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Genetic Parameters for Milk Production Traits in a Closed Herd of Egyptian Buffaloes

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A TOTAL of 2780 lactation records collected during the period 1960 - 1983 on the herd of buffaloes raised at Mehallet Mousa Station, Ministry of Agriculture were used to calculate estimates of heritability, repeatability, genetic and phenotypic correlations for initial (first 90 - day), 305 - day and 336 - day milk yield. Effects of month and year of calving and parity (as fixed effects), and sire and cows within sire (as random effects) were investigated. Highly significant effects ($P<0.01$) was found for year of calving, season of calving and parity on all traits studied. Heritability estimate for initial milk yield, 305 - d milk yield and 336 - d milk yield were 0.07, 0.05 and 0.09 respectively. Corresponding repeatability estimates were 0.25, 0.40, 0.42. Phenotypic and genetic correlations between different traits were positive and highly significant.

Keywords : Egyptian buffaloes, genetic parameters.

The basic information needed for planning breeding programs are mainly the genetic and phenotypic parameters such as repeatability, heritability, genetic and phenotypic correlations. These estimates help the buffaloe breeder to improve the productivity of his herd for milk production at different stages of lactation.

Many investigators estimated the heritability of milk production traits in Egypt by using different methods under different sets of data (Asker and Bedier, 1961; Asker *et al.*, 1965; Ragab *et al.*, 1970; Mourad, 1984 and Mohamed, 1986).

Genetic and phenotypic correlations between milk yield traits of Egyptian buffaloes were calculated by a few investigators using different methods of estimation. In this respect, Asker and Bedeir (1961), Asker *et al.*, (1965), Afifi and Barrada (1973), Ashmawy (1981) and Mourad (1984) reported high and positive estimates of phenotypic and genetic correlations between initial and 305- day milk yield. Similarly, results ob-

tained by Soliman (1976) and Ashmawy (1981) revealed that estimates of phenotypic and genetic correlations between initial and total milk yield were positive and high in magnitude. Moreover, high magnitude and significant genetic correlation among partial milk yield was reported by El - Chafie (1981) with Egyptian buffaloes using (BLUP) methods of estimation.

In the present work the authors attempted to apply new statistical methods to estimate the genetic and phenotypic parameters for milk production traits using the Mixed Model Techniques.

Material and Methods

Milk records of a herd of Egyptian buffaloes stationed at Mehallet Mousa Experimental Farms, Animal Production Research Institute, Ministry of Agriculture were used in this study. Data were collected over a period of 24 years from 1960 to 1983.

The traits examined were initial (first - 90 day), 305 - day and 336 - day milk yield. A total of 2780 lactation records were analyzed. Number of sires and cows invloved were 68 and 730, respectively. The harmonic mean of daughters per sire was 12.5 and the number of records per daughter was 3.80. Records on daughters of sires with fewer than 4 daughters were excluded. Feeding system and management was as described by Mourad *et al.* (1986).

Data were analyzed by the least squares and maximum likelihood program of Harvey (1977). The following mixed model was used.

$$Yijklmn = U + Si + DiJ + Ak + Bl + Cm + eijklmn$$

YiJklmn = the performance of the observation ijklmn; μ = the overall mean; Si = random effect of the ith sire of the jth cow; DiJ = random effect of the Jth cow nested within a random effect of the sire; Ak = fixed effect of the Kth year of calving; BL = fixed effect of the 1th parity; Cm = fixed effect of the mth month of calving and eiJklmn = random effect peculiar for each observation and assumed to be independent and randomly distributed $(0, Ó^2e)$.

However, it was not possible to calculate the interactions between the main effects, because the equations for estimation would have involved a matrix too large to invest. The Limited numbers of records on their absence in some subclasses, did not permit the inclusion of such interactions.

Estimates of sire ($Ó^2s$), cow within sire ($Ó^2c : s$) and error ($Ó^2e$) components of variance and covariance were computed according to method II of Henderson (1953). Estimates of heritability were calculated for the studied traits by paternal half - sib method, across all parities has four times the interclass correlation coefficient between half - sibs.

$h^2S = 4\sigma^2S / (\sigma^2S + \sigma^2C : S + \sigma^2e)$

Repeatability esimates were computed from the ratio of sire, cow within sire variance components to the sum of sire, cow within sire and the remainder variance components as follow :

$t = \sigma^2S + \sigma^2C : S / (\sigma^2S + \sigma^2C : S + \sigma^2e)$

Standard errors for heritability and repeatability estimates were calculated using an approximation formula as described by Swiger *et al.* (1964).

Genetic correlation (with standard error) and phenotypic correlation were computed by LSML 76 program of Harvey.

Results and Discussion

Mean and variation of uncorrected records

The means, standard deviations and coefficients of variation of initial milk yield (first 90 - day), 305 - day and 336 - day milk yield are given in Table 1. The mean of initial milk yield is close to that obtained by El - Irian (1981). On the other hand, this mean was lower than that reported by Bedeir (1965) and Salem (1983).

TABLE 1. Means, standard deviations (S.D.) and coefficients of variation of milk production traits.

Trait	Mean (kg)	S.D. (kg)	CV%*
Initial milk yield (kg) (first 90 - day)	597	192	33.80
305 - day milk yield (kg)	1459	522	38.61
336 - day milk yield (kg)	1510	561	40.15

* Coefficient of variation calculated as the remainder standard deviation divided by the overall least squares mean of the trait. (Harvey, 1977).

The actual mean of 305 - day milk yield is nearly to that observed by Mourad (1984) in Egyptian buffaloes. But, this result is lower than that estimated by Ashmawy (1981) and Salem (1983). While the highest coefficient of variation is recorded by 336 - day milk yield trait when compared by both of 305 - day and initial milk yield. The great variation of milk traits and the differences between the estimates of means traits studied and those reported by other investigators in Egyptian buffaloes may be attributed to one or more of the following reasons :

(1) Different climatic and managerial conditions, (2) genetically differences and / or (3) differences in the models of the analysis used.

Year of calving

Results presented in Table 4 indicated that milk production traits differ with year of

calving and the differences were highly significant (P<0.01). Similarly, results of other Egyptian investigators (Soliman, 1976; Mourad, 1978; Abdel - Aziz and Hamed 1979; Ashmawy, 1981; El - Irian, 1981; El - Chafie, 1981; Mourad, 1984; Mohamed, 1986; Mourad *et al* . 1986; Kotby *et al* ., (1989) reported that year of calving was significant source of variation in initial milk yield and / or 305 - day milk yield of Egyptian buffaloes.

Parity

The results obtained in Tables 2 and 4 revealed that initial, 305 - day and 336 - day milk yield increased from the first parity up to the fifth one and decreased (P<0.01) thereafter with advance of parity. El - Barbay and Badran (1986) arrived at the same results, using another herd of Egyptian buffaloes. Similar trend was reported by many Egyptian workers (Ragab *et al* ., 1973; Soliman, 1976; Ashmawy, 1981; Mourad, 1984; Mohamed, 1986; Kotby *et al* ., 1989). The major reason of such increase in milk yield is due to the increase in weight and size of buffaloes with advance of age (*i.e.* development of the physiological functians of buffaloes with an increase in the udder capacity until the animal reach the mature age and weight).

Month of calving

The least squares analysis of variance (Table 4) revealed that 90 - d milk yield, 305 - d milk yield and 336 - d milk yield were significantly (P<0.01) influenced by month of calving. The highest 90 - d milk yield was observed on June, the highest 305 - d milk yield and 336 - d milk yield were observed on May, while the lowest three traits were observed on October. Table 3. The significant effect of month and season of calving on milk yield was reported by many investigators in different breeds of dairy animals (Abdel - Aziz and Hamed, 1979; Kawthar Mourad, *et al* ., 1986 and Kotby *et al* ., 1989). Effect of month of calving reflect the influence of climate condition and kind of the available feedstuffs in the different months of the year.

Random component of variance

Results obtained in the present study show that the sire of the cow affected significant on all traits studied (Table 5). The sire component accounted for approximately 1.6, 1.3 and 1.7% of the total variation in 90 - d milk yield, 305 - d milk yield and 336 - d milk yield, respectively, which are lower than those reported by Ruvuna *et al* (1984).

The effect of cow within sire was highly significant effect on all traits studied (Table 4). Tajena and Siddiquee (1985) arrived at the same conclusion on Mehsam buffaloes. This factor accounted for 23.6, 39.6 and 40.7 percent of the total variablility in 90 - d milk yield, 305 - day milk yield and 366 - d milk yield, respectively. These figures are greater than that 20% of the total variation in total milk yield as reported by Ruvuna *et al*., (1984) working on Tharparkar cattle. The effect of cow is due to the permenant environmental which transmit from record to another.

TABLE 2. Least squares means and standard errors (S.E.) for the effect of parity on productive traits of Egyptian buffaloes.

Parity	N	90 - d milk yield		305 - d milk yield		336 - d milk yield	
		LSM, kg	S.E.	LSM, kg	S.E.	LSM, kg	S.E.
1	722	432	46	1185	162	1251	178
2	702	585	41	1562	151	1666	166
3	467	639	38	1638	144	1788	159
4	337	668	36	1699	140	1840	155
5	215	674	36	1644	140	1872	155
6	158	621	37	1621	142	1812	157
7	82	626	40	1642	148	1851	164
8	51	618	44	1642	156	1849	172
9	46	624	50	1604	170	1844	187

TABLE 3. Least squares means and standard errors (S.E.) for the effect of month of calving on productive traits of Egyptian buffaloes.

Month of Calving	N	90 - d milk yield		305 - d milk yield		336 - d milk yield	
		LSM, kg	S.E.	LSM, kg	S.E.	LSM, kg	S.E.
Jan.	293	629	35	1574	138	1748	155
Feb.	282	630	36	1621	140	1806	155
March	227	587	36	1638	140	1831	156
April	209	586	36	1688	140	1875	156
May	218	619	36	1713	140	1903	156
June	113	639	37	1667	140	1830	158
July	127	628	37	1658	143	1817	158
Aug.	145	607	37	1573	143	1723	155
Sep.	263	603	36	1530	143	1666	155
Oct.	300	571	36	1442	140	1580	155
Nov.	298	596	36	1442	140	1579	155
Dec.	305	621	36	1505	140	1651	155

TABLE 4. F- value for different sources of variation of milk production traits.

S.O.V.	d.f.	F - value		
		90 - d milk yield	305 - d milk yield	336 - d milk yield
Sire	67	2.37**	3.00**	3.37**
Cow / sire	662	2.16**	3.46**	3.59**
Year of calving	23	4.40**	3.62**	3.48**
Parity	8	65.44**	43.18**	40.18**
Month of calving	11	6.02**	10.14**	12.86**

Residual mean squares of 90 - d milk yield, 305 - d milk yield and 336 - d milk yield were 16600, 128533 and 148769 kg with d.f. 2008

* $P < 0.05$

** $P < 0.01$

TABLE 5. Variance component estimates (δ^2) and proportions of variation (v%) due to sire and / or cow - within sire effects for some productive traits.

Variance Traits	Sire of Cow		Cow / Sire		Remainder	
	δ^2	V%	δ^2	V%	δ^2	V%
90 - day milk yield	355	1.6	5232	23.60	16600	74.8
305 - day milk yield	2753	1.3	86183	39.60	128533	59.1
336 - day milk yield	4371	1.7	105167	40.70	148769	57.6

Heritability estimates (h^2)

Estimates of heritability (h^2) for yield traits in Egyptian buffaloes ranged from 0.05 to 0.09 and significant different form zero (Table 6) which was similar to 0.07 reported by Abubakar *et al* (1986), but less (0.11 to 0.36) than in Mourad (1984), Cady *et al* (1983), Mohamed (1986), Singh and Yadau (1987) and Kornel and Patro (1988). The results obtained in this paper indicated that the additive genetic variance for milk yield traits studied were very low, it may be due to 1. using the same sires for a large period and 2. culling is made in this herd on a particular level of production that caused more resemblance between cows.

Repeatability

Repeatability estimates for intial milk yield was 0.25 (Table 6), which is lower than that reported by Bedier, (1965) and Soliman (1976). The estimates of repeatability for 305 - d milk yield and 336 - d milk yield are 0.40 and 0.42, respectively (Table 6). The two values were found to be nearly equal. Mohamed (1986) and Basu and Ghai (1978) working on Egyptian buffaloes and Murrah buffaloes found that the repeatability of milk yield were 0.33 and 0.50, respectively.

TABLE 6. Estimates of heritability (on diagonal) and genetic (below diagonal) and phenotypic (above diagonal) correlations for productive traits of buffaloes.

Traits	90 - day milk yield	305 - day milk yield	336 - day milk yield	repeatability estimates
90 - day milk yield	0.07± 0.02	0.46 **	0.62**	0.25 ± 0.01
305 - day milk yield	0.83 ± 0.15	0.05 ± 0.02**	0.98**	0.40 ± 0.01
366 - day milk yield	0.82 ± 0.14	1.0 ± 0.012**	0.09± 0.02	0.42 ± 0.03

** $P < 0.01$

The results revealed that 90 - d milk yield and 305 - d milk yield are moderately repeatable traits, and these traits can be used to predict the values of these traits in subsequent lactation with reasonable accuracy. These estimates also suggested that fair proportion of culling might will be done on the performance of the first lactation rather than waiting till subsequent ones.

Phenotypic correlations

Phenotypic correlations between initial milk yield and each of 305 - day and 336 - day milk yield were positive significant ($P<0.01$) and high in magnitude (Table 6). These part / whole relationship reveal that an increase in initial milk yield was associated with an increase in both 305 - day and 336 - day milk yield. Similar results was reported by Asker *et al* . (1965), Beider (1965), Ashmawy (1981) and El - Chafie (1981) in Egypt. Accordingly, selection for superior initial milk yield of Egyptian buffaloes would result in a considerable improvement in 305 - day, 336 - day and total milk yield.

Genetic correlations

The genetic correlation between initial milk yield and each of 305 - d milk yield and 336 - d milk yield were 0.83 and 0.82, respectively, both were highly significant. These results are in agreement with similar work on buffaloes (Asker *et al.* , 1965, Soliman, 1976, Ashmawy, 1981 and Mohamed, 1986).

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"المقاييس الوراثية لصفات انتاج اللبن فى قطيع من الجاموس المصرى"

كوثر عبدالمنعم مراد ، محاسن معوض محمد
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معهد بحوث الإنتاج الحيوانى - وزارة الزراعة - الجيزة وكلية الزراعة - جامعة طنطا - كفر الشيخ - مصر .

أجريت الدراسة على ٢٧٨٠ سجل لبن خلال الفترة من ١٩٦٠ - ١٩٨٣ وذلك على الجاموس الموجود فى محطات التربية بمحلة موسى التابعة لمعهد بحوث الانتاج الحيوانى بوزارة الزراعة.

واستخدمت تلك البيانات فى تقدير العمق الوراثى - المعامل التكرارى - الارتباطات المظهرية والوراثية لانتاج اللبن المبدىء (انتاج أول ٩٠ يوما) وانتاج اللبن فى ٣٠٥ يوما وكذلك ٣٣٦ يوما . درس تأثير الشهر وسنة الولادة وترتيب موسم الولادة وكذلك تأثير الطلوقة والجاموسة داخل الطلوقة . وكان تأثير الموسم وسنة الولادة وكذلك ترتيب الولادة عالية المعنوية على جميع الصفات المدروسة.

كانت قيم العمق الوراثى لانتاج اللبن المبدئى ، انتاج اللبن فى ٣٠٥ يوما ، انتاج اللبن فى ٣٣٦ يوما كان ٠٧ر٠ ، ٠٥ر٠ ، ٠٩ر٠ على الترتيب.

وكانت قيم المعامل التكرارى للصفات السابقة هى : ٢٥ر٠ ، ٤٠ر٠ ، ٤٢ر٠ . على التوالى . وكانت قيم الارتباطات المظهرية والوراثية بين جميع الصفات المدروسة موجبة وعالية المعنوية.