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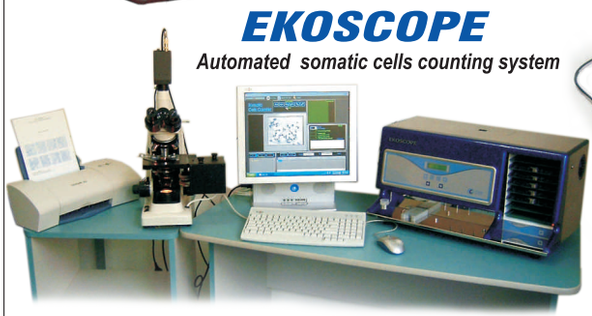

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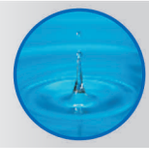

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Effects of days open on the milk yield and the duration of the concurrent lactation in Bulgarian Murrah buffaloes

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Abstract. *A study assigning 1021 lactations of 313 Bulgarian Murrah buffalo cows with milk yield recorded on the farm of Agricultural Institute – Shumen during the period 1967-2001 was initiated with the objective to estimate the effect of days open on the milk yield and the duration of the concurrent lactation. Using linear LS-analyses, significant antagonistic effect of days open on 305-day milk yield and especially on complete days in milk was established. Service period of three to five months is expected to be the most beneficial for the balance between reproductive efficiency and productive performance, at preferable lactation duration.*

Keywords: days open, milk yield, days in milk, LS-analysis, buffaloes

Introduction

Compared to bovine cows, in buffalo cows the moment of rebreeding is to a less extent a management decision and to a larger- a management success depending on the species specific peculiarities of reproduction – primarily the high incidence of silent estrus and the relatively irregular cyclicity, penalizing efficiency of reproduction and of artificial insemination in particular.

While in dairy cattle delaying conception could bring good returns from prolonged lactation (Knight, 2001; Arbel et al., 2001; De Vries, 2006), in a high-longevity species like the water buffalo days open is of utmost importance for optimization of the productive life, as the economic effects of the reproductive traits on profitability indicate (Peeva, 2000; S. Khan et al., 2008).

An array of research works have studied the correlation between days open (or calving interval) and lactation milk (Penchev, 1999; Peeva, 2000; Mendoza et al., 2009), establishing low values of the coefficient. However, in broad terms, the interrelationship between the two traits is difficult to study because of its great effect on culling rate, in view of the practically equal chances of low- and high-yielding cows to be culled for sub-fertility (Dunlap et al., 2000).

A more appropriate approach should be to test the specific effect of service period on the profit-making traits, like milk yield in dairy buffaloes. Having low heritability (Peeva, 2002; Thevamanoharan et al., 2002; Khan et al., 2007), days open is not strictly an environmental factor, like season and year of calving, but a characteristic of the recorded individual linked with farming practices. In our previous study we established the detrimental effect of advanced gestation on the concurrent lactation performance in buffaloes (Penchev et al., 2009), which in turn proposes a presumptive relevant effect of days open on productivity. Adverse effect of service period on milk performance has been observed in the buffalo abroad (Afzal et al., 2007; Qureshi et al., 2007; S. Khan et al., 2008), but on national scale this issue has not been on focus since the early stages of creation of the Bulgarian Murrah (Boikovski, 1977), in particular its effect as a source of specific variation.

In respect to milk productivity, another relevant object of selection and management interest is the trait lactation duration, which has been problematic in the buffaloes in Bulgaria and a serious cause for culling (Ilieva, 2006). Its variance has been subject of many studies, showing prevalence of the non-genetic factors (Penchev, 1999; Suhail, et al., 1998; Tiwana and Dhillon, 1998; Peeva, 2000; Tonhati et al., 2000; Aziz et al., 2001), but paying no respect to the effect of days open.

The present study was initiated with the aim to test the specific effect of days open on the 305-day milk productivity and the complete days in milk of the concurrent lactation in Bulgarian Murrah buffalo cows.

Material and methods

Subject of the study were 1021 lactations of 313 Bulgarian Murrah buffalo cows with recorded milk yield bred on the farm of Agricultural Institute – Shumen in the period 1967-2001.

The LS-analyses assigned data for two traits: milk yield within 305-day lactation and compete lactation duration. They are expressed by the following equations, respectively for first and second-plus parity:

$$Y_{1st} = \mu + DO_i + SC_j + PC_k + AFC_l + e_{i,l}\,, \quad (1)$$

$$Y_{2nd+} = \mu + DO_i + SC_j + PC_k + P_p + MY_q + e_{i,q}\,, \quad (2)$$

where μ is the mean value of the trait, and DO_i, SC_j, PC_k, AFC_l, P_p, and MY_q – respectively the fixed effects of days open (i=1…4), season of calving (j=1…4), period of calving (k=1…8), age at first calving (l=1…3), parity (p=2…4), previous full lactation milk yield (q= 1…4), and $e_{i,l}$ and $e_{i,q}$ – the residual effects.

The data were processed using the software products LSMLMW and MIXMDL (Harvey, 1990). Except for the two

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mentioned traits, to the conventional statistical procedure were subjected also days open and yield per day of calving interval.

Results

The ANOVA for the lactation milk yield (Table 1) shows that the effect of days open after first and second-plus calving is respectively moderately and highly significant (F=4.13, P<0.01; F=12.27, P<0.001). On lactation length this effect (Table 2) is even better pronounced (F=57.68, F=131.1, P<0.001), greatest of all explanatory variables.

The distribution of data in subsets (Table 3) indicates that after first calving conceptions occur comparatively late – 35% within 6 to 8 mo, nearly a quarter in the end of lactation, and only 12% in 2 mo post partum. The adult buffaloes, however, demonstrate better reproductive ability, 30% of them conceiving early and a total of 71% till lactation day 150.

The information in Table 3 shows that in both primiparous and pluriparous buffaloes that rebreed within two months post calving, the milk yield obtained at the concurrent lactation is the lowest. There is a gradual increase in productive performance in response to stretching the service period, better expressed in the first calvers; with each 3-month delay of conception the yield per 305 d improves by 60, 99 and 124 kg, which is relatively 4.1, 6.5 and 7.6%. In the buffaloes at second-plus lactation the estimates are from LSM= 1688 to LSM=1976, at an overall mean of LSM=1850. In distinction to the primiparous buffaloes, here the largest relative increase is observed in the buffaloes conceiving within 61-90 d post partum – 8.8%.

It is obvious that the changes in milk productivity are not fully correspondent to those in lactation length. This is demonstrated by the relevant daily milk yield (a function of the two traits, Table 3), more noticeably declining with delaying the moment of conception after first calving – from 5.405 to 4.175 kg. Table 3 also presents the results of the effect of days open on days in milk, every higher class creating an increase in first lactation length by 33.2, 78.0 and 154.7 d. This increase is smaller for the duration of second-plus lactation – by 25.1, 63.9 and 96.6 d. It is obvious that first lactation is shorter than second and more – overall means LSM=337.0 and LSM= 314.5.

The information from the conventional statistical procedure (Table 4) shows that the mean value of the trait days open is 135.9 d (~ 4 mo, 2 wk). The longest days open belongs to the first-lactation buffaloes (178.8 d), by 46 to 61 d over second to fourth-plus lactation (P<0.001), which is commensurate with the data in Table 3. There is a considerable variation increasing with the advance in parity order – from CV=50.1 to CV=71.4. In milk yield there is a corresponding increase from first to second lactation only – 91 kg (P<0.05), along with a substantial shortening of days open after first lactation (P<0.001).

The above mentioned reproductive ability and productive performance after first calving result in significantly lower relative productivity at first lactation – 3.808 kg of milk per day of calving interval (P<0.001) that comes to 1161 kg of annualized yield.

Table 1. ANOVA for the trait milk yield per 305-day lactation

	Primiparous (R^2= 0.278)				*Pluriparous (R^2= 0.402)*			
Factors	df	MS	F		df	MS	F	
Days open	3	713446	4.13	**	3	2287848	12.27	***
Age of calving	2	407932	2.36	n.s.				
Previous yield					3	7959487	42.71	***
Parity					2	167876	0.90	n.s.
Season	3	285530	1.65	n.s.	3	275468	1.48	n.s.
Period	7	1632437	9.45	***	7	4661577	25.01	***
Remainder	224	172682			762	186371		

Table 2. ANOVA for the trait complete lactation duration

	Primiparous (R^2= 0.498)				*Pluriparous (R^2= 0.411)*			
Factors	df	MS	F		df	MS	F	
Days open	3	176119	57.68	***	3	242824	131.1	***
Age of calving	2	1236	0.41	n.s.				
Previous yield					3	20292	10.95	***
Parity					2	7658	4.13	*
Season	3	4512	1.48	n.s.	3	147	0.08	n.s.
Period	7	5528	1.81	n.s.	7	8174	4.41	***
Remainder	224	3053			762	1853		

Discussion

The phenotypic variability of days open (Table 4) is substantial, especially at later parity, which might be attributed to species-specific causes affecting chiefly the efficiency of artificial insemination over most of the period under examination (prior to 1996) when it was a major breeding practice applied.

The CV-estimates (Table 4) represent the variability of 305-day milk yield between 24.9 and 30.4%, and that of days in milk – 17.3-21.1%. A relatively satisfactory proportion of it is explained by the two models (Tables 1 and 2), except for that concerning first lactation milk yield.

The ANOVA results are in agreement with the significant effect of days open on milk productivity observed by other authors abroad (Afzal et al., 2007; Khan et al., 2008). The higher F-values for both traits in the pluriparous buffaloes could be ascribed to the conventional assumption that the higher the parity the greater the proportion of non-genetic effects on traits (Penchev, 1999; Peeva, 2000).

The present results define as reliable the observed antagonistic effect in the Bulgarian Murrah buffaloes – the deterioration of milk performance at the concurrent lactation in response to faster rebreeding (Table 3). In view of the relevant contrary change in daily productivity, this could be attributed not only to the shrunk lactation period (Table 3), but also to other genetic and physiological factors like duration and intensity of milk secretion in the previous lactation (Table 1) and adverse effect of the concurrent pregnancy (Penchev et al., 2009).

In the adult buffaloes delaying conception to 3-5 mo would gain a 17% total increase in the current performance. This implies that management practices are to be focused on optimizing the post partum to this length in order to maintain best balance between reproductive efficiency and productive performance, which is favoured by the high variability, especially of days open (Table 4). These changes in milk yield are in direct proportion to the respective changes in days in milk, where the better-pronounced effect of days open is chiefly due to the time-related nature of factor and trait. It is noteworthy that the shortest days open results in the shortest lactations of approximately 270 d which in this case appears to be the moment of reaching seventh-eighth month of gestation, having highly suppressive effect (Penchev et al., 2009) resulting in drying off, natural or on management grounds.

In general, very short and very long service periods cause respectively very short and very long lactations, which is apparently

Table 3. Effect of days open on milk yield and days in milk

Days open subclasses	*n*	*305-days milk yield* LSM ± SE	*Days in complete lactation* LSM ± SE
Primiparous			
60	28	1462 ± 87	270.5 ± 11.6
61 ÷150	71	1532 ± 58	303.7 ± 7.6
151 ÷ 240	84	1631 ± 55	348.5 ± 7.3
> 240	57	1775 ± 63	425.2 ± 8.3
Overall LSM	240	1600 ± 38	337.0 ± 5.1
Pluriparous			
60	235	1688 ± 31	268.1 ± 3.1
61 ÷ 150	319	1836 ± 26	293.2 ± 2.6
151 ÷ 240	142	1901 ± 38	332.0 ± 3.8
> 240	85	1976 ± 49	364.7 ± 4.9
Overall LSM	781	1850 ± 21	314.5 ± 4.9

Table 4. Means and variability of traits by the conventional statistical procedure

Lactation order	*n*	*Days open*		*305-days milk yield, kg*		*Days in complete lactation*		*Milk / day of calving interval, kg*	
		$\bar{x}$ ± S$\bar{x}$	CV	$\bar{x}$ ± S$\bar{x}$	CV	$\bar{x}$ ± S$\bar{x}$	CV	$\bar{x}$ ± S$\bar{x}$	CV
First	227	178.8 ± 5.9 ^{ABC}	50.1	1698 ± 28.0*	24.9	353.4 ± 4.95 $_{BC}$	21.1	3.808 ± 0.071 $_{ABC}$	28.1
Second	206	133.0 ± 6.0 ^{A}*	65.2	1789 ± 32.8*	26.3	310.6 ± 4.11 $_{z}$	19.0	4.242 ± 0.090 $_{A}$	30.4
Third	147	119.0 ± 6.7 ^{B}	67.8	1790 ± 42.5	28.8	306.6 ± 4.62*	18.3	4.336 ± 0.112 $_{B}$	31.2
Fourth plus	369	117.8 ± 4.4 ^{C}*	71.4	1738 ± 27.5	30.4	295.7 ± 2.66 $_{Cz}$*	17.3	4.179 ± 0.069 $_{C}$	31.5
Overall	949	135.9 ± 2.9	65.4	1748 ± 15.9	28.1	314.4 ± 2.07	20.3	4.128 ± 0.041	30.8

Difference significance among levels: for identical symbols A, B or C – P≤0.001; for z – P≤0.01; for * – P≤0.05

partly due to the different intensity of secretion implied in the milk per day of lactation (Table 3). If for economic or selection reasons decision should be made for lactation duration closest to 305 d, again this is the three to five months of open period. This is achievable by selection on days open as well, but in both cases it is management-related, both days open and lactation duration being strongly dependant on non-genetic factors (Penchev, 1999; Peeva, 2000; Aziz et al., 2001; Khan et al., 2007).

As a consequence of the so far mentioned, the economic expression of productive and reproductive efficiency, the trait yield per day of calving interval, shows significantly lowest relative productivity between first and second calving in keeping with the findings of Ramos et al. (2004) and Khan et al. (2008). On one hand, our results are commensurate with our previous and other observations that delaying conception is favourable to the milk yield at the concurrent lactation (Afzal et al., 2007; Penchev et al, 2009) but, on the other, it plays negative impact on profitability of buffalo breeding (Peeva, 2000; S. Khan et al., 2008), unlike the bovine species where some authors recently recommend it for the benefit of the prolonged lactations (Knight, 2001; Arbel et al., 2001; De Vries, 2006).

Conclusion

The study established significant effect of days open on 305-day milk yield and especially on complete lactation duration in the Bulgarian Murrah buffaloes, expressed in decline in productivity at the concurrent lactation in response to early rebreeding. Service period of three to five months appears to be the most beneficial for the balance between reproductive efficiency and productive performance, at preferable lactation duration.

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