Egyptian J. Anim. Prod. (2023) 60(3):113-122

GENETIC AND ENVIRONMENTAL ESTIMATES FOR MILKING-ABILITY TRAITS IN HOLSTEIN CATTLE UNDER EGYPTIAN CIRCUMSTANCES

Faid-Allah E., E. Ghoneim, and M. Al-Khomri

Department of Animal Production, Faculty of Agriculture, Menoufia University, Egypt
E-mail: ifaidallah@agr.menofia.edu.eg

Submitted: 12/12/2023; Accepted: 18/2/2024; Published: 19/3/2024

SUMMARY

The study was conducted to investigate genetic and environmental factors affecting, and estimating genetic parameters, for milk production and milking-ability traits of Holstein cows. The data obtained from six herds from a commercial farm called Dina for agriculture investment, located in Cairo-Alex. desert road (80 Km) from Cairo, Menoufia, Egypt. It included 3881 cows as progenies of 3321 dams and 261 sires in 6 herds that represented the period from 2007 to 2014. Studied Traits are milk production trait 305-days milk yield (305-dMY), and milking-ability traits like average flow rate (kg/min), peak flow rate (kg/min) and milking duration (min) for cows have Age at First Calving (AFC) equal 24.8±2.3 month. The means (CV%) of milk production and milking-ability traits as 305-dMY, AFR, PF, and MD were 9399±1767 kg, (18.8%), 2.21±0.78 kg/min, (35%), 3.93±1 kg/min, (25%), and 4.09±1.29 min, (32%), respectively. Sire, dam, herd, parity, year, and season of calving had significant effects on studied traits. Heritability estimates were 0.27 ±0.061, 0.20 ±0.013, 0.07 ±0.002, and 0.09 ±0.001 for 305-dMY, AFR, PF, and MD, respectively. Estimates of r_G and r_P among studied traits were positive. Moderate estimates of heritability and positive genetic correlation among certain studied traits suggested that genetic improvement would be achieved via selection of appropriate breeding program.

Keywords: Genetic Parameters, Milk Production, Milking-ability, Holstein Cattle

INTRODUCTION

Cow's Milking-ability traits are becoming more important for dairy producers all over world to reduce working time, minimize the total milking time, which would result in increasing welfare of cows in the whole herd, without affecting the total yield production (Samoré *et al*., 2011). Milking-ability traits consist of milk duration, peak flow rate and average flow rate, as well as a division of the milking phase into time for increasing flow rate, time for peak flow rate and time for reduced flow rate (Lee and Choudhary, 2006).

Genetic selection for the milk yield in dairy cattle has been mostly based on the basis of 305-day milk yield (Bilal and Khan, 2009).

Increasing milking speed results in reducing milking working time, which leads to decrease the cost of labor and operating energy. Also, reduce use of milking equipment (Lee and Choudhary, 2006; Gray *et al*., 2012, and Vosman *et al*., 2014).

Profitability of milk production depends on the cow's milking efficiency, that is affected by many factors, especially milking frequency, milk yield, and milking speed (Aerts *et al*., 2022).

This study was conducted to investigate genetic and environmental factors affecting milk production and to estimate genetic parameters for milking-ability traits of Holstein cattle under Egyptian conditions.

MATERIALS AND METHODS

This study was conducted following the guidelines set by Menoufia University for the ethical treatment of animals in scientific research. The approval of Ethics Committee, The Institutional Animal Care and Use Committee (IACUC), Menoufia Univ. Ref. № (MUFAG/F/AP/5/23).

The data were collected from six herds at Dina farm, a commercial farm specializing in agriculture investment, located in the Cairo-Alex. desert road approximately 80 kilometers away from Cairo, Egypt. The dataset consists of information on 3,881 cows, which are the offspring of 3,321 dams and 261 sires across the six herds. The data covers the period from 2007 to 2014. Various factors were considered, including the sire and dam as random factors, the herd (1 to 6), parity (1st to 5th), year of calving (2007 to 2014), and season of calving (summer: June 22nd to September 21st; autumn: September 22nd to December 21st; winter: December 22nd to March 21st; spring: March 22nd to June 21st). Age at first calving was used as a co-variate.

Management and feeding system :

The subject animals were of the American Holstein cattle breed and were kept in both shaded and open yards. They were grouped based on factors such as daily milk yield per cow, and lactation period. The heifers, specifically, are artificially inseminated using imported frozen semen from American Holstein bulls. This process begins when the heifers reach 12 months of age and weigh 350 kg, with a height of 125 cm. Pregnancy is confirmed through rectal palpation 35 days after the insemination process.

Alpro management system and Dairy comp305

(DC305) were used for computer-recording system and were fed ad-lib on TMR system all year round, as recommended by N.R.C (NRC, 2001). Milking cows are fed according to their production and the days in milk, where the milking rations are divided into three rations of fresh, high milking and low milking yield. The fresh ration fed to the cow from zero days in milk to 25 days in milk, then cows were fed high milking ration until days in milk increases and the average daily milk production decreases, to less than 20 kg of milk per day, and then they were fed on a low ration to dry off.

These rations are formulated from corn silage, alfalfa hay, soya bean meal, corn grains, wheat bran, corn gluten feed, protected fat and mixed from vitamins and minerals.

The cows were milked three times daily by Delaval parlors according to the milking order with milking routine. Cows identified in parlor with electronic chipset. Fresh cows enter the parlor in the 1st group, 1st parity in 2nd group, and from 2nd parity and above in 3rd group, and the low production in 4th group.

Studied traits:

Studied traits are automatically measured during milking, using automatic milking, and recording systems. Milk production trait include 305-days milk yield (305-dMY), and Milking-ability traits include:

1-Average flow rate, AFR (kg/min) was milk harvested until machine stripping divided by cumulative time (Petersen *et al*., 1986).

2-Peak flow rate, PF (kg/min) was maximum milk harvested during a one min interval (Petersen *et al*., 1986).

3-Milking duration, MD (min) was the actual time taken to milk out a cow as a time span between time any teat started giving milk until last teat stopped giving milk (Gäde *et al*., 2006).

Statistical model:

Factors affecting studied traits were analyzed by general linear model (GLM) with Duncan test at α=0.05 using SAS computer program (SAS, 2002) as the following model:

$$\mathbf{Y_{ijklmno}=\mu+S_i+D_j+p_k+t_l+o_m+h_n+e_{ijklmno}}$$

where: $Y_{ijklmno}$ = The individual observation; μ= Overall mean; S_i = Random effect of i^{th} sire, i=1: 261; D_j = Random effect of j^{th} dam, j= 1:3321; p_k = Fixed effect of k^{th} parity of cow, k=1:5; t_l = Fixed effect of l^{th} year of calving, l=1:8; o_m = Fixed effect of m^{th} season of calving, m=1:4 (winter= 1, spring = 2, summer = 3, autumn = 4); h_n = Fixed effect of n^{th} herd, n =1…6; and $e_{ijklmno}$ = Error term NID (0, σ^2e).

Genetic parameters:

Genetic parameters were conducted by derivative-free REML with a simplex algorithm using the Multi-Trait Derivative-Free Rest. Max. Likelihood that abbreviate as MTDFREML (Boldman *et al*., 1995). Model in matrices notation was as follow:

$$\mathbf{Y = X_b + Z_a + e}$$

where: Y = Vector of observations (milk production and milking-ability traits); b = Vector of fixed effects (herd, parity, calving year, calving season, and AFC as a covariate); a = Vector of random animal additive genetic effects; X, Z = Known incidence matrices relating observations to the respective traits and e = Vector of residual effects (0, $I\sigma_e^2$).

RESULTS AND DISCUSSION

Statistical description:

Table (1) displays the mean, standard deviation (SD) and coefficient of variability (CV%) of 305-day milk yield was 9399 ±1767 kg, (18.8%) and it was ranged between 3370 and 14440 kg.

The mean ±SD (CV%) of 305-dMY for Holstein cows were 4295 (19.7%), 10847 ±2206 Kg (20%), 9038 (13.1%), 2737 ±1044 Kg (25.6%), 8455.4 ±1535.1 (18.2%) and, 7208.72 ±1753.6 kg (24.33%) in Egypt as stated by (Ashmawy and Khalil, 1990, Abou-Bakr *et al*., 2006, Salem *et al*., 2006, Oudah and Khalefa, 2010, Hammoud, 2013 and Faid-Allah, 2015), respectively; and ranged between 2042 to 6557 kg for 305-dMY (Usman *et al*., 2012).

Table 1. Descriptive statistics of milk production and milking-ability traits in Holstein cows

Traits	Mean	SD	Max	Min	CV (%)
Milk Yield at 305d, 305-dMY, kg	9399	1767	14440	3370	18.8
Average flow rate, AFR, kg/min.	2.21	0.78	7.69	0.45	35
Peak flow rate, PF, kg/min	3.93	1.00	8.53	2.00	25
Milking durations, MD, min.	4.09	1.29	9.25	0.67	32

SD=Standard deviation, Max=Maximum, Min=Minimum, CV = Coefficient of variation

The age of first calving (AFC) for cows under study was 24.8±2.3 (9.2%) month. The mean of AFC for Holstein cows differs from 31.8 ±0.1(SE) month (Hammoud *et al*., 2010) to 27.1 ±2.4 month (8.8%) (Salem and Hammoud, 2016a) in Egypt. However, means of AFC in Holstein cattle raised in outside Egypt differs from 39.1±11.5 month (29.4%) (Boujenane and Hilal, 2012) to 24.18 ±1.59 month (Marestone *et al*., 2013).

The effective management strategy implemented in this specific dairy cattle herd is evident from the low AFC. achieved. The exceptional level of management enables the young heifers to attain the appropriate body weight for breeding at an earlier stage, consequently resulting in a reduced AFC.

Table (1) displays the mean (CV%) for milking-ability traits such as average flow rate (AFR), Peak flow Rate (PF), and milking durations (MD). The values for AFR. are 2.21 ±0.78 kg/min (35%), for peak flow rate are 3.93 ±1 kg/min (25%), and for MD are 4.09 ±1.29 min (32%).

In Swedish Holstein cows, MD were 4.58±1.61 min, and ranged between 1.03 to 16.54 min for 1st parity, and 4.97 ±1.82 min, and ranged between 0.69 to 19.90 min for 2nd and 3rd parity; AFR were 3.65 ±1.08 kg/min, and ranged between 0.48 to 8.46 kg/min for 1st parity, and 4.14 ±1.16 kg/min, and ranged between 0.30 to 8.50 kg/min for 2nd and 3rd parity; PF were 5.32 ±1.35 kg/min, and ranged between 0.72 to 10.98 kg/min for 1st parity, and 5.93 ±1.47 kg/min, and ranged between 0.60 to 11.00 kg/min for 2nd and 3rd parity; and milk yield per time were 12.1 ±3.19 kg, and ranged between 1.04 to 34.16 Kg for 1st parity, and 14.92 ±4.48 kg, and ranged between 1.0 to 34.99 Kg for 2nd and 3rd parity (Carlström *et al*., 2013). In Jersey cattle, MD were 9.94 ±2.23 min, and ranged between 5.79 to 13.58 min; AFR were 1.66 ±.36 kg/min and ranged between 1.04 to 2.64 kg/min; PF were 2.49 ±0.57 kg/min and ranged between 1.04 to 2.64 kg/min; and milk yield per day were 22.23 ±8.02 kg and ranged between 10.4 to 38.2 Kg (Bobić *et al*., 2020).

The means of AFR kg/min for Holstein cows differs from 2.3 ±0.61 (Lee and Choudhary, 2006) and 2.59 ±0.91 (Aerts *et al*., 2022), respectively to 3.65 ±1.08 in 1st parity (Gäde *et al*., 2007) and 4.14 ±1.16 in >1st parity (Carlström *et al*., 2013). Many investigators stated that AFR was above 2.0 kg/min (Gäde *et al*., 2007; Rahmatalla *et al*., 2011; Lučić *et al*., 2013 and Laureano *et al*., 2014). The mean of AFR is 2.21 kg/min in Germany Holstein cattle (Rahmatalla *et al*., 2011). Mean for peak flow rate noted in this study was 3.93 ±1.0 kg/m (25%) like 3.8 ±1.2 kg\m in Italian Holstein (Sandrucci *et al*., 2007). Higher peak flow rate values (5.932 ±1.47 kg/m) were noted in Swedish Holstein cattle (Carlström *et al*., 2013). slightly lower PF rate (2.49 ±0.57 kg/m) in jersey cattle (Bobić *et al*., 2020). Milk duration in the current study was 4.09±1.29 min. and this value lower than many investigators results which ranged from 5.71 to 12.9 minutes (Povinelli *et al*., 2003; Carlström *et al*., 2013; and Bobić *et al*., 2020).

According to these results we can conclude that milking abilities play a crucial role in dairy management as it aims to maximize production capacity and ensure high-quality milk. It is not merely a process of extracting milk from the cow's teats; rather, it triggers various physiological mechanisms within the lactating cow's body. These mechanisms have a significant impact on the regulation of production capacity, milk composition, feed intake, and animal behaviors. Therefore, the milking technique and routines offer an opportunity to interact with the cow's biology and achieve optimal yield and superior milk quality. The duration of milking holds significant economic importance as it directly impacts the overall milking time of cows in the milking parlor and any prolongation in milking time adversely affects production costs by increasing labor time. The variation in Milking-ability traits across assorted studies may be attributed to the distinct designs of milking parlors, herd management practices, and the utilization of enhanced breeds in different farms. Understanding animal behaviors, social interactions, and the psychological needs of animals is unquestionably crucial for achieving optimal and productive milk production.

Genetic and Environmental factors:

Table (2) demonstrates that the milk production and milking-ability traits were significantly influenced by sires and dams as a random factor (P≤0.05). These results agree with (Hamed and Soliman, 1994; Hammoud and Salem, 2013, and Faid-Allah, 2015) for 305-dMY, and for milking-ability traits in this study (Petersen *et al*., 1986, and Gäde *et al*., 2006).

Table 2. Genetic factors affect milk production and milking-ability traits in Holstein cows.

Genetic factors	**Milk production & Milking-ability traits**			
	305-dMY	**AFR**	**MD**	**PF**
Sire (n=261)	**	*	*	*
Dam (n=3321)	*	*	*	*

305-dMY= Milk yield at 305 days; AFR= Average flow rates; MD = Milk durations; PF= Peak flow rate.
* Significant differences (P ≤0.05), ** Highly significant differences (P ≤0.01).

This indicates the presence of heritable differences in the studied traits, and the assessments of heritable parameters were found to be extremely sensitive and capable of facilitating selection for heritable improvements in the studied traits.

The inclusion of parity as a fixed effect had a remarkably significant influence (P≤0.01) on 305-day milk yield and a significant impact (P≤0.05) on average flow rate, peak milk flow rate, and milk duration (Table 3).

Table (3) displays a highly significant on 305-dMY and this result is in accordance with (Atil, 2000); (Tadesse *et al*., 2010; (Usman *et al*., 2012; Chegini *et al*., 2015; Al-Samarai *et al*., 2015; Faid-Allah, 2015; Mikó *et al*., 2016; Salem and Hammoud, 2016a, and Koc, 2017). Also, parity has a significant effect on AFR, PF and MD this result is in accordance with (Petersen *et al*., 1986; Sandrucci *et al*., 2007; Gäde *et al*., 2007; Guler *et al*., 2009; Antalík and Strapák, 2011, and Berry *et al*., 2013).

Parity is one of the most influential factors affecting productive and reproductive traits because increasing and development of the size of the udder, increasing body size and body weight over and enlargement of the digestive system and the mammary gland that of the first lactation animal (Ruiz-Sánchez *et al*., 2007, and Badri *et al*., 2011).

Table (3) reveals that in the first and second parity exhibited the highest means of 305-day milk yield in general. However, as the parity advanced, this measure gradually decreased, reaching its lowest level in the fourth and fifth parities. This decline can be attributed to the fact that highly productive cows are more prone to mastitis and are overly sensitive to changes in environmental factors. The trend of AFR, PF, and MD showed a significant decrease from the first to the fifth parity.

Table 3. Environmental factors affecting milk production and milking-ability traits in Holstein cows

Environmental factors	Milk production & milking-ability traits							
	305-dMY		AFR		PF		MD	
	Mean	Sd	Mean	Sd	Mean	Sd	Mean	Sd
Parity	**		*		*		*	
1	10710.8[a]	1933.1	2.0[a]	0.672	3.7[ab]	0.888	3.7[d]	1.160
2	9520.6[b]	1736.2	1.7[b]	0.571	3.7[ab]	0.879	4.0[c]	1.203
3	9204.1[c]	1730.4	1.6[c]	0.549	3.6[b]	0.864	4.2[b]	1.304
4	8729.8[d]	1624.8	1.6[c]	0.538	3.6[ab]	0.891	4.3[ab]	1.280
≥5	8164.2[e]	1534.9	1.5[d]	0.509	3.4[c]	0.816	4.4[a]	1.394
Year of calving	**		*		*		*	
2007	8776.6[c]	1584.0	1.4[cd]	0.470	3.2[b]	0.768	5.0[a]	1.568
2008	7700.7[d]	1404.3	1.4[d]	0.452	2.7[c]	0.641	4.0[cd]	1.203
2009	8714.2[c]	1638.3	1.5[cd]	0.515	3.3[b]	0.792	4.5[b]	1.397
2010	8987.9[c]	1672.8	1.5[bc]	0.504	3.5[ab]	0.866	4.2[bc]	1.250
2011	9066.1[c]	1704.4	1.6[bc]	0.543	3.6[ab]	0.864	4.2[bc]	1.331
2012	9532.2[b]	1774.1	1.6[b]	0.518	3.6[ab]	0.891	4.1[cd]	1.220
2013	9963.6[a]	1854.4	2.0[a]	0.672	3.8[ab]	0.941	3.7[de]	1.101
2014	9712.3[ab]	1807.7	2.1[a]	0.706	3.4[ab]	0.842	3.6[e]	1.075
Herd	**		**		*		*	
№ 3	9278.0[b]	1674.5	1.8[b]	0.600	3.8[a]	0.912	3.9[c]	1.223
№ 6	9057.6[c]	1651.7	1.5[d]	0.504	3.8[a]	0.901	3.9[c]	1.173
№ 9	9869.4[a]	1855.4	1.5[d]	0.515	3.6[a]	0.864	4.7[a]	1.450
№ 10	9443.6[b]	1751.6	1.8[b]	0.605	3.3[b]	0.817	3.3[e]	0.982
№ 11	8843.4[d]	1662.6	1.7[cd]	0.577	3.5[b]	0.840	4.1[b]	1.239
№ 12	10042.9[a]	1860.2	2.1[a]	0.706	3.8[a]	0.940	3.7[d]	1.101
Season of Calving	*		**		*		*	
Winter	9346.1[bc]	1686.8	1.7[b]	0.571	3.6[ab]	0.864	4.0[b]	1.254
Spring	9213.5[c]	1680.2	1.6[c]	0.538	3.5[b]	0.831	3.9[b]	1.170
Summer	9367.8[b]	1761.1	1.7[b]	0.580	3.6[ab]	0.864	4.1[a]	1.293
Autumn	9563.8[a]	1780.0	1.8[a]	0.605	3.7[a]	0.916	4.2[a]	1.250

Means within column classification followed by different superscript are different significantly ($P \leq 0.05$). 305-dMY= Milk yield at 305 days; AFR= Average flow rates; MD= Milk durations; PF= Peak flow rate. * Significant differences ($P \leq 0.05$) , ** Highly significant differences ($P \leq 0.01$).

Table (3) illustrates the noteworthy impact ($P \leq 0.01$) of the calving year on the examined factors in Holstein cows. It is observed that the cows exhibit variations in their milk production and milking-ability characteristics from year to year. Similar results for all studied traits stated by (Al-Samarai *et al*., 2015, Faid-Allah, 2015; Awady *et al*., 2016; Koc, 2017; and Hadad, 2020) for milk production traits and in accordance with for milking-ability traits for Holstein dairy cattle in South African (Tshilate, 2017).

Furthermore, the cows experienced the highest 305-day milk yield values in the years 2013-2014 compared to other years. This could be attributed to effective management decisions made during the selection process. The year of calving plays a significant role in these changes, influenced by annual variations in temperature, alterations in management systems, and the availability of feed resources.

Table (3) indicates that the herd had a remarkably significant impact ($P \leq 0.01$) on 305-day milk yield and AFC. Furthermore, the herd had a significant influence ($P \leq 0.05$) on peak milk flow and milk duration.

Comparable results had noticed via many authors and commented that one of the factors affecting Milking-ability traits were resulting from herd management and it can be changes from farm to another farm (Mohsen *et al*., 1999; Al-Timimy, 2003; Rehman *et al*., 2008; Sudhakar *et al*., 2013, and Petrović *et al*., 2015). Furthermore, each herd has its own feeding system significant effects were noted on milking characteristics including average milk flow and milking duration (Blake and McDaniel, 1978; Thomas *et al*., 1991; Mohsen *et al*., 1999; McCarthy *et al*., 2007, and Mijić *et al*., 2007).

Table (3) displays that the effect of season of calving had a significant effect ($P \leq 0.05$) on 305-dMY, PF and MD; and a highly significant effect ($P \leq 0.01$) on AFR. Milk production traits affected by calving season (M'hamdi *et al*., 2012; Sahin *et al*., 2012; Bouallegue *et al*., 2013; Hammoud, and Salem, 2013; Froidmont *et al*., 2013; Kaygisiz, 2013; Ríos-Utrera *et al*., 2013; Bernabucci *et al*., 2014; Torshizi, 2016; Hassan *et al*., 2017; Cheruiyot *et al*., 2020; and Badr *et al*., 2020) that agree with the study.

Milking-ability traits affected by calving season (Tančin *et al*., 2006, and M'hamdi *et al*., 2012) that agree with the study. But some authors mentioned that had no significant effect by season of calving on milking-traits (Aydin *et al*., 2008). Effect of calving season had significant effect on AFC (Faid-Allah, 2015, and Salem and Hammoud, 2016b) that agree with this study.

Dairy farmers employ various techniques to cool lactating cows in the summer, with the most prevalent method being the use of water spray and fans to facilitate evaporative cooling. Implementing suitable housing that aids in dissipating heat could potentially alleviate the severity of these issues (Osman *et al*., 2013).

Heritability Estimates:

Table (4) presented heritability estimates (h^2), genetic (r_G) and phenotypic (r_P) correlation coefficients among various milk production and milking-ability traits. Heritability estimates for 305-dMY, PF and MD were 0.27±0.061, 0.20 ±0.013, 0.07 ±0.002, and 0.09 ±0.001, respectively.

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

Traits	305-dMY	AFR	PF	MD
305-dMY	**0.27±0.061**	.334±0.116**	.225±0.099**	.110±0.102**
AFR	.221**	**0.20±0.013**	.585±0.124**	-.393±0.145**
PF	.179**	.640**	**0.07±0.002**	.585±0.095**
MD	.183**	.683**	.663**	**0.09±0.001**

305-dMY= Milk yield at 305 days; AFR= Average flow rates; MD= Milk durations; PF= Peak flow rate.

These estimates are low to moderate and in accordance with most of the previous authors in Egypt for Holstein cows. Heritability estimates were 0.29, 0.42, 0.20, and 0.184 ±0.032 as stated by (Dadpasand *et al*., 2013, Hammoud and Salem, 2013, Kaygisiz, 2013, and Faid-Allah, 2015). for 305-dMY.

In literature, heritability estimate for AFR were ranging from 0.21 to 0.41, 0.28 to 0.37, and 0.21 to 0.36 for 1st, 2nd, and above parities, respectively as stated by (Dodenhoff and Emmerling, 2008, and Carlström *et al*., 2014). Furthermore, heritability's for PF were 0.55, .56, 0.40, 0.41, 0.11, 0.41, and 0.50 as stated by (Gäde *et al*., 2006; Gäde *et al*., 2007; Gray *et al*., 2011; Samoré *et al*., 2011; Gray *et al*., 2012, Carlström *et al*., 2014, and Pretto *et al*., 2014), respectively. moreover, heritability's for MD were 0.18, 0.19, 0.17, 0.39, 0.38, 0.37, 0.23, and 0.11 as stated by (Moore *et al*., 1983, Povinelli *et al*., 2003, Zwald *et al*., 2005, Gäde *et al*., 2006, Gäde *et al*., 2007, Aydin *et al*., 2008, Guler *et al*., 2009, and Gray *et al*., 2011), respectively. In previous studies, heritability ranging from 0.1 :0.6 were estimated for Milking-ability traits (Zwald *et al*., 2005, Carlström *et al*., 2009, and Edwards *et al*., 2014).

Genetic and Phenotypic Correlation's coefficients:

Table (4) illustrates genetic (r_G) and phenotypic (r_P) correlation's coefficients for the studied traits. All the coefficients displayed positive values except r_G between MD and AFR (-0.393 ±0.145). Table (4) shows a significant genetic correlation between 305-day milk yield and milking-ability traits. That in accordance with many authors working on Holstein cattle (Gäde *et al*., 2006, Gäde *et al*., 2007, Guler *et* *al*., 2009, Samoré *et al*., 2011, and Laureano *et al*., 2014).

The positive genetic and phenotypic correlations between milk yield and rates of flow and milking times were observed (Petersen *et al*., 1986). The genetic correlations among milk yield and average milk flow, maximum milk flow, and milking time are 0.51, 0.44, and -0.23, respectively. (Gäde *et al*., 2006)

The genetic correlation between milk yield and average milk flow showed a positive relationship (0.334*). Similar findings were stated by (Miller *et al*., 1976) in terms of genetic correlations.

The genetic and phenotypic correlations between MD The variations in parameters for measuring milk flow rate, as reported by different authors, could be attributed partly to variations in definitions and recording methods of the trait, as well as breed disparities (Williams *et al*., 1984). Genetic correlations (rg) between AFR and PF ranged from 0.89 to 0.91 (Gäde *et al*., 2006, and Gäde *et al*., 2007). Negative genetic correlations between AFR and MD have been stated in the literature (Gäde *et al*., 2006, Gäde *et al*., 2007, and Erdem *et al*., 2010). A moderate genetic correlation between the AFR and MD was obtained in the Italian Holstein cattle by (Samoré *et al*., 2011)

Coefficients of genetic and phenotypic correlations (±S.E) among Milking-ability traits were 0.79 ±0.09, 0.86 ±0.01 for AFR and PF; -0.35 ±0.23, -30 ±0.03 for AFR and MD; and -0.46 ±0.18, -0.32 ±0.03 for PF and AFR, respectively (Tshilate, 2017).

CONCLUSION

Estimate genetic parameters and association of milking-ability and milk production traits in Egyptian herds of dairy cows suggested that the potential use of milking-ability traits in genetic selection to improve profitability of dairy cattle, although its association with milking-ability and hygiene traits warrants further research. Based on the estimates of heritability's and the positive genetic correlations observed for some of studied traits, it is anticipated that a selection breeding program would lead to significant genetic improvement in selected breeds of milk cows.

ACKNOWLEDGMENTS

The authors thanks Eng. Tarik Attia (the livestock director) and Dina farms team of the Dina commercial farm for agriculture investment, to its collaborate and make available the databases required to conduct the research.

REFERENCES

Abou-Bakr, S., H. Alhammad, R. Sadek and A. Nigm, 2006. Productive and reproductive characteristics of Holstein cows raised under intensive farming system in Egypt. Egypt J Anim Prod 43:91-98.

Aerts, J., M. Kolenda, D. Piwczyński, B. Sitkowska and H. Önder, 2022. Forecasting Milking Efficiency of Dairy Cows Milked in an Automatic Milking System Using the Decision Tree Technique. Animals 12(8):1040.

Al-Samarai, F., Y. Abdulrahman, F. Mohammed, F. Al-Zaidi and N. Al-Anbari, 2015. Comparison of several methods of sire's evaluation for total milk yield in a herd of Holstein cows in Yemen. Open veterinary journal 5(1):11-17.

Al-Timimy, A., 2003. Genetic Evaluation of Holstein Friesian Bulls at the Artificial Insemination Center in Abu-Ghraib. M. Sc. Thesis. College of Agriculture, University of Baghdad.

Antalík, P. and P. Strapák, 2011. Effect of parity and lactation stage on milk flow characteristics of Slovak Simmental dairy cows. Veterinarija Ir Zootechnika (Vet Med Zoot) 54(76):8-13.

Ashmawy, A. and M. Khalil, 1990. Single and multi-trait selection for lactation in Holstein-Friesian cows. Egyptian Journal of Animal Production 27(2):171-184.

Atil, H., 2000. Genetic relationship between days open and days dry with milk yield in a herd of Holstein Friesian cattle. Archives Animal Breeding 43(6):583-590.

Awady, H., A. El-Khalek and M. Abo Elreesh, 2016. Genetic evaluation for some productive and reproductive traits by using animal model in a commercial Friesian herd in Egypt. Journal of Animal and Poultry Production 7(7):279-285.

Aydin, R., M. Yanar, O. GÜLER, S. Yuksel, F. UĞUR and L. Turgut, 2008. Study on milkability traits in Brown Swiss cows reared eastern region of Turkey. Journal of Animal and Veterinary Advances 7(10):1218-1222.

Badr, A.A., A.A. Amer and A. Khattab, 2020. Genetic Evaluation for Some Economically Importance Variables in Friesian Cows. Journal of Animal and Poultry Production 11(4):133-136.

Badri, T., M. Atta, M. T. Ibrahim and K. Gubartalla, 2011. Genetic and non-genetic factors affecting production potential of Butana dairy cows at Atbara Research Station, Sudan. Research Opinions in Animal & Veterinary Sciences 1(7):429-433.

Bernabucci, U., S. Biffani, L. Buggiotti, A. Vitali, N. Lacetera and A. Nardone, 2014. The effects of heat stress in Italian Holstein dairy cattle. Journal of dairy science 97(1):471-486.

Berry, D., B. Coughlan, B. Enright, S. Coughlan and M. Burke, 2013. Factors associated with milking characteristics in dairy cows. Journal of Dairy Science 96(9):5943-5953.

Bilal, G., and M. S. Khan, 2009. Use of test-day milk yield for genetic evaluation in dairy cattle: a review. Pakistan Veterinary Journal 29(1):35-41.

Blake, R.W. and B. McDaniel, 1978. Relationships among rates of milk flow, machine time, udder conformation, and managemental aspects of milking efficiency: a review. Journal of Dairy Science 61(4):363-378.

Bobić, T., P. Mijić, V. Gantner, G. Bunevski and M. Gregić, 2020. Milkability Evaluation of Jersey Dairy Cows by Lactocorder. Macedonian Veterinary Review 43(1):5-12.

Boldman, K. G., L. Kriese, L. Van Vleck, C. Van Tassell and S. Kachman, 1995. A manual for use of MTDFREML. A set of programs to obtain estimates of variance covariances. USDA, ARS, Lincoln, NE.

Bouallegue, M., B. Haddad, M. Aschi and H. Ben, 2013. Effect of environmental factors on lactation curves of milk production traits in Holstein–Friesian cows reared under North African condition. Lives Res Rural Develop 25:5.

Boujenane, I. and B. Hilal, 2012. Genetic and non genetic effects for lactation curve traits in Holstein-Friesian cows. Archives Animal Breeding 55(5):450-457.

Carlström, C., G. Pettersson, K. Johansson, E. Strandberg, H. Stålhammar and J. Philipsson, 2013. Feasibility of using automatic milking system data from commercial herds for genetic analysis of milk-ability. Journal of dairy science 96(8):5324-5332.

Carlström, C., G. Pettersson, K. Johansson, H. Stålhammar and J. Philipsson, 2009. Phenotypic and genetic variation in milk flow for dairy cattle in automatic milking systems. EAAP, Barcelona, Future of non-production traits for breeding and management of beef and dairy husbandry. Session 11:1-7.

Carlström, C., E. Strandberg, K. Johansson, G. Pettersson, H. Stålhammar and J. Philipsson, 2014. Genetic evaluation of in-line recorded milkability from milking parlors and automatic milking systems. Journal of dairy science 97(1):497-506.

Chegini, A., A. Shadparvar and N. Ghavi Hossein-Zadeh, 2015. Genetic parameter estimates for lactation curve parameters, milk yield, age at first calving, calving interval and somatic cell count in Holstein cows. Iranian Journal of Applied Animal Science 5(1):61-68.

Cheruiyot, E., T. Nguyen, M. Haile-Mariam, B. Cocks, M. Abdelsayed and J. Pryce, 2020. Genotype-by-environment (temperature-humidity) interaction of milk production traits in Australian Holstein cattle. Journal of Dairy Science 103(3):2460-2476.

Dadpasand, M., M. Zamiri and H. Atashi, 2013. Genetic correlation of average somatic cell score at different stages of lactation with milk yield and composition in Holstein cows. Iranian J Vet Res. 14:190-196.

Dodenhoff, J. and R. Emmerling, 2008. Genetic correlations between somatic cell count and milkability in the first three lactations in Fleckvieh. Interbull bulletin (38):55-55.

Edwards, J., J. Jago and N. Lopez-Villalobos, 2014. Analysis of milking characteristics in New Zealand dairy cows. Journal of dairy science 97(1):259-269.

Erdem, H., S. Atasever and E. Kul, 2010. Relationships of milkability traits to udder characteristics, milk yield and somatic cell count in Jersey Cows. Journal of Applied Animal Research 37(1):43-47.

Faid-Allah, E., 2015. Genetic and non-genetic analysis for milk production and reproductive traits in Holstein cattle in Egypt. Jurnal Ilmu Ternak dan Veteriner 20 (1) : 10-17. doi: http://dx.doi.org/10.14334/jitv.v20i1.1111

Froidmont, E., P. Mayeres, P. Picron, A. Turlot, V. Planchon and D. Stilmant, 2013. Association between age at first calving, year, and season of first calving and milk production in Holstein cows. Animal: An International Journal of Animal Bioscience 7(4):665.

Gray, K., F. Vacirca, A. Bagnato, A. Samoré, A. Rossoni and C. Maltecca, 2011. Genetic evaluations for measures of the milk-flow curve in the Italian Brown Swiss population. Journal of dairy science 94(2):960-970.

Gray, K. A., J. P. Cassady, Y. Huang and C. Maltecca, 2012. Effectiveness of genomic prediction on milk flow traits in dairy cattle. Genetics Selection Evolution 44(1):24.

Guler, O., M. Yanar, R. Aydin, B. Bayram, U. Dogru and S. Kopuzlu, 2009. Genetic and environmental parameters of milkability traits in Holstein Friesian cows. Journal of Animal and Veterinary Advances 8(1):143-147.

Gäde, S., E. Stamer, J. Bennewitz, W. Junge and E. Kalm, 2007. Genetic parameters for serial, automatically recorded milkability and its relationship to udder health in dairy cattle. Animal 1 (6):787-796.

Gäde, S., E. Stamer, W. Junge and E. Kalm, 2006. Estimates of genetic parameters for milkability from automatic milking. Livestock Science 104 (1):135-146.

Hadad, J. M. A., 2020. Performance of Friesian, Simmental and Bokane Cows for Milk Traits in Erbil Province-Kurdistan, Salahaddin University-Erbil.

Hamed, M. K. and A. M. Soliman, 1994. Single trait selection for 305-day milk, fat, and protein yield in Fleckvieh cattle. Egypt. J. Anim. Prod 31:281-496.

Hammoud, M., S. El-Zarkouny and E. Oudah, 2010. Effect of sire, age at first calving, season and year of calving and parity on reproductive performance of Friesian cows under semiarid conditions in Egypt. Archiva Zootechnica 13(1):60.

Hammoud, M. and M. Salem, 2013. The genetic evaluation of some first lactation traits of Holstein cows in Egypt. Alex J Agric Res 58(1):1-8.

Hammoud, M. H., 2013. Genetic aspects of some first lactation traits of Holstein cows in Egypt. Alex J Agric Res 58(3):295-300.

Hassan, F.A., M.A. Ali and M.S. El-Tarabany, 2017. Economic impacts of calving season and parity on reproduction and production traits of buffaloes in the sub-tropics. Environmental Science and Pollution Research 24(11):10258-10266.

Kaygisiz, A., 2013. Estimation of genetic parameters and breeding values for dairy cattle using test-day milk yield records. J Anim Plant Sci 23(2):345-349.

Koc, A., 2017. Effects of Some Environmental Factors on Milking Time Milk Yield in Red Holstein Cows. Turkish Journal of Agriculture-Food Science and Technology 5(8):917-922.

Laureano, M., A. Bignardi, L. El Faro, V. Cardoso, H. Tonhati and L. Albuquerque, 2014. Random regression models using different functions to model milk flow in dairy cows. Genetics and Molecular research:7528-7541.

Lee, D. and V. Choudhary, 2006. Study on milkability traits in Holstein cows. Asian-australasian journal of animal sciences 19 (3): 309-314.

Lučić, M., I. Pocrnić, M. Špehar, M. Štepec, Z. Ivkić and Z. Barać, 2013. Estimation of genetic parameters for milking speed for Holstein cattle in Croatia. In: 24th International Scientific-Expert Conference of Agriculture and Food Industry, Book of Abstracts, Sarajevo, Sept. 25-28, 2013. p 52.

Marestone, B.S., É.R. dos Santos, F.B.S. Serra, C.A.d.S.D. Muniz, C.P. Marques, K.B. Alves, M.V. Alves and R.C.M. Alves, 2013. Características reprodutivas, de crescimento e idade ao primeiro parto em bovinos da raça Holandesa Reproduction traits, growth traits and age at first calving in Holstein heifers. Semina: Ciências Agrárias, Londrina 34(6 suplemento 2):4105-4112.

McCarthy, S., D. Berry, P. Dillon, M. Rath and B. Horan, 2007. Effect of strain of Holstein–Friesian and feed system on udder health and milking characteristics. Livestock Science 107(1):19-28.

Mijić, P., I. Knežević, M. Matković, M. Baban and Z. Ivkić, 2007. The milkability and somatic cell counts of milk cows in various systems of keeping and milking. Biotechnology in Animal Husbandry 23(5-6-1):209-216.

Mikó, J., S. Atasever, G. M. Kocsisné and H. Erdem, 2016. Non-genetic factors affecting milk yield, composition and somatic cell count in Hungarian Holstein cows. Kafkas Universitesi Veteriner Fakultesi Dergisi 22(3):361-366.

Miller, R., R. Pearson, B. Weinland and L. Fulton, 1976. Genetic parameters of several measures of milk flow rate and milking time. Journal of dairy science 59(5):957-964.

Mohsen, M., E. Tawfik and H. El-Awady, 1999. Some non-genetic factors affecting milk production of Friesian herds. Der Tropenlandwirt-Journal of Agriculture in the Tropics and Subtropics 100(1):49-58.

Moore, R., J. Moxley, B. Kennedy and E. Burnside, 1983. Relationships between speed of milking and somatic cell count and production in Holsteins. Canadian Journal of Animal Science 63(4):781-789.

M'hamdi, N., M. Bouallegue, S. Frouja, Y. Ressaissi, S.K. Brar and M.B. Hamouda, 2012. Effects of environmental factors on milk yield, lactation length and dry period in Tunisian Holstein cows, Milk Production-An Up-to-Date Overview of Animal Nutrition, Management and Health. IntechOpen. p. 153-164.

NRC, 2001. Nutrient Requirements of Dairy Cattle. 7th ed. Washington DC USA: National Academy of Science, National Research Council.

Osman, M., K. El-Bayomi and S. Moawed, 2013. Genetic and non-genetic factors affecting some productive and reproductive traits in Holstein-Friesian dairy cows raised in Egypt for the first two lactations. Suez Canal Veterinary Medical Journal. 18(1):99-113.

Oudah, E. and Z.A. Khalefa, 2010. Genetic Evaluation for Friesian Cattle in Egypt Using Single-Trait Animal Model. Journal of Animal and Poultry Production 1(9):371-381.

Petersen, M., L. B. Hansen, C. Young and K. Miller, 1986. Rates of milk flow and milking times resulting from selection for milk yield. Journal of Dairy Science 69(2):556-563.

Petrović, D. M., V. Bogdanović, M. M. Petrović, S. Bogosavljević-Bošković, R. Đoković, R. Đedović and S. Rakonjac, 2015. Effect of non-genetic factors on standard lactation milk performance traits in Simmental cows. Annals of Animal Science 15(1):211-220.

Povinelli, M., C. Romani, L. Degano, M. Cassandro, R. Dal Zotto and G. Bittante, 2003. Sources of variation and heritability estimates for milking speed in Italian Brown cows. Italian Journal of Animal Science 2 (sup1):70-72.

Pretto, D., A. Tänavots, H. Kiiman, E. Pärna, H. Viinalass and T. Kaart, 2014. Genetic parameters of average milk flow recorded electronically from milking parlors and automatic milking systems in Estonian Holstein dairy cows. In: Proc. 10th World Congress of Genetics Applied to Livestock Production, Vancouver, BC, Canada. WCGALP Digital Archive, http://www.wcgalp.org. p 616.

Rahmatalla, S.A., U. Müller, E.M. Strucken, M.

Reissmann and G.A. Brockmann, 2011. The F279Y polymorphism of the GHR gene and its relation to milk production and somatic cell score in German Holstein dairy cattle. Journal of applied genetics 52(4):459-465.

Rehman, Z.U., M.S. Khan, S.A. Bhatti, J. Iqbal and A. Iqbal, 2008. Factors affecting first lactation performance of Sahiwal cattle in Pakistan. Arch. Tierz. Dummerstorf 51(4):305-317.

Ruiz-Sánchez, R., R. Blake, H. Castro-Gámez, F. Sánchez, H. Montaldo and H. Castillo-Juárez, 2007. Changes in the association between milk yield and age at first calving in Holstein cows with herd environment level for milk yield. Journal of dairy science 90(10):4830-4834.

Ríos-Utrera, Á., R.C. Calderón-Robles, J. R. Galavíz-Rodríguez, V.E. Vega-Murillo and J. Lagunes-Lagunes, 2013. Effects of breed, calving season and parity on milk yield, body weight and efficiency of dairy cows under subtropical conditions. International Journal of Animal and Veterinary Advances 5(6):226-232.

Sahin, A., Z. Ulutas, A.Y. Adkinson and R.W. Adkinson, 2012. Genetic and environmental parameters and trends for milk production of Holstein cattle in Turkey. Italian Journal of Animal Science 11(3):e44.

Salem, M. and M. Hammoud, 2016a. Estimates of heritability, repeatability, and breeding value of some performance traits of Holstein cows in Egypt using repeatability animal model. Egyptian J Anim Prod 53:147-152.

Salem, M. and M. Hammoud, 2016b. Genetic parameters of first lactation traits of Holstein cows in Egypt. Egyptian J. Anim. Prod 53(2):75-80.

Salem, M.A., H.M. Esmail, R.R. Sadek and A.A. Nigm, 2006. Phenotypic and genetic parameters of milk production and reproductive performance of Holstein cattle under the intensive production system in Egypt. Egypt. J. Anim. Prod 43(1):1-10.

Samoré, A., S. Román-Ponce, F. Vacirca, E. Frigo, F. Canavesi, A. Bagnato and C. Maltecca, 2011. Bimodality and the genetics of milk flow traits in the Italian Holstein-Friesian breed. Journal of dairy science 94(8):4081-4089.

Sandrucci, A., A. Tamburini, L. Bava and M. Zucali, 2007. Factors affecting milk flow traits in dairy cows: results of a field study. Journal of dairy science 90(3):1159-1167.

SAS, 2002. Statistical Analysis Systems. Version 9.1. SAS Institute Inc., Cary.

Sudhakar, K., S. Panneerselvam, A. Thiruvenkadan, J. Abraham and G. Vinodkumar, 2013. Factors effecting milk composition of crossbred dairy cattle in southern India. International Journal of Food, Agriculture and Veterinary Sciences 3(1):229-233.

Tadesse, M., J. Thiengtham, A. Pinyopummin and S. Prasanpanich, 2010. Productive and reproductive performance of Holstein Friesian dairy cows in Ethiopia. Livestock research for rural development 22 (2): 20-34.

Tančin, V., B. Ipema, P. Hogewerf and J. Mačuhová, 2006. Sources of variation in milk flow characteristics at udder and quarter levels. Journal of Dairy Science 89(3):978-988.

Thomas, C.V., D.K. Force, D.H. Bremel and S. Strasser, 1991. Effects of pulsation ratio, pulsation rate, and teatcup liner design on milking rate and milk production. Journal of Dairy Science 74(4):1243-1249.

Torshizi, M. E., 2016. Effects of season and age at first calving on genetic and phenotypic characteristics of lactation curve parameters in Holstein cows. Journal of animal science and technology 58(1):8-22.

Tshilate, T. S., 2017. Genetic Parameter Estimates of Milkability Traits in South African Holstein Cattle, University of Venda, South Africa,M.Sc.

Usman, T., G. Guo, S.M. Suhail, S. Ahmed, L. Qiaoxiang, M.S. Qureshi and Y. Wang, 2012. Performance traits study of Holstein Friesian cattle under subtropical conditions. J Anim Plant Sci 22(2):92-95.

Vosman, J., G. de Jong and H. Eding, 2014. Breeding of cows suitable for an automatic milking system. Interbull bulletin, Berlin, Germany, May 20-21 (48):32-36.

Williams, C., E. Burnside and L. Schaeffer, 1984. Genetic and environmental parameters of two field measures of milking speed. Journal of Dairy Science 67(6):1273-1280.

Zwald, N., K. Weigel, Y. Chang, R. Welper and J. Clay, 2005. Genetic evaluation of dairy sires for milking duration using electronically recorded milking times of their daughters. Journal of dairy science 88(3):1192-1198.

التقديرات الوراثية والبيئية لصفات القدرة على الحلب في أبقار الهولشتين تحت الظروف المصرية

اسلام فيض الله عباس، الهام محمد إسماعيل غنيم، محمد عادل الخمري

قسم الإنتاج الحيواني، كلية الزراعة، جامعة المنوفية، المنوفية، مصر

تم إجراء الدراسة لتقدير تأثير العوامل الوراثية والبيئية وتقدير المقاييس الوراثية لصفات إنتاج اللبن والقدرة على الحلب لأبقار الهولشتين. تم الحصول على البيانات من ستة قطعان من مزرعة تجارية (دينا للاستثمار الزراعي)، الموجودة في طريق القاهرة -الإسكندرية الصحراوي ٨٠كم من القاهرة، محافظة المنوفية، مصر. تضمنت البيانات ٣٨٨١ بقرة ناتجة عن ٣٣٢١ أم و٢٦١ أب تمثل الفترة من عام ٢٠٠٧ إلى ٢٠١٤. الصفات التي تمت دراستها هي صفة إنتاج اللبن في ٣٠٥ يوم [305-d.M. Y]وصفات القدرة على الحلب مثل متوسط معدل التدفق(كجم/دقيقة)، وذروة التدفق (كجم/دقيقة) ومدة الحلب (دقيقة) .كانت قيم المتوسط الحسابي والانحراف المعياري ومعامل الاختلاف (%) لصفات اللبن والقدرة على الحلب كالتالي ٩٣٩٩ ± ١٧٦٧كجم (١٨,٨٪) ، ٢,٢١±٠,٧٨ كجم\ دقيقه (٣٥٪) ،٣,٩٣ ± ١ كجم\ دقيقه (٢٥٪) ، ٤,٠٩ ± ١,٢٩ دقيقه (٣٢٪) على التوالي. كان تأثير الآباء والأمهات والقطعان وسنوات وفصول الولادة تأثيرات معنوية على الصفات المدروسة. تم تقدير المكافئ الوراثي بنسبة ٢٧,٠ ±٠,٠٦١ و٠,٢٠ ±٠,٠١٣ و٠,٠٧ ± ٠,٠٠٢ و٠,٠٩ ±٠,٠٠١ لصفات [305-d.M. Y] و[AFR] و [PF]و[MD] على التوالي. أظهرت تقديرات معاملات الارتباط الوراثية والمظهرية بين الصفات المدروسة إتجاهًا إيجابيًا، أشارت التقديرات المعتدلة للوراثة والارتباط الوراثي الإيجابي بين بعض الصفات المدروسة إلى أن التحسين الوراثي سيتحقق عن طريق برامج الانتخاب الوراثي.