2	Summer	49	1237.9	± 31.5	17.8	827	1596	2-[1,3,4]*
3	Autumn	23	1122.9	± 36.9	15.8	853	1312	
4	Winter	19	1111.8	± 48.2	18.9	950	1744	
i	Overall	154	1167.7	± 15.5	16.4			
			Summer borne					
1	Spring	95	1087.9	± 17.4	15.6	933	1762	
2	Summer	98	1170.0	± 17.4	14.7	1017	1836	1-2***
3	Autumn	24	1144.4	± 35.0	15.0	802	1515	
4	Winter	20	1135.7	± 50.0	19.7	839	1660	
ii	Overall	237	1131.6	± 11.6	15.8			
			Autumn borne					
1	Spring	34	1133.0	± 34.6	17.8	872	1625	
2	Summer	45	1143.7	± 26.1	15.3	963	1421	NS
3	Autumn	22	1169.0	± 35.0	14.0	1021	1500	
4	Winter	14	1133.2	± 43.5	14.4	815	1242	
iii	Overall	115	1144.1	± 16.6	15.6			
			Winter borne					
1	Spring	27	1253.4	± 39.4	16.3	815	1902	
2	Summer	32	1234.8	± 41.8	19.2	886	1674	
3	Autumn	14	1095.9	± 44.3	15.1	956	1403	3-[1,2]*
4	Winter	10	1263.4	± 82.1	20.5	1035	1819	
iv	Overall	83	1220.9	± 24.4	18.2			
			Overall means by season of calving					
1	Spring	219	1132.1	± 12.3	16.0			
2	Summer	224	1188.8	± 13.1	16.5			1-2**
3	Autumn	83	1136.8	± 18.5	14.9			2-3*
4	Winter	63	1148.2	± 27.1	18.7			
	Overall	589	1156.1	± 7.9	16.5			
t-test by seasons of birth			*ii-iv*** *iii-iv***					

Significance of differences: *** – P≤0.001, ** – P≤0.01, * – P≤0.05, NS – P>0.05

– by 89.3 days than those in summer (P≤0.001) and by 76.8 days compared to those in autumn (P≤0.01); the differences with the spring calvers are not significant. Figure 2 illustrates the differences in AFC among the seasons of birth as influenced by season of calving. Despite of the high average age at calving of the winter-borne heifers, there is markedly lowest AFC (P≤0.05) established in those of them calving in autumn (1095.9±44.3 days) – by 157.5 and 138.9 days than the ones calved respectively in spring and summer. In the same time, the age of the heifers borne in winter and calving in autumn is comparatively low also compared to all other subsets. These are only a few young female buffaloes (n=14, Table 3) who, like all the other winter-borne ones, usually join the main herd also in winter or possibly earlier (in autumn) but, unlike them, have come in heat and conceived in short term. As the relatively close extremes and low phenotypic variability (15.1%) of the autumn calvers suggest, very few of them failed to conceive and skipped a year. Nevertheless, as it was implied above, they are the sooner to be considered an exception, while the majority of winter-borne heifers skipped the forthcoming typical breeding season and stayed barren until the other favourable opportunities to breed, so they calved in the spring or summer of the next years. AFC is very high in the heifers borne and calved in winter, which are also very few (n=10) and characterized by high variability of the trait (20.5%), great statistical error (SE), explaining the non-significant difference of 167.5 days. Except for autumn season of birth, the mean values of AFC for the winter borne animals have greatest SE values and relatively high variability (from 18.9 to 20.5%).

For the subset of data about the spring births, remarkable is the highest AFC of the heifers calving in summer (1237.9±31.5 days) – compared to those in spring by 91.5 days and especially to those in autumn and winter by respectively 115.0 and 126.1 days (P≤0.05, Table 3; Figure 2). The analysis of the information shows that, entering the main herd in spring (possibly even in winter), these animals stay non-pregnant until late summer and autumn (the main breeding season) while the majority of heifers even skip it to stay barren for one more year. To calve in the highest season, spring, the heifers have conceived in late spring and summer, shortly after joining the main herd. As for the early calvings in autumn and winter, these are presumably fast-growing animals entering the main herd at relatively low age and conceiving in short term though out of season. This applies even to a greater extent to the heifers that have calved in autumn, where the extremes are in relatively close range. Their mean age of calving suggests that their time of conception is just in season, which is discrepant to the analysis of the season of calving (n-values and relevant %, Table 3, Figure 1). This discrepancy can be attributed to the small number of animals with high variability of the trait and high statistical error (Table 3).

Within the animals borne in summer – the main calving season of adult buffaloes (Alexiev et al., 1988; Penchev, 1999; Peeva et al., 2011) – the differences in AFC among seasons of calving are smaller. In spring the age of calving is lowest (1087.9±17.4 days), by 82.1 days significantly lower than summer (P≤0.001) and by up to two months than autumn and winter (P>0.05). This is actually the most favorable value of the trait among all subsets, concerning namely the heifers with the mentioned most typical season of calving, taking advantage of the typical breeding season just after joining the main herd.

In the heifers borne in autumn there are even smaller differences in AFC among seasons of calving – ranging within 36 days (Table 3, Figure 2). Calving in season (spring and mostly summer) requires conceiving in roughly three months after entering the main herd, to justify the comparatively low overall mean AFC of this subset of animals (1144.1±16.6

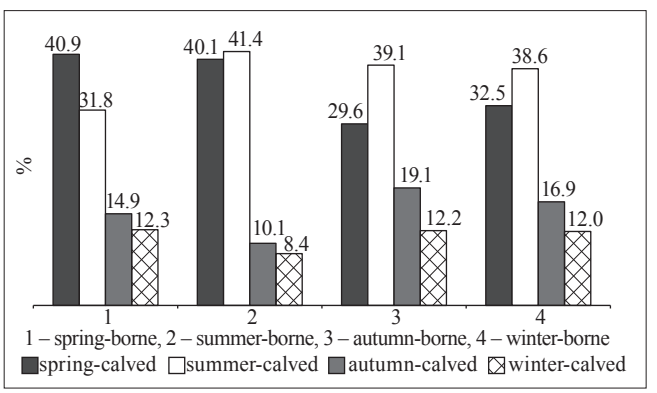

Fig. 1. Seasonality of calving within the different seasons of birth

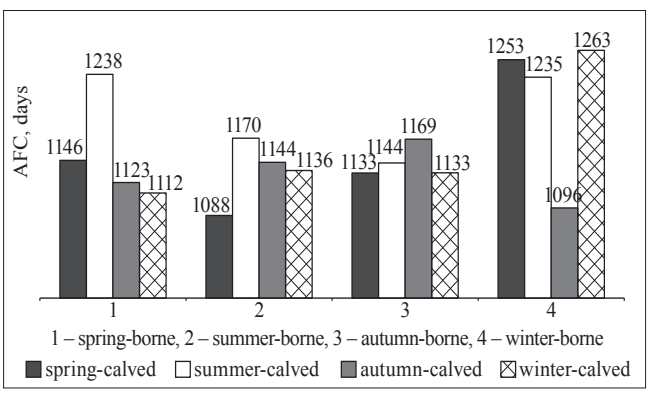

Fig. 2. Age at first calving (AFC) as affected by season of calving within the different seasons of birth

days). However, there are also individuals that skip a year – mostly spring calvers because of the wider extremes compared to summer calvers (Table 3). Noticeable are also the little differences between minimum and maximum recorded value in the autumn-borne young buffaloes that calved in autumn and winter (Table 3).

In view of the observed spring (Peeva et al., 2011) or spring-summer (Table 3) seasonality of first calving in the Bulgarian Murrah buffalo breed, it can be summarized that to certain extent the season of birth of heifers predetermines the season of their calving. The animals borne in the typical summer season of calving of their dams have expressed better this typical for heifers seasonality of calving, compared to those borne in the other seasons, while the heifers borne in spring calve chiefly in spring. Autumn- and winter-borne tend to calve mostly in summer, but they are a small number. There are some indications for certain heritability and respectively for certain success of the selection on reproductive seasonality observed in Italy (Seren et al., 1995), where the market demands for dairy products are also rather seasonal. This is a possible perspective for managing the breeding seasonality of young and adult Bulgarian Murrah buffaloes in a natural way, as an alternative of hormonal treatment, respecting market demands or organic farming regulations.

Conclusions

Season of birth was established to have specific effect on the trait age at first calving (AFC) in the Bulgarian Murrah buffalo breed (P=0.0025), expressed in lower age of the heifers calving in summer and autumn.

The majority of heifers have been borne in summer, with most pronounced spring-summer seasonality of calving; their AFC was not affected by season of calving.

The heifers borne in spring were found to calve chiefly in spring with significantly highest AFC when calving in summer. The minority of heifers that have been borne in winter show highest AFC, with most pronounced influence of season of calving, those calving in autumn having significantly earliest age of calving.

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