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GENETIC AND PHENOTYPIC ASPECTS OF MILK YIELD TRAITS AND REPRODUCTIVE PERFORMANCE OF EGYPTIAN BUFFALOES

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SUMMARY

Data of Egyptian buffaloes from three experimental stations, belonging to Animal Production Research Institute were used to estimate the heritabilities of the first five of some milk traits parities along with repeatability and heritability of all parities. Also, genetic and phenotypic correlations between milk traits (70DMY, 180DMY and TMY) and reproductive measures (NSPC,DO and CI) of Egyptian buffaloes were studied. The data comprised 1687 normal milk records of 480 buffalo cows.

The heritability estimated in the first five parities ranged from 0.10±0.114 to 0.36±0.142 for 70DMY, 0.08±0.092 to 0.35±0.141 for 180DMY, 0.03±0.085 to 0.20±0.125 for TMY, and 0.04±0.081 to 0.36±0.136 for LP.

Repeatability estimates for 70DMY, 180DMY, TMY and LP of all parities respectivety were 0.37±0.031, 0.43±0.031, 0.50±0.030, and 0.37±.031 while heritability estimated were 0.16±0.062 ,0.20±0.069, 0.11±0.054, 0.00, in the same order.

Non significant and low magnitude of genetic and phenotypic correlations were found among all milk traits and reproductive measurements of Egyptian buffaloes.

Keywords: Buffalo, genetic aspects, reproductive and productive performances

INTRODUCTION

The breeding plan of Egyptian buffaloes depends on

intensive selection program inside the breed rather than from crossbreeding plan. The magnitude of heritability of different parities helps the breeder to plan the breeeding programs of early selection to select superior dams and sires. For Egyptian buffaloes, many investigators estimated heritability of initial milk yield, which ranged from 0.02 to 0.43 (Bedire, 1965; Mohamed, 1986; Zeidan, 1990; Ashmawy 1991 and Mourad Kawthar et al.,1991). However, culling and selection could be done from part lactation instead of waiting to the end of lactation.

Also, magnitude of heritability of both 305-day milk yield and total milk yield indicated that heritabile of these traits are heritabile, and thus, permitted genetic progress through selection.

Moderate repeatability value of milk traits of Egyptian buffaloes revealed that culling plan may be done from one record only, as reported by Zeidan, (1990) and Mourad Kawthar, et al. (1991).

Few investigations on genetic and phenotypic correlations between milk production and measures of fertility have been carried out on Nili Ravi Cady et al. (1983) and Singh et al.(1987) and they indicated that the genetic and phenotypic correlations were very low. For Egyptian buffaloes, El-Fouly et al. (1977) and Youssef et al. (1988) reported significant correlations between post-partum service interval, days open and milk yield and lactation length.

The objectives of this work are 1) estimating the heritability of milk production traits with advanced parities, and 2) estimating the genetic and phenotypic correlations between these productive traits and reproductive measured in Egyptian buffaloes.

MATERIALS AND METHODS

Normal productive and reproductive records of Egyptian buffaloes were collected from three experimental stations belonging to the Animal Production Research Institute, Ministry of Agriculture, were used in this study .The three farms are Mehalet Mousa in Northern part of the Delta ,Sids in the upper Egypt and Gimmeza in the middle of the Delta. These data covered the period from 1962 to 1972 including 1687 normal records of 480 buffalo cows which have been breed by 74 sires.

Management and systems of feeding were as reported by Mourad Kawthar et al. (1985). The investigated productive traits involved first 70 day milk yield (70DMY), 6-months milk yield (180DMY), total milk yield (TMY)and lactation length (LP).

Reproductive traits were used to examine genetic and phenotypic correlations with productive traits included number of service per conception (NSPC), days open (DO)and calving interval (CI).

Data from the three experimental stations were used to estimate the heritabilities in each parity from the 1st to the fifth lactation separatly. To estimate heritabilities of the productive traits along with genetic and phenotpic correlations between productive and reproductive traits for all parities, the data from Mehalet Mousa experimental satition were only used to avoid the confounding effect between sire and farm.

The mixed modle least squares and maximum likelihood program described by Harvey (1977) were used for the analysis of data. For each lactation separately, estimates of variance and covariance componants for sire (σ^2_s) and remainder (σ^2_e) were calculated, while estimate of sire, cow within sire ($\sigma^2_{c:s}$) and remainder were calculated across all lactations. The following mixed model was used to study the productive traits mentioned above for all parities,

$$Y_{ijklmn} = \mu+S_i+D_{ij}+R_k+T_l+P_m+b(X_{ijklmn}-X_{ijklmn})+e_{ijklmn}$$

where:

Y_{ijklmn} = the performance of the observation Y_{ijklmn}, μ = the common mean; S_i = random effect of ith sire of the jth cow; D_{ij} = random effect of jth cow nested within sire; R = fixed effect of the kth year of calving ; T_l = fixed effect of the lth month of calving; P_m = fixed effect of mth parity; b = the linear regression coefficients of 70DMY, 180DMY, TMY and LP on age at calving; X_{ijklmn} = age of the cow; X_{ijklmn} = average of age and e_{ijklmn} = random effect associated with each observation and assumed to be independent and randomly distributed ($o,\sigma^2 e$).

Data of 70DMY, 180DMY, TMY and LP of each parity were analysed using a mixed model including the effects of year and month of calving and farm as fixed effects and

sire as a random effect. The absence of records in some subclasses did not permit the inclusion of all possible interactions. Henderson's Method 3 (1953) was used to estimate variances and covariances components of sire (σ^2 s). Cow within sire (σ^2 c:s) and error (σ^2 e). For variance components across all lactations, sire effect tested against cow within sire and other effects tested against remainder mean squares. Heritability estimates were calculated for productive traits by paternal half-sib method in each lactation; $h^2 = 4\ \sigma^2_s / \sigma^2_s + \sigma^2_e$ while they were calculated across all lactations as four times the intraclass correlation $h^2 = 4\ \sigma^2\ s\ /\ (\sigma^2\ s + \sigma^2\ c{:}s + \sigma^2\ e)$. Standard errors for heritability estimates were computed using an approximate formulae as reported by Swiger *et al.* (1964). Repeatability estimate was calculated as $(\sigma^2\ s + \sigma^2\ c{:}s)\ /\ (\sigma^2\ s + \sigma^2\ c{:}s + \sigma^2\ e)$. Genetic correlation (with their approximate standard errors) and phenotypic correlations coefficients were calculated by using the formulae described by Harvey (1977).

RESULTS AND DISCUSSION

Means and standard deviations for 70DMY, 180DMY, TMY and LP of all parities are presented in Table 1. Results of ANOVA obtained have revealed a significant influence of year and month of calving and parity on most traits in the study ($P<0.05$ - $P<0.001$).

Table 1. Actual means and their standard deviations (SD) of milk yield traits of all parities of Egyptian buffaloes

Trait	Mean	S.D
70DMY (kg)	456	115.00
180DMY (kg)	1208	234.10
TMY (kg)	1879	454.10
LP (day)	322	68.19

Random components of variance

Sire component of the 1st 70-day milk yield (70DMY), 180-day milk yield (180DMY) and total milk yield (TMY), increased from the first to the second parity and decreased thereafter, up to the fourth parity and

increased again in the fifth lactation (Table 2). However, the sire component of lactation period length (LP) increased in general as parity advanced (Table 2).

Table 2. F-Values of factors affecting milk yield traits of the first 6 records of Egyptian Buffaloes

Source of Variation	d.f	F- Value			
		70-DMY	180-DMY	TMY	LP
Sire	73	1.61^{**}	1.73^{**}	1.43^{**}	$1.03^{N.S}$
Buffaloe cow/sire	406	2.74^{**}	3.27^{**}	4.20^{**}	2.99^{**}
Year of calving	5	15.28^{**}	21.76^{**}	3.70^{**}	5.56^{**}
Month of calving	11	$1.56^{N.S}$	1.85^{*}	4.69^{**}	3.31^{**}
Parity	5	27.62^{**}	24.04^{**}	7.54^{**}	3.08^{**}
Regression on age at calving	1	53.27^{**}	72.97^{**}	24.79^{**}	0.04
Remainder mean squars	1185	550399.69	220743.27	949011.69	4340.15

N.S.= Non significant, * P< 0.05, ** P< 0.01.

Sire of buffalo cow had a significant effect on 70DMY, 180DMY and TMY through the first five parities except in 3rd and 4th lactation (P<0.05 - P<0.01). Results presented in Table 2, indicated that sire of buffalo affected significantly LP across the first five lactations, except the 1st one (P<0.01 Table 2).

Analysis of all parities revealed significant effect of sire of buffalo cow on 70DMY, 180DMY and TMY (P<0.01) (Table 3).In contrary, nonsignificant influence of sire of buffalo cow was observed on LP of all lactations (Table 3). These findings were in agreement with those reported by other Egyptian investigators (Afifi and Barrada, 1973; EL-Chafie, 1981; Ziedan 1990 and Mourad Kawthar et al. 1991) working on Egyptian buffaloes and Cady et al. (1983) on Nili Ravi buffaloes.

Sire component attributed 3.9,5.0 and 2.6% of the total variability in 70DMY, 180DMY and TMY, respectively (Table 3).

These results are higher than those estimated by Zeidan (1990) and Mourad Kawthar et al.(1991) using another date set of Egyptian buffaloes. Cady et al. (1983) reported 4.3,2.8,1.1% for 60-day,250-day and 305-day milk yield respectively on Nili Ravi buffaloes. The estimate of sire component for LP was zero (Table 3).

Table 3. Varianc component estimates (σ^2), heritability estimates (h^2) and percentages of variation (V) due to sire effects and remainder for milk traits in the first five lactations of Egyptian buffalo

Traits	Parity	Sire Component			Remainder Component			$h^2 \pm$ S.E
		d.f	$\sigma^2 s$	V %	d.f	$\sigma^2 e$	V %	
70DMY	1	91	2216	5.6^{**}	673	37233	94.4	0.23 ± 0.103
	2	97	4511	7.1^{**}	753	58918	92.9	0.28 ± 0.102
	3	78	1914	$2.4^{N.S}$	473	78674	97.6	0.10 ± 0.114
	4	67	3192	$3.5^{N.S}$	575	87062	96.5	0.14 ± 0.100
	5	60	8013	8.9^{**}	446	81786	91.1	0.36 ± 0.142
180DMY	1	91	7204	4.3^{**}	673	161831	95.7	0.17 ± 0.098
	2	97	19871	6.6^{**}	753	282463	93.4	0.26 ± 0.100
	3	78	9283	$2.7^{N.S}$	473	335410	97.3	0.11 ± 0.116
	4	67	7639	$2.0^{N.S}$	575	377531	98.0	0.08 ± 0.092
	5	60	33396	8.8^{**}	446	345251	91.2	0.35 ± 0.141
LP	1	97	94	$1.1^{N.S}$	725	8623	98.9	0.04 ± 0.081
	2	102	442	5.3^{**}	783	7594	94.7	0.21 ± 0.093
	3	82	686	9.2^{**}	505	6766	90.8	0.36 ± 0.136
	4	67	379	5.9^{**}	575	6077	94.1	0.24 ± 0.111
	5	60	547	8.9^{**}	446	5597	91.1	0.36 ± 0.142
TMY	1	97	28929	2.4^{*}	725	1175146	97.6	0.10 ± 0.086
	2	102	65396	3.7^{*}	783	1701375	96.3	0.15 ± 0.087
	3	82	56342	$3.1^{N.S}$	505	1748587	96.9	0.13 ± 0.113
	4	67	11912	$0.7^{N.S}$	575	1807547	99.3	0.03 ± 0.085
	5	60	91817	5.1^{*}	446	1706273	94.9	0.20 ± 0.125

N.S.= Non significant, * P< 0.05, ** P< 0.01.

Buffalo cow within sire had a highly significant effects on all productive traits investigated (P<0.01, Table 4). Ziedan (1990), Mourad Kawthar et al. (1991) and Cady et al. (1983) concluded the same results for Egyptian buffaloes and Nili Ravi buffaloes, respectively. The contribution of genetic components of buffalo cow within sire were 32,8,38.3,47.5 and 37.2% for 70 DMY,180DMY, TMY and LP, respectively (Table 3). These finding are more than 7.0,14.7,13.9% for 60-day, 250-day and 305-day milk yield respectively reported by Cady et al. (1983). However, these results are closed to that stated by (Ziedan) 1990 and Mourad Kawthar et al. (1991) on Egyptian buffaloes. The magnitude of sire and cow within sire components compared to the total variance of milk traits studied indicated the possibility of genetic progress through intensive selection of superior sires and dams for milk traits.

Table 4. Percentage of variance component, estimate of heritabilit(h^2) and repeatability (t) of milk yield traits for all parities of Egyptian buffaloes

Trait	Sire	Buffalo cow/sire	Remainder	h^2±SE	t±SE
	V %	V %	V %		
70DMY	3.9**	32.8**	63.3	0.16±0.062	0.37±0.031
180DMY	5.0**	38.3**	56.7	0.20±0.069	0.43±0.031
TMY	2.6**	47.5**	49.8	0.11±0.054	0.50±0.030
LP	0.0	37.2**	62.8	a	0.37±0.031

A Negative estimate of variance components set to zero.
** P < 0.01.

Heritability estimates

Heritability estimates (h^2) for 70DMY, 180DMY and TMY in the first five parities and all parities are given (Tables 2 & 3).

Generally, h^2 increased but not significantly from the 1st to the second lactation and declined thereafter. Also, these results indicated that heritability estimates for milk yield traits were the highest in early days of lactation declined for 180DMY and TMY in

the first five lactations (except in third lactation). Estimates of h^2 in the first five parities for milk yield traits were the lowest in early lactation; increased for 180DMY and declined for TMY. The same trend was reported by Cady et al. (1983) on Nili Ravi buffaloes. Ziedan (1990) and Mourad Kawthar (1991) working on Egyptian buffaloes concluded an opposite trend with advance of lactation curve. Estimates of h^2 in the present study for milk traits are higher than the corresponding estimates reported on Egyptian buffaloes (Ashmawy,1981; EL-Chafie, 1981; Mourad Kawther, 1984; Ziedan,1990; kawthar Mourad et al., 1991).
Higher heritability magnitudes of 70DMY and 180DMY than that of TMY indicated that it may be profitable to select buffalo cows on the basis of part lactation record rather than on complete milk record.

Estimates of h^2 for LP increased as parity advanced from 0.04 in the 1st parity to 0.36 in the 5th parity but h^2 values of all lactations were set to zero due to negative estimate of sire variance component. Mourad Kawthar (1984) reported 0.039 for the 1st LP but Ziedan (1990) calculated 0.109 and 0.037 for the 1st lactation and all lactations respectively, on Egyptian buffaloes. However low estimate of h^2 for LP can be attributed due to low additive genetic variance of this trait and the majority part of variation in this trait is due to non-genetic effect.

Repeatability estimates

Repeatability estimates of 70DMY, 180DMY and TMY are given in (Table 3). Repeatability of 70DMY, 180DMY and TMY were 0.37,0.43 and 0.50 which are higher than those estimates reported by Bedier (1965), Soliman (1976), Mohamed (1986), Ziedan (1990), Ashmawy (1991) and Mourad Kawthar et al. (1991) on Egyptian buffaloes. Basu and Ghai (1978) and Cady et al. (1983); working on Murrah and Nili Ravi buffaloes, respectively.

Repeatability estimate of LP was 0.37±0.03 (Table 3). This value is higher than that of 0.27, 0.21 and 0.35, respectively reported by Asker et al. (1965), Ashmawy (1991) and Zeidan (1990) working on Egyptian buffaloes.

Moderate estimates of repeatability for all milk yield traits studied indicate that selection of females after the first parity can be used as reasonably accurate prediction for performance for these milk traits in

subsequent parities.

Genetic correlations

Genetic correlations (r_G) between productive and reproductive traits are represented in Table 4. The magnitude and sign of correlations indicate an antagonistic relationship between milk yield traits and reproductive performances. Results reveled a pronounced trend between milk 70DMY, 180DMY and TMY and NSPC,DO and CI. Genetic correlations between DO and CI with milk yield traits were decreased from 70DMY to TMY. On contrast, genetic correlations between NSPC and milk yield traits were increased from 70DMY to TMY. A highest correlations between measures of reproduction and 305 day milk yield but less for the 180 day and 60 day milk yield which were unaffected by pregnancy concluded, Burger et al. (1981).

Estimates of genetic correlations between milk traits and reproductive measures reported by cady et al. (1983), Singh et al. (1987), Dong and Van Vleck (1989) on Nili Ravi buffaloes and Holstein cows, respectively were low.

Genetic correlations between reproductive traits (NSPC, DO and CI) with lactation period were regard to zero .

This antagonism may be over-shadowed by good management, effective estrus detection, which are the major factor to improve the reproductive efficiency in Egyptian buffaloes.

Phenotypic correlations

Estimates of phenotypic correlation between DO, NSPC, CI, 70 DMY,180 DMY,TMY and LP, in general, were much low, concluded a lack of phenotypic relation among productive and reproductive traits in Egyptian buffaloes Table 5. These results are disagree with the significant correlations between post-partum service interval and days open with milk yield and lactation length, which reported by El-Fouly et al. (1977) and Youssef et al. (1988) and significant linear and quadratic regression coefficient of total milk yield and annualized milk yield on days open on Egyptian buffaloes, (Ashmawy 1991) on Egyptian buffaloes. Singh et al. (1987) reported low and positive phenotypic correlation between 1st lactation yield with both 1st lactation period and 1st

calving interval.

Table 5. Estimate of genetic (r_G) and phenotypic (r_P) correlations among productive and reproductive traits of all lactation Egyptian buffaloes

Traits corrlation	r_G	r_P
70DMY&NSCP	-0.11 ± 0.39	-0.01
&DO	-0.68 ± 0.42	0.01
&CI	-0.52 ± 0.22	0.04
180DMY&NSCP	0.21 ± 0.37	-0.01
&DO	-0.37 ± 0.38	0.01
&CI	-0.39 ± 0.21	0.05
TMY&NSCP	0.36 ± 0.44	0.02
&DO	-0.12 ± 0.44	0.06
&CI	-0.33 ± 0.25	0.13
LP&NSCP	a	0.04
&DO	a	0.1
&CI	a	0.18

a: Negative estimate of variance components set to zero.
NSCP: Number of service per conception.
DO: Days open.
CI: Calving interval.

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التقديرات الوراثية والمظهرية لكل من انتاج اللبن والأداء التناسلى فى الجاموس المصرى

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استخدمت البيانات المجمعة من ثلاث محطات بحثية للجاموس المصرى تابعة لمعهد بحوث الإنتاج الحيوانى لتقدير العمق الوراثى لمواسم الحليب المختلفة من الموسم الأول حتى الموسم الخامس وكذا تقدير المعامل التكرارى والعمق الوراثى لجميع المواسم (١-٦). كما قدرت معاملات الارتباط الوراثى والمظهرى بين الصفات الانتاجية المختلفة {الحليب الأولى (٧٠ يوم حليب ، ١٨٠ يوم حليب) وانتاج اللبن الكلى} وكذلك لمقاييس الكفاءة التناسلية (عدد التلقيحات اللازمة للاخصاب، فترة الاخصاب، الفترة مابين الولادتين) وتمت الدراسة على عدد ١٦٧٨٧ سجل لبن لعدد ٤٨٠ جاموسة

وكانت قيمة العمق الوراثى للمواسم المختلفة من الأول الى الخامس بالنسبة للصفات الانتاجية تتراوح مابين ٠,١±٠,١١٤ الى ٠,٣٦±٠,١٤٢ لانتاج اللبن المبدنى، ٠,٠٨±٠,٠٩٢ الى ٠,٣٥±٠,١٤١ لانتاج اللبن فى ١٨٠ يوم ، ٠,٠٣±٠,٠٨٥ الى ٠,٢±٠,١٢٥ لانتاج اللبن الكلى ، ٠,٠٤±٠,٠٨١ الى ٠,٣٦±٠,١٣٦ لفترة الحليب .

وكان المعامل التكرارى والعمق الوراثى لانتاج اللبن فى ٧٠ يوم ،١٨٠ يوم، اللبن الكلى ، فترة الحليب لكل المواسم المدروسة كالأتى ٠,٣٧±٠,٠٣١، ٠,٤٣±٠,٠٣١، ٠,٥٠±٠,٠٣٠، ٠,٣٧±٠,٠٣١، ٠,١٦±٠,٠٦٢، ٠,٢±٠,٠٦٩، ٠,١١±٠,٠٥٤، ٠,٠ ، ٠,٠ على الترتيب.

وقد وجد أن كل الارتباطات الوراثية والمظهرية منخفضة القيمة وغير معنوية بين كل الصفات الانتاجية المدروسة وكذلك مقاييس الكفاءة التناسلية للجاموس المصرى.