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Estimation of Genetic Parameters and Genetic Trends for Some Milk Traits in a Herd of Egyptian Buffaloes

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A NORMAL first lactation records of 1180 Egyptian buffalo were collected from Mehallet Mousa , Ministry of Agriculture during the period from 1966 to 1987 . Data were used to estimate phenotypic and genetic parameters for 90 day milk yield (90MY), total milk yield (TMY) and lactation period (LP) . In addition, phenotypic and genetic trends of these traits were also examined .

Heritability estimates were 0.10 ± 0.06 , 0.17 ± 0.07 and 0.13±0.06 for 90MY, TMY and LP, respectively . All phenotypic and genetic correlations among different traits studied were positive and significant ($p < 0.01$).

Sires with at least 10 daughters were evaluated by best linear unbiased prediction (BLUP). Sire transmitting abilities ranged from - 24 to +33 kg for 90MY , from - 147 to + 154 kg for TMY and from - 20 to + 31 d for LP.

Estimates of annual phenotypic changes were 4.0 ± 1.3 kg , 16.2 ± 4.0 kg and - 5.7 ± 1.6 d for 90MY, TMY and LP, respectively. All of these estimates were significant ($p < 0.01$), while the annual genetic changes for all traits studied were not significant .

Key words : Egyptian buffaloes , genetic trends , genetic parameters .

A goal of dairy cattle breeders is to increase genetic merit for milk production . To determine the effectiveness of breeding programs , genetic trends in dairy cattle population must be monitored.

The measure of genetic and environmental changes from field data have problems since many factors are confouned with both genetic and environmental changes. (Canon and Munoz , 1991). Henderson (1959) suggested a maximum likelihood method using repeatability of cow's production records to separate genetic and environmental effects . While, Rege (1991) used only first lactation records since the first lactations are free from selection, repeatability and age bias.

In Egypt , few studied have been carried out to estimate genetic and phenotypic trends for dairy traits in Egyptian buffaloes. Mourad (1984) used three methods to estimate genetic improvement per generation for 305 day milk yield : regression coefficients of generation means on generation numbers, doubling regression coefficients of sire generation means on sire generation numbers and regression coefficients of individual records on generation numbers. Sharaby and El Kimary (1982) estimated genetic trend for lactation period using best linear unbiased prediction (BLUP).

The objectives of this study were (1) to estimate phenotypic and genetic parameters of 90 day milk yield (90MY), total milk yield (TMY) and lactation period (LP) and (2) to estimate phenotypic and genetic trends for these traits in a herd of Egyptian buffaloes.

Material and methods

Data

Data were obtained from a herd of Egyptian buffaloes at Mehallet Mousa Farm, Animal Production Research Institute , Ministry of Agriculture, Egypt. They comprised 1180 normal first lactation records covering the period from 1966 to 1987. Number of sires and average of daughters per sire were 87 and 12.1, respectively. Sires with less than 10 daughters were excluded . Abnormal records affected by diseases such as mastitis and udder troubles or disorders such as abortion were excluded. Traits studied were 90 day milk yield (9OMY), total milk yield (TMY) and lactation period (LP). The number of records and least squares means of different traits are presented in Table 1.

TABLE 1. Least squares means and their standard errors (S.E.) for traits studied*.

Traits	Mean	S.E.
90 day milk yield (90 MY, kg)	464	6
Total milk yield (TMY, kg)	1309	24
Lactation period (LP, d)	322	5

*Number of records = 1180

Bulls were assigned to naturally mate the female at random. Artifical insemination is only practised when there was a probability of genital disease infection. Heifers were served for the first time when they reached 24 mo or 320 kg. Pregnancy was detected by rectal palpation 60 days after the last service. Buffalo bulls were chosen for breeding purposes at 2-3years of age. They were evaluated for body conformation and for semen characteristics. Each bull was used for breeding for about 3-7 years.

Animals were grazed on Egyptian clover, berseem, during December-May. During the rest of the year the animals were fed on concentrate mixture along with rice straw. Cows producing more than 10 kg a day and those that are pregnant in the last two months of pregnancy were supplemented with extra concentrate ration. Buffaloes were hand milked twice a day.

Analysis

Data were analysed using the Mixed Model Least Squares and Maximum Likelihood Computer Program of Harvey (1987). For total milk yield the model included year and month of calving as fixed effects, age at first calving (AFC) and lactation period as a covariate and sire as a random effect. For 90 day milk yield (90MY) and lactation period (LP) the model included year and month of calving as a fixed effects, AFC as a covariate and sire as a random effect.

Paternal half sib heritabilities (h^2s) were calculated as four times ratio of σ^2s (sire variance components) to the sum of the σ^2s and σ^2e (residual variance components) . Genetic and phenotypic correlation coefficients between any two traits were computed by using the formula outlined by Harvey (1987). The approximate standard errors of h^2s and genetic correlations were computed according to Swiger *et al.* (1964).

Estimating of sire transmitting ability (ETA)

Sire transmitting abilites were calculated using best linear unbiased prediction (BLUP).

In matrix notation . the models above can be written as :

$$Y = xf + Zs + wb + e$$

Where Y was a vector of observations for each trait, x was a known fixed design matrix, f was an unknown vector of fixed effects representing the mean, year and month of calving , Z was a known design matrix, S was an unobservable vector of random sire effect, w was a vector of covariate variable (independent variable *i.e.*, LP and or AFC) , b was a vector of partial regression of Y on W, and e was an unobservable random vector of errors with mean zero and variance - covariance martix $1\sigma^2e$.

The mixed model equations (Henderson. 1973) are

$$\begin{bmatrix} X'X & X'Z & X'W \\ Z'X & Z'Z + K & Z'W \\ W'X & W'Z & W'W \end{bmatrix} \begin{bmatrix} \hat{f} \\ \hat{s} \\ \hat{b} \end{bmatrix} = \begin{bmatrix} X'Y \\ Z'Y \\ W'Y \end{bmatrix}$$

Where $k = (4-h^2) / h^2$, for each trait was added to the diagonal of sire effects in the matrix .

Estimating of phenotypic and genetic trends

The annual phenotypic change for different traits studied was computed as the regression coefficients of trait values on the year of calving after adjusting the records for season of calving , AFC and LP for TMY and season of calving and AFC for 90MY and LP.

Trends in transmitting abilities of sires for different traits studied were estimated by regressing ETA' s for each year on year of calving. For the y th year. s 2y/r where r is the number of daughters born in the y th year.

Results and Discussion

Least squares means of different traits studied are presented in table 1. The mean of TMY was 1309 ± 24 kg produced in a lactation period (LP) 322 ± 5d, respectively , a period recommended as the ideal period for buffaloes. EL Barbary and Badran (1986) found that the average first lactation milk yield was 1916 kg with LP of 328 days. The present estimate of TMY is lower than the estimate of 2241 kg and 2131 kg reported by Badran *et al.* (1991) and Pagnacco *et al.* (1992) working on Egyptian buffaloes and Italian buffaloes, respectively. Mostageer *et al.* (1987) reported that a lower average TMY of 1160 kg produced in 199 days was obtained when no animals were culled because of low production. Least squares mean of 90 day milk yield (90 MY) was 464± 6 kg. The present mean is similar to that reported by Mohamed (1986) (416 ± 5 kg) using another set of Egyptian buffaloes. EL Chaife (1981) using two herds of Egyptian buffaloes calculated the average milk yield of first 100 days of lactation as 640 and 462.

The differences between the performance found here and those reported by other workers could be attributed to one or more of the following reasons : (1) the herds were treated under different climatic and managerial conditions and or (2) different herds could possibly be genetically and phenotypically different from each other.

Sire variance components

Sire of the heifer had a significant effect on different traits studied ($p < 0.05$ or $p < 0.01$, Table 2) and accounting for 2.5 %, 4.2% and 3.3 % of the total variance for 90MY, TMY and LP, respectively. Most of these findings are similar to those obtained by Badran *et al.* (1991) working on Egyptian buffaloes and Pagnacco *et al.* (1992) working on Italian buffaloes.

TABLE 2. Variance components estimates (σ^2) and proportions of variation (V) due to sire effects for productive traits.

Traits	Sire of heifers			Remainder		
	d.f.	σ^2s	V%	d.f.	σ^2e	V %
90 MY	86	347	2.5*	1060	13481	97.5
TMY	86	8533	4.2**	1060	195139	95.8
LP	86	344	3.3**	1060	10234	96.7

* $P < 0.05$ ** $P < 0.01$

Phenotypic and genetic parameters

Estimates of heritability (h^2s) for productive traits and phenotypic and genetic correlations among different traits studied are given in Table 3. Estimates of h^2 for 90MY, TMY were 0.10± 0.06 and 0.17±0.07 respectively. The low h^2s estimates for milk yield indicate that selection based on the phenotypic merit of the animal would not be effective. Information on the pedigree combined with the phenotypic of the individual may be used for selection of females in the initial stages, while progeny testing will be the right procedure for the selection of bulls. The present h^2 estimate of TMY is nearly similar to the estimate by Pagnacco *et al.* (1992) working on first lactation records of Italian buffaloes.

TABLE 3. Estimates of heritability with standard error (on diagonal), genetic correlations (below diagonal) and phenotypic correlations (above diagonal) for productive traits.

	90 MY	TMY	LP
90 MY	0.10± 0.06	0.61	0.25
TMY	0.62 ± 0.24	0.17 ± 0.07	0.73
LP	0.20 ± 0.10	0.97 ± 0.10	0.13 ± 0.06

On the other hand, other investigators reported higher estimate of h^2 for milk yield. Asker *et al.* (1965) working on Egyptian buffaloes found that h^2 for 90MY and TMY were 0.43 ± 0.12 and 0.27 ± 0.14,respectively using daughtrers dam regression and 0.25 ± 0.13 and 0.49 ± 0.15, respectively using paternal half sib methods. El Barbary and Badran (1986) using another herd of Egyptian buffaloes, found that h^2 of 70MY and 305MY were 0.24 and 0.22, respectively . In addition, Singh and Basu (1988) found h^2 for milk yield was 0.29 ± 0.13 on Murrah buffaloes.

Heritability estimate of LP was 0.13 ± 0.06 (Table 3). The present estimate was in the range between 0.11 to 0.24 reported by Asker *et al.* (1965),Patro and Bhat (1979) and Singh and Basu (1988). The present result indicate that the major part of the variation in this character is due to nongenetic factors. In addition, great improvement in this trait could be possible by improving feeding and management system. On the other hand, higher estimate of h^2 for LP was reported by Sharaby and El Kimary (1982) working on two herds of Egyptian buffaloe being 0.32 and 0.43.

Phenotypic correlation between 90MY and TMY was 0.61 (Table 3), the present estimate is in a greement with those of Asker *et al.* (1965), El - Barbary and Badran (1986) , Jain *et al.* (1986) and Kassab (1988) which ranged from 0.20 to 0.86. Our results indicate that 90MY could be used in evaluating the milk producing ability in buffaloes. Phenotypic correlations between LP and each of 90MY and TMY are 0.25 and 0.73, respectively ($p < 0.01$, table 3). The present results indicate that high productive cows were lactating for longer time.

Genetic correlation between 90MY and TMY is 0.62 ± 0.23 (Table 3) The present estimate is similar to those of Asker *et al.* (1965) , Jain *et al.* (1986), Kassab (1988) and Verma *et al.* (1990) which ranged between 0.76 to 0.96. The present estimate indicate that milk yield in 90MY of lactation could be a good indicator of production in TMY. Consequently . selection for high yield of milk at 90 day of lactation will be associated with genetic improvement in the corresponding trait of TMY. Jain *et al.* (1986) reported that selection on the basis of part lactation may result in more genetic progress than on the basis of total milk yield. Genetic correlations between LP and each of 90 MY and TMY were 0.20 ± 0.10 and 0.97 ± 0.10. respectively (Table 3) The high genetic correlation between LP and TMY indicate that selection for high milk yield bring correlated response for lactation period .

Sire transmitting ability ETA'S)

Sire values for 90MY, TMY and LP were estimated using best linear unbiased prediction (BLUP). Number of daughters per sire ranged from 10 to 57.

Estimates of sire transmitting ablility (ETA'S) as deviation from the mean ranged from - 24 to + 33 kg for 90MY, from - 147 to + 154 kg for TMY and from - 20 to + 31 d for LP. The present results show large differences among sires in productive traits.

Similarly, EL- Chaife (1981) working on two herds of Egyptian buffaloes, found that the range of breeding values for 100MY and LP were large and ranged from -56 to + 88 kg for 100MY and from - 39 to + 32 d for LP. Cady *et al.* (1983) working on 5716 lactation records of Nili Ravi buffaloes in pakistan, found that predicted sire values (BLUP) for 305 day milk yield ranged from-173 to + 260 kg. In addition, Kassab (1988) using 1564 lactation records of Egyptian buffaloes reported that the predicted sire values for 305MY ranged from - 297 to + 346 kg. On the other hand, Basu and Ghai (1978) and Mohamed (1986) working on Murrah buffaloes and Egyptian buffaloes, respectively found that the expected sire breeding values did not show large genetic differences among sires.

Regarding , 90MY, TMY and LP, about 44%, 53 % and 57 % of sires had negative values, respectively . Table 4 presents proof for 90MY , TMY and LP of ten sires with the largest number of daughters in all data. Only 2 of these sires had a negative proof. The single most frequently used sire (19516) with a total of 57 daughters in the data had positive (11.2 kg, 154 kg and 31.2 d) proof for 90MY , TMY and LP , respectively.

TABLE 4. Ten most frequently used sires and their proofs for productive traits.

Sire	N+	Proof		
		90 MY, kg	TMY, kg	LP,d
15627	57	11.2	154	31.2
17443	43	4.4	82.3	12.8
3051	43	6.5	22.8	4.3
15006	41	19.0	121.9	17.6
21666	40	18.1	65.3	9.7
19968	29	-8.5	-31.7	-2.8
2707	26	6.7	69.7	15.2
2754	25	-4.1	-53.5	-7.3
15627	13	11.0	111.9	15.3
17592	10	9.8	125.2	20.7

\+

Number of half sib daughters

Product moment correlation of EBV's between 90MY and TMY was 0.70. The product moment correlations between LP and each of 90MY and TMY were 0.34 and 0.80, respectively. The high product moment correlation between 90MY and TMY , indicated that sire evaluation could be possible using initial milk yield in order to minimize the time required for progeny test. This could reduce the cost of evaluation and decrease the generation interval to increase the annual genetic gain.

Phenotypic and genetic trends

Estimates of phenotypic and genetic trends for productive traits studied are given in Table 5. Annual phenotypic change for 90MY, TMY and LP were 4.0+ 1.3 kg, 16.2 + 4.0 kg and - 5.7 + 1.6 d, recpectively. All of these estimates were significant ($P < 0.01$, Table 5). The present estimates indicate that phenotypic improvement in milk production was achieved during the period of the study. The present results also indicate that the differences in performance between years are mainly due to different nutritional, climatic conditions and management practices prevalent over different times. The observed negative phenotypic change in the length of lactation period is unexpected because the same data indicated high positive phenotypic correlations between LP and each of 90MY and TMY (Table 3). The estimate of the negative change in LP seems to be biased down wards and this seems to be due to the data were recorded some time ago from 1966 and may have been biased by environmental effects now unknown. Therefore it could not be explained .

Similar to the present results, Mourad (1984) with first lactation of Egyptian buffaloes found positive annual phenotypic change of 6.64 ±1.09 kg and 17 ± 3.9 kg for 70 and 305 day milk yield, respectively . She found negative phenotypic change for LP (- 2.9 ± 1.1 d). In addition, Vij and Tiwana(1986) working on Murrah buffaloes. reported that the phenotypic change for 305MY and LP were 72.0 kg and - 0.31 d, respectively . On the other hand, negative annual phenotypic change for milk yield have been reported by Canon and Munoz (1991) (- 78 ± 8.3 kg) and Rege (1991) (- 5.5 kg) working on Spanish Holstein and Kenya cows, respectively.

No specific genetic trends were observed in the productive traits (Table 5). The regression of the sire breeding values on time indicated an increase of 0.06 ± 0.50 kg per year for 90MY and a decrease of - 1.60 ± 1.80 kg for TMY and - 0.40 ± 0.40 for LP. All of them were not significantly different from zero (Table 5). The present results indicate that the sires used in the later years were of inferior genetic worth to those used in the earlier years. It can be inferred that the sires used in the later years did not prove to be superior sires . This may be because of ineffective selection or lack of acclimatization of the animals or both. The present estimates are in agreement with rege (1991) working on Kenya cows, found that the genetic trend per year for 305MY and first lactation milk yield were negative and not significant , being - 2.50 kg/year and - 5.20 kg/ year , respectively . Mourad (1984) estimated genetic trend by three methods , found that genetic trend per generation for 70MY ranged from - 1.4 ± 4.9 kg to + 5.6 +

5.3 kg , for 305MY ranged from - 4.1 ± 20.5 kg to + 11.8 ± 7.7 kg and for LP ranged from - 2.0 ± 5.9 to + 6.0 ± 3.3 d. In addition , Powell *et al* (1977) found strong negative genetic trend in two regions in the United States from 1961 to 1970 with an average sire breeding values for milk (kg.) dropping from 100 to - 220 kg from 1961 to 1964 in the West region and from 25 to - 150 kg during the same period of the time in the Midwest region .

TABLE 5. Summary of phenotypic (P) and genetic trends (EBV) in 90 day milk yield (90 MY), total milk yield (TMY), and lactation period (LP).

Year	90 MY , kg		TMY , kg		LP,d	
	P	EBV	P	EBV	P	EBV
1966	498	18.5	1250	105.6	323	7.0
1967	424	4.6	1190	36.4	468	6.4
1968	472	-24.7	1234	-181.4	380	-16.1
1969	411	-1.1	1188	13.2	322	0.8
1970	397	-5.5	1044	20.9	330	1.0
1971	377	0.3	1105	34.4	367	1.5
1972	437	-0.8	1213	17.2	360	17.6
1973	443	-0.3	1302	26.4	359	3.2
1974	438	2.1	1186	30.1	311	2.6
1975	444	-3.3	1250	39.9	302	8.3
1976	444	4.8	1157	28.6	291	1.1
1977	497	5.4	1389	34.0	303	-1.0
1978	472	1.5	1507	16.6	349	-1.38
1979	419	5.9	1154	57.6	288	0.58
1980	548	6.7	1396	46.9	368	-2.18
1981	529	2.2	1415	34.0	319	-2.66
1982	452	2.5	1396	04.7	365	1.30
1983	459	12.9	1302	01.8	296	-0.46
1984	509	-8.2	1312	-34.6	256	-0.16
1985	516	-1.7	1301	-56.9	261	-1.12
1986	543	-3.3	1466	-36.6	220	-0.80
1987	470	-3.1	1753	-21.4	239	-1.10
+	4.0	0.06	16.2	-1.6	-5.7	-0.4
b	++					
	(1.3)	(0.50)	(4.0)	(1.8)	(1.6)	(0.4)

+
b = annual phenotypic change (adjusted for the other fixed effects) or genetic trend.

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Values between parentheses are standard errors.

On the other hand, Positive genetic trend have been reported for milk yield and LP (Sharaby and EL kimary , 1982; Weller *et al.* 1986 ; and Vij and Tiwana , 1986) ranging from 4.5 kg/ year (Vij and Tiwana, 1986) to 102 kg/ year (Weller *et al.*, 1986). Sharaby and El Kimary (1982) working in two herds of Egyptian buffaloes, found that the expected genetic change for LP were 22 and 8 d/ year.

Given these results, some efforts must be made to monitor genetic trends in Egyptian buffaloes and check the effectiveness of breeding programs using all available information.

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تقدير المعايير الوراثية والتغير الوراثى لبعض صفات انتاج اللبن على قطيع من الجاموس المصرى

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استخدام ١١٨٠ سجلا لموسم الحليب الاول لقطيع الجاموس المصرى بمحطة محلة موسى التابعة لمعهد بحوث الانتاج الحيوانى بالقاهرة فى الفترة من ٦٦ : ٨٧ بهدف دراسة المعايير المظهرية والوراثية لكل من انتاج اللبن فى ٩٠ يوما ، انتاج اللبن فى ٣٠٥ يوما وطول موسم الحليب كذلك بفرض تقدير التغير الوراثى لهذه الصفات .

بلغت قيمة المكافىء الوراثى ١٠ر ± ٠.٦ر ، ١٧ر ± ٠.٧ر ، ١٣ر ± ٠.٦ر لكل من انتاج اللبن فى ٩٠ يوما ، ٣٠٥ يوما وطول موسم الحليب على التوالى ، كانت جميع معاملات الارتباطات الظهرية والوراثية بين الصفات المدروسة عالية المعنوية .

قدرت القيمة التربوية بالاباء التى لها عشرة أبناء فاكثر بطريقة أفضل انحدار خطى غير منحدر تراوحت قيم المقدرة العبورية للاباء مابين - ٢٤ كم الى + ٣٣ كم لكمية اللبن فى ٩٠ يوما ، مابين - ١٤٧ كم إلى + ١٥٤ كم لكمية اللبن فى ٣٠٥ يوما ، مابين - ٢٠ يوما الى + ٣١ يوما لطول موسم الحليب .

بلغ التغير المظهرى السنوى ٤ ± ١٣ ر كم ، ٢ر١٦ ± ٤ كم ، - ٥.٧ ± ٦ر١ يوم لكل من انتاج اللبن فى ٩٠ يوما ، ٣٠٥ يوما ، طول موسم الحليب على التوالى كانت جميع القيم معنوية بينما كانت قيم التغير الوراثى السنوى للصفات الثلاثه غير معنوى .