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GENETIC STUDY FOR A PART OF LACTATION PERIOD IN FRIESIAN COW

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ABSTRACT

This work was conducted to investigate a genetic relationship between part lactation period and total milk yield, in order to take advantage the information provided by a part record of lactation period (months) for evaluating of production efficiency which bulls can be evaluated for sire index. This study was included a monthly milk yield of 424 lactation records during 1978-2001 of pure breed Friesian in Mosul city (Iraq). The records were adjusted for fixed effects of calving season and monthly milk production records. The maximum average milk production was in the second month (395.6kg). The highest heritability (h^2) estimated was (0.41) in the production of the third month, therefore, the production of the third month may be utilized for selecting animals for rapid improvement. While, the highest heritability estimated for cumulative monthly production was (0.32) for the first four month of lactation. Coefficients of genetic and phenotypic correlation between monthly milk production and total lactation production showed increasing trend with increase a cumulative months in milk production. The results of heritabilities and genetic correlation reveal that the part of milk production record was based on the third month of milk production was efficient as the total lactation production.

***Keyword**: milk yield, monthly and cumulative milk production, heritability, genetic and phenotypic correlations.*

INTRODUCTION

The milk production of dairy animals is one of the major factors besides age at first calving and breeding efficiency, which effect the economics of dairy enterprise (Groen *et al.,* 1996; Pedersen 1997 and Purwantara *et al.,* 2001).

Holstein- Friesian considered the most prevalent dairy breeds over the world due to their characteristic and production ability as well as their adaptation to the different climate. Breeders are interested in this breed and they try to increase their production by genetic improvement and best management (Schmidt *et al.,* 1988; Maule, 1990; Caraviello 2004 and Dabdoub 2005).

The genetic makeup of the cows as well as the nongenetic factors have great effects on dairy merits (Jones *et al.,* 1994). Therefore the information on the inheritance of a part of lactation period and their relationship with total lactation production are rather scanty (Bastos, 1989; Fuerst and Solkner, 1994; Smith and Becker, 1999; White *et al.,* 1999; Purwantara *et al.,* 2001 and Van Arendonk and Liinamo, 2003).

The aim of this work was conducted to investigate the genetic relationship between a part of lactation period and total milk yield and suggest the part record of milk production on which bulls can be evaluated for sire index. Therefore, estimate the heritabilities of monthly, cumulative monthly and total lactation production, as well as to study genetic and phenotypic relationship of cumulative monthly milk yield with total milk production.

MATERIALS and METHODS

The monthly milk yield of 424 normal lactations records completed during 1978-2001 by pure breed Friesian cows, from Al-Rashidia farm in Mosul city (Iraq) were included in this study. The records were adjusted for significant effect of calving season and lactation months as described by Cunningham (1980) and Becker (1985). The inheritance was studied in terms of heritability based on monthly and cumulative monthly milk production records.

The following equation describes the data for genetic and environmental study of milk production:

$$Y_{ij}klm = \mu + Li + C_j + S_k + D_{kl} + \zeta_{ij}klm$$

Where, $Y_{ij}klm$: is total lactation production, cumulative monthly milk production, or monthly milk production of the m^{th} record of the i^{th} cow and k^{th} sire in j^{th} season of calving and i^{th} lactation.

μ: overall mean
Li: fixed effect of r^{th} lactation.

C_j: fixed effect of j[th] calving season.
S_k: random effect associated with k[th] sire.
D_{kl}: random effect associated with l[th] dam within k[th] sire.
$\zeta_{ij}klm$: random effect.

Four classes of lactation were parity 1, 2, 3 and 4, parity 4 included 4[th] and later lactation. Calving season was divided into four classes as follows: 1[st] class for winter season (December, January, February), 2[nd] class for spring season (March, April, May), 3[rd] class for summer season (June, July, August), and 4[th] class for fall season (September, October, November).

Random effects were assumed to have zero mean and variance σ_s^2, σ_D^2 and σ_e^2, are sire, cow and error components of variance. From estimating these variance components, heritability estimates were obtained for sire variance component which represent half-sib covariance and the formula is:

$$\hat{h}^2_s = \frac{4\sigma s^2}{4\sigma s^2 + 4\sigma D^2 + 4\sigma e^2}$$

Where σ_s^2, σ_D^2 and σ_e^2 are estimated for the sire, cow and error component of variance (Cunningham 1980, and Becker, 1985). The variance for heritabilities and hence SE (h^2), as well as the genetic and phonotypic correlation and their standard error were estimated as described by Cunningham (1980) and Becker (1985), these estimates were based on the record having complete lactation length of at least 180 days.

Averages cumulative monthly yields were estimated from records having complete lactation length of 270 days. Whereas, genetic and phenotypic correlation of total lactation production with cumulative monthly milk production were estimated for records having complete lactation length more than ten months.

RESULTS and DISCUSSION

The averages monthly and cumulative monthly yield with their standard errors and coefficients of variation along with their estimates of heritability (h^2) and standard errors (SE) are presented in Table (1).

Table 1: Average monthly milk production along with their estimates of heritability (h^2) and standard errors (SE).

Month of lactation	Number of observations	$\bar{X}$ kg average	SE	CV%	h^2	SE
First	424	382.5	2.36	12.7	0.24	0.12
Second	424	395.6	2.43	12.6	0.27	0.13
Third	424	349.0	2.38	14.0	0.41	0.16
Fourth	424	324.9	2.24	14.2	0.39	0.14
Fifth	424	305.6	2.39	16.1	0.30	0.12
Sixth	424	296.2	2.33	16.1	0.22	0.11
Seventh	396	278.3	2.29	16.4	0.16	0.14
Eighth	338	259.5	2.32	16.6	0.17	0.15
Ninth	289	254.7	2.50	16.7	0.19	0.11
Tenth	247	245.1	2.60	16.8	0.08	0.20
Eleventh	216	200.9	2.29	17.0	0.07	0.16
overall total lactation production	424	3318.9	34.9	21.6	0.26	0.17

The average monthly milk production increased only up to the second month (395.6 kg ± 2.43), where in peak was attained. In subsequent months it decline gradually as the lactation advanced which is clear after the third month. Maximum variability (coefficients of variation, C.V.) was observed in the last month, and minimum in the first two months of lactation period.

The estimates of heritability along with their standard errors for monthly milk production are shown in Table (1). These estimates were in the range of other estimates (Pedersen, 1997; White *et al.,* 1999; and Purwantara *et al.,* 2001). They reported that the highest heritability was estimated for the fifth month's production. While, in the present study it was the highest for the third month of lactation period (Table 1). This difference could be due to the variation in lactation length and other traits among herd. The estimates of heritabilities for production of the last two months were not significant different from zero. Similar results were reported by (White *et al.,* 1999; Van Arendonk and Liinamo, 2003).

In general, the heritability estimates of milk production be increased from the first to the third month of lactation period and decline then after. Similar trend was reported (White *et al.,* 1999; Purwantara, 2001; Van Arendonk and Liinamo, 2003). Thus, the production of the third month may be utilized for selecting animals for rapid improvement of milk production and for evaluation of breeding value.

The heritability estimates of various cumulative monthly production records (Table 2) showed the highest estimate (0.32±0.19) for the production in the first four months of lactation period. In which the cumulative monthly milk production was (14503 ± 9.34).

Table 2: Cumulative monthly milk production along with their estimate of heritability (h^2) and standard errors (SE).

(Month) cumulative yield	No. of observations in each month	$\bar{X}$ average kg	SE	CV%	h^2	SE
First two	289	776.5	5.82	12.7	0.26	0.18
First three	289	1120.6	7.38	11.3	0.31	0.18
First four	289	1450.3	9.34	11.0	0.32	0.19
First five	289	1756.9	10.83	10.5	0.30	0.17
First sex	289	2058.1	12.58	10.4	0.27	0.18
First seven	289	2350.4	14.23	10.3	0.25	0.16
First eight	289	2620.3	15.79	10.3	0.26	0.17
First nine	289	2875.0	17.26	10.2	0.24	0.16
First ten	247	3120.1	19.80	10.0	0.25	0.17
up to last day	216	3321.0	21.48	9.6	0.23	0.18

2003). The coefficients of phenotypic correlation of the cumulative a part of production of varying durations, with the complete lactation production, showed increasing trend with addition of each month of milk production (Table 3).

Considerably high coefficients of genetic correlation were between the cumulative monthly milk production and total milk production (Table 3). Similar results were reported by (White *et al.,* 1999; Purwantara, 2001; Van Arendonk and Liinamo,

Table 3: Genetic and phenotypic correlation of total lactation production with cumulative monthly milk production.

Duration of lactation production	Genetic correlation	SE of Gen. Corr.	Phenotypic Correlation	SE of Phen. Corr.
First month	0.80	0.11	0.69	0.08
First 2 months	0.88	0.09	0.74	0.08
First 3 months	0.90	0.08	0.78	0.07
First 4 months	0.91	0.07	0.81	0.06
First 5 months	0.93	0.07	0.89	0.06
First 6 months	0.97	0.03	0.92	0.05
First 7 months	0.98	0.01	0.94	0.03
First 8 months	0.99	0.01	0.97	0.01
First 9 months	1.00	-	0.99	0.01
First 10 months	1.00	-	0.99	0.01

All the coefficients were high, and compared fairly with other reports (Pedersen, 1997; White *et al.,* 1999; Purwuntara *et al.,* 2001; Van Arendonk and Liinami 2003; Caraviello, 2004).

Considering the estimates of heritability and correlations together, it can be concluded that for the purpose of sire index, estimating the breeding value of cows and bulls, and selection for maximum genetic gains in milk yield, a part of milk production record was based on the third month's production was efficient as the total lactation production.

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دراسة وراثية لجزء من فترة الحليب في أبقار الفريزيان

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صمم البحث لدراسة العلاقة الوراثية بين الإنتاج لجزء من فترة الحليب وإنتاج الحليب الكلي، لأجل الاستفادة من المعلومات التي توفرها جزء من فترة الإنتاج في تقييم الكفاءة الإنتاجية. حيث يمكن تقيم الطلائق كدليل الطلوقة. اشتملت هذه الدراسة الإنتاج الشهري والكلي لسجلات (٤٢٤) فترة إنتاج الحليب والتي هي واقعة خلال الأعوام (١٩٧٨- ٢٠٠١) لسجلات الفريزيان النقي في مدينة الموصل. عدلت السجلات لتأثير موسم الولادة ودورة موسم الحليب وسجلات إنتاج الحليب الشهرية. أعلى معدل لإنتاج الحليب كان في الشهر الثاني (٣٩٥,٦) كغم، وأعلى مكافئ وراثي (٠,٤١) كان في الشهر الثالث من فترة الحليب. لذا يمكن استخدام إنتاج الشهر الثالث لانتخاب الحيوانات من اجل التحسين السريع. أعلى مكافئ وراثي للإنتاج التراكمي الشهري كان (٠,٣٢) لأول أربعة أشهر من فترة الحليب. معامل الارتباط المظهري والارتباط الوراثي بين إنتاج الحليب الشهري وإنتاج الحليب الكلي اظهر زيادة معامل الارتباط مع زيادة الإنتاج التراكمي من إنتاج الحليب. أظهرت نتائج المكافئ الوراثي ومعامل الارتباط أن إنتاج الحليب الجزئي لإنتاج الشهر الثالث له نفس كفاءة الإنتاج الكلي لفترة إنتاج الحليب.

الكلمات الدالة: إنتاج الحليب الكلي والشهري التراكمي، المكافئ الوراثي، الارتباط الوراثي والمظهري.