# DAYS-OPEN ADJUSTMENT FACTORS AND GENETIC EVALUATION FOR LACTATION TRAITS IN EGYPTIAN BUFFALOES

BY

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## ABSTRACT

Data on 2732 lactation records for an Egyptian buffalo herd including 576 buffalo cows (Paternal half-sisters) representing 67 sires were used to estimate the genetic and phenotypic variations and covariations of lactation period (LP) and yield of milk recorded on 90 days (90DY), 180 days (180DY), 305 days (305DY) and total lactation (TY). Averages of 90DY, 180DY, 305DY, TY and LP were 604, 1003, 1366, 1567 kg and 289 days, respectively. Parity effects were highly significant (P<0.001) for all milk yield traits. All productive traits increased curvilinearly with parity order till reaching the peak and declined thereafter, except TY and LP increased linearly as order of lactation advanced. Season of calving affected (P <0.01 or P <0.001) all productive traits except LP and 180DY. Spring calvers had the highest LP, 180DY, 305DY and TY, but winter calvers had the highest 90DY. Year of calving constituted highly significant (P <0.001) source of variation for all productive traits studied. All milk yield traits increased in curvilinear form as age at calving advanced. Most lactation traits increased linearly (P <0.001) as days open increases. Days open correction factors for 180DY, 305DY and TY decreased with the increase of the open period and the curve for 180DY was nearly similar to the curves of 305DY and TY. For all lactations, sire of the cow affected significantly most productive traits studied. Cow within sire contributed significantly (P <0.001) in the variation of productive traits in all lactations. Repeatability estimates were moderate and ranged from 0.357 to 0.478 for all lactation traits, while heritability estimates in the first and across all lactations were low and ranged between 0.015 to 0.166. Genetic, Phenotypic and environmental correlations between lactation traits were positive and high.

## INTRODUCTION

Some studies on Egyptian buffaloes (Abdel-Aziz and Hamed, 1979; Mourad et al. 1986) estimated different sets of age correction factors for 305-day and/or total milk yield, but no account was taken for days open. Also, information on genetic aspects of production traits in Egyptian buffaloes is scarce. Without knowledge for the genetics of this species, effective improvement will be hampered. Therefore, the main objectives of this study were (1) to investigate some non-genetic factors affecting the lactational performance of the Egyptian buffaloes, (2) to derive sets of correction factors of milk yield for days open, and (3) to estimate the genetic and phenotypic parameters of lactation traits in this type of buffaloes.

## MATERIAL AND METHODS

This work was carried out using the production records of the buffalo herd raised at Mehallet Mousa Experimental Farm, Animal production Research Institute, Ministry of Agriculture, Egypt. This farm is located in the northern part of Nile Delta in Kafer El-Sheikh Governorate.

### Management and feeding

Animals were kept under routine system of feeding and management. During winter and spring months from December to May, animals were kept on berseem (*Trifolium alexandrinum)* all time (day and night) to graze ad libitum. Heavy milk buffalo cows and those in the last two months of pregnancy were supplemented with dry concentrate mixture proportional to their weight and production. During summer and autumn months from June to the end of November, animals were housed in open sheds for protection from direct solar radiation and fed on a dry concentrate mixture (according to their weight and production) in addition to clover hay and rice or wheat straw.

Animals in lactation were hand milked twice daily. For two months before the next expected calving dates, buffalo cows still lactating were dried off by milking them once a day, then once every two days until dry.

### Breeding plan and data

Bulls were assigned to mate the females naturally at random. Buffalo-heifers were served for the first time when they reached 24 months or 330 kg, while buffalo-cows (calvers) were usually served two months post-partum. Pregnancy was detected by rectal palpation 60 days after the last service. Buffaloes that failed to conceive were rebred in the next heat period. Bulls were chosen for breeding purposes at 2-3 years of age. They were evaluated before being used for body conformation and for semen characteristics.

Data on 2732 lactation records of 576 buffalo cows sired by 67 bulls were collected over a period of 16 years started by 1970. Lactation traits studied were first 90-day (90DY), 180-day (180DY), 305-day (305DY) and total milk yield (TY) and length of lactation period (LP). The 90-day milk yield was considered as initial milk yield.

### Statistical analysis

Data were analysed using Harvey's (1990) mixed model computer program. Data of 1st lactation were analysed by fitting the effects of year and season of calving, year X season interaction (as fixed effects) and sire of cow (as random effect) along with age at calving and days open (as covariates). For estimation of genetic and phenotypic parameters across all lactations, data were analysed fitting the effects of year, season, parity, days open (12 classes of 20-day interval) and year x season interaction (as fixed effects) and sire and cow within sire (as random effects). To detect the effect of age of cow on lactation traits, data across all lactations were analysed once more using a model included year, season, days open and age (35 classes of 3-month interval) as fixed effects along with sire and cow within sire as random effects.

Days open correction factors for 180DY, 305DY and TY were constructed by smoothing the curve representing the relationship between least-squares means of milk yield with classes of days open using third degree polynomial regression analysis. In case of nonsignificant partial cubic regression coefficient, second degree polynomial regression was used and if the quadratic term was not significant the relationships between days open and lactation traits were examined for linearity. The prediction equations of adjusted-lactation traits (adjested for other effects included in the model) were estimated as (Harvey, 1990) :

$$Y=\mu + b_L (X-X_\mu) + b_Q(X-X\mu)^2+b_C(X-X\mu)^3$$

Where Y= the predicted value of a trait, = overall least-square mean of a given lactation trait (adjusted for effects in the model), $b_L$ , $b_Q$ and $b_C$= estimates of partial linear, quadratic and cubic regression coefficients of a given lactation trait on days open, X= days open, and $X\mu$ the mean of days open. The multiplicative days open correction factors for 180DY, 305DY, and TY were computed on the basis of modal class (the most frequent class) as $C_i = \mu m/\mu_i$, where $C_i$ = the multiplicative days open correction factor, $\mu_m$= the predicted milk yield at modal class and $\mu_i$ = the predicted average of milk at each class of days open.

**Estimation of genetic parameters**

By equating mean squares of random effects to their expectations, estimates of variance components, i.e. sire ($\sigma^2_s$), Cow ($\sigma^2_c$) and remainder ($\sigma^2_e$) were obtained. Henderson method 3 was utilized to estimate the genetic and phenotypic variance and covariance components for the different traits. Paternal half-sib heritability ($h^2_s$) for different traits in the first lactation were calculated as $h^2_e = 4\sigma^2_s/(\sigma^2_s + \sigma^2_s)$. Heritability across all lactations was estimated by the paternal half-sib method as $h^2_s = 4\sigma^2_s / (\sigma^2_s+\sigma^2_{c \cdot s}+\sigma^2_e)$ and repeatability or intraclass correlation (t) as $t = (\sigma^2_s+\sigma^2_{c \cdot s})/(\sigma^2_s+\sigma^2_{c \cdot s}+\sigma^2_e)$. Genetic, phenotypic and environmental correlation coefficients between any two traits were estimated by the formulae outlined by Harvey (1990). Approximate standard errors for heritability, repeatability and genetic correlation estimates were computed by the LSMLMW program of Harvey (1990).

## RESULTS AND DISCUSSION

### Means and variation of uncorrected records

Means, standard deviations (SD) and coefficients of variation (CV) for initial 90-day (90DY), 180-day (180DY), 305-day (305DY) and total (TY) milk yields and days of lactation length (LP) in 1st lactation and across all lactations are presented in Table 1. Means reported here for 305DY, TY and LP fall within the range of most estimates obtained for Egyptian buffaloes (e.g. Rashad, 1989; Ashmawy, 1991) and for Murrah buffaloes (e.g. Johari and Bhat, 1979). Mean of 90DY of all lactations is close to those obtained by other Egyptian investigators (e.g. Salem, 1983; the estimate was 653 kg). Also, the mean of 180DY (Table 1) is close to the mean estimated by Mourad (1984) for Egyptian buffaloes.

Estimates of CV given in Table 1 showed that variation in most yield traits (i.e. 180DY, 305DY and TY) was relatively high compared with that of 90DY or LP. Poor managerial procedures of such a buffalo herd may have lead to such high variation. Also, it may be due to that fluctuation of milk production along 180DY, 305DY and TY was high compared with 90DY .

### Year and season of calving

Estimates of individual year effects are too numerous to be reported here. There was an increase ($P < 0.05$) in milk yield traits and LP with advancing of year of calving. However, year effects represent primarily managerial and feeding changes. F-ratios given in Table 2 indicated that season of calving had more influence on milk yields at late stage of lactation ($P < 0.001$) than at early lactation ($P > 0.05$). This is similar to what was found by Mourad (1984), Khattab *et al.*, (1985) and Mohamed (1986).

Least-squares means given in Table 3 show generally that spring calvers had higher milk production than calvers at other seasons, along with the longest LP (Table 3). These findings are in agreement with those of other Egyptian studies (e.g. Mostageer *et al.*, 1981; Mourad, 1984; Kotby *et al.*, 1988; Rashad, 1989). Level of nutrition and exercise appear to be the main factors responsible for seasonal variation in productive performance of Egyptian buffaloes.

### Parity

Least-squares means in Table 3 show that most milk yield traits increased in a curvilinear manner as parity advanced, while LP increased linearly ($P < 0.001$) up to the 7th parity. A similar trend was observed by most Egyptian investigators

*Table 1.* **Actual means[+], standard deviations (S.D.) and coefficients of variations (CV) for productive traits in Egyptian buffaloes.**

| Trait | First lactation | | | All lactations | | |
|---|---|---|---|---|---|---|
| | Mean | S.D. | CV% | Mean | S.D. | CV% |
| 90DY (kg) | 441 | 120 | 25.8 | 604 | 180 | 19.4 |
| 180DY (Kg) | 731 | 370 | 47.5 | 1003 | 477 | 35.3 |
| 305DY (Kg) | 1037 | 562 | 49.4 | 1366 | 684 | 35.4 |
| TY (Kg) | 1249 | 370 | 43.0 | 1567 | 673 | 28.1 |
| LP (days) | 295 | 120 | 30.7 | 289 | 99 | 22.5 |

[+]Number of lactation records was 2732.

*Table 2*. **Least squares analysis of variance of factors affecting milk production traits across all lactations.**

| Source of variation | d.f | F-ratios | | | | |
|---|---|---|---|---|---|---|
| | | 90DY | 180DY | 305DY | TY | LP |
| Sire | 66 | 1.65*** | 1.35* | 1.39* | 1.40* | 1.43* |
| Cow within sire+ | 509 | 3.54*** | 3.38*** | 4.04*** | 4.92*** | 3.98*** |
| Year of calving | 15 | 5.78*** | 4.30*** | 4.97*** | 4.94*** | 10.88*** |
| Season of calving | 3 | 3.80** | 0.65ns | 4.68*** | 6.55*** | 5.82ns |
| Parity | 6 | 94.54*** | 35.52*** | 34.58*** | 45.46*** | 6.96*** |
| Year x season | 45 | 3.38*** | 2.09*** | 2.11*** | 2.77*** | 1.87* |
| Days open | 20 | 0.66ns | 1.44ns | 5.25*** | 13.39*** | 28.54*** |
| Remainder df | 2067 | | | | | |
| Remainder mean squares | | 13808 | 125244 | 234465 | 193520 | 4227 |
| $R^2$ of model | | 0.64 | 0.55 | 0.56 | 0.58 | 0.62 |

+ Sire effect tested against cow within sire and other effects tested against remainder mean squares.
ns= non-significant, *= P<0.05, **= P<0.01, ***= P<0.001.

*Table 3.* **Least squares means and standard errors (S.E.) of milk production traits of parity and season of calving groups.**

| Classes of variable | No. | 90DY(Kg) Mean | 90DY(Kg) S.E. | 180DY(Kg) Mean | 180DY(Kg) S.E. | 305DY(Kg) Mean | 305DY(Kg) S.E. | TY(Kg) Mean | TY(Kg) S.E. | LP(days) Mean | LP(days) S.E. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Parity:* | | | | | | | | | | | |
| 1st | 596 | 419 | 22 | 677 | 65 | 965 | 191 | 1143 | 84 | 278 | 12 |
| 2nd | 608 | 593 | 16 | 1040 | 47 | 1463 | 68 | 1660 | 64 | 311 | 9 |
| 3rd | 508 | 658 | 13 | 1112 | 36 | 1552 | 52 | 1801 | 51 | 313 | 7 |
| 4th | 367 | 697 | 12 | 1208 | 33 | 1659 | 48 | 1883 | 47 | 309 | 6 |
| 5th | 247 | 725 | 14 | 1227 | 38 | 1685 | 56 | 1946 | 54 | 313 | 7 |
| 6th | 176 | 714 | 18 | 1248 | 52 | 1674 | 73 | 1920 | 68 | 315 | 10 |
| ≥7th | 239 | 687 | 25 | 1226 | 75 | 1694 | 104 | 1988 | 96 | 335 | 14 |
| *Season of calving:* | | | | | | | | | | | |
| Autumn | 813 | 636 | 11 | 1095 | 30 | 1462 | 45 | 1683 | 45 | 299 | 6 |
| Winter | 956 | 655 | 11 | 1087 | 30 | 1488 | 45 | 1734 | 44 | 310 | 6 |
| Spring | 636 | 627 | 12 | 1120 | 32 | 1587 | 47 | 1821 | 45 | 321 | 6 |
| Summer | 321 | 650 | 13 | 1120 | 37 | 1573 | 54 | 1814 | 52 | 311 | 7 |

(e.g. Mostageer *et al*, 1981; Mourad. 1984; Mohamed. 1986; Rashad. 1989; Ashmawy, 1991). The relatively high values of F-ratios given in Table 2 indicate that parity was one of the most important non-genetic factors influencing ($P < 0.001$) yield traits and LP of the Egyptian buffaloes. Among the successive parities, the first had the lowest ($P < 0.01$) means of yield traits and LP.

**Age at calving**

Buffalo cow age had significant effect on most milk traits studied (Table 4). The significant effect of age at calving on milk traits in buffaloes was also reported by many investigators for Egyptian buffaloes (e.g Ragab *et al.*, 1973; Mourad, 1984; Rashad, 1989) and for Indian buffaloes (e.g. Umrikar and Deshpande, 1985). Most estimates of partial regression coefficients (b's) given in Table 4 lead to the conclusion that there was a curvilinear relationship between milk traits of all lactations and age of cow. The Egyptian studies had confirmed this trend (e.g. Ragab *et al.*, 1973; El-Tawil *et al.*, 1976; Mourad, 1984). Accordingly, curvilinear relationships for age of cow could be fitted on data of milk traits of Egyptian buffaloes. From partial linear and quadratic regression coefficients presented in Table 4, prediction equations for milk traits for the first lactation (adjusted for other effects in the model) were calculated. Therefore, early prediction based on the regression of each yield and LP on age of cow at calving could be obtained and plotted to indicate the changes that would be expected in such traits with advance of age of cow.

**Days open**

Days open affected ($P < 0.001$) 305DY, TY and LP (Table 2) as was reported by many investigators (e.g. Ashmawy, 1991). The nonsignificant effect of days open at 90 and 180 days in milk could be attributed to the competition between milk production of buffalo cow and the needs of growth of her foetus especially with the beginning of the 6th month of pregnancy.

The estimates of partial regression coefficients of different milk traits on days open in first lactation and across all lactations are presented in Table 5. For each additional day open, 180DY, 305DY and TY of all lactations increased significantly ($P < 0.001$) by 0.364, 1.051 and 1.652 kg/day, respectively. For Egyptian buffaloes, Ashmawy (1991) found that estimates of partial linear and quadratic regression coefficients on days open were 2.76 kg/day and -0.0003 kg/day$^2$ for TY and -1.72 kg/day and 0.001 kg/day$^2$ for 305DY . Lundstrom *et al.*, (1982) reported that the delaying of days open may be caused by several factors, e.g. faulty management (poor oestrus detection, missing of oestrus) and culling policy. Accordingly, the breeders were to inseminate their high yielding cows later than moderate or low-performing cows. This could automatically produce an antagonistic relation between milk traits and days open.

*Table 4*. Partial linear, quadratic and cubic regression coefficients (b) and their standard errors (S.E) and prediction equations of lactation yield (Kg) and length (days) of 1st lactation and across all lactations on age of the cow (months).

| Trait | Linear (unit/month) | | Quadratic (unit/month$^2$) | | Cubic (unit/month$^3$) | | Prediction equation$^+$ |
|---|---|---|---|---|---|---|---|
| | b | S.E. | b | S.E. | b | S.E. | |
| *First lactation:* | | | | | | | |
| 90DY | 0.36$^{ns}$ | 1.23 | -0.022$^{***}$ | 0.125 | ns | | 90DY= 431 +0.36(AC - 38.1) - 0.022(AC - 38.1)$^2$ |
| 180DY | -2.97$^{ns}$ | 3.76 | 0.595$^{***}$ | 0.384 | ns | | 180DY= 680 -2.97(AC - 38.1) + 0.595(AC - 38.1)$^2$ |
| 305DY | -2.86$^{ns}$ | 5.54 | 0.890$^{**}$ | 0.566 | ns | | 305DY= 97 -2.86(AC - 38.1) + 0.890(AC - 38.1)$^2$ |
| TY | -8.12$^{ns}$ | 5.81 | 1.191$^{**}$ | 0.593 | ns | | TY= 1205 -8.12(AC - 38.1) + 1.191(AC - 38.1)$^2$ |
| LP | -1.44$^{**}$ | 0.98 | 0.272$^{ns}$ | 0.100 | ns | | LP= 285 -1.44(AC - 38.1) + 0.272(AC - 38.1)$^2$ |
| *All lactations:* | | | | | | | |
| 90DY | 5.38$^{***}$ | 0.38 | -0.057$^{***}$ | 0.003 | 0.00019$^{ns}$ | 0.00013 | 90DY= 623+ 5.38(AC - 81) - 0.057 (AC - 81)$^2$ |
| 180DY | 1.85$^{***}$ | 1.12 | -0.105$^{***}$ | 0.010 | 0.00116$^{**}$ | 0.00040 | 180DY= 1040+ 1.85(AC - 81) - 0.105 (AC - 81)$^2$+ 0.00116(AC-81)$^3$ |
| 305DY | 10.52$^{***}$ | 1.53 | -0.149$^{***}$ | 0.014 | 0.00197$^{***}$ | 0.00055 | 305DY= 1406+10.52(AC - 81) - 0.149 (AC - 81)$^2$+ 0.00197(AC-81)$^3$ |
| TY | 12.29$^{***}$ | 1.37 | -0.160$^{***}$ | 0.013 | 0.00157$^{***}$ | 0.00049 | TY= 1604+12.29(AC - 81) - 0.160 (AC - 81)$^2$+ 0.00157(AC-81)$^3$ |
| LP | 0.05$^{ns}$ | 0.20 | -0.009$^{***}$ | 0.002 | 0.00024$^{***}$ | 0.00007 | LP= 282+ 0.05(AC - 81) - 0.009 (AC - 81)$^2$+ 0.00024(AC-81)$^3$ |

$^+$AC= observed age at calving; ns= non-significant (P>0.05), *= P<0.05, **= P<0.01, ***= P<0.001.

In first lactation, 180DY, 305DY and TY increased linearly (P <0.001) with the increase of days open (Table 5). The trend for 90DY and 180DY in the first lactation is nearly similar to the trend in all lactations. For all lactations, it was also observed that the means for 305DY in different days-open classes were similar to the means of TY (Table 6). For instance, the quantity of 305DY across all lactations increased by only 416 kg, from class of ≤30 (1st class) to the class of ≥ 430 days (last class), i.e. over about 13 months of lactation. Consequently, 90 days open period was desirable for economic production in Egyptian buffaloes. Ashmawy (1991) concluded that reduction of days open in buffaloes is a desirable goal of dairymen. In practice, the farmers will inseminate their low performing cows as early as possible.

**Year x season interaction**

The effect of interaction between year and season of calving was significant in all traits (Table 2). Availability of green fodder and seasonality (especially for ambient temperature, dryness and relative humidity) and their pattern in different years in Egypt may be responsible for such significant interaction.

**Days open correction factors**

The value of the modal class (i.e. the most frequent class) in the present study is 71-90 days open. Schaeffer and Henderson (1972) reported that correction factors for days open could be computed to any desirable base. Correction factors for days open across all lactations are presented in Table 6. These factors indicated that days-open correction factors based on polynomial regression analysis for lactation traits decreased with the increase of the open period. Correction factors of the present study also show that the curve for 180DY was nearly similar to the curves of 305DY and TY.

**Estimates of variance components**

Effects of sires on lactation traits in the first lactation and across all lactations are given in Table 7. Results obtained in the present study for all lactations show that the sire of the cow affected significantly (P <0.05 or P <0.01 or P <0.001) all lactation traits studied (Table 7). Findings of the first lactation indicate that there was a significant sire effect (P <0.05) for 90DY, while other traits were not affected. This is a consequence of the limited data used. Cady *et al.*, (1983) concluded that sire effects on milk yield traits of buffaloes were significant. Also, a significant buffalo cow effect (P <0.001) on lactation traits was observed (Table 7). Similar findings were reported by Cady *et al.*, (1983) for initial and 305DY of Nili-Ravi buffaloes.

*Table 5.* **Partial regression coefficients (b) and their standard errors of polynomial regression analysis for production traits on days open.**

| Trait | Linear (unit/day) | | Quadratic (unit/day$^2$) | | Cubic (Unit/day$^3$) |
|---|---|---|---|---|---|
| | b | E.E. | b | S.E | b |
| *First lactation* | | | | | |
| 90DY, kg | ns | | ns | | |
| 180DY, kg | 0.283* | 0.142 | ns | | |
| 305DY, kg | 0.722*** | 0.209 | ns | | |
| TY, kg | 1.117*** | 0.219 | ns | | |
| LP, day | 0.326*** | 0.037 | -0.0005*** | 0.0001 | |
| *All lactations* | | | | | |
| 90DY | ns | | ns | | ns |
| 180DY | 0.364*** | 0.084 | ns | | ns |
| 305DY | 1.051*** | 0.115 | -0.0032*** | 0.0009 | ns |
| TY | 1.652*** | 0.104 | -0.0020** | 0.0008 | ns |
| LP | 0.364*** | 0.015 | ns | | ns |

ns= nonsignificant (P>0.05), *= P<0.05, **=P<0.01, ***=P<0.001.

*Table 6.* Days-open least squares means (Kg) and correction factors (CF) for lactation traits in Egyptian buffaloes.

| | | 180DY | | 305DY | | TY | |
|---|---|---|---|---|---|---|---|
| Class | N | Mean | CF | Mean | CF | Mean | CF |
| ≤30 | 165 | 1019 | 1.027 | 1236 | 1.134 | 1346 | 1.115 |
| 31-50 | 198 | 988 | 1.020 | 1255 | 1.092 | 1449 | 1.076 |
| 51-70 | 185 | 1049 | 1.012 | 1360 | 1.056 | 1520 | 1.041 |
| 71-90 | 201 | 1061 | 1.006 | 1349 | 1.024 | 1508 | 1.010 |
| 91-110 | 173 | 1066 | 0.999 | 1424 | 0.995 | 1573 | 0.982 |
| 111-130 | 178 | 1099 | 0.992 | 1452 | 0.970 | 1591 | 0.956 |
| 131-150 | 162 | 1125 | 0.985 | 1546 | 0.947 | 1746 | 0.932 |
| 151-170 | 160 | 1111 | 0.975 | 1515 | 0.920 | 1677 | 0.900 |
| 171-190 | 127 | 1084 | 0.973 | 1520 | 0.911 | 1694 | 0.890 |
| 191-210 | 116 | 1059 | 0.965 | 1464 | 0.896 | 1721 | 0.872 |
| 211-230 | 110 | 1135 | 0.959 | 1580 | 0.883 | 1801 | 0.855 |
| 231-250 | 124 | 1093 | 0.953 | 1539 | 0.871 | 1772 | 0.840 |
| 251-270 | 124 | 1132 | 0.946 | 1606 | 0.862 | 1840 | 0.826 |
| 271-290 | 105 | 1144 | 0.941 | 1639 | 0.854 | 1873 | 0.813 |
| 291-310 | 87 | 1148 | 0.935 | 1642 | 0.847 | 1913 | 0.801 |
| 311-330 | 90 | 1143 | 0.929 | 1626 | 0.843 | 1988 | 0.790 |
| 331-350 | 69 | 1124 | 0.923 | 1660 | 0.839 | 1987 | 0.781 |
| 351-370 | 73 | 1159 | 0.917 | 1695 | 0.837 | 2030 | 0.771 |
| 371-390 | 55 | 1198 | 0.912 | 1704 | 0.836 | 1969 | 0.763 |
| 391-410 | 57 | 1117 | 0.905 | 1607 | 0.836 | 1988 | 0.756 |
| 411-430 | 173 | 1162 | 0.900 | 1652 | 0.838 | 2038 | 0.749 |

*Table 7.* **Variance component estimates ($\sigma^2$) and proportions of variation (V%) due to random effects for lactation yields and length in Egyptian buffaloes.**

| | First lactation | | | | | | All lactations | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sire | | | Remainder | | | Sire | | | Cow within sire | | | Remainder | | |
| Trait | d.f | $\sigma^2_s$ | V% | d.f | $\sigma^2_e$ | V% | d.f | $\sigma^2_s$ | V% | d.f | $\sigma^2_{c:s}$ | V% | d.f | $\sigma^2_e$ | V% |
| 90DY | 59 | 562 | 4.1* | 480 | 12989 | 95.9 | 66 | 548 | 2.5*** | 509 | 7372 | 33.9*** | 2067 | 13808 | 63.6 |
| 180DY | 59 | 533 | 0.4ns | 480 | 120751 | 99.6 | 66 | 1638 | 0.8* | 509 | 68086 | 34.9*** | 2067 | 125245 | 64.2 |
| 305DY | 59 | 5006 | 1.9ns | 480 | 262419 | 98.1 | 66 | 4364 | 1.1* | 509 | 162744 | 40.5*** | 2067 | 234485 | 58.4 |
| TY | 59 | 1091 | 0.4ns | 480 | 288614 | 99.6 | 66 | 4265 | 1.1* | 509 | 173136 | 46.7*** | 2067 | 193520 | 52.2 |
| LP | 59 | 67 | 0.8ns | 480 | 8220 | 99.2 | 66 | 95 | 1.3** | 509 | 2873 | 39.9*** | 2067 | 4227 | 58.8 |

ns= non-significant, *= $P<0.05$, **= $P<0.01$, ***= $P<0.001$.

The percentage of variance attributable to the sire and cow-within-sire components for all milk traits of all lactations are given in Table 7 Slight differences in sire component of variance were observed between the different traits. The sire contribution ranged from 0.4 to 4.1% in first lactation and from 0.8 to 2.5% across all lactations. These estimates for milk traits are generally lower than values reported by some Egyptian investigators (e.g. Mourad. 1984). Possibly one should state management changes in the farms where data come from are necessary.

The proportion of variance attributable to cow-within-sire for lactation traits ranged from 33.9 to 46.7%. Most of these findings are similar to those obtained by Cady *et al.*, (1983) from Nili-Ravi buffaloes.

**Repeatability estimates**

Repeatability estimates (t) for different milk traits across all lactations were moderate and ranged from 0.357 to 0.478, all with standard errors of values around 0.025 (Table 8). Similar estimates were obtained by many investigators (e.g. Mohamed, 1986 and Ashmawy, 1991 for Egyptian buffaloes and Cady *et al.*, 1983 for Indian buffaloes). Accordingly, moderate estimates of repeatability for milk traits obtained in the present and reviewed studies lead to the conclusion that culling of buffalo cows for productive traits based on a single production record, as commonly practiced by buffalo breeders, would be efficient with regard to improvement of productive potential and consequently assessment of several records are not required before selection of cows.

**Heritability estimates**

Estimates of heritability based on paternal half-sib for productive traits in first and across all lactations ranged from 0.015 to 0.166 (Table 8). The relatively low estimates for productive traits obtained in the present study could be due to some confounding with year or season of calving (in a few cases, a sire was used in just one year and season). Another reason for such low estimates of heritability may be selection, based on culling policies, which was commonly applied in this herd of Egyptian buffaloes. The heritability estimates of around 5% for lactation traits would require large progeny groups which as far as are illusory in buffaloes. However, the low magnitude of heritability estimates for milk production traits of Egyptian buffaloes suggest that a small extent of additive genetic variation in these traits was detected and consequently the non-genetic factors (i.e. managerial practices) are playing the major source of contribution in such variation. These estimates agree with other Egyptian reports (e.g. Mourad. 1984; Mohamed, 1986) and Indian reports (Gurung and Johar, 1982; Singh *et al.*, 1984). Higher estimates were reported by Kornel and Patro (1988) from Indian buffaloes. The estimates of heritability for LP were also low (Table 8) and consequently one can conclude that

*Table 8.* **Estimates of repeatability (t) and heritability ($h^2$) of milk production traits in Egyptian buffaloes.**

| Trait | Repeatability | | Heritability | | | |
| --- | --- | --- | --- | --- | --- | --- |
| | | | First lactation | | All lactations | |
| | t | S.E. | $h^2$ | S.E. | $h^2$ | S.E. |
| 90DY | 0.364 | 0.025 | 0.166 | 0.112 | 0.101 | 0.038 |
| 180DY | 0.357 | 0.025 | 0.018 | 0.092 | 0.034 | 0.026 |
| 305DY | 0.416 | 0.025 | 0.075 | 0.100 | 0.043 | 0.028 |
| TY | 0.478 | 0.025 | 0.015 | 0.092 | 0.046 | 0.029 |
| LP | 0.412 | 0.025 | 0.032 | 0.094 | 0.053 | 0.030 |

*Table 9.* **Estimates of genetic correlation and their standard errors (below diagonal) and phenotypic and environmental correlations (above diagonal)[*] for lactation traits.**

| Trait | 90DY | 180DY | 305DY | TY | LP |
| --- | --- | --- | --- | --- | --- |
| 90DY | | 0.66(0.63) | 0.61(0.59) | 0.64(0.65) | 0.35(0.33) |
| 180DY | 1.147 ± 0.179 | | 0.95(0.95) | 0.76(0.77) | 0.63(0.63) |
| 305DY | 1.009 ± 0.134 | 0.972 ± 0.032 | | 0.88(0.88) | 0.75(0.74) |
| TY | 0.660 ± 0.186 | 0.621 ± 0.255 | 0.885 ± 0.093 | | 0.85(0.84) |
| LP | 0.622 ± 0.227 | 0.629 ± 0.265 | 0.858 ± 0.134 | 1.070 ± 0.061 | |

[*]Environmental correlations are given in parentheses adjacent to the phenotypic correlations.

the major part of the variation in this trait is of non-genetic origin. This is expected and most estimates reported in the literature (e.g. Johari and Bhat, 1979; Mourad, 1984) confirm it.

**Correlations**

Genetic ($r_G$), phenotypic ($r_P$) and environmental ($r_E$) Correlations among lactation traits are presented in Table 9. Most estimates of $r_G$ were similar to the corresponding estimates of $r_P$ and $r_E$ in directions but slightly higher in magnitudes.

Estimates of $r_G$ and $r_P$ among yield traits (90DY, 180DY, 305DY and TY) are positive and high ranging from 0.610 to 1.147 as to be expected on account of the part-whole relationship as also observed by Mourad (1984). These mainly part-whole genetic and phenotypic associations indicate that milk yield in 90-day of lactation could be good indicators for production in total lactation. Consequently, early selection for high yield of milk at 90 days of lactation will be associated with an improvement in the corresponding traits of 180DY, 305DY and TY.

Estimates of $r_G$ and $r_P$ between milk yield and LP were generally positive and high; ranging from 0.35 to 1.070 (Table 9). They indicates that a positive genetic and phenotypic dependency of milk yield on LP was obtained.

Estimates of $r_E$ amongst lactation traits were positive and generally high (Table 9). These estimates emphasize the large environmental influences and therefore an improvement in the environment (i.e. management, feeding, housing ) affecting LP would be associated with an improvement in environment affecting the other yield traits (90DY, 180DY, 305DY and TY). This indicates also that better environmental and managerial conditions will optimize LP and consequently more yield obtained.

## CONCLUSION

1. Effects of days-open on lactation traits in Egyptian buffaloes were significant and consequently correcting lactation records for days open is recommended. Schaeffer and Henderson (1972) concluded that adjust-ment of milk records for days open appears necessary and would not introduce genetic biases.
2. Owing to moderate repeatabilities for lactation traits obtained here, a single production record should be considered when evaluating buffalo cow records for selection or culling purposes .
3. Low genetic variation due to sires (i.e. low heritability for most lactation traits) obtained here suggest that there is little scope for improving the lactation performance of Egyptian buffalo through individual selection.

4. High estimates of genetic and phenotypic correlation in the present study offer the possibility to select for yield traits at early ages, i.e. at 90 days of lactation. The positive and high correlation between lactation length and milk yield is desirable to combine them into an index with a view to improve lactation efficiency of Egyptian buffaloes.

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## عوامل التصحيح لفترة الايام المفتوحه والتحليل الوراثى لصفات الادرار فى الجاموس المصرى

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استخدمت بيانات ٣٧٣٢ سجل ادرار لاحدى قطعان الجاموس المصرى لعدد ٥٧٦ جاموسه (مجموعات أنصاف أشقه ) تمثل بنات ٦٧ طلوقة وذلك لتقدير التباين الوراثى والمظهرى لبعض الصفات الانتاجيه . اشتملت الصفات الانتاجيه على طول فترة الادرار ومحصول اللبن عند ٩٠ ، ١٨٠ ، ٣٠٥ يوما من الادرار واجمالى ادرار الموسم ، تتلخص النتائج المتحصل عليها فيما يلى :-

١- كان متوسط انتاج اللبن خلال ٩٠ يوما ، ١٨٠ يوما ، ٣٠٥ يوما ، من الادرار والادرار الكلى هو ٦٠٤ ، ١٠٠٣ ، ١٣٦٦ ، ١٥٦٧ كيلو جرام على التوالى وكان متوسط طول فترة الادرار ٢٨٩ يوما .

٢- كان لترتيب موسم الادرار تاثيرا معنويا ( عند مستوى ٠,٠١) على جميع الصفات الانتاجيه المدروسه - حدث زيادة مستمرة فى بعض الصفات الانتاجيه مع تقدم موسم الادرار الى أن وصلت الى أعلى مستوى من الادرار ثم انخفضت مرة أخرى . هذا فيما عدا انتاج اللبن الكلى وطول فترة الادرار حيث حدث بها زيادة مستمرة فى صورة حطيه مع تقدم موسم الادرار .

٣- ظهر لفصل وسنة الولادة تأثيرا معنويا ( عند مستوى ٠,٠١) على معظم الصفات الانتاجيه المدروسه أعطت ولادات فصل الربيع أعلى انتاج من اللبن خلال ١٨٠ يوما ، ٣٠٥ من الادرار وللانتاج الكلى من الادرار بينما أعطت ولادات فصل الصيف أعلى قيمه من انتاج اللبن خلال ٩٠ يوم .

٤- كان لعمر الجاموسه عند الولادة تأثيرا معنويا ( عند مستوى ٠,٠٥ أو ٠,٠١ ) على كل الصفات الانتاجيه المدروسه حيث لوحظ تناقص انتاج اللبن بصورة خطيه انحنائيه وذلك بتقدم عمر الجاموسه.

٥- تزايدت معظم صفات الادرار زيادة خطيه ( مستوى معنوية ٠,٠٠١) بزيادة طول فترة الايام المفتوحه . ثم اشتقاق معاملات تصحيح لطول فترة الايام المفتوحه .

٦- أوصت الدراسه لتصحيح سجلات اللبن لطول فترة الايام المفتوحه ومن ثم لتصحيح سجلات انتاج اللبن للجاموس المصرى . تناقصت معاملات التصحيح لسجلات اللبن مع زيادة فترة الايام المفتوحه وكان منحنى معاملات تصحيح ١٨٠ يوما من الادرار يشابه تقريبا منحنيات معاملات التصحيح لانتاج ٣٠٥ يوما من الادرار وللادرار الكلى.

٧- كان هناك تأثيرا واضحا للطلوقه ( أباء الجاموسه ) على جميع الصفات الانتاجيه وذلك بالنسبه لمواسم الادرار مجتمعه كذلك كان للبقرة تأثيرا معنويا واضحا ( على مستوى ٠,٠١) على جميع الصفات الانتاجيه المدروسه .

٨- كانت قيم المعامل التكرارى لصفات محصول ادرار اللبن ولطول فترة الادرار متوسطة القيمه حيث تراوحت القيم من ٠,٣٥٧ الى ٠,٤٧٨ مما يقودنا الى الاعتماد على سجل انتاجى واحد لانتخاب اناث الجاموس المصرى ٠

٩- كان المكافىء الوراثى منخفض لجميع صفات الادرار سواء فى الموسم الاول أو لكل مواسم الادرار حيث تراوحت القيم بين ٠,٠١٥ الى ٠,١٦٦

١٠- كانت الارتباطات الوراثيه والمظهريه والبيئيه بين صفات الادرار موجبه وعاليه القيمه وبالتالى يمكن عن طريق الانتخاب تحسين صفات ادرار اللبن عند الاعمار المبكرة ( عند ٩٠ يوم من الادرار )٠