رقم البحث (51)

EVALUATION OF DIFFERENT COMPONENTS OF LACTATION CURVE IN DAIRY COWS

BY

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ABSTRACT

Data for the present investigation were obtained from 2201 lactation records during the years from 2005-2007, at Dina Farms which located eighty kilometers north of Cairo. The data were analyzed statistically and results showed that age at first calving, order of lactation, and year of calving, have significant effects on all factors affecting the shape of lactation curve, and its components. Preceding calving interval, current days open, and dry period have significant effects on all factors affecting the shape of lactation curve, its components, except for the rate of ascending of lactation curve is non-significant. Season of calving has a great effect on all factors affecting the shape of lactation curve, and its components except for time to attain peak milk yield, rate of ascending of the lactation curve, and time to attain low milk yield are non-significant.

High and medium heritability estimates were obtained for various factors affecting the shape of lactation curve, and its components including lactation length, total milk yield, 305-day mature equivalent, peak milk yield, dry period, days open, calving interval, initial milk yield, time to attain peak milk yield, and low milk yield. On the other hand, low heritability estimates were obtained for age at first calving, rate of ascending of the lactation curve, time to attain low milk yield and rate of descending of the lactation curve.

Phenotypic and genetic correlations between different factors affecting the shape of lactation curve, and its components were estimated. High positive phenotypic and genetic correlations were generally present such as total milk yield phenotypically and genetically

positive correlated with each of calving interval, and days open. While negative phenotypic and genetic correlations were, generally present such as age at first calving and 305-day mature equivalent. In case of low genetic correlations as age at first calving, with each of time to attain peak milk yield and low milk yield. In summary lactation curve, and its components affected by several population parameters such as heritability, phenotypic and genetic correlations. However non- genetic factors such as preceding calving interval, current days open, dry period and season of calving.

INTRODUCTION

Lactation curve depicts a cow's milk yield after colostrum to drying– off (about 300 days). It shows the peak production level, persistency and the effects of specific events on milk production. Because the shape of the lactation curve is fairly constant, milk yield in the early portion of the lactation curve can be used to predict milk yield for the entire lactation period.

Typical milk curve has an initial, short ascending segment after calving then peak and end by long, steady declining portion from peak to drying – off **(Ibrahim, 2002)**. The present study was designed to investigate different segments of lactation curve include initial, short ascending segment, peak, and long descending segment.

MATERIALS AND METHODS

Data for present study were obtained from 2201 lactation records, covering the period between 2005 and 2007. The data were taken from the milk records of U.S. Holstein cows belonging to Dina Farms (The Modern Agricultural Development), located about 80 km in Cairo- Alexandria Desert Road.

Lactation curve components are initial milk yield (IMY), rate of ascending of the lactation curve (RALC), peak milk yield (PMY), rate of descending of the lactation curve (RDLC) and low milk yield (LMY). Initial milk yield (IMY) is defined as milk production for the first monthly test-day. The peak milk yield (PMY) is the maximum yield can be obtained

by the cow. Moreover, the time needed to reach maximum production called time to attain peak milk yield (TAPMY). The rate of ascending of the lactation curve (RALC) and the rate of descending of the lactation curve (RDLC) can be calculated through the following formula according to **Ibrahim (2002).**

$$RALC = \frac{PMY - IMY}{TAPMY} \qquad RDLC = \frac{PMY - IMY}{TALMY - TAPMY}$$

RESULTS AND DISCUSSION

I. Non-genetic factors affecting the shape of lactation curve and its components:

Table (1) showed the least squares means, standard errors and test of significance of differences among means for different factors affecting initial milk yield and peak milk yield.

Age at first calving had significant effects on both of initial milk yield and peak milk yield in first lactation. The significant effect of age at first calving on first lactation milk yield is in agreement with the results reported by **Cziszter et al .(1997)** and **Tekerli et al. (2000)** . On the other hand, the previous results are in contrast with the finding of **Ragab (1950)** who achieved that the delay in first calving is associated with an increase in milk production and initial milk yield. While the significant effect of age at first calving on peak milk yield is in agreement with the results reported by findings of **Chaudhry et al. (2000)** and **Ibrahim (2002).**

Table (1) Least Squares Means, Standard Errors of Various Factors Affecting Initial Milk Yield and Peak Milk Yield.

Classification	Initial milk yield				Peak milk yield			
	No.	mean	±	S.E.	No.	mean	±	S.E.
Age at first calving (months)								
Less than 30	638	23.97^{c}	±	0.55	836	39.09^{a}	±	0.24
30 – 41	63	27.57^{a}	±	1.78	78	39.23^{a}	±	0.76
42 – 53	68	25.09^{b}	±	1.99	65	37.29^{c}	±	0.77
54 – and over	87	19.06^{d}	±	1.89	84	38.48^{b}	±	0.71
Order of lactation								
The first	177	19.16^{c}	±	1.29	169	36.82^{d}	±	0.66
The second	633	24.27^{b}	±	0.92	722	43.43^{c}	±	0.44
The third	485	25.68^{a}	±	0.97	509	45.76^{a}	±	0.48
The fourth	252	24.78^{b}	±	1.16	272	44.93^{b}	±	0.56
The fifth and higher lactation	408	24.61^{b}	±	1.02	442	44.11^{b}	±	0.49
Calving interval (days)								
Less than 365	456	24.21^{a}	±	0.99	494	42.85^{b}	±	0.48
365 – 424	568	23.73^{b}	±	0.96	612	42.90^{b}	±	0.47
425 – 484	330	23.58^{b}	±	1.11	366	42.51^{b}	±	0.54
485 and over	601	23.28^{b}	±	0.91	642	43.78^{a}	±	0.45
Days open (days)								
Less than 85	379	24.65^{a}	±	1.08	401	41.84^{b}	±	0.53
85 – 114	360	24.53^{a}	±	1.06	390	43.33^{a}	±	0.51
115 – 144	306	22.71^{b}	±	1.11	324	43.83^{a}	±	0.54
145 and over	910	22.91^{b}	±	0.89	999	43.05^{a}	±	0.43
Dry period (days)								
Less than 45	104	20.19^{d}	±	1.57	114	41.72^{c}	±	0.76
45 – 59	783	26.86^{a}	±	0.82	861	43.85^{a}	±	0.39
60 – 74	875	24.05^{b}	±	0.81	939	43.88^{a}	±	0.39
75 and over	193	23.68^{c}	±	1.27	200	42.59^{b}	±	0.62
Season of calving								
Summer (May to October)	760	22.33^{b}	±	0.89	839	42.44^{b}	±	0.43
Winter (November to April)	1195	25.07^{a}	±	1.04	1275	43.58^{a}	±	0.51
Year of calving								
2005	164	24.39^{b}	±	1.48	180	43.06^{b}	±	0.72
2006	1372	25.05^{a}	±	0.77	1504	44.18^{a}	±	0.38
2007	419	21.65^{c}	±	1.09	430	41.79^{c}	±	0.54

Within the same classification, the appearance of the same letter with two means signifies that they do not differ significantly (5% level). Otherwise they do.

The significant effect of calving interval on initial milk yield is in agreement with the findings of **Ibrahim (2002).** On the contrary, to the pervious results, **Asker et al. (1962)** observed the effect of calving interval on initial milk yield was non- significant.

Days open had significant effects on both of initial milk yield and peak milk yield. The above result is in consistence with the findings of **Moon and Kim (1989)**. While the significant effect of days open on peak milk yield is in consistence with the findings of **Tekerli et al. (2000).**

Longer dry periods are important for building up the body reserves and the condition of the udder, so the milk yield would be increased. This result is in accordance to the finding of **El-Bayomi (1986).** The significant effect of year of calving on initial milk yield is in agreement with the findings of **Wang et al. (1994)** and **Ibrahim (2002).** On the contrary, **Vaccaro et al. (1999)** observed that the effect of year of calving on initial milk yield was non-significant.

Table (2) showed the least squares means, standard errors and test of significance of differences among means for different factors affecting rate of ascending of lactation curve and rate of descending of lactation curve.

Age at first calving had significant effects on the rate of ascending of lactation curve and the rate of descending of lactation curve. The significant effect of age at first calving on rate of ascending of the lactation curves is in agreement with the findings of **Ibrahim (2002).** Lactation order had significant effects on both of rate of ascending of the lactation curve and rate of descending of the lactation curve.

The rate of decline after peak was constant across parities. In contrast to the above result, the significant effect of lactation order on rate of descending of the lactation curve is disagreeing with the findings of **Aziz et al. (2006).**

Table (2) Least Squares Means, Standard Errors of Various Factors Affecting Rate of Ascending of Lactation Curve and Rate of Descending of Lactation Curve.

Classification	Rate of Ascending of Lactation Curve				Rate of Descending of Lactation Curve			
	No.	mean	±	S.E.	No.	mean	±	S.E.
Age at first calving (months)								
Less than 30	559	0.26[a]	±	1.45	575	- 9.22[d]	±	4.84
30 – 41	59	0.19[b]	±	4.40	64	- 0.50[b]	±	0.37
42 – 53	60	0.19[b]	±	4.26	61	- 0.29[a]	±	0.14
54 – and over	79	0.27[a]	±	3.57	72	- 8.80[c]	±	0.11
Order of lactation								
The first	161	0.23[b]	±	0.03	154	- 0.13[a]	±	0.15
The second	576	0.27[a]	±	0.02	629	- 0.12[a]	±	0.10
The third	438	0.29[a]	±	0.02	480	- 0.15[b]	±	0.11
The fourth	223	0.29[a]	±	0.03	251	- 3.61[c]	±	0.13
The fifth and higher lactation	372	0.29[a]	±	0.02	402	- 0.17[b]	±	0.11
Calving interval (days)								
Less than 365	418	0.26[a]	±	0.03	444	6.91[a]	±	0.11
365 – 424	515	0.28[a]	±	0.03	569	0.17[c]	±	0.10
425 – 484	288	0.26[a]	±	0.03	317	4.15[b]	±	0.12
485 and over	549	0.29[a]	±	0.02	586	0.19[c]	±	0.09
Days open (days)								
Less than 85	319	0.25[a]	±	0.03	344	- 0.14[a]	±	0.12
85 – 114	330	0.26[a]	±	0.03	362	- 0.18[b]	±	0.11
115 – 144	283	0.32[a]	±	0.03	306	- 5.38[c]	±	0.12
145 and over	838	0.26[a]	±	0.02	904	- 0.10[a]	±	0.09
Dry period (days)								
Less than 45	96	0.33[a]	±	0.04	105	- 5.35[c]	±	0.17
45 – 59	709	0.25[a]	±	0.02	775	- 4.23[b]	±	0.09
60 – 74	796	0.27[a]	±	0.02	852	- 0.16[a]	±	0.09
75 and over	169	0.26[a]	±	0.03	184	- 0.22[a]	±	0.14
Season of calving								
Summer (May to October)	713	0.28[a]	±	0.02	754	- 0.28[b]	±	0.09
Winter (November to April)	1057	0.30[a]	±	0.03	1162	4.36[a]	±	0.11
Year of calving								
2005	155	0.23[b]	±	0.04	163	2.02[a]	±	0.16
2006	1256	0.28[a]	±	0.02	1364	- 0.12[b]	±	0.08
2007	359	0.30[a]	±	0.03	389	- 0.25[c]	±	0.12

Within the same classification, the appearance of the same letter with two means signifies that they do not differ significantly (5% evel). Otherwise they do.

The significant effect of year of calving on both of rate of ascending of the lactation curve and rate of descending of the lactation curve are in consistence with the findings of **Wang et al. (1994).**

II. Genetic parameters affecting the shape of lactation curve and its components:

II. 1. Heritability estimate:

Table (3) showed the estimates of heritability of various factors affecting the shape of lactation curve and its components.

Moderate heritability estimates were obtained for each of peak milk yield (0.24), dry period (0.27), initial milk yield (0.26) and low milk yield (0.30). The moderate estimates of heritability for initial milk yield are in consistence with the findings of **El-Arian et al. (2003)**. On contrary, **El-Bayomi (1986)** reported low heritability for peak milk yield. While, **Ibrahim (2002)** achieved low heritability for initial milk yield.

II. 2. Phenotypic correlation among different investigated traits:

Table (4) showed the phenotypic correlation among different factors affecting of lactation curve and its components. Positive significant phenotypic correlation of AFC with PMY (0.16) is in accordance with the findings of **Ibrahim (2002).** Positive significant and highly significant phenotypic correlations were obtained between PMY with each of IMY (0.17), RALC (0.18) and LMY (0.28).

Table (3) Heritability Estimates of Various Factors Affecting the Shape of Lactation Curve and Its Components.

Trait	$h^2 \pm$ S.E.
AFC	0.14 ± 0.19
LL	0.64 ± 0.22
TMY	0.73 ± 0.23
305 – day ME	0.42 ± 0.21
PMY	0.24 ± 0.20
DP	0.27 ± 0.20
DO	0.33 ± 0.21
CI	0.39 ± 0.21
IMY	0.26 ± 0.20
TAPMY	0.49 ± 0.22
RALC	0.07 ± 0.19
LMY	0.30 ± 0.21
TALMY	0.16 ± 0.19
RDLC	- 0.79 ± 0.09

A highly significant positive phenotypic correlation between PMY and IMY is in consistence with the finding of **El-Bayomi (1986).** On the other hand, the non-significant positive phenotypic correlation of PMY with RDLC is contradicted with the finding of **Ibrahim (2002).** Positive highly significant phenotypic correlations were obtained between IMY with each of LMY (0.24) and TALMY (0.18). Moreover, negative significant and highly significant phenotypic correlations were obtained between IMY with each of TAPMY (-0.14), and RALC (-0.60). On the other hand, Positive non-significant phenotypic correlations were obtained between IMY with RDLC (0.06).

II. 3. Genetic correlation among different investigated traits:

Table (4) showed the genetic correlation among different factors affecting the shape of lactation curve and its components.

There were positive highly significant genetic correlations were obtained between PMY with each of TAPMY (0.18), and RALC (0.20). Moreover, negative highly significant genetic correlations were obtained between PMY with each of IMY (-0.26), TALMY (-0.25). Positive significant genetic correlations of PMY with each of RALC and TAPMY are in consistence with the finding of **Ibrahim (2002).**

Concerning to IMY, there was negative highly significant genetic correlation was obtained between IMY with TAPMY (-0.20). On the other hand, positive non-significant genetic correlations were obtained between IMY with each of LMY (0.02), TALM (0.11). Negative non-significant genetic correlations were obtained between IMY with each of RALC and RDLC are in accordance with findings of **Fadlelmoula et al. (2007).** Furthermore, a negative significant genetic correlation was obtained between IMY and TAPMY is in agreement with the finding of **Ibrahim (2002).** Concerning to rate of ascending of lactation curve (RALC), there was positive significant genetic correlation was obtained between RALC with LMY (0.24).

Table (4): Phenotypic and Genetic Correlations Among Different Factors Affecting the Shape of Lactation Curve and its Components.

Trait	AFC	LL	TMY	305-day ME	PMY	DP	DO	CI	IMY	TAPMY	RALC	LMY	TALMY	RDLC
AFC	—	- 0.04	- 0.01	- 0.30**	0.16*	0.07	- 0.04	- 0.05	0.03	- 0.04	0.05	0.02	- 0.03	- 0.01
LL	0.25**	—	0.90**	0.23**	0.05	- 0.02	0.83**	0.08	0.02	0.21**	- 0.09	- 0.38**	0.58**	0.05
TMY	0.20**	0.44**	—	0.24**	0.25**	- 0.01	0.81**	0.15*	0.09	0.22**	- 0.07	- 0.22**	0.51**	0.05
305-day ME	- 0.24**	- 0.09	0.02	—	0.42**	- 0.01	0.17**	0.15*	0.06	0.17**	0.04	0.32**	0.03	0.02
PMY	- 0.08	0.08	0.12	0.25**	—	- 0.01	0.04	0.11	0.17**	0.12	0.18**	0.28**	- 0.04	0.01
DP	0.20**	0.30**	0.27**	- 0.07	0.03	—	0.01	0.28**	- 0.05	0.02	0.02	- 0.01	- 0.002	- 0.05
DO	0.27**	0.27**	0.26**	- 0.25**	- 0.01	0.47**	—	0.15*	0.04	0.14*	- 0.07	- 0.31**	0.47**	0.05
CI	0.38**	0.32**	0.23**	- 0.37**	0.07	0.37**	0.43**	—	- 0.02	0.13*	0.002	0.04	- 0.03	0.001
IMY	0.02	-0.30**	- 0.11	- 0.07	- 0.26**	- 0.02	- 0.10	-0.01	—	- 0.14*	- 0.60**	0.24**	0.18**	0.06
TAPMY	0.14*	0.08	0.16*	0.04	0.18**	0.12	0.29**	0.28**	- 0.20**	—	- 0.31**	- 0.10	0.02	- 0.03
RALC	- 0.08	0.01	0.06	0.14*	0.20**	- 0.04	- 0.06	- 0.10	- 0.09	0.10	—	- 0.02	- 0.13*	0.01
LMY	- 0.14*	- 0.10	- 0.08	0.23**	0.09	- 0.23**	- 0.16*	- 0.25**	0.02	0.06	0.24**	—	- 0.42**	0.01
TALMY	- 0.03	0.01	- 0.03	- 0.20**	- 0.25**	0.36**	- 0.03	- 0.16*	0.11	- 0.42**	- 0.09	- 0.13*	—	0.13*
RDLC	- 0.04	- 0.11	- 0.09	- 0.04	- 0.04	0.04	- 0.15*	- 0.01	- 0.07	- 0.01	- 0.03	0.11	- 0.23**	—

N.B. Figures above the diagonal represent phenotypic correlations, while these below the diagonal represent genetic correlations.

* Significant at level 0.05

** Significant at level 0.01

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تعيين المكونات المختلفة لمنحنى الحليب في أبقار اللبن

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**قسم تنمية الثروة الحيوانية - كلية الطب البيطري - جامعة الزقازيق

أجريت الدراسة على منحنى الحليب في الأبقار لمعرفة تأثير بعض العوامل على شكل منحنى الحليب ،و مكوناته. وقد جمعت بيانات هذه الدراسة من مزارع دينا الواقعة ٨٠ كم شمال القاهرة ، وقد تم الحصول على بيانات ١٩٥٥ – ٢٢٠١ سجل لبن لأبقار فريزيان نقية خلال الفترة من ٢٠٠٥ – ٢٠٠٧ ، وأجريت التحليلات الإحصائية للبيانات الخاصة بالدراسة اعتمادا على برنامج SAS .

وقد أظهرت الدراسة النتائج الآتية :

١- العمر عند أول ولادة، ترتيب موسم الحليب، وسنة الولادة كان لهم تأثير معنوي على كل الصفات التى تمت دراستها على شكل منحنى الحليب ومكوناته.

٢- كان للفترة بين ولادتين ، للفترة المفتوحة، و لفترة الجفاف تأثير معنوي على جميع صفات اللبن الإنتاجية المؤثرة على منحنى الحليب ، ومكوناته ماعدا معدل صعود منحنى الحليب.

٣- موسم الولادة كان له تأثير معنوي على كل صفات إنتاج اللبن ماعدا الوقت الذي وصل إنتاج اللبن فيه لذروته، معدل صعود منحنى الحليب، والوقت الذي وصل فيه إنتاج اللبن لأقل كمية.

٤- كان لبعض صفات اللبن الإنتاجية مكافئ وراثي منخفض مثل العمر عند أول ولادة، الوقت الذي وصل فيه الإنتاج لأقل كمية، معدل هبوط منحنى الحليب ،و معدل صعود منحنى الحليب.أما باقى صفات اللبن الإنتاجية فكان لها مكافئ وراثي متوسط أو عالي وقد شملت طول فترة الحليب ، الإنتاج الكلى للبن ، الإنتاج خلال ٣٠٥ يوم ، أعلى إنتاج للبن ، فترة الجفاف ، الفترة المفتوحة، الفترة بين ولادتين ، الإنتاج الأولى للبن ، الوقت الذي وصل فيه الإنتاج لذروته و، أقل إنتاج للبن.

٥- اختلفت الارتباطات الوراثية والمظهرية بين مكونات منحنى الحليب وبين العوامل المؤثرة عليها ، فكانت هذه مثل الارتباطات الوراثية والمظهرية الموجبة بين الإنتاج الكلى للبن و بين كل من الفترة بين ولادتين و الفترة المفتوحة . بينما كانت الارتباطات الوراثية والمظهرية سالبة في بعض الحالات مثل العمر عند أول ولادة وإنتاج اللبن خلال ٣٠٥ يوم. في حالات الارتباطات الوراثية الضعيفة مثل الارتباط بين العمر عند أول ولادة و بين كل من أقل إنتاج للبن و الوقت الذي وصل فيه الإنتاج لذروته.