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GENETIC EVALUATION OF INDIVIDUAL TEST DAY MILK YIELDS, REPRODUCTION AND PERSISTENCY OF LACTATION OF FRIESIAN COWS IN EGYPT

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ABSTRACT

Data comprised 11231 test day (TD) milk yield records from 1209 Holstein heifers calved between 2000 and 2003 were used in the present study. In addition to individual ten TD milk yield records and 305-day lactation yield records (305-dMY), the persistency of lactation (Per MY), days open (DO), peak daily milk yield (PEAK) and days from parturition to day of peak milk yield (DPMY) were recorded. All studied traits considered as different traits. Genetic parameters and breeding values for all studied traits were estimated by the REML method using single trait animal models analysis. Series of bivariate animal model analyses were used to estimate genetic and phenotypic correlations among all studied traits. Also, the Spearman rank correlations among estimated breeding values (EBV) for different studied traits were calculated.

Milk yield increased with time up to 2nd TD (around 52.87 days) and decreased afterwards. The average of PEAK was 30.39 kg. Higher 305-dMY recorded in the present study (6183 kg) was associated with longer DO (159.8 days). The coefficients of variations of TD milk yields were ranged from 29.05 to 42.63%, while the coefficient of variation of 305-dMY was 26.49%.

Heritability estimates for individual test day records using a single-trait animal model ranged from 0.20±0.10 to 0.26±0.06. The lowest heritability estimate was recorded in TD8 as well as TD1 of lactation, increased toward the middle of lactation period (TD5), and then decreased to raise again at the last two tests (TD9 and TD10). However, the heritability estimate of 305-dMY was 0.31±0.07. Heritability estimate for days open, persistency of lactation, peak daily milk yield and days of peak milk yield were 0.10±0.05, 0.08±0.05, 0.25±0.08 and 0.06±0.04, respectively.

Phenotypic and genetic correlations among test day milk yield records ranged from 0.11 to 0.85 and 0.62±0.09 to 0.99±0.06, respectively. Correlations among TD milk yields tended to decrease as the TD intervals increased, with largest estimates in mid-lactation than at both the beginning and the end of lactation. Genetic correlations between different TD milk yields and 305-dMY were high and positive, ranged from 0.80±0.09 to 0.99±0.04, while the estimates of phenotypic correlations ranged from 0.44 to 0.86, with highest values in the middle of lactation.

Estimated genetic and phenotypic correlations between DPMY and Per MY were 0.29±0.13 and 0.15, respectively. Also, the genetic and phenotypic correlations between DPMY and peak milk yield were negative (-0.66±0.08 and -0.25, respectively).

Higher rank correlations of breeding values for TD milk yields occurred at the mid-lactation than that between TD at the beginning and the end of lactation. Also, the higher rank correlations between breeding values of 305-dMY and TD milk yields were observed in the mid-lactation. Positive rank correlation was obtained between breeding values for peak milk yield and days open, while the negative ones were recorded between PEAK and each of DPMY and Per MY. The present results indicated that the TD milk yields at the mid-lactation were informative enough to represent the 305-dMY than the others. Also, the selection strategy could be attempted by decreasing stressful peak yields and maintaining a high level of production after peak yield, which is expected to improve energy balance at an earlier stage in lactation in first parity and may lead to an improve in animal reproduction and health.

Keywords: Individual test day, peak milk yield, persistency of lactation, reproduction, genetic parameters, breeding values.

INTRODUCTION

In general, genetic evaluation system of dairy cattle based to large extent on 305-days milk yield records. A test day (TD) record is the daily milk yield of a cow at the time of testing, and usually recorded at monthly intervals to be the basic for calculation of yields during 305 days milk yield (305-dMY). Changes in milk yield production across the lactation period represent the lactation curve, and TD measurements are represent points on the lactation curve. Consequently, there are two approaches for using TD data, firstly, estimation of genetic parameters for individual TD, as selection criteria, secondly, modeling the shape of the lactation curve.

In lactating dairy cattle, milk production (energy expenditure) usually reaches the peak at 4 to 8 weeks postpartum, while the peak of dry matter intake (energy intake) lags until 10 to 14 weeks postpartum (National Research Council, 1989). Therefore, many health and reproductive problems arise from increasing production of high producing cows which are under negative energy balance in early lactation (at peak milk yield). Negative energy balance in early lactation requires cows to mobilize body tissue in support of lactation. Negative energy balance and excessive body tissue mobilization are associated with increased incidence of metabolic disorders and poor fertility (Loeffler *et al.*, 1999 and De Vries and Veerkamp, 2000). High peak at early lactation have been shown to be associated with stressful situations and higher prevalence of disease (Collard *et al.*, 2000). Moreover, good persistency leads to a reduction of health and reproductive problems, and thus to lower milk production costs (Dekkers *et al.*, 1998). Consequently, a possible way to increase total yields without increasing the occurrence of disease or reproductive failure is to select for increasing lactation persistency. This could be attempted by decreasing stressful peak yields and maintaining a high level of production after peak yield, thereby flattening and extending the lactation curve.

Several authors (Swalve, 1995; Gadini, 1997 and Strabel et al., 2005) estimated genetic parameters of test-day milk yields, and concluded that the using of TD model with early TD records enables breeders to make earlier selection decisions to save time, reduction in costs on milk yield recording, minimization of selection bias because of culling after first lactation and increase response to genetic selection due to reductions in the generation intervals.

Therefore, the objectives of this study were: (1) to estimate genetic parameters and breeding values for individual TD and 305-dMY and to compare the results from TD and 305-dMY analyses by the use of a single trait derivative-free restricted maximum likelihood procedure; (2) to estimate the genetic parameters of persistency of lactation, day of peak milk yield, peak milk yield and days open; (3) to estimates genetic and phenotypic correlations among various studied traits and (4) to estimate Spearman rank correlation among estimated breeding values (EBV) for different studied traits, to evaluate the possibility of utilizing these traits as alternate selection traits, using the first lactation records of commercial Holstein Friesian cows in Egypt.

MATERIALS AND METHODS

Data comprised 11231 test day milk (TD) records from 1209 Holstein heifers calved between 2000 and 2003. Cows with records were daughters of 75 sires (each sire with at least five daughters), and were collected from two commercial dairy herds. Both herds are situated in Cairo-Alexandria desert road and named Green land or Delta Masr which far from Cairo by about 80 km and Alex-Kobenhagen farm which far from Alexandria by about 78 km. The intervals between calving and 1st TD were 4 to 45 days, then test day milk yields were recorded at approximately monthly intervals throughout lactation (TD1-TD10). In the test day analysis, the first individual ten TD yields were used. Cows with at least 7 TD were extracted, the number of TD in the 8, 9 and 10th were 1135, 941 and 692 test day, respectively. Recording system used in the two farms was computer program system (Dairy cattle comp.). Details of animal and herds managements were described previously by Shalaby (2005).

In addition to individual ten TD and 305-dMY records, the persistency of lactation (Per MY) have been calculated {measured as partial yield (days 121–210) divided by partial yield (days 31–120)} according to Danell (1982). The reproductive trait in this study represented days open (DO). Peak daily milk yield (PEAK) and days from parturition to day of peak milk yield (DPMY) were recorded.

The statistical analyses were performed using the MTDFREML (multivariate derivative free restricted maximum likelihood) program (Boldman *et al.*, 1995). In this study, test-day records yield in each interval was analyzed separately. Model for 305-dMY, persistency of lactation and peak daily milk yield was as follows:

$$Y_{ijklm}=\mu + A_i + F_j + YR_k + M_l + bL_1 (x_1- \bar{x}_1) + bQ_1(x_1- \bar{x}_1)^2 + bL_2(x_2- \bar{x}_2) +bQ_2(x_2- \bar{x}_2)^2 + e_{ijklm}$$

where,

Y_{ijklm} = observations of the 305-dMY, persistency of lactation and peak daily milk yield,

μ = overall mean,

A_i = the random additive genetic effect of ith animal,

F_j = the fixed effect of jth farm,

YR_k = the fixed effect of kth year of calving,

M_l = the fixed effect of lth month of calving,

bL_1 & bQ_1 = partial linear and quadratic regression coefficients, respectively for 305-dMY, persistency of lactation and peak daily milk yield on age at first calving,

bL_2 & bQ_2 = partial linear and quadratic regression coefficients, respectively for respective traits on days open,

$x_1 - \bar{x}_1$ = x_1 age at first calving of cow, $\bar{x}_1$ average AFC,

$x_2 - \bar{x}_2$ = x_2 days open, $\bar{x}_2$ average days open, and

e_{ijklm} = the residual effect for each observation.

The same models for individual TD (TD1-TD10) were used with replace days open by days in milk at first TD as a covariate. The model for day of peak milk yield (DPMY) was used with covariate of age at first calving only.

Firstly, single-trait animal model analyses for all traits, secondly, several two-trait animal model genetic analyses were performed to calculate relationships among traits studies.

Mixed-model equations in the analyses were solved iteratively. Based on the variance of the log-likelihood function values, the convergence criterion was 1×10^{-9}. In addition, several restarts were necessary until changes in the log-likelihood function values were less than 1×10^{-5}. Estimated breeding values (EBV) were obtained by back-solution using the MTDFREML program for all animals in the pedigree file for single-trait animal model genetic analysis. Spearman rank correlations between EBV for studied traits were estimated.

RESULTS AND DISCUSSION

Unadjusted means and standard deviations for the first 10 test day milk yields (TD) are presented in Table 1. The average of days in milk at first TD was 24.46 days. The standard deviations were slightly decreased with advanced in test day up to 6th TD. These results are in agreement with those obtained by Swalve (1995), who found that the variation of milk yield declined from TD 1 to TD 8. Milk yield increased with time up to 2nd TD (about 52.87 days) and decreased afterwards. In the present study, the average peak daily milk yield was 30.39 kg, similar to the results of Batra *et al.* (1987), since they reported an average week of peak yield of 8 weeks (56 days) for cows in the first lactation. Swalve (1995) and Machado *et al.* (1999) noticed that the highest value of TD occurred at TD2 (23.71 and 23.6 Kg, respectively). Milk yield peaked at around 45 days in milk and then declined as lactation progressed (Kaya *et al.*, 2003). Muir *et al.* (2004) found that DPMY and PEAK were 57.55 days and 31.35 kg, respectively for Canadian Holsteins with first parity. While, Ferris *et al.* (1985) reported an average DPMY and PEAK in first lactation of 69.1 days and 26.3 kg, respectively. Lean *et al.* (1989) found that DPMY and PEAK were 69 days and 37.36 kg, respectively for all combined lactations.

Phenotypic mean for 305-dMY in the present study was 6183 kg. This value is nearly similar to that (6003 kg) reported by Swalve (1995) for Friesians in the first lactation. However, it was lower than those reported by Jamrozik *et al.* (1998) and Muir *et al.* (2004), being 7452 and 7689 kg, respectively in the first lactation. The higher 305-dMY recorded in the present study was associated with longer days open (159.8 days). Several authors reported that means of days open ranged from 141 to 169.3 days (Dematawewa and Berger, 1998; Shalaby *et al.*, 2001; Ibrahim *et al.*, 2002 and Shalaby, 2005). Higher value of days open reported herein (lower reproductive efficiency) could be indicated that higher producing cows during the early stage of lactation are more likely to be in negative energy balance when re-breeding is attempted under commercial production system in Egypt.

The coefficients of variation of TD milk yields were ranged from 29.05 to 42.63%, while the coefficient of variation of 305-dMY was 26.49% reflected wide variations among cows in the TD milk yield than 305-dMY. Such large coefficients of variation are well indicative for opportunities for improvement in TD milk yields.

Table 1: Unadjusted means ($\bar{x}$), standard divisions (S.D), coefficients of variation (C.V %) and heritability estimates (h^2) for 305-dMY, test-day milk yields, days open, days in milk at first TD, peak daily milk yield and persistency of lactation.

Traits	$\bar{x}$	S.D	C.V%	h^2± S.E
Days open (DO, day)	159.8	84.6	52.94	0.10±0.05
Milk yield in 305 days (305-dMY, Kg)	6183	1638	26.49	0.31±0.07
Days in milk at first TD (Day)	24.46	9.54	39.00	....
Peak daily milk yield (PEAK , Kg)	30.39	7.44	24.48	0.25±0.08
Day of peak milk yield (DPMY, day)	52.87	32.45	61.38	0.06±0.04
Persistency of lactation (Per MY)	00.81	0.10	12.35	0.08±0.05
TD1, (Kg)	25.60	9.18	35.86	0.21±0.08
TD2	25.51	8.28	31.23	0.24±0.07
TD3	25.36	7.40	29.18	0.24±0.08
TD4	23.51	6.83	29.05	0.25±0.08
TD5	21.13	6.46	30.57	0.26±0.06
TD6	19.76	6.09	30.82	0.24±0.08
TD7	18.47	6.26	33.89	0.22±0.09
TD8	16.63	7.09	42.63	0.20±0.10
TD9	15.81	6.10	38.58	0.24±0.09
TD10	14.74	5.86	39.76	0.25±0.09

Heritability

Estimates of Heritability for TDI to TDI0 and 305-dMY are presented in Table 1. Heritability estimates for test day records using a single-trait animal model ranged from 0.20±0.10 to 0.26±0.06. In this concern, the heritability estimates for daily milk yield throughout lactation are varied among published data being 0.17-0.27 (Pander *et al.*, 1992); 0.31–0.51 (Olori *et al.*, 1999); 0.14–0.19 (Strabel and Misztal, 1999); 0.08–0.18 (Brotherstone *et al.*, 2000); 0.20–0.28 (Kettunen *et al.*, 2000) and from 0.16 to 0.39 (Druet *et al.*, 2003).

Generally, the lowest heritability estimate was recorded in TD1 and TD8 as well; increased toward the middle lactation (TD5) and then decreased to raise again in the last two tests (TD9 and TD10). In this respect, Zavadilová *et al.* (2005) showed that the lowest heritabilities for daily milk yield were estimated in the early stage of lactation then there was an increase afterwards, and the highest values were observed at the end of lactation. However, several researchers (Swalve, 1995; Rekaya *et al.*, 1999; Liu *et al.*, 2000; Pool *et al.*, 2000; Auvray and Gengler, 2002; Jakobsen *et al.*, 2002; Druet *et al.*, 2003 and Strabel *et al.*, 2005) reported that the heritability estimates for TD milk yields recorded lower values at the beginning and at the end of lactation, while the highest values were obtained in the middle of lactation. While, Brotherstone *et al.* (2000) showed that the lowest estimate of heritability was recorded during the first 14 days of lactation, then stable values during most of lactation, and slightly lower values towards the end of lactation. Swalve (1995) stated that higher estimate of heritabilities for mid-lactation was a function of increasing additive genetic variance than of decreasing residual variance. The highest estimates of heritability in mid-lactation indicated that the test-day milk yields could be utilized in place of 305-dMY in genetic evaluations of dairy animals as selection criteria, leading to reduction in generation interval. Similar findings were reported by Meyer *et al.* (1989) and Pander *et al.* (1992). On contrary; large values estimated at the peripheries and low values in the middle part of lactation were also found (Jamrozik and Schaeffer, 1997; Strabel and Misztal, 1999 and Kettunen *et al.*, 2000) using different models.

Heritability estimate of 305-dMY in the first lactation in the present study was moderate (0.31±0.07) (Table 1). Similar moderate estimates (0.30) were reported by Lidauer *et al.* (2003); Rekaya *et al.* (1999); Zavadilová *et al.* (2005), while Dematawewa and Berger (1998) recorded this value (0.20) for Holsteins. In the other side, Jamrozik *et al.* (2001) and Schaeffer *et al.* (2000) obtained (0.47) and Muir *et al.* (2004) recorded (0.45) by using different models. Machado *et al.* (1999) showed that heritability estimate for 305-dMY was 0.32 and similar to heritability for largest heritability estimates of TD milk yield found in mid-lactation.

A heritability estimate of 0.10±0.05 was obtained for days open in the current study (Table 1). Similar estimates were reported by Hayes *et al.* (1992) (0.10) and Shalaby (2005) (0.11±0.066). Several authors (Pryce *et al.*, 1997; Abdallah and McDaniel, 2000 and Weigel and Rekaya, 2000) obtained lower estimates, while Dematawewa and Berger (1998) recorded higher estimate (0.12) for DO in first lactation. The heritability estimate of 0.08±0.05 obtained for Per MY (Table 1) was somewhat more close to those obtained by Haile-Mariam *et al.* (2003) (0.09) and Shalaby (2005) (0.08±0.052). Higher estimates of heritability of Per MY (0.18) were recorded by Van der Linde *et al.* (2000) and Muir *et al.* (2004). The difference between the present heritability estimate of Per MY and those reported in the literature may be due to different methodology, statistical model and level of production.

Heritability estimates of peak daily milk yield (PEAK) and days of peak milk yield (DPMY) were 0.25±0.08 and 0.06±0.04, respectively (Table 1) which were lower than the values recorded by Muir *et al.* (2004) who found that heritabilities of PEAK and DPMY were 0.50 and 0.09, respectively. Also, Ferris *et al.* (1985) reported the heritability of timing of peak yield to be 0.07. They added that DPMY was much less heritable than persistency and would not perform as well as persistency as an indicator trait for genetically improving persistency.

Genetic and phenotypic correlations

Phenotypic and genetic correlations (Table 2) among test day milk yields records ranged from 0.11 to 0.85 and from 0.62±0.09 to 0.99±0.06, respectively. Correlations between TD milk yields tend to decreased as the TD intervals increased, with largest estimates in mid-lactation than between TD at the beginning and at the end of lactation (Table 2). These results indicated that the TD measurements in the mid-lactation were more repeatable than the TD at the peripheries of lactation. Nearly similar results were obtained by Strabel and Misztal (1999). Moreover, Jamrozik and

Schaeffer (1997) and Rekaya *et al.* (1999) obtained negative genetic correlations between TD milk yields in early and late lactation. Phenotypic correlations presented in the literature ranged from 0.50 to 0.76 and from 0.58 to 0.90 as reported by Rekaya *et al.* (1999) and Vargas *et al.* (1998), respectively. While, the genetic correlations ranged from 0.39 to 0.95, from 0.73 to 0.99, from 0.43 to 0.95 and from 0.49 to 1.0 as reported by Meyer *et al.* (1989), Pander *et al.* (1992), Reents *et al.* (1995) and Vargas *et al.* (1998), respectively.

Genetic correlations between different TD milk yields and 305-dMY were high and positive, ranged from 0.80±0.09 to 0.99±0.04, while the estimates of phenotypic correlations were ranged from 0.44 to 0.86, with higher values for middle of lactation than either at the beginning and at the end of lactation. Relative low genetic and phenotypic correlations of the TD day at the peripheries of the lactation with 305-dMY indicated that predicating complete lactation milk yield using these TD measurements could not be accurate. Similar trend was reported by Machado *et al.* (1999) who found that genetic correlations between TD milk yields and 305-dMY varied from 0.78 to 1.00, while the estimates of phenotypic correlations were ranged from 0.56 to 0.97, with higher values in mid-lactation. However, Rekaya *et al.* (1995) showed that the highest genetic correlation between the first test (TD1) and 305-dMY was 0.89, and tended to decrease in the second half of lactation.

Regarding the peak daily milk yield (PEAK), genetic and phenotypic correlations between PEAK and 305-dMY were high and positive (0.96±0.05 and 0.74, respectively). Also, strong and positive correlation estimates were found between PEAK and different TD day milk yields (Table 2). The genetic correlations between days open and each of PEAK and 305-dMY were 0.39±0.20 and 0.68±0.09, respectively. Also, positive and moderate genetic correlations were estimated between days open and TD milk yields, the highest estimate was observed in the 2nd TD. The obtained results in the present study show positive (unfavorable) correlation between days open and milk production traits (PEAK, TD and 305-dMY). Previous research has indicated an antagonistic relationship between reproductive performance and milk (Grosshans *et al.*, 1997; Dematawewa and Berger, 1998; Kadarmideen *et al.*, 2000; Roxström *et al.*, 2001; Haile-Mariam *et al.*, 2003 and Shalaby, 2005). High producing dairy cows in the first parity especially at peak milk yield are not able to meet the energy requirements for growth, maintenance, and milk production in early lactation, therefore it becomes in a negative energy balance prior to peak milk production. In the same time, negative energy balance was associated with longer days open. Therefore, the selection strategy would be attempted by decreasing stressful peak yields and maintaining a high level of production after peak yield. Estimated genetic and phenotypic correlations between PEAK and persistency of lactation were negative and low (-0.21±0.12 and -0.18, respectively). Also, test-day yields at start of lactation (from TD1 to TD4) were negatively correlated with persistency of lactation, indicating that high peak milk yield tended to decrease persistency. Tekerli *et al.* (2000) estimated the phenotypic correlation between peak milk yield and persistency to be negative (-0.23).

Table 2: Genetic correlations ± S.E. (above diagonal) and phenotypic correlations (below diagonal) among TD milk production, reproduction and persistency traits.

	Do	305-dMY	PEAK	DPMY	Per MY	TD1	TD2	TD3	TD4	TD5	TD6	TD7	TD8	TD9	TD10
DO		0.44	0.16	0.13	0.17	-0.04	0.16	0.16	0.10	0.11	0.12	0.09	0.12	0.14	0.12
305-dMY	0.68±0.09		0.74	0.11	0.06	0.44	0.83	0.84	0.83	0.86	0.85	0.83	0.80	0.79	0.72
PEAK	0.39±0.20	0.86±0.05		-0.25	-0.18	0.72	0.74	0.72	0.66	0.62	0.57	0.56	0.46	0.56	0.51
DPMY	0.22±0.06	0.20±0.18	-0.66±0.08		0.15	-0.44	-0.13	0.01	0.11	0.10	0.11	0.09	0.15	-0.06	-0.04
Per MY	0.51±0.11	0.37±0.27	-0.21±0.12	0.29±0.13		-0.10	-0.31	-0.24	-0.14	0.15	0.28	0.31	0.22	0.04	0.02
TD1	0.59±0.12	0.80±0.09	0.71±0.06	-0.82±0.07	-0.51±0.12		0.38	0.33	0.27	0.28	0.27	0.24	0.11	0.30	0.28
TD2	0.65±0.09	0.99±0.05	0.79±0.05	-0.24±0.12	-0.37±0.20	0.97±0.05		0.84	0.77	0.73	0.68	0.64	0.54	0.64	0.59
TD3	0.43±0.13	0.98±0.05	0.74±0.06	-0.03±0.21	-0.37±0.21	0.78±0.09	0.99±0.06		0.84	0.77	0.74	0.71	0.60	0.65	0.58
TD4	0.25±0.15	0.99±0.04	0.69±0.07	-0.20±0.18	-0.34±0.22	0.75±0.09	0.97±0.05	0.97±0.05		0.83	0.73	0.72	0.64	0.63	0.57
TD5	0.36±0.21	0.99±0.04	0.67±0.08	-0.40±0.21	0.44±0.19	0.71±0.08	0.94±0.06	0.94±0.05	0.98±0.05		0.81	0.73	0.66	0.67	0.59
TD6	0.37±0.20	0.99±0.05	0.61±0.09	0.18±0.14	0.48±0.18	0.75±0.07	0.94±0.06	0.95±0.06	0.97±0.06	0.94±0.05		0.81	0.68	0.65	0.57
TD7	0.35±0.21	0.97±0.05	0.62±0.09	0.08±0.11	0.52±0.22	0.73±0.06	0.94±0.06	0.96±0.06	0.97±0.06	0.94±0.06	0.94±0.07		0.78	0.64	0.57
TD8	0.54±0.12	0.97±0.06	0.58±0.09	0.17±0.17	0.22±0.19	0.65±0.08	0.88±0.09	0.91±0.07	0.96±0.05	0.96±0.06	0.95±0.08	0.94±0.08		0.63	0.58
TD9	0.53±0.10	0.96±0.06	0.56±0.10	0.13±0.14	0.37±0.17	0.67±0.08	0.82±0.08	0.90±0.09	0.95±0.06	0.97±0.05	0.93±0.08	0.91±0.08	0.93±0.09		0.85
TD10	0.55±0.08	0.95±0.07	0.52±0.11	0.22±0.22	0.34±0.21	0.62±0.09	0.84±0.09	0.87±0.10	0.94±0.06	0.94±0.07	0.94±0.09	0.92±0.08	0.92±0.10	0.93±0.08	

Estimated genetic and phenotypic correlations between interval from initiation of lactation to peak yield (DPMY) and persistency of lactation were 0.29±0.13 and 0.15, respectively. Also, the genetic and phenotypic correlation between DPMY and peak milk yield were negative (-0.66±0.08 and -0.25, respectively). The present results indicated that longer interval from initiation of lactation to peak yield was associated with lower peak milk yield, but the persistency of lactation improved. Also, persistency of milk yield (i.e. a lower peak yield) is expected to improve energy balance at an earlier stage in lactation in first parity. In this connection, Tekerli *et al.* (2000) reported that the phenotypic correlation between the timing of peak yield and persistency was 0.80. Positive and high or moderate genetic correlations between persistency and timing of peak yield were found by Ferris *et al.* (1985); Batra *et al.* (1987) and Rekaya *et al.* (2000). Furthermore, Muir *et al.* (2004) showed that genetic correlation between DPMY and persistency of lactation was positive and moderate (0.54). They add that these traits are genetically similar and the selection on one trait should improve the other.

Rank correlations among estimated breeding values for test-day milk yields (TD) across the first lactation period are presented in Table 3. The present results showed that the higher rank correlations of breeding values for TD milk yields occurred in the mid-lactation than that between TD at the beginning and the end of lactation. These results indicated that changes in the rank of animal (re-ranking) were higher at the peripheries of lactation than in mid-lactation. Also, the higher rank correlations between breeding values of 305-dMY and TD milk yields were observed in the mid-lactation. The present results indicated that the changes in animal ranking of breeding values for TD milk yields in the mid-lactation and 305-dMY were more similar than those for TD at the beginning and the end of lactation. The TD milk yields in the mid-lactation were informative enough to represent the 305-dMY than the others. In this respect, Jamrozik *et al.* (1997) found that the correlation between the estimated breeding values (EBV) from TD model with the EBV from 305-day milk yield model was 0.94. Moreover, they recommended that using TD measurements in a TD multiple trait random regression model provide greater flexibility to milk recording programs and these results suggests that TD milk yields could be used instead of 305-dMY for the genetic evaluation of dairy cattle. The same conclusion was obtained by Swalve (1995) and Kaya *et al.* (2003). Positive rank correlation was obtained between breeding values for peak milk yield and days open, while negative rank correlations were recorded between PEAK and each of interval from initiation of lactation to peak yield (DPMY) and persistency of lactation (Table 3). Therefore, the selection strategy could be attempted by decreasing stressful peak yields and maintaining a high level of production after peak yield, which is expected to improve energy balance at an earlier stage in lactation in the first parity and may lead to an improve in cow's reproduction and health.

Table 3: Rank correlations among estimated breeding values (EBV) for 305-dMY, test-day milk yields, days open, days in milk at first, peak daily milk yield and persistency of lactation.

	305-dMY	PEAK	DPMY	Per MY	TD1	TD2	TD3	TD4	TD5	TD6	TD7	TD8	TD9	TD10
DO	0.16	0.15	0.09	0.03	0.11	0.20	0.14	0.11	0.16	0.15	0.15	0.19	0.20	0.24
305-dMY		0.80	0.07	0.17	0.53	0.85	0.86	0.86	0.87	0.87	0.86	0.82	0.72	0.63
PEAK			-0.15	-0.13	0.75	0.81	0.79	0.77	0.73	0.68	0.67	0.63	0.61	0.56
DPMY				0.14	-0.38	-0.05	0.03	0.05	0.02	0.03	0.06	0.09	0.02	0.03
Per MY					0.03	-0.05	-0.05	0.05	0.23	0.35	0.35	0.26	0.15	0.10
TD1						0.53	0.48	0.46	0.47	0.41	0.40	0.36	0.41	0.40
TD2							0.88	0.83	0.81	0.76	0.72	0.68	0.68	0.62
TD3								0.87	0.81	0.77	0.75	0.69	0.66	0.57
TD4									0.87	0.79	0.78	0.74	0.67	0.60
TD5										0.84	0.78	0.75	0.68	0.61
TD6											0.85	0.76	0.66	0.57
TD7												0.84	0.67	0.58
TD8													0.65	0.60
TD9														0.75

Conclusions

Higher coefficients of variations and heritability estimates of individual TD milk yield records in the mid-lactation, also high and positive genetic and phenotypic correlations between TD milk yields in the mid-lactation and 305-dMY were observed; indicating that TD milk yields in the mid-lactation could be used as selection criteria, particular for young bulls which can be selected earlier in breeding programs, leading to a reduction in generation interval. The present results can be used to develop management tools in the design of a breeding scheme by using the TD milk yield records instead of 305-dMY, particularly in developing countries, resulting in reducing the cost and time of recording system. Higher 305-dMY recorded in the present study was associated with longer days open. Peak milk yield and the timing of peak milk yield were correlated with days open and persistency of lactation, therefore, the selection strategy would be attempted by decreasing stressful peak yields and more persistent lactation to decrease fertility and metabolic stress. Further research with larger data set are needed for verification and interpretation of these results, especially with different measurements of the persistency of lactation and reproduction traits, use of random regression test-day models and determine the genetic response in both cases of TD and/or 305-dMY records.

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التقييم الوراثي لإنتاج اللبن الفردى في يوم الاختبار والصفات التناسلية و المثابرة على إنتاج اللبن لماشية الفريزيان فى مصر

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أجريت هذه الدراسة على ١١٢٣١ سجل إنتاج اللبن اليومي في يوم الاختبار على ١٢٠٩ بقرة هولشتين فريزيان والتي ولدت مابين عام ٢٠٠٠ إلى ٢٠٠٣. بالإضافة إلى عشرة عينات ليوم الاختبار خلال الموسم الأول، وتم حساب إنتاج اللبن فى ٣٠٥ يوم والمثابرة على إنتاج اللبن، وعدد الأيام المفتوحة، والفترة من بداية الموسم حتى الوصول لأقصى إنتاج ، وأقصى إنتاج يومى خلال موسم الحليب. وتم التعامل مع كل الصفات المدروسة على انها صفات مختلفة. وتم تقدير المعالم الوراثية و القيم التربوية لكل الصفات المدروسة باستخدام التحليل الفردي بنموذج الحيوان، كما تقدير الارتباطات الوراثية والمظهرية بسلسلة من التحليلات الثنائية بين كل الصفات المدروسة. وتم حساب معاملات الارتباط الرتب للقيم التربوية لكل الصفات المدروسة. وأشارت أهم النتائج إلى:

- أزداد أنتاج اللبن مع التقدم فى موسم الحليب وبلغ أقصى إنتاج عند يوم الاختبار الثاني (بعد حول ٥٢,٨٧ يوم) ثم نقص بعد ذلك. وبلغ أعلى إنتاج ٣٠,٢٩ كجم . ارتبط إنتاج اللبن العالي (٦١٨٣ كجم) في هذه الدراسة مع زيادة طول فترة الأيام المفتوحة (١٥٩,٨ يوم). بلغ مدى معاملات الاختلافات لعينة يوم الاختبار الفردية من ٢٩,٠٥ إلى ٤٢,٦٣ %، بينما بلغ ٢٦,٤٩ % لإنتاج اللبن فى ٣٠٥ يوم.
- تراوحت تقديرات المكافئ الوراثى لعينات يوم الاختبار من ٠,٢٠ ±٠,١٠ إلى ٠,٢٦ ±٠,٠٦. كانت أقل قيم المكافئ الوراثي فى يومي الاختبار الثامن والأول ، وزادت القيم مع التقدم فى موسم الحليب، وكانت أعلى القيم فى منتصف موسم الحليب (الاختبار الخامس) ثم نقص بعد ذلك، وارتفع مره أخرى فى آخر اختبارين (التاسع والعاشر). بينما قيمة المكافئ الوراثي لإنتاج اللبن فى ٣٠٥ يوم كانت٠,٣١ ±٠,٠٧. وكانت قيم المكافئ الوراثي للأيام المفتوحة والمثابرة على الإنتاج وأقصى إنتاج لبن يومى والفترة من بداية الإنتاج حتى الوصول إلى أقصى إنتاج هى ٠,١٠ ±٠,٠٥، ٠,٠٨ ±٠,٠٥، ٠,٢٥ ±٠,٠٨ و٠,٠٦ ±٠,٠٤ على التوالي.
- تراوح مدى قيم معاملات الارتباط المظهري والوراثية بين عينات يوم الاختبار من ٠,١١ إلى ٠,٨٥ ومن ٠,٦٢ ±٠,٠٩ إلى ٠,٩٩ ±٠,٠٦ على التوالي، تميل قيم معاملات الارتباط إلى النقص مع التقدم فى موسم الحليب، وبلغت أعلى القيم فى منتصف موسم الحليب بالمقارنة ببداية ونهاية موسم الحليب. تراوحت قيم معاملات الارتباطات الوراثية بين عينات يوم الاختبار ومحصول اللبن في ٣٠٥ يوم من ٠,٨٠ ±٠,٠٩ إلى ٠,٩٩ ±٠,٠٤، بينما تراوحت قيم معاملات الارتباطات المظهرية من ٠,٤٤ إلى ٠,٨٦، وسجلت أعلى القيم فى منتصف موسم الحليب. بلغت قيم معاملات الارتباط الوراثي والمظهري بين عينات يوم الاختبار والفترة من بداية الموسم حتى الوصول لأقصى إنتاج ٠,٢٩ ±٠,١٣ و٠,١٥ على التوالي. بينما كانت قيم معاملات الارتباط الوراثي والمظهري بين الفترة من بداية الموسم حتى الوصول لأقصى إنتاج وأقصى إنتاج يومى خلال موسم الحليب سالبة (- ٠,٦٦ ±٠,٠٨ و-٠,٢٥ على التوالي).
- كانت أعلى قيم لمعاملات ارتباط الرتب للقيم التربوية لعينات يوم الاختبار فى منتصف موسم الحليب بالمقارنة ببداية ونهاية موسم الحليب. وأيضا فقد كانت أعلى ارتباطات الرتب بين القيم التربوية لإنتاج اللبن فى ٣٠٥ يوم و القيم التربوية لعينات يوم الاختبار في منتصف موسم الحليب. وأيضا فقد كان معامل ارتباط الرتب بين القيم التربوية لأقصى إنتاج يومى خلال موسم الحليب والأيام المفتوحة موجبا. بينما كان هناك ارتباط سالب بين أقصى إنتاج يومى خلال موسم الحليب وكلا من الفترة من بداية الموسم حتى الوصول لأقصى إنتاج والمثابرة على إنتاج اللبن .

ويستخلص من هذه الدراسة أن عينات يوم الاختبار الفردية بمنتصف موسم الحليب يمكن أن تكون مؤشرا جيدا يعطى معلومات كافية وممثلة لإنتاج اللبن فى ٣٠٥ يوم عن باقي عينات يوم الاختبار الأخرى. وأيضا يجب أن يكون من إستراتيجية الانتخاب هو محاولة تقليل الإجهاد الناشئ عن أقصى إنتاج اللبن العالي مع المحافظة على مستوى عالى من الإنتاج بعد ذلك والذي يمكن أن يحسن ميزان الطاقة فى بداية موسم الحليب فى الموسم الأول مما يحسن من الأداء التناسلي وصحة الحيوان بصفة عامة.