Genetic and Non-Genetic Analysis for Milk Production and Reproductive Traits in Holstein Cattle in Egypt

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ABSTRAK

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Penelitian ini dilakukan untuk mempelajari faktor-faktor genetik dan non-genetik yang mempengaruhi serta menduga nilai parameter genetik dari sifat-sifat reproduksi dan produksi susu sapi Friesian Holstein (FH) melalui *animal model*. Data didapatkan dari peternakan komersial (Safi Masr for Developing the Animal Resources), yang berlokasi di Delta Nil, Dakahlia, Mesir, yang meliputi 4791 catatan dari 1797 ekor betina, yang berasal dari 794 ekor induk dan 67 ekor pejantan selama periode 2002-2012. Nilai rataan dan koefisien variasi (CV %) dari sifat produksi susu yang terdiri dari total produksi susu (TMY), produksi susu 305 hari (305 dMY), masa laktasi (LP) dan masa kering (DP) adalah 7208,72 kg (24,33%), 6384,95 kg (19,37 %), 332 hari (14,87%) dan 72,33 hari (27,69%), berturut-turut. Nilai rataan dan koefisien variasi (CV %) dari sifat-sifat reproduksi yang terdiri dari masa kosong (DO), umur pertama beranak (AFC) adalah 157,9 hari (22,6%) dan 30,5 bulan (16,8%) berturut-turut. Pejantan, induk, paritas, tahun dan musim beranak berpengaruh nyata terhadap sifat-sifat yang diamati. Nilai dugaan heritabilitas adalah 0,223; 0,184; 0,112; 0,118; 0,105; dan 0,285 untuk sifat-sifat TMY, 305-dMY, LP, DP, DO dan AFC berturut-turut. Nilai dugaan korelasi genetik (r_g) dan fenotipik (r_p) antar sifat-sifat produksi susu adalah positif, tetapi negatif pada DP dan DO. Estimasi heritabilitas yang moderat dan korelasi genetik yang positif dari sebagian besar sifat-sifat yang diamati menegaskan bahwa perbaikan secara genetik pada sifat-sifat ini dapat dicapai melalui seleksi multi sifat.

Key Words: Parameter Genetik, Produksi Susu, Reproduksi, Sapi Friesian Holstein

ABSTRACT

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This study was carried out to investigate genetic, non-genetic affecting factors and estimate genetic parameters for milk production and reproductive traits of Holstein cows via animal model. The data was obtained from a commercial farm (Safi Masr for Developing the Animal Resources), located in the Nile Delta, Dakahlia, Egypt. Data included 4791 records of 1797 cows, 794 dams and 67 sires that represented the period from 2002 to 2012. The means and coefficient of variability (CV%) of milk traits as total milk yield (TMY), 305 days milk yield (305-dMY), lactation period (LP) and dry period (DP) were 5787.8 kg (31.1%), 4695 kg (22.1%), 332 days (14.9%) and 72.3 days (27.7%), respectively. Also, the means (CV%) of reproductive traits as days open (DO) and age at first calving (AFC) were 157.9 days (22.6%) and 30.5 month (16.8%), respectively. Sire, dam, parity of cow, year and season of calving had significant effects on traits studied. Heritability estimated were 0.223, 0.184, 0.112, 0.118, 0.105 and 0.285 for TMY, 305-dMY, LP, DP, DO and AFC, respectively. Estimated r_G and r_P among milk production traits were positive but it takes negative trend with DP and DO. Moderate heritability estimates and positive genetic correlation for most of traits studied suggested that genetic improvement of these traits would be achieved via multi-trait selection.

Key Words: Genetic Parameters, Milk Production, Reproductive, Friesian Holstein Cattle

INTRODUCTION

Friesian cattle are the most reputed dairy cattle in Egypt. In livestock population under computerized recording system, a large size of phenotypic observations is available at low cost and it is worthwhile to use them in estimation of genetic parameters for economic traits. Milk production and reproductive traits are the most important economic traits as sources of income for dairy farmers where high producing and fertile cows are usually profitable. Heritability is the key of genetic parameter which determines the amount of possible genetic progress for selected traits (Usman et al. 2012). Milk yield and adaptability of Holstein are factors of major concern under tropical and subtropical conditions. Under these conditions the focus had always been on milk production, adaptability and survival, they were often overlooked (Usman et al. 2013).

In dairy breeding, selection for the milk yield has been mostly made on the basis of 305-days milk yield (Seyedsharifi et al. 2008; Bilal & Khan 2009). Dry period is one of the important management strategies. Previous studies reported that to maximize milk yield in the next lactation in dairy cows, a 50 to 60 d dry period is necessary (Safa et al. 2013). Reducing dry period length may affect fertility efficiency (Watters et al. 2009). This study was carried out to investigate genetic, non-genetic factors affecting and estimate genetic parameters for milk production and reproductive traits of Holstein cows in Egypt via animal model.

MATERIALS AND METHODS

Data

The data obtained from a commercial farm (Safi Masr for Developing the Animal Resources), located at the Nile Delta, Dakahlia, Egypt. Data were comprised from 4791 records of 67 sires and 794 dam during the year 2002 to 2012. Genetic and non-genetic factors as sire, parity (1^{st} to $\geq 6^{th}$), year of calving (2002 to 2012) and calving season (winter from 22/12 to 21/3, spring form 22/3 to 21/6, summer from 22/6 to 21/9 and autumn from 22/9 to 21/12).

Feeding and management

Animals were housed free in shaded open yards, grouped according to average daily milk yield, and fed on TMR system a round year as recommended by NRC (1989). Heifers were artificially inseminated (imported semen of Holstein sires) for the first time when reaching 350 : 370 kg of weight and pregnancy was detected by rectal palpation at 60 days after service. The cows were machine milked three times per day.

Traits studied

Traits studied are total milk yield (TMY), 305-days milk yield (305-dMY), lactation period (LP) and dry period (DP) as milk production traits and days open (DO) and age at first calving (AFC) as reproductive traits.

Statistical model

Factors affecting traits studied were analyzed by general linear model (GLM) using SAS computer program (SAS 2002) as follow model:

$$Y_{ijklmn}=\mu+S_i+D_j+p_k+t_l+o_m+e_{ijklmn}$$

where:

Y_{ijklmn} = The individual observation
μ = Overall mean
S_i = Effect of i^{th} sire, i= 1,…., 67
D_j = Effect of j^{th} dam, j= 1,…., 794
p_k = Effect of k^{th} parity of cow, l=1,…,5, ≥6
t_l = Effect of l^{th} year of calving, m=1,….,11
o_m = Effect of m^{th} season of calving, k =1,…,4
where: 1= winter, 2= spring, 3= summer, 4= autumn
e_{ijklmn} = Error term NID (0, σ^2e)

Genetic parameters

The genetic parameters were estimated by derivative free REML with a simplex algorithm using the Multiple Trait Derivative-Free Restricted Maximum Likelihood (MTDFREML) program of Boldman et al. (1995). The animal model in matrix notation as follow**:**

$$Y = Xb + Za + e$$

where:

Y = Vector of observations (milk production and reproductive traits)
b = Vector of fixed effects (i.e. parity, year and season of calving)
a = Vector of random additive genetic direct effects (i.e. sire and dam)
X, Z = Known incidence matrices relating observations to the respective traits
e = Vector of residual effects (0, $I\sigma_e^2$)

RESULTS AND DISCUSSION

Descriptive statistics

Table (1) shows the mean, standard deviation (SD) and coefficient of variability (CV) of milk production traits as total milk yield, 305 days milk yield, lactation period and dry period are 7208.72 kg (24.33%), 6384.95 kg (19.37 %), 332 days (14.87%) and 72.33 days (27.69%), respectively. The average of 305-days milk yield for Holstein cows were 4295 (CV%=19.7), 9038 kg (CV%=13.1%) and 8455.4 (CV%=18.2) in Egypt as reported by Ashmawy & Khalil (1990), Salem et al. (2006) and Hammoud (2013), respectively.

Osman et al. (2013a) reported that the average of total milk yield for first and second parities in a herd of Holstein cows in Egypt were 8954±3489 kg (CV%=38.96) during 398.8±126.6 day and 8686±69.11 kg (CV%=35.48) during 355.2±100.2 day. Furthermore, Usman et al. (2012) reported that the mean of TMY in Holstein cows was 3438±887.19 kg (CV%=25.81), and ranged between 2042 to 6557 kg.

Table 1. Descriptive statistics of milk production and reproductive traits in Holstein cows

Traits	Records №	Mean	SD	CV (%)
Milk production traits				
Total milk yield (TMY), kg	4791	7208.72	1753.6	24.33
Milk yield at 305d (305-dMY), kg	4791	6384.95	1236.9	19.37
Lactation period (LP), day	4791	332.00	49.38	14.87
Dry period (DP), day	3574	72.33	20.03	27.69
Reproductive traits				
Age at first calving (AFC), month	2431	30.51	5.12	16.79
Days open (DO), day	3108	157.93	35.72	22.62

The lactation period (LP) for Holstein cows was found to vary from 286 to 407 days and the coefficient of variability of lactation period ranged from 5 to 31.74% as mentioned by El-Arian et al. (2003), Salem et al. (2006), Hammoud (2013) and Osman et al. (2013a) in Egypt.

Usman et al. (2012) reported that lactation period of Holstein cows ranged from 185 to 514 days with mean of 366.5±76.71 days (CV=20.93 %).

Osman et al. (2013a) represented that the average of dry period (DP, day) for the second parity in Holstein cows in Egypt were 76.71±69.11 day (CV%=90.09).

Hammoud (2013) reported that the least squares analysis with unequal subclass numbers indicated that the overall means of TMY, 305-dMY, LP and DO were 10341.8±2980.1 kg (CV%=28.8), 8455.4±1535.1 kg (CV%=18.2), 391.2±115.9 day (CV%=29.6) and 181.4±117.0 day (CV%=64.5), respectively.

The mean (CV%) of reproductive traits as days open and age at first calving (Table 1) are 157.93 day (22.62%) and 30.51 month (16.79%), respectively. The low age at first calving in a particular dairy cattle herd is a reflection of the good managerial strategy adopted in that herd. High level of management allows the growing heifers to reach the suitable body weight for breeding earlier and this in turn leads to lower age at first calving.

Osman et al. (2013a) reported that in the first parity the average of days open and age at first calving in Holstein cows in Egypt were 185.9±131.7 day (CV%=70.8) and 33.38±5.48 month (CV%=16.41), respectively. Furthermore, the mean of the days open for the second parity was 155.5±120.0 day (CV%=77.17)

Table (1) shows the mean of TMY and 305-dMY were lower than those found by Abou-Bakr et al. (2006) being 13172 and 10847 kg, respectively and those reported by Salem et al. (2006) being 12054 and 9038 kg, respectively Holstein cows in Egypt. The mean of LP was lower than the mean of 370 and 407 days obtained by Abou-Bakr et al. (2006) and Salem et al. (2006), respectively. The estimate of DO obtained in this study was shorter than that of 255 days found by Abou-Bakr et al. (2000), but was similar to 154 days obtained by Abou-Bakr et al. (2006).

Genetic factors

Table (2) shows that sires and dams as a random factors ($P \leq 0.05$) significantly affected the milk production and reproductive traits in dairy cattle. This is in agreement with Hamed & Soliman (1994) and Hammoud (2013) for 305-dMY and in agreement with Hamed & Soliman (1994), Hammoud (2013) and Osman et al. (2013a) for LP and DP. Also, the same trend shows for age at first calving as reported by Mokhtar et al. (1993) and Osman et al. (2013a).

Osman et al. (2013a) reported that sire as a random effect was significantly affected TMY, and DO. On the contrary, Mokhtar et al. (1993) evidenced that the effect of sire on the dry period was not significant. This means that there are genetic variations for traits studied and the estimations of genetic parameters were high in its accuracy and the possibility in selection was found to get genetic progress for traits studied.

Non-genetic factors

The parity effect was significant ($P \leq 0.01$) on milk production and reproductive traits in Holstein cows (Table 3). Similar results reported by Usman et al. (2012). Table (3) also revealed that cows in the first and the second parity had almost the lightest means of 305dMY and TMY in general and it increased with advance of parity and mostly reached its maximum in the 4th and 5th parities. Trend of means for LP, DP and DO increased significantly from first to sixth parity. Also, AFC tend to have a similar trend.

Usman et al. (2012) found significant effect of parity on milk yield ($P<0.05$) while the effect of season

Table 2. Genetic factors affecting milk production and reproductive traits in Holstein cows

Genetic factors	Milk production and reproductive traits					
	TMY	305-dMY	LP	DP	AFC	DO
Sire (n=67)	**	**	*	*	*	*
Dam (n=794)	*	*	*	*	*	*

TMY = Total milk yield
305-dMY = Milk yield at 305 days
LP = Lactation period
DP = Dry period
AFC = Age at first calving
DO = Days open
* = Significant differences (P ≤0.05)
** = Highly significant differences (P ≤0.01)

and year of calving was non-significant. Parity 7th had a highest average milk yield of 4392 kg than other parities. Cows calved in spring had highest milk yield than other seasons. Also, Season of calving had a significant (P<0.05) effect while parity and year of calving had a non-significant effect on lactation length.

The results in table (3) represent the significant effect of year of calving on the milk production and reproductive traits in Holstein cows and the cows vary in their milk production and reproductive traits from year to year. El-Arian & Shalaby (2001) and Hammoud (2013) came to the same results for 305-days milk yield. The same results found by Kassab (1995) for lactation period. Moreover, Osman et al. (2013a) reported that year of calving as a fixed effect was significantly affected TMY, LP, DP and DO. This effect was attributed by different investigators to fluctuations in environmental conditions particularly those associated with managerial procedures, weather conditions, nutritional level and feeding practices which would change over years (Mokhtar et al. 1993). In addition, the cows in 2007 were the highest values for 305-days milk yield and TMY in general compared to the other years that may be due to good management decisions in that year.

The effect of season of calving on milk production and reproductive traits were significant (Table 3). The present results are in agreement with those reported by El-Arian & Shalaby (2001) and Usman et al. (2012). On contrary, insignificant effect shown by El-Barbary et al. (1999) for 305-days milk yield. In addition, Kassab (1995) reported a significant season of calving effect on LP. On the contrary, an insignificant difference in LP due to season of calving was reported by Salem & Omar (1994). Significant season of calving effect on DP was reported by Hamed & Soliman (1994) and Kassab (1995). However, season of calving had non-significant effect on DP (Kassab 1995). Moreover, Osman et al. (2013a) reported that that season as a fixed effect was significantly affected TMY, LP and DO except DP was not affected significantly.

Table (3) shows that the cows vary (P≤0.01) in their milk production and reproductive traits due to season of year and shows high mean values in spring and winter for 305-dMY and TMY. Kaygisiz (2013) came to the same conclusion that year and season of calving significantly influenced 305-dMY (P<0.01). Endris et al. (2013) reported that the effect of year-season of calving had a very highly significant (P<0.001) effect on total milk yield, and 305d milk yield of Holstein crossbred cows. In contrary, Usman et al. (2011) found non-significant effect of season of calving on milk yield. In addition, significant effect of season of calving on age at first calving was found by Sandhu et al. (2011) and Sahin et al. (2012).

Sandhu et al. (2011) and Usman et al. (2011) found higher lactation milk yield in spring and lower in the summer. Abdel-Gader et al. (2007) reported that milk production was highest in winter than the other seasons. Javed et al. (2004) reported that milk production was highest in the autumn and spring seasons and lowest in hot summer.

The discrepancy in milk yield, especially lower milk production in the summer, may be due to heat stress, lower metabolism, poor quality and inadequate quantity of feed and high parasitic load in this weather that suffered the cattle to the extent that the animals could not maintain their production. Overcoming the environmental barriers the production can be intensified in these conditions, which can be achieved by management interventions by providing suitable environment and balanced ration in the hot summer. A number of methods are been used by dairy farmers to cool lactating cows during summer, but the most common is use of water spray and fans to facilitate evaporative cooling. Appropriate housing that assists in dissipating heat might bring about reduction in the severity of the problems (Usman et al. 2013).

Table 3. Non-genetic factors affecting milk production and reproductive traits in Holstein cows

Non-genetic factors	Milk production and reproductive traits					
	TMY	305-dMY	LP	DP	AFC	DO
Effect of parity	**	**	**	**	**	**
1	5220.24^{d}	5211.90^{d}	283.83^{d}	63.35^{d}	25.00^{bc}	100.78^{c}
2	6356.16^{c}	6139.07^{c}	298.99^{bcd}	67.80^{cd}	23.02^{c}	120.39^{c}
3	7510.65^{b}	6880.95^{b}	319.03^{bc}	70.63^{bc}	31.43^{ab}	143.26^{bc}
4	8212.88^{a}	7111.32^{a}	337.60^{b}	73.68^{b}	26.86^{bc}	164.88^{b}
5	8377.69^{a}	6850.38^{b}	356.37^{ab}	76.54^{ab}	33.08^{a}	186.51^{b}
≥6	7682.54^{b}	5975.97^{c}	377.48^{a}	79.24^{a}	30.67^{ab}	210.32^{a}
Effect of year of calving	**	**	**	**	**	**
2002	6764.73^{f}	6590.38^{bc}	294.54^{g}	64.54^{g}	27.62^{cd}	112.68^{h}
2003	6114.95^{g}	5195.82^{e}	293.31^{g}	66.78^{f}	26.98^{d}	113.70^{h}
2004	6662.59^{f}	6278.65^{d}	305.47^{f}	69.66^{e}	28.19^{cd}	128.73^{g}
2005	7102.90^{e}	6514.32^{c}	314.20^{e}	70.42^{e}	33.95^{b}	138.22^{f}
2006	7659.36^{b}	6691.30^{b}	332.26^{d}	72.55^{d}	39.06^{a}	158.41^{e}
2007	8483.90^{a}	6932.81^{a}	358.01^{c}	74.84^{c}	38.34^{a}	186.45^{d}
2008	8194.92^{ab}	6470.61^{c}	370.91^{b}	77.24^{b}	35.31^{b}	201.76^{c}
2009	7450.40^{d}	5764.20^{f}	378.02^{a}	79.02^{b}	29.52^{c}	210.64^{b}
2010	7076.91^{e}	5428.99^{g}	381.69^{a}	82.06^{a}	31.78^{c}	217.34^{a}
2011	7780.12^{c}	6413.97^{d}	354.15^{c}	76.21^{b}	31.59^{c}	183.96^{d}
2012	8030.11^{ab}	6519.30^{c}	362.00^{c}	76.72^{b}	30.95^{c}	192.32^{d}
Effect of season of Calving	**	**	*	**	**	*
Winter	7280.15^{a}	6415.56^{a}	328.59^{a}	72.85^{a}	31.02^{a}	155.05^{a}
Spring	7278.13^{a}	6442.62^{a}	327.53^{ab}	70.92^{ab}	28.22^{c}	152.04^{b}
Summer	7144.77^{b}	6343.99^{b}	325.11^{b}	71.85^{bc}	29.86^{b}	150.56^{b}
Autumn	6886.17^{c}	6124.16^{c}	325.06^{b}	70.35^{c}	29.78^{b}	149.01^{b}

Means within column classification followed by different superscript are different significantly (P≤0.05)
TMY = Total milk yield
305-dMY = Milk yield at 305 days
LP = Lactation period
DP = Dry period
AFC = Age at first calving
DO = Days open
* = Significant differences (P≤0.05)
** = Highly significant differences (P≤0.01)

Heritability estimates (h^2)

Table (4) show estimates of heritability (h^2) as well as genetic correlations (r_G) and phenotypic correlations (r_P) among different milk production and reproductive traits. Heritability estimates for TMY, 305-dMY, LP, DP, DO and AFC are 0.223, 0.184, 0.112, 0.119, 0.105, and 0.285, respectively. These estimates are low to moderate and in agreement with most of the previous investigators. Heritability estimates were 0.17, 0.29 and 0.20 as reported by Meyer (1985), Dadpasand et al. (2013) and Kaygisiz (2013) for 305-dMY; 0.06, 0.07 and 0.184±0.161 as reported by Lakshmi et al. (2009), El-Arian et al. (2003) and Usman et al. (2012) for lactation period; 0.20±0.06 and 0.03 as reported by Shitta et al. (2002) and El-Arian et al. (2003) for dry period, respectively, and 0.23±0.105 as reported by Salem et al. (2006) for age at first calving.

In Egypt, heritability estimates of TMY, LP and DO were 0.37, 0.38 and 0.42 (El-Shalmani 2011) and 0.14, 0.04 and 0.20 (Shalaby et al. 2012) for first lactation of Friesian cows. Moreover, Hammoud (2013) showed that heritability estimates of TMY, 305-dMY, LP, and DO were 0.44, 0.42, 0.48 and 0.54 for first lactation Holstein cows, respectively.

Osman et al. (2013b) showed that heritability estimates at the first parity of TMY, LP, DO and AFC were 0.29±0.09, 0.107±0.07, 0.313±0.09 and 0.431±0.103, respectively for Holstein cows, respectively. Furthermore, the estimates for TMY, LP, DO and DP at the second parity were 0.490±0.109, 0.166±0.077, 0.117±0.071 and 0.534±0.113, respectively. Furthermore, Abdel-Gader et al. (2007) found heritability estimate of LP to be 0.17.

Abdel-Gader et al. (2007) and Suhail et al. (2010) reported heritability estimates of DP to be 0.04 and 0.10±0.21, respectively.

Heritability estimates of TMY and LP were 0.27 and 0.02 (Tekerli & Kocak 2009) of Holstein cows in Turkey. Endris et al. (2013) mention that estimates of heritability for total milk yield, 305d milk yield and adjusted 305 d milk yield of Holstein crossbred cows were 0.20±0.13, 0.24±0.12 and 0.37±0.11, respectively. Heritability estimates for first lactation Holstein cows of TMY and DO were 0.20 and 0.03 (Zink et al. 2012) and 0.22±0.009 and 0.05±0.006, respectively (Zavadilová & Zink 2013).

The previous investigations revealed a substantial variation in heritability estimates of AFC. High estimates were 0.48 and 0.42 as reported by Suhail et al. (2010) and Ayied et al. (2011), respectively. On the contrary, low heritability estimate of AFC was 0.098 that mentioned by Abdel-Gader et al. (2007).

Genetic and phenotypic correlation coefficients

Table (4) represents coefficients of genetic correlation (r_G) and phenotypic correlation (r_P) among milk production and reproductive traits. All coefficients were positive, except that between DP and each of TMY, 305-dMY and LP were negative. Moreover, 305-dMY with DO had also negative correlation.

Positive genetic correlation between 305-dMY in dairy cattle and LP were reported by El-Arian et al. (2003), Salem et al. (2006) and Hammoud (2013). Also, genetic and phenotypic correlations of 305-dMY and DP were negative as reported by EL-Arian et al. (2003) and Salem et al. (2006). Genetic correlation between 305-dMY and DP were positive (r_G=0.54 and 0.29) as mentioned by Ojango & Pollott (2001) and Hammoud (2013), respectively.

Table (4) shows that genetic correlation coefficients between LP and DP were negatively correlated. Similar results reported by El-Arian et al. (2003) and Salem et al. (2006). The positive genetic correlations between traits especially productive ones clarified that these traits could be improved simultaneously via multi-trait selection breeding program.

Elshalmani (2011) depicted positive genetic correlations of 0.23 to 0.98 among TMY, LP and DO of Holstein cows. Moreover, Zink et al. (2012) obtained genetic correlation of 0.39 between TMY and DO.

Hammoud (2013) obtained negative genetic correlation in Holstein cows (rg=-0.31) between TMY and DO; positive genetic correlation (rg=0.35) between TMY and 305-dMY; between LP and TMY (rg=0.31), 305-dMY (rg=0.29); positive genetic correlations between DO and 305-dMY (rg=0.32), LP (rg=0.34).

Osman et al. (2013b) obtained positive genetic and phenotypic correlations in Holstein cows at the first parity between TMY and DO (rg=0.706 and rp=0.462);

Table 4. Heritability estimates (diagonal), genetic (below) and phenotypic (above) correlation coefficients for milk production and reproductive traits in Holstein cows

Traits	TMY	305-dMY	LP	DP	AFC	DO
TMY	0.223±0.036	0.869	0.491	-0.075	0.063	0.428
305-dMY	0.943±0.017	0.184±0.032	0.037	-0.089	0.009	-0.005
LP	0.678±0.084	0.406±0.131	0.112±0.025	-0.104	0.092	0.894
DP	-0.031±0.137	-0.038±0.142	-0.188±0.158	0.119±0.025	0.130	0.353
AFC	0.059±0.117	-0.178±0.118	0.601±0.106	0.293±0.124	0.285±0.042	0.145
DO	0.645±0.093	0.413±0.135	0.882±0.035	0.297±0.145	0.725±0.095	0.105±0.024

TMY = Total milk yield
305-dMY = Milk yield at 305 days
LP = Lactation period
DP = Dry period
AFC = Age at first calving
DO = Days open

DO and AFC (rg=0.833 and rp=0.076); DO and LP (rg=0.990 and rp=0.771); LP and AFC (rg=0.676 and rp=0.084); TMY and AFC (rg=0.168) and TMY and LP (rp=0.485). Furthermore, obtained negative correlations between TMY and LP (rg=-0.144) and TMY and AFC (rp=-0.002). In addition, positive genetic and phenotypic correlations at the second parity were observed between TMY and DO (rg=0.251and rp=0.027); TMY and LP (rg=0.882 and rp=0.573); LP and DO (rg=0.298 and rp=0.544) and DP and DO (rg=0.328 and rp=0.237). Furthermore, negative correlations were observed between TMY and DP (rg=-0.452 and rp=-0.216) and LP and DP (rg=-0.692 and rp=-0.286).

CONCLUSION

According to the present study indicated that Holstein breed in Egypt can show high milk production and good reproductive traits under adequate circumstances.

Moderate heritability estimates and positive genetic correlation for most of traits studied suggested that genetic improvement of these traits would be achieved via multi-trait selection. The high positive genetic correlations between traits especially productive ones clarified that these traits could be improved simultaneously via multi-trait selection breeding program.

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