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A GENETIC STUDY ON THE LACTATION CURVE IN FRIESIAN CATTLE

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SUMMARY

Weekly milk production of 3735 records from 1545 Friesian cows belonging to Sakha and Alkarada farms, Ministry of Agriculture, were utilized to estimate the shape of lactation curve using the gamma function of Wood (1967), ($Y_n = a\, n^b\, e^{-cn}$), where Y_n is the average daily yield in the *nth* week, a, b, c are estimated parameters of the curve and e is the base of the natural logarithm. Extensions factors for extending incomplete records to 305-day milk yield were developed. The parameters of the function (a,b,c) and three generated traits (week of peak (b/c), peak yield ($a(b/c)^b\ e^{-b}$), and persistency ($(c)^{-b+1}$)) were estimated for each record.

The least squares means± standard errors of a, b, c, week of peak, peak yield, persistency, total milk yield, 305-day milk yield and lactation length were 72.03 ± 3.80, 0.1964 ± 0.03, 0.0337 ± 0.01, 7.03 ± 0.36 wk, 79.3 ± 4.41Kg, 99.7±5.46, 3537±181 Kg, 2673±144Kg and 427±12 day, respectively.

The estimates of the gamma function parameters were found to be affected ($P<0.05$) by cow, parity, season of calving, year of calving and the linear effect of age at calving. Sire affected the parameter "a", week of peak, peak yield, total milk yield and 305-day milk yield. Farm did not affect any of the parameters or the related traits. All traits studied except the 305-day milk yield were affected by parity.

Heritability estimates for "a" week of peak, peak yield, persistency, total milk yield, 305-day milk yield were .125, .036, .154, .025, .104 and .125, respectively. The heritability of "b", "c" and lactation length were considered 0, because of negative estimates of their respective sire variance components.

Estimates of repeatability were 0.140, 0.113, 0.227, 0.009, 0.217, 0.006, 0.341, 0.339 and 0.269 for "a", "b", "c", week of peak, peak yield, persistency, total milk yield, 305-day milk yield and lactation length, respectively.

Positive genetic correlation was found between peak week and peak yield of 0.496 but the phenotypic correlation between them was negative and non-

significant (-0.04). The resulting heritabilities and correlations indicated that selection for high peak yield could be more effective for higher 305-day milk yield than direct selection.

Keywords: Dairy cattle, lactation curve, Gamma function

INTRODUCTION

Lactation curve is the graphical representation of the relationship between milk yield and time since calving. A functional form is needed to describe the lactation curve in order to predict the milk yield at any given stage of lactation. Such predictions, if accurate, can be used as a basis for decisions to cull or to retain a cow at an earlier stage. Many different models have been developed to describe the lactation curve from linear, exponential, parabolic, inverse polynomial and gamma type functions. Wood (1967) used the natural logarithmic transformation for the non-linear gamma type function, $\ln(y_n) = \ln(a) + b \ln(n) - cn$.

Fitting the gamma function with least squares method for logarithmic transformation accounted for at least 73% of the variation in the logarithm of milk yield data (Wood, 1969; Cobby and Le Du, 1978; Madalena *et al.*, 1979; Shanks *et al.*, 1981; Goodall, 1986). However, the gamma-type function was applied also by Guo *et al.* (1990), Rook *et al.* (1993), Velarde *et al.* (1995) and Singh *et al.* (1996).

The objectives of this study were: (1) to describe the lactation curve in a Friesian herd cattle raised in Egypt using gamma function, (2) estimate the curve parameters, and (3)) to study the traits constructed from the estimates of parameters of the lactation curve (persistency, week of peak and peak yield). Genetic and non-genetic factors affecting the shape of the lactation curve and these derived traits were evaluated. The study also estimated heritabilities and repeatabilities of the lactation curve parameters and constructed traits. Genetic and phenotypic correlations were also estimated between them. Extending by factors for incomplete lactations was estimated from the gamma function to predict the 308-day (44 wk) milk yield.

MATERIALS AND METHODS

Data

Data used in this study were collected from Sakha and Alkarada Experimental stations belonging to Animal Production Research Institute, Ministry of Agriculture. Both Stations are in Kafrelsheikh Governorate. Data were collected over the period from 1970 to 1988 and included 4762 records of 1545 Friesian cows (daughters of 179 sires).

Animals were mainly pen-fed and water was available all the time. The cows were machine-milked and their production was measured twice daily at 0700 h and 1700 h. Cows with the high levels of production were dried off 60 days before calving by incomplete milking quarter by quarter. Low producer cows were dried off about 90 days before calving or if the cow gave less than 3 kg milk daily. Heat detection was carried out twice daily at 0850 h and 1450 h. Visual observations for mounting activity, vulval mucus discharge and other signs of estrus were used as indicators of the onset of heat. According to the farm routine, it was not allowed to inseminate a cow earlier than 40 day after calving.

Fitting the Lactation Curve and Estimating the Parameters.

Fitting the gamma function to the lactation data using the non-linear technique improves the fit of the curve by reducing its residual mean squares if compared with the linear technique (Cobby and Le Du, 1978).

A sample of 100 records was randomly drawned to compare the non-linear form of gamma function ($Y_n = a n^b e^{-cn}$) with the linear logarithimc transformed function ($\ln Y_n = \ln(a) + b \ln(n) - cn$). The unknown constants ln (a), (b) and (c) were estimated by the least squares for each record, similar to a regression equation. The results revealed that $R^2 \pm$ standard errors were very close for the linear and non-linear forms of the gamma function; being 0.82 ± 0.43 and 0.82 ± 0.44, respectively. The linear form is easier to be programmed and faster solved. Therefore, the linear form of the gamma function was adopted to fit each lactation record for every individual cow. Estimates for the parameters a, b, c and the generated traits, i.e. peak yield ($a (b/c)^b e^{-b}$), week of peak (b/c), persistency ($c^{-(b+1)}$) and R^2 of the model were obtained by IMSL STAT / LIBERARY (1984), and they utilized for further statistical analysis. Only typical lactations (3735) records; 79% of all lactations) with positive parameters a, b and c were involved in the statistical analysis. Atypical lactations (21%) were excluded.

Mixed Model Analysis.

A mixed model was used to test the effect of the fixed environmental factors: farm, season of calving , year of calving, age at calving as covariable with linear and quadratic terms, parity and all possible interactions and to estimate the variance components of the random effects of sire and cows within sire on the parameters of the function and the generated milk traits studied. The following linear model, utilizing LSMLMW and MIXMDL Program (Harvey, 1990), was used:

$$Y_{ijklmno} = \mu + S_i + C_{ij} + F_k + V_l + R_m + P_n + FV_{kl} + FP_{kn} + VP_{ln} + b_1 X_{ijklmno} + b_2 X^2_{ijklmno} + e_{ijklmno};$$ where

$Y_{ijklmno}$ the estimated parameter of the lactation curve or the generated traits studied,

μ the overall mean,

S_i the random effect of sire, assumed to be normally and independently distributed

with 0 mean and variance σ^2_S, i= 1,...., 179;

C_{ij} the random effect of cow within sire assumed to be normally and independently

distributed with 0 mean and variance σ^2_c;

F_k the fixed effect due to farm, k= 1, 2;

V_1 the fixed effect due to season of calving, 1= 1,..., 4;

R_m the fixed effect due to year of calving, m= 1,..., 19;

P_n the fixed effect due to parity, n= 1,..,9;

FV_{kl} the interaction between farm and season of calving;

FP_{kn} the interaction between farm and parity;

VP_{ln} the interaction between season of calving and parity;

b_1 a partial linear regression coefficient of the trait or the parameter on the age of cow at parturition;

$X_{ijklmno}$ the deviation of age of cow at each record from the average of cows;

b_2 the partial quadratic regression coefficient of the trait or the parameter on the age of cow at parturition;

$X^2_{ijklmno}$ the square of the deviation of age of cow from its mean; and

$e_{ijklmno}$ the random error associated with each observation assumed to be normally and independently distributed with 0 mean and variance σ^2_e.

Estimating Genetic Parameters.

The variance components obtained from the analysis were: sire component (σ^2_s), cows within sire ($\sigma^2_{c:s}$) and the error component (σ^2_e). These components were used to estimate the heritabilities, repeatabilities and genetic and phenotypic correlations according to Harvey (1990).

Calculating Extension Factors for Part Lactations

Factors (f_j) were generated from the gamma-type function to extend a part of lactation of length n week, where j = 1,....,43.

$f_j = \sum_{i=1}^{44} Y_i / \sum^{n} Y_j$,where $\sum_{i=1}^{44} Y_i$ is the total milk yield in 44 weeks,

$\sum_{j=1}^{n} Y_j$ is the cumulative weekly milk yield up to the n^{th} week and

Y_i is $a\,n^b\,e^{-cn}$, where a,b,c and n are as previously defined.

RESULTS AND DISCUSSION

Fitting the Lactation Curve

The application of the gamma function transformed to the linear form using the natural logarithm yielded 79% typical lactation curves with positive "a" , "b" and "c" and 21% atypical lactation curves with negative "b" and (or) "c". These atypical lactation curves would have a peak yield prior to parturition if "b" was negative and "c" positive or a concave shape if both "b" and "c" were negative. This percentage of atypical lactations is lower than that 34% reported by Shimizu and Umrod (1976) when they applied the gamma function using the logarithmic transformation.

Accuracy

The correlation between the predicted value from the function and the actual weekly yield was estimated for each lactation. On average, the gamma function accounted for 74% of the weekly variation in milk yield. However, Wood (1969) reported an average of 82.3% with a range from 73.8% to 91.2%. R^2 obtained in the present study ranged from 21% to 95% in different classes. Madalena *et al.* (1979) reported similar estimate of R^2 (.74). However, the present estimate is lower than that provided by Wood (1976), Shanks *et al.* (1981) and Goodall (1986). The estimated lactation curve from typical lactations and the means of actual weekly milk yield are presented in Figure 1.

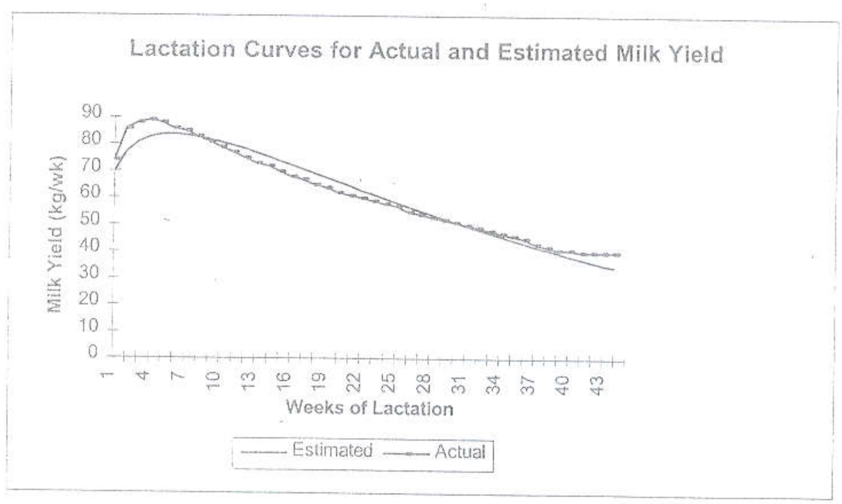

Figure 1. Lactation curves for actual and estimated milk yield

Shape of the Lactation Curve and Generated Traits.

Least squares means for the gamma function parameters obtained from the analysis (Table 1) are 72.03, .1964 and .0337 for "a", "b" and "c", respectively.

The estimate of the parameter "a" (72.03) is higher than that reported by Wood (1967, 1969 and 1970) for Friesian cattle, Cobby and Le Du (1978), Congleton and Everett (1980) for Holstein Friesian, Shanks *et al.* (1981) for Holstein, Rowlands *et al.* (1982) for Friesian and Mainland (1985) for Ayrshire. This result reflects the relatively high initial production for the Friesian cattle included in this study.

The estimate of the parameter "b" (.1964) is higher than the estimates obtained by Wood (1967) and Mainland (1985) but lower than those of Wood (1970), Cobby and Le Du (1978), Shanks *et al.* (1981), Rowlands *et al.* (1982) and Goodall (1983). A relatively low estimate of "b" in the present study indicates that the rate of ascending to the peak yield is not fast.

The estimate of the rate of declining after peak "c" (.0337) is lower than that of Wood (1976).

The least squares mean of week of peak yield is 6.71 (at about 47 days). This estimate is lower than that estimated by Rowlands *et al.* (1982), Ferris *et al.* (1985) and Jasiorowski *et al.* (1988), while it is higher than that of Wood (1968 and 1976).

Least squares mean of peak yield is 79.34 kg/wk. This estimate can be considered low if compared with other reported estimates (Shanks *et al.*, 1981; Moon *et al.* ,1982; Ferris *et al.*, 1985; Jasiorowski *et al.*, 1988).

Persistency factor was estimated to be as 99.73. It is higher than those of Wood (1968 and 1970), Shanks *et al.* (1981) except the first parity factor and Rowlands *et al.* (1982). In general, the estimated lactation curve is characterized by a moderate initial milk production rising to a moderate peak yield at a slow rate of ascending to peak, peaking after moderate length of time and higher persistent than the average of reported estimates.

Estimating Total Milk Yield, 305-day Milk Yield and Lactation Length

Least squares means for total milk yield in the present study was found to be 3537 kg, an estimate being higher than that reported by Khattab and Ashmawy (1988) for Friesian cows. While 305-day milk yield was estimated as 2673 kg, an estimate being lower than those of Ashmawy (1975), El-Tawil *et al.* (1977), Khattab and Ashmawy (1988) and El-Sedafy (1989) on Friesian cattle in Egypt.

Lactation length estimate was 427 d, which is higher than those reported by Fahmy *et al.* (1963), Quawasmi (1971), Galal *et al.* (1974), Ashmawy (1975) and El-Sedafy (1989) for Friesian Cattle in Egypt.

Table 1. Least squares means ± standard errors (SE) of fixed effects affecting the lactation curve parameters and generated traits.

Item	No.	a		b		c		Week of Peak		Peak Yield (kg/wk)		Persistency Kg/week	
		Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
μ	3735	72.03	3.80	.1964	.0291	.0337	.0051	6.7	.39	79.3	4.41	99.7	5.46
Farm		(P>.73)		(P>.61)		(P>.71)		(P>.45)		(P>.81)		(P>.49)	
Sakha	1654	74.03	7.03	.1623	.0750	.0300	.0114	7.4	.99	78.0	7.45	108.8	14.58
Elkarada	2081	70.01	6.91	.2306	.0736	.0375	.0112	6.0	.98	80.7	7.33	90.6	14.29
Parity		(P<.01)		(P<.0001)		(P<.0001)		(P<.00)		(P<.01)		(P<.0001)	
1	1129	53.64	7.48	.5961	.0808	.0771	.0122	8.9	1.07	107.6	7.88	77.7	15.71
2	887	63.14	5.60	.4845	.0563	.0709	.0087	7.6	.75	100.7	6.07	75.1	10.89
3	646	66.75	4.32	.3959	.0378	.0609	.0062	7.0	.50	93.5	4.88	79.6	7.21
4	422	69.97	3.84	.2901	.0298	.0484	.052	6.7	.40	84.4	4.45	91.6	5.60
5	278	73.95	4.08	.1628	.0338	.0329	.0057	6.0	.45	75.3	4.66	96.0	6.42
6	179	75.58	4.76	.0814	.0444	.0244	.0071	6.0	.59	66.8	5.29	102.9	8.54
7	91	79.35	5.96	-.009	.0610	.0099	.0094	6.8	.81	64.7	6.41	133.2	1.83
8	62	78.42	7.57	-.118	.0820	-.014	.0124	6.3	1.09	56.0	7.98	126.2	15.95
9	41	87.36	9.84	-.116	.1101	-.007	.0165	5.2	1.46	65.1	10.76	115.3	1.46
Season of Calving		(P<.00)		(P<.001)		(P>.13)		(P<.00)		(P<.00)		(P<.001)	
Winter	1160	71.35	3.98	.2423	.0322	.0376	.0055	6.8	.43	83.9	4.58	96.1	6.10
Spring	941	79.79	4.02	.1803	.0329	.0360	.0056	6.2	.44	85.6	4.61	94.0	6.23
Summer	658	71.44	4.11	.1467	.0344	.0307	.0558	6.2	.46	72.5	4.69	96.3	5.54
Fall	976	65.53	4.02	.2163	.0328	.0305	.0056	7.7	.44	75.5	4.61	112.5	6.22
Regression on age of cow/day multiplied by 10^{-5}													
Linear (mean age day)		-1649	694.50	34.5	8.13	3.3	1.2	319	108	2294	705	1446	1588
Quadratic		-.4	.14	-00.0	0.00	0.0	0.0	-00.0	000	-1.0	.10	-.2	.3

Random Factors Affecting the shape of the Lactation Curve and Generated Traits.

1. Sire

Analysis of variance reveals that the random effect of sire affected (P<.01) the parameter "a", peak yield (P<.01) and week of peak yield, (P<.05) but not "b", "c" or persistency (P>.06). Wood (1970) showed an effect (P<.05) of sire on the three parameters of the gamma function. Persistency was not significantly affected by sire. Madsen (1975) reported an effect of sire (P<.01) on persistency. Although many workers have included effect of sire in their analyses (Schneeberger, 1981; Shanks *et al.*, 1981; Ferris *et al.*, 1985), they did not report its effect on the curve parameters or generated traits. They used its effect to compute the variance and covariance components for estimating genetic parameters of the lactation curve.

2. Cow

The effect of cow within sire was significant (P<.01) on the parameters of the lactation curve. Similar effect of cow within sire on the three parameters of the gamma function was reported by Wood (1970) on Friesian cattle, (P<.05) for the "a" parameter, (P<.01) for "b" and "c". Kellogg *et al.* (1977) found that cows of Holstein-Friesian stock affected the two parameters "a" and "c" (P<.01) of the gamma function.

Among lactation curve traits, peak yield is the only one that was affected (P<.00) by the cow. Madsen (1975) reported similar effect of cow on peak yield (P<.01)

In the present study, persistency and week of peak were not affected (P>.80) by cow. Madsen (1975) also reported no significant effect of cow on 1970).

Differences among the cows in this study may refer to the genetic as well as permanent environmental differences among them.

Heritability

Heritability estimates for the lactation curve parameters and generated traits are presented in Table 2. Heritability for the parameter "a" is .125, higher than reported by Shanks *et al.* (1981), Ferris (1982) . Heritability of "b" and "c" were considered 0.0 because of the negative sire component.

Heritability estimates of persistency, week of peak and peak yield were .025, .036 and .154, respectively. These estimates are lower than those of Madsen (1975), Shanks *et al.* (1981), Ferris *et al.* (1985) and Batra *et al.* (1987).

Results of this study revealed low sire variance components for "a", persistency, week of peak and peak yield and negative for "b" and "c". The negative sire components resulted in 0.0 estimate of heritabilities. The lower estimates of heritabilities than the literature could be attributed to the differences in the methods of the estimation of the variance components or to the amount of genetic variation in the population.

Table 2. Estimates of genetic correlations ± S.E.(above diagonal), phenotypic correlations (below the diagonal), heritabilities ± S.E. (on the diagonal) and repeatabilities ± S.E. of curve parameters and traits for typical lactations.

Variable	a	b	c	Peak week	Peak yield	Persistency	TMY	M305
a	.125 ±.043	ne	ne	.117 ±..364	.784 ±..096	.509 ±..495	.982 ±..109	.863 ±..106
b	-.543	.00	ne	ne	ne	ne	ne	ne
c	-.256	.820	.00	ne	ne	ne	ne	ne
Peak week	-.507	.350	-.031	.036 ±..032	.496 ±..325	1.071 ±..182	.196 ±..328	.355 ±..304
Peak yield	.548	.268	.234	-.038	.154 ±..046	.407 ±..418	.853 ±..111	.888 ±..077
Persistency	-.262	-.047	-.320	.790	-.166	.025 ±.031	.593 ±..378	.659 ±..388
TMY	.456	-.295	-.472	.112	.449	.236	.104 ±..040	.982 ±..021
M305	.468	-.209	-.425	.139	.594	.188	.909	.125 ±..043
Repeatability	.140 ±..019	.113 ±..018	.227 ±..020	.009 ±..015	.217 ±..020	.006 ±..015	.341 ±.021	.339 ±..021

ne: non-estimable because of negative estimate of variance component.
If r > |0.06| then (P<0.05); if r >|0.08| then (P<0.01).

Heritability estimates of 305-day milk yield was .125. The lower heritability estimates obtained in the present study could be due to the differences between models and methods of estimation of variance components and also between degree of environmental and genetic variation affecting different measurements. Total milk yield had also low estimate (.104).

Repeatability (t).

Repeatability estimates for the lactation curve parameters and the generated traits are shown in Table 2. Repeatability estimate for "a" was .14. This is higher than those reported by Wood (1970) and Rao and Sundaresan (1982).

The repeatability estimate for the parameter "b" was .113. This estimate is lower than that reported by Wood (1970) but higher than that of Rao and Sundaresan (1982). The estimate of the repeatability of the parameter "c" is .227 which is similar to that reported by Wood (1970) but higher than that of Rao and Sundaresan (1982).

In general, estimates of repeatability of the curve parameters are within the range of estimates in the available literature.

Repeatability estimates for the lactation curve traits are .006, .009 and .217 for persistency, week of peak and peak yield respectively. These estimates are lower than those of Wood (1970) and Rao and Sundaresan (1982) for persistency and than that of Madsen (1975) for peak yield.

Estimates of repeatability for total milk yield and 305-day milk yield were .341 and .339, respectively. These estimates are lower than those reported by Madsen (1975) for 305-day milk yield and Rao and Sundaresan (1982) for total milk yield.

Genetic Correlations

Estimates of genetic correlations (r_G) are listed in Table 2. The genetic correlations between the curve parameters were not estimable because of the obtained negative estimates of variance components.

High positive genetic correlation ($P<.01$) was found between "a" and 305-day milk yield (.863). Schneeberger (1981) also reported positive genetic correlation but smaller in magnitude. In contrast, Ferris (1982) and Ferris *et al.* (1985) reported negative genetic correlation between "a" and 305-day milk yield. A positive genetic correlation ($P<.01$) between "a" and peak yield was also found (.784). Similar result was reported by Shanks *et al.* (1981) for the four parities studied. Also high positive genetic correlation ($P<.01$) were found between peak yield and 305-day milk yield (.888) and between 305-day milk yield and persistency (.659). Madsen (1975), Ferris (1982), Ferris *et al.* (1985) reported similar results.

Peak yield was positively genetically correlated ($P<.01$) with week of peak (.496) and persistency (.407). Shanks *et al.* (1981) found positive correlation between peak yield and week of peak in the first and third lactations but negative in the fourth or later lactations. The result of Madsen (1975) confirms the positive genetic correlation between persistency and peak yield but these results were in contrast with Shanks *et al.* (1981) who reported negative estimates of correlations.

The genetic correlation between persistency and week of peak exceeded 1.0 with small standard error (.182). Persistency was positively correlated (P<.01) with "a". These results are in agreement with Shanks *et al.* (1981) for the correlation between persistency and week of peak but are in disagreement for the correlation between "a" and persistency.

Genetic correlations between generated traits and each of "b" and "c" were not estimable because of negative (co)variance components were obtained.

Selection indices could be useful in changing the shape of the lactation curve. The resulting correlations indicate that initial milk yield "a" is positively correlated with 305-day milk yield and peak yield. Also, peak yield is positively correlated with each of 305-day milk yield and persistency.

Selecting for high initial yield "a" is genetically associated with high peak yield (genetic correlation is .78) and late week of peak because peak yield is positively correlated with week of peak. Selection for high peak yield would be effective for higher 305-day milk yield (h^2 for peak yield = .154 and r_G with 305-day milk yield =.888) than direct selection.

Phenotypic Correlations.

Phenotypic correlations (r_P) are presented in table 2. The parameter "a" was negatively phenotypically correlated (P<.01) with "b" (-.543) and "c" (-.256). Positive phenotypic correlation (P<.01) was also found between "b" and "c" (.82). Schneeberger (1981) reported similar results except for the correlation between "a" and "c" which was positive. These results indicate that high "a" (initial yield) is associated with low rate of ascending to peak yield and low rate of descending after peak yield. Positive phenotypic correlations (P<.01) were found between "a" and 305-day milk yield (.468) and peak yield (.548).

The parameter "b" was negatively phenotypically correlated with persistency and 305-day milk yield (P<.01). The parameter "c" had also a negative phenotypic correlation (P<.01) with persistency. This result reflects the fact that low rate of declining after peak is associated with higher persistent cows. These results are in agreement with Schneeberger (1981) and Shanks *et al.* (1981).

The 305-day milk yield was positively phenotypically correlated (P<.01) with persistency (0.188), week of peak (0.) and peak yield (0.594). The highest phenotypic correlation coefficient was found between 305-day milk yield and peak yield (.594). Ferris (1982) reported similar result. This means that peak yield is an indicator for 305-day milk yield. Week of peak yield had a positive phenotypic correlation (P<.01) with persistency and a negative correlation with peak yield. These results are similar to those of Shanks *et al.* (1981).

Decreasing rate of ascending to peak "b" may be associated with a decreasing rate in peak yield. The latter is associated with late week of peak (negatively correlated) and late week of peak associated with high persistency.

Extending Factors for Part Lactations.

Extension factors for extending part lactations were estimated. Resulting factors can be multiplied by the cumulative production of a cow that dried off obligatory at any given week of lactation to predict the 305-day milk production. The accuracy of using the incomplete gamma function for extending the partial record was also investigated in this study. The correlation coefficients between the actual 305-day milk yield and that obtained from utilizing the incomplete gamma function (from parts of 10 random samples of cows that completed their records to 44 weeks of production) were estimated. These correlation coefficients showed an increasing trend with the increase of number of weeks used in the sample, increasing from .59 to reach .90 for the first parity. In the second parity to the sixth, the correlation coefficients were the highest among all weeks of lactations (from .69 for the second parity at four weeks to .99 in the fifth parity at the thirty five weeks).

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دراسة وراثية على مُنحنى اللبن فى الأبقار الفريزيان

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شملت هذه الدراسة ٣٧٣٥ سجلاً لإنتاج اللبن الأسبوعى لعدد ١٥٤٥ بقرة فريزيان فـى قطعين بمزرعتى سخا والقرضا التابعتين لمعهد بحوث الإنتاج الحيوانـى - وزارة الزراعـة. وكـان الهدف من هذه الدراسة هو إختبار دالة جاما لوصـف مُنحنـى الحليب فـى الأبقـار الفريزيـان وتطبيـق هذه الدالة على إنتاج اللبن الأسبوعى لسجل البقرة بغرض عمل مُنحنـى حليب لكـل واحـدة علـى حده، دراسة العوامل الوراثية (مُتمثلة فى تأثير الطلوقة والبقرة) وبعض العوامـل البيئيـة (السنة- العمـر عند الولادة- ترتيب موسم الحليب - القطيع- وبعض التداخلات).

وقد تم إستنباط ثلاث صفات من ثوابت المعادلة هى المُثابرة وأسبوع الإنتـاج الأقصـى لـلإدرار وأقصى إدرار (كج/أسبوع) وحللت إحصائياً مع إنتاج اللبن الكلـى وإنتـاج ٣٠٥ يـوم وطـول موسـم الحليب بإستخدام نموذج خطى مُختلط أحتوى علـى تـأثير الطلوقـة والبقرة داخـل الطلوقـة كعوامـل عشوائية. وأيضاً تم إستنباط مُعاملات تمديد لتقدير كمية اللبن الكلية من السـجلات الغير كاملـة إلـى طول ٤٤ أسبوع حليب.

وقد أظهرت نتائج الدراسة مُلائمة دالة جاما لوصف مُنحنى اللبـن فـى قطيـع الأبقـار الفريزيـان وكانت متوسطات الثوابت أ، ب، ج ومتوسطات أسبوع أقصى إدرار والمُثـابرة وإنتـاج اللبـن الكلـى (كجم) وإنتـاج ٣٠٥ يـوم (كجم) وطـول فتـرة الحليب (يومـاً) علـى التوالـى ٧٢,٠٣، ٠,١٩٦٤، ٠,٠٣٣٧، ٦,٧، ٧٩,٣، ٩٩,٧، ٣٥٣٧، ٢٦٧٣، ٤٢٧ وكانت تقديرات المُكافئ الوراثـى ٠,١٢٥، ٠,٠٣٦، ٠,١٥٤، ٠,٠٢٥، ٠,١٠٤، ٠,١٢٥ وذلك للثابت أ والصفات أسبوع أقصى إدرار وأقص إدرار والمُثابرة وإنتاج اللبن الكلى وإنتاج ٣٠٥ يوماً على التوالى - أما الثوابت ب، ج وصفة طول فترة الحليب فقد قُدر المُكافئ الوراثى لها بصفر وذلك نتيجة للحصول على تقديرات مكونـات تبـاين سالبة. تم تقدير المعامل التكرارى للثوابت والصفـات كمـا تـم تقديـر الإرتبـاط الوراثـى والإرتبـاط المظهرى بينهم.

كما بينت الدراسة إن الإنتخاب على أساس أقصى إدرار محسوباً من دالة جاما قد يُحسن إنتاج ٣٠٥ يوماً للبقرة بمُعدل أسرع من الإنتخاب المُباشر لإنتاج ٣٠٥ يوماً. ولكن هذا لا ينطبق فى حالة إعتبار موسم الحليب الأول وحده. _