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GENETIC AND PHENOTYPIC STUDIES ON MILK PRODUCTION TRAITS OF FRIESIAN COWS IN EGYPT.

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ABSTRACT

Total of 2860 records from 1st to 6th lactations of Friesian cows were used in the present study. Number of sires and the average number of daughters per sire were 231 and 12.4, respectively. These data were used to estimate genetic and phenotypic parameters for total milk yield (TMY), 305 day milk yield (305 DMY) and lactation period (LP). The statistical model included the effect of sire as random effect, month of calving, year of calving and parity as fixed effects and both of cow weight at calving (CW) and age at first calving (AFC) as covariate on milk production traits.

The results obtained could be Summarized as follows :

1- The arithmetic means of TMY, 305 DMY and LP were 4851 kg, 4205kg and 405 day, respectively.

2- Month of calving had significant effect ($P< 0.05$) on TMY and 305 DMY and non significant effect on LP.

3- Year of calving had highly significant effect ($P< 0.01$) on TMY and 305 DMY, while non significant on LP.

4- Parity had highly significant effect ($P< 0.01$) on all traits under study.

5- Estimation of partial linear regression coefficients of TMY on CW was positive and highly significant ($P< 0.01$), and only significant ($P< 0.05$) for 305 DMY on CW, while, partial quadratic regression coefficients of TMY and 305 DMY on CW were positive and highly significant ($P< 0.01$), partial quadratic regression coefficients for traits under study of AFC were positive and highly significant ($P< 0.01$)

6- The sire had highly significant effect ($p< 0.01$) on TMY and LP, but only significant effect ($P< 0.05$) on 305 DMY .

7- Heritability estimates (± SE) for TMY, 305 DMY and LP were 0.11± 0.03, 0.04 ± 0.02 and 0.07± 0.02, respectively.

8- Each of genetic and phenotypic correlations between traits the present under study were positive and highly significant.

Keywords: Friesian cows, milk production traits and genetic and phenotypic parameters.

INTRODUCTION

As a matter of fact, a large gap in milk production in relation to the actual needs for human milk consumption could be found in Egypt. Therefor the reflection in large number of Friesian herds in - addition to the other breeding system for improving the local Egyptian cows represent the right way for increasing milk production. In spite of these herds were established as imported pure or local Friesian cattle, an actual needs for raising or maintaining the level of production of this herds represent the role of breeders. Additionally, for a successful breeding program an understanding of the degree of genetic and phenotypic association and other genetic parameters among traits is essential. However, the genetic improvement of dairy cows seldom involves only one economical traits.

In this respect, the objective of this study were to estimate:

1- means of milk production traits, the effect of sire, month of calving , year of calving and parity, cow weight at calving and age at first calving on total milk yield (TMY), 305 day milk yield (305DMY) and lactation period (LP).

2- heritability for milk production traits , genetic and phenotypic correlations between traits under study.

MATERIALS AND METHODS

The data used in this study were derived from 2860 records from 1st to 6th lactations collected during the period from 1968 to 1992. These animals were maintained at Sakha Research Station, Kafr El-sheikh Governorate, belonging to Animal Production Research Institute, Ministry of Agriculature. The farm located at the Northern Middle part of the Delta, Egypt.

The animals were kept in open shad yards under the feeding and management system of Animal production Research Institute. During winter and spring seasons (from December to May), the animals were fed on Berseem (Trifolium Alexandranum) supplemented with rice straw and concentrate mixture. During summer and autumn seasons (from June to November), animals fed on pellets of concentrates mixture, rice straw and clover hay. Concentrate mixture was given twice a day to the milking cows according to their average daily milk yield and to the dried cows (those in the last two months of pregnancy period) according to their body weights. The lactating cows were milked twice a day at 7.00 a.m. and 4.00 p.m. Cows were dried off about two months before the expected calving date.

Cows were artificially inseminated using frozen semen at least 45 days after calving. Heifers were put for insemination for the first time when they reached about 350 kg body weights or 18 months of age. Pregnancy was detected by rectal palpation 60 days after service cows and heifers failed to conceive were artificially inseminated again in the next heat.

Data for 1st to 6th lactations were analyzed using least squares and maximum likelihood program for Harvey (1990). The following mixed model was used to analyse total milk yield (TMY), 305 day milk yield (305 DMY) and lactation period (LP).

$$Yijklm = \mu + si + mj + yk + P_L + bL_1 (\overline{x_1} - x_1) + bQ_1(\overline{x_1} - x_1)^2 + bl_2 (\overline{x_2} - x_2) + bQ_2 (x_2 - x_2)^2 + eijklm.$$

Where:

Yijklm = the individual observation;

μ = the over all mean;

si = the random effect of the i th sire;

mj = the fixed effect of the j th month of calving j=1,2,3.... to 12 (Jan. to Decem.);

yk = the fixed effect of the k th year of calving k = 1,2,3... to 25 (from 1968 to 1992);

P_L = the fixed effect of the L th number of parity L = 1,2,3,.... to 6 parity;

bL_1&bQ_1 = partial linear and quadratic regression coefficients for the parity , traits studied on cow weight at calving;

bL_2 & bQ_2 = Partial linear and quadratic regression coefficients for the studied traits on age at first calving;
x_1= cow weight at calving (CW), $\overline{x}_1$ average CW;
x_2= age at first calving (AFC), $\overline{x}_2$ average AFC and;
eijklm = residual term assumed to be randomly as normally distributed with mean zero and variance δ^2.

Estimates heritability (h^2) were computed by the paternal half-sibs method according to the formula:

$$h^2 = 4\delta^2 s/(\delta^2 s+\delta^2 e)$$

where : $\delta^2 s$ = the sire component variance, $\delta^2 e$ = the error component of variance;

RESULTS AND DISCUSSION

Arithmetic means, standard deviation has and coefficient of variations of TMY, 305 DMY and LP are presented in Table 1. The present means of TMY, 305 DMY and LP were 4857 kg, 4205 kg and 405 days, respectively.

Table (1): Arithmetic means, standard divisions (SD) and coefficient of variations (CV%) of milk production traits.

Traits		Mean	S.D	C.V%
Total milk yield (kg)	TMY	4857	1675	34.5
305 day milk yield (kg)	305 DMY	4205	1391	33
Lactation period (day)	LP	405	91	22.5

The over all mean of total milk yield in this study (4857 kg) Table (1) was similar to that obtained by Hussein (2000) being 4765 kg and Abdel-Glil *et al.*. (2004) being 4467 kg. This value was higher than those reported by Oudah *et al.*. (2000) being 3681 kg Alemam (2002) being 3103 kg and Hussein and Salem (2005) being 4331 kg, but it is lower than those reported by Tag El Dein (1997) being 5465 kg, Khattab *et al.*. (2000) being 5076 kg, Abdel- Salam *et al.*. (2001) being 7128kg, El- Arian *et al.*. (2003) being 5021 kg and Gabr (2005) being 6845 kg.

The present mean of 305 day milk yield in this study (4205kg) Table (1) was in agreement with those obtained by Farrag *et al.*. (2000a) being 4566 kg and El- Arain and Shalaby (2001) being 4061kg. The lower value obtained in the present study for 305 day milk yield was reported by Oudah *et al.*. (2000) being 3181kg, Abdel- Glil *et al.*. (2004) being 3623 kg and Hussein and Salem (2005) being 3550 kg. The higher value was reported by Atil and Khattab (2000) being 4606 kg, El- Awady *et al.*. (2002) being 6096 kg and Gabr (2005) being 5743 kg.

Table (1) shows that the overall mean of lactation period was 405 day. It is close to that obtained by Abdel-Glil *et al.*. (2004) being 409 day and Hussein and Salem (2005) being 401 day. The lower value was reported by Farrag *et al.*. (2000a) being 309 day, Oudah *et al.*. (2000) being 338 day, Alemam (2002) being 319 day by using Friesian cows in Egypt.

Table 1 shows that the coefficient of variation for TMY was 34.5%. This value is close to that found by Abdel-Glil (1991) being 33.7%. However, the coefficient of variation for 305 DMY 33% is close to that of Oudah *et al.*. (2000) being 31.2% and Gabr (2005) being 35.4%.Also , the coefficient of variation for LP was 22.5% . It is close to that of Alemam (2002) being 24.7%, Abdel-Glil *et al.*. (2004) being 22% and Hussein and Salem (2005) being 21%.

The differences between the present values of milk production traits and those reported in the literature may be due to change in environmental temperature , number of records used, management and years of the studies. Least square means for milk production traits presented in Table 2.It was found significant effect ($p<0.05$) on total milk yield and 305 day milk yield, while, non significant effect on lactation period by month of calving. These results in agreement with Abdel-Gili *et al.*. (2004) for total milk yield, 305 day milk yield and lactation period.

Table 2. F- ratios factors affecting milk Production traits under study.

S.O.V	D.F	TMY	305DMY	LP
Sire	230	1.61**	1.22*	1.41**
Month of calving	11	1.97*	1.71*	1.44
Year of calving	24	1.60**	10.16**	1.11
Parity	5	12.59**	12.20**	1.15**
Regression:				
CW linear	1	4.91*	15.76**	0.18
CW quadratic	1	11.77**	19.40**	1.01
AFC linear	1	0.253	1.67	0.74
AFC quadratic	1	8.95**	18.78**	6.42**
Reminder	2585	3021930.24	1581791.11	7889.09

* at 0.05 ** at 0.01

Year of calving had highly significant effect ($P<0.01$) on total milk yield and 305 day milk yield, as shown in Table 2. These results were in similar agreement with the findings results on dairy cattle rasied in Egypt as reported by Salem and Kassab (1999) Hussein (2000), Oudah *et al.*. (2000) and Abdel- Glil *et al.*. (2004), while, it had non significant effect on lactation period, (Table 2). This results in close agreement with the findings of Oudah *et al.*. (2000) and Hussein and Salem (2005), on the other hand Abdel-Glil *et al.*. (2004) found significant effect ($P< 0.05$) on lactation period by year of calving.

Parity had highly significant effect ($P<0.01$) on milk production traits (Table 2). These results agreed that of Alemam (2002) for total milk yield and Gabr (2005) for total milk yield and 305 day milk yield . On other side, Hussein (2000) recorded non significant effect of parity on both of total milk yield, 305day milk yield and lactation period.

The differences between present results and those reported by different authors may be due to the differences in one or more of the factors; genotype, management, climate, conditions, number of animals and methods of the statistical analysis.

Estimates of partial linear and quadratic regression coefficient (Table 2) of total milk yield and 305 day milk yield on cow weight (CW) were positive and highly significant ($P<0.01$). Estimates of partial quadratic regression coefficient of total milk yield, 305 day milk yield and lactation period on age at first calving (AFC) were positive and highly significant ($P<0.01$) as shown in Table 2.

The effect of sire on each of total milk yield and lactation period were highly significant effect ($P<0.01$) and it was only significant effect ($P<0.05$) on 305 day milk yield (Table 2). These results were in agreement with Farrag *et al.*. (2000b) Aly (2001) Hussein and Salem (2005) and Gabr (2005) using Friesian cows in Egypt. The present results indicated to the possibility of genetic improvement in milk production traits through sire selection which is well established by may investigators (Oudah *et al.*., 2000 and Hussein and Salem, 2005).

Table 3: Heritability estimates (on diagonal), genetic correlation (above diagonal) and phenotypic correlation (below diagonal) between examined different milk production traits.

Traits	TMY	30SDMY	LP
TMY	0.11 ± 0.02	0.99 ± 0.10**	0.93 ± 0.10**
305 DMY	0.81**	0.04 ± 0.02	0.95 ± 0.15**
LP	0.52**	0.09**	0.07± 0.02

** at 0.01

Heritabilities, genetic and phenotypic correlations.

Heritability (h^2), genetic and phenotypic correlations of studied traits are presented in Table 3.The estimates of heritability (h^2) (±SE) for TMY, 305 DMY and LP were 0.11 ± 0.02, 0.04 ± 0.02 and 0.07 ± 0.02, respectively. The present results of 305 DMY was in close agreement with those obtained by Farrag *et al.*. (2000b) being (0.02 ±0.04), while, lower than that reported by Oudah *et al.*. (2000) being 0.42 ± 0.08, Abdel. Glil *et al.*. (2004) being 0.42 ± 0.11 and Hussein and Salem (2005) being 0.39 for TMY. In general, estimates of h^2 for TMY is higher than those for 305 DMY. These differences could be attributed to the greater influence of environmental factors on 305 DMY than those TMY. However, the present heritability estimate of LP (0.07 ± 0.02) was nearly similar to that of EL-Awady (1998) 0.08, Farrag *et al.*. (2000b) 0.05 and Abdel- Glil *et al.*. (2004) 0.09. Low heritability estimate for LP suggest that management can ply a greater role than selection for improving this trait .

Regarding the genetic correlations, (Table 3) it were found that TMY with 305 DMY and LP (0.99 and 0.93) were correlated positively and high significant . Additionally, the correlation was highly significant between 305 DMY and LP (0.95) . In the same trend, Farrag *et al.*. (2000b), Oudah *et al.*. (2000), Abdel-Glil *et al.* (2004)and Hussein and Salem (2005) found that genetic correlations between TMY with 305 DMY and LP were positive and highly significant. These results indicate that genes of parent producing animals with long LP are correlated with those genes favorable for milk production and therefore, selection against short LP is also expected to be

guided against low production (Ashmawy 1981) came to the same conclusion . Also, 305DMY are excellent guide to the total lactation yield and could be used as indicator to early selection process .

Estimates of phenotypic correlation between different traits studied are given in Table 3. The phenotypic correlations between TMY with both of 305 DMY and LP were (0.81 and 0.52), respectively. These estimates were in agreement with that found by Abubakar *et al.*. (1986) which showed high positive phenotypic correlation between milk yield and LP which lead to the positive dependency of milk yield on LP. Also, the phenotypic correlations between 305 DMY and LP (0.09) was positive and highly significant which were similar to that of Tagel-Dein (1997), Al-Awady (1998), Farrage *et al.* (2000b), Abdel-Glil *et al.*. (2004) and Hussein and Salem (2005). These results indicate that caws lactating for the longer time tended to have the higher TMY and 305 DMY .

It is important to noticed the large genetic differences among sires for milk production traits, which lead to the importance of high potential improving milk traits by the way of sire selection.

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دراسات وراثية ومظهرية لصفات انتاج اللبن على ابقار الفرزيان فى مصر .

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استخدم فى هذه الدراسة ٢٨٦٠ سجل حليب من الموسم الأول إلى السادس لأبقار الفرزيان التابعة لمحطة بحوث الانتاج الحيوانى – سخا – كفر الشيخ وكان عدد الطلائق المستخدمة فى التلقيح ومتوسط عدد البنات لكل طلوقة ٢٣١ ، ١٢,٤على التوالى.
واستخدمت هذه البيانات لدراسة العوامل المظهرية والوراثية لصفات إنتاج اللبن الكلى وإنتاج اللبن فى ٣٠٥ يوم وطول موسم الحليب.

وتضمن النوذج الإحصائى فى التحليل على تأثيركلا من الطلوقة ومواسم الحليب وموسم وسنة الولادة على صفات انتاج اللبن كما إشتمل على وزن الأم عند الولادة والعمر عند أول ولادة كإنحدار لصفات إنتاج اللبن المدروسة وكانت النتائج المتحصل عليها هى:

١- متوسط إنتاج اللبن الكلى ، إنتاج اللبن فى ٣٠٥ يوم وطول موسم الحليب بلغت ٤٨٥٧ كجم ، ٤٢٠٥ كجم ، ٤٠٥ يوم على التوالى.
٢- لشهر الولادة تأثير معنوى ($P< 0.05$) على كل من إنتاج اللبن الكلى وإنتاج اللبن فى ٣٠٥ يوم وغير معنوى على طول موسم الحليب.
٣- لسنة الولادة تأثير عالى المعنوية ($P< 0.01$) على كل من إنتاج اللبن الكلى وإنتاج اللبن خلال ٣٠٥ يوم بينما غير معنوى على طول موسم الحليب.
٤- ترتيب موسم الحليب ذات تأثير عالى المعنوية ($P< 0.01$) على جميع الصفات موضع الدراسة.
٥- تقدير معامل الإنحدار الخطى لكل من إنتاج اللبن الكلى وإنتاج اللبن فى ٣٠٥ يوم على وزن البقرة عند الولادة موجب ومعنوى ($P< 0.01$) وكان معامل الإنحدار التربيعى لإنتاج اللبن الكلى وإنتاج اللبن فى ٣٠٥ يوم موجبا وعالى المعنوية ($P< 0.01$) بينما معامل الإنحدار التربيعى لكل من إنتاج اللبن الكلى وإنتاج اللبن فى ٣٠٥ يوم وطول موسم الحليب على العمر عند أول ولادة كان موجبا وعالى المعنوية ($P< 0.01$).
٦- تأثير الطلوقة عالى المعنوية ($P< 0.01$) على كل من إنتاج اللبن الكلى وطول موسم الحليب ومعنوى ($P< 0.05$) على إنتاج اللبن فى ٣٠٥ يوم.
٧- تقديرات المكافىء الوراثى لكل من إنتاج اللبن الكلى وإنتاج اللبن فى ٣٠٥ يوم وطول موسم الحليب بلغت (١١, ± ٠٣, ، ٠٤, ± ٠٢, ، ٠٧, ± ٠٢,) على التوالى.
٨- جميع معاملات الارتباط (الوراثى والمظهرى) بين الصفات المدروسة موجبة وعالية المعنوية.