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Birth Weight and Gestation Length in the Egyptian Buffalo and Factors Influencing Them

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The importance of birth weight in the Egyptian buffalo is evident from the fact that the majority of male calves are marketed as veal calves. Also, as Ahmed and Tantawy (1954) indicated, high correlations between birth weight and subsequent weights prevailed until the age of 18 months. A sound estimate of the gestation length, however, is a desired element in the management of the dairy herd.

While some estimates are available of the birth weight and gestation length in the Egyptian buffalo, none of them has been corrected for all factors thought to affect these two traits simultaneously, although they have certainly served to indicate the values around which birth weight and gestation length may vary. The need was therefore felt for estimates less biased by the disproportionality of subclasses.

This study had three aims; to estimate the birth weight and gestation length, to study the factors affecting the two traits and to investigate the relationship between them.

MATERIALS AND METHODS

Data representing 515 gestations and 445 birth weights were obtained from the records of a private buffalo dairy herd in the vicinity of Cairo.

A least-squares model was assumed to estimate birth weight (b. wt) and gestation length (g.1.) and to study factors affecting these two traits. The following model was thus used.

$$Y_{ijkl} = \mu + s_i + p_j + t_k + e_{ijkl}$$

where Y_{ijkl} is the observation of the trait studied, i.e. b.wt or g. 1. on the lth animal of the ith sex of the jth calving (parity) and born or calving in the kth season, μ is an effect common to all animals, s_i is an effect due to the ith sex, p_j is an effect due to the jth calving, t_k is an effect due to the kth season of calving, and e_{ijkl} is a random error particular to the observation and assumed to be $N(0,\sigma_e^2)$. The restrictions of $\Sigma s_i = \Sigma p_j = \Sigma t_k = 0$ were imposed on the model to render the normal equations solvable for the desired effects.

After obtaining the least-squares estimates of the different effects the data were corrected for these effects. Corrected data were then used in subsequent analyses of the relationship between b.wt and g.1. and heritability and repeatability studies.

RESULTS AND DISCUSSION

The effects of different factors influencing b.wt and g.l. are shown in *Table 1*. *Table 2* shows the analyses of variances for both traits.

Birth weight

The birth weight of 33·84 kg found in this study is somewhat lower than those reported by ASKER and RAGAB (1952) and TANTAWY and AHMED (1953) of 37·48 and 40·09 kg respectively. A reason that may account partly for the difference between the estimate obtained in the present study and that of TANTAWY and AHMED (1953) is that a relatively larger proportion of older cows contributed to the latter data. These older cows gave calves of heavier b.wt both in their study and in that reported here. Thus, in a non-least-squares estimate of such data the older cows' calves contribute more to the general mean, hence biasing the estimate upward.

All factors assumed in the model had a significant effect on b.wt (*Table 2*).

Male calves weighed 2·36 kg more at birth than female calves (*Table 1*). This agrees with the findings of ASKER and RAGAB (1952), TANTAWY and AHMED (1953) and AHMED and TANTAWY (1954).

The effect of the number of calvings on the b.wt of calves is highly significant. The calf of the heifer cow is lighter than the average by 5·44 kg.

Table 1. Least squares constants obtained for birth weight (kg) and gestation length (days)

Class	Birth weight		Gestation length	
	No.	Constant	No.	Constant
Mean μ	445	33·84 ± 0·30	515	317·7 ± 0·39
Sex:				
male	228	1·18 ± 0·21 a*	255	0·4 ± 0·28 a
female	217	−1·18 ± 0·21 b	260	−0·4 ± 0·28 a
Parity:				
1	180	−5·44 ± 0·41 a	190	−2·5 ± 0·56 a
2	96	−2·09 ± 0·48 b	111	−0·7 ± 0·65 ab
3	48	−1·09 ± 0·61 bc	56	−0·5 ± 0·82 ab
4	34	0·52 ± 0·71 cde	51	0·2 ± 0·86 b
5	24	1·80 ± 0·81 de	33	−0·6 ± 1·0 ab
6	15	3·22 ± 1·0 e	23	1·8 ± 1·2 b
7	17	3·23 ± 0·95 e	18	1·1 ± 1·3 b
8	31	−0·15 ± 0·70 cd	33	1·1 ± 1·0 b
Season:				
spring	78	0·97 ± 0·42 a	99	1·1 ± 0·56 a
summer	92	−0·19 ± 0·40 b	114	−0·8 ± 0·54 b
autumn	210	−0·26 ± 0·32 b	228	−1·7 ± 0·44 b
winter	665	−0·53 ± 0·45 b	74	1·4 ± 0·62 a

*Within the same classification, any two constants having no letter in common differ significantly from each other at the five per cent level.

Table 2. Analysis of variance of birth weight and gestation length

Source of variation	Birth weight		Gestation length	
	DF	Mean square	DF	Mean square
Sex	1	603·10**	1	66·59
Parity	7	486·69**	7	125·48**
Season	3	32·69*	3	284·40**
Residual	433	18·63	503	40·17

*$P < 0·05$. **$P < 0·01$.

However, the b.wt of the calf increases from the first calving to the sixth and seventh and then starts to decrease. This conforms with the biological phenomenon that at younger ages the cow would still be growing, so some of the nutrients are used for the growth of maternal tissues during pregnancy. However, as the cow matures in body size more nutrients are channelled through for embryonic development, thus the calf delivered is heavier. The works of ASKER and RAGAB (1952) and TANTAWY and AHMED (1953) have shown that the highest birth weight was attained at the fourth calving.

There was also a significant effect on birth weight due to seasons. However, the three degrees of freedom among seasons may be partitioned to a significant degree of freedom between spring and the average of the other seasons and two non-significant ones among summer, autumn and winter. The superiority in b.wt of calves born during the spring may be attributed to cows calving in that season having the longest period of feeding on the nutritious Egyptian clover (*Trifolium alexandrinum*). Animals usually start feeding on Egyptian clover in late September and continue till mid-May.

Gestation length

The estimate of g.l. of 317·7 days obtained in this study (*Table 1*) is in close agreement with those obtained by EL-SHEIKH and MOHAMED (1965), KHISHIN *et al.* (1963), EL-DESSOUKY and RAKHA (1964), TANTAWY and AHMED (1953) and RAGAB and ASKER (1951) as 316·7, 317·4, 317·98, 316·4, 318 and 316·7 days respectively.

The gestation period of cows calving male calves was significantly longer by 0·8 day than those calving female calves. This agrees with the findings of LASLEY *et al.* (1961) in Hereford cattle. KHISHIN *et al.* (1963) reported no significant difference in g.l. between cows calving males and those calving females, though the former had slightly longer periods. EL-DESSOUKY and RAKHA (1964) also found no significant effect on g.l. due to sex of calf or season of calving. However, RAGAB and ASKER (1951) found that cows conceiving male calves had significantly longer g.l. than those conceiving females. GHANEM *et al.* (1955a) also found a significant difference in g.l. due to sex, but with the female-conceiving cows having longer periods.

There is a general trend for the g.l. to increase from the first to the eighth calving except for the fourth calving which departs from that trend (*Table 1*). The difference due to parity was significant. TOUCHBERRY and BEN BERESKIN (1966), KHISHIN *et al.* (1963), FOOTE *et al.* (1960) and GHANEM *et al.* (1955a) presented results and reported that younger cows had a significantly shorter g.l. than older ones. There is similar evidence from the data of TANTAWY and AHMED (1953) on buffalo and STALLCUP *et al.* (1956) on Holstein and Jersey cattle. RAGAB and ASKER (1951), however, reported that there was no significant effect due to sequence of calving. Also, JOUBERT and BONSMA (1959) reported that neither age of dam nor season of calving had any marked effect on g.l. in cattle.

The effect of season of calving was relatively appreciable (*Table 2*). Cows calving in summer and autumn had significantly shorter gestation periods than those calving in winter and spring. This agrees with the findings of KHISHIN *et al.* (1963) and GHANEM *et al.* (1955a). JOUBERT and BONSMA (1959) found that Holstein cows terminating their gestations in the cool months had slightly longer periods while Jersey cows terminating their gestations in the warm months had slightly longer periods. The interplay of temperature, light and availability of feed in affecting g.l. in different animals is not fully known. In Egypt, however, spring and winter months are generally milder in temperature and have longer days; animal feedingstuffs are more abundant at that time than in the summer and autumn months.

Heritability and repeatability estimates

After the data were corrected for the factors assumed in the model they were analysed as between sires and within sires to estimate the sire component. Heritabilities as estimated from the sire component were 0·98 ± 0·40 and > 1 for b.wt and g.l. respectively. Gestation length is treated here as a trait of the calf since data were not available to estimate it as a trait of the cow. Both estimates of heritability are inflated, which might indicate that differences among sires were exaggerated. Part of this inflation may be because year effect was not included in the model and because all sires were not used in all years, the resulting partial confounding might have introduced some non-genetic differences among sires. However, taking parity into account should have partly eliminated some of the year effect. The inflation of the heritability estimates was not thought to be a result of underestimating the error terms, for they were within the range of similar estimates quoted in the literature.

There were only 22 pairs of full sibs from which another estimate of heritability of b.wt was calculated as 0·06 ± 0·14 with 20 degrees of freedom, too few for the estimate to be of real value.

GHANEM *et al.* (1955b) reported a value of 0·31 as the percentage of total variance attributable to additive gene effects in the g.l. of buffalo as a trait of the calf. WHEAT and RIGGS (1958) estimated the heritability of g.l. in cattle as 0·22, 0·36 and 0·5 from maternal half sibs, full sibs and paternal half sibs respectively. STALLCUP *et al.* (1956) estimated the heritability of g.l. by intrasire regression of offspring on dam as 0·00 and 0·24 for the Holstein and Jersey respectively. ASKER and RAGAB (1952) estimated the heritability of birth weight in the buffalo as 0·56.

Repeatabilities were estimated from between-cows and within-cows analysis of the corrected data. Estimates were 0·017 and 0·59 for b.wt and g.l. respectively. ASKER and RAGAB (1952) reported a value of 0·048 for repeatability of b.wt in the Egyptian buffalo while ALIM (1964) found values of 0·32 and 0·30 respectively for male and female calves in Sudanese cattle. WHEAT and RIGGS (1958) estimated repeatability of g.l. as 0·21 and 0·19 from maternal half sibs and full sibs respectively.

Correlation between birth weight and gestation length

The correlation coefficient between b.wt and g.l. was estimated as 0·17. Although this estimate is of low magnitude it reached the significance level because of the relatively high number of degrees of freedom. TANTAWY and AHMED (1953) reported an estimate of 0·28 in the buffalo. ALIM (1964) reported a value of 0·27 for this correlation while STALLCUP *et al.* (1956) estimated it as negative in the Holstein and 0·12 for the Jersey.

SUMMARY

This study included records of 445 birth weights and 515 gestations for the Egyptian buffalo. A least-squares model was assumed to estimate means of birth weight and gestation length and the effects of sex, calvings and season of the year on both traits.

Birth weight was estimated as 33·4 kg while gestation length was estimated as being 317·7 days. All factors assumed in the model contributed either significantly or highly significantly to the variability in both traits, except sex which had no significant effect on birth weight.

Birth weight increased from the first to the seventh calving and started to decrease in the eighth. Calves born in the spring had significantly higher birth weights than those born in other seasons.

Cows calving male calves had longer gestation periods than those calving female calves. A general trend was detected for gestation periods to increase from the first to the seventh calving. Cows calving in winter and spring had shorter gestation periods than those calving in other seasons.

Heritabilities of birth weight and gestation length as a trait of the calf were estimated as 0·98 ± 0·4 and > 1, respectively, while repeatabilities were estimated at 0·017 and 0·59 respectively. The reliability of these estimates was discussed.

Phenotypic correlation between birth weight and gestation length was estimated at 0·17.

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