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Genetic Evaluation for Milk Production Traits A Herd of Friesian Cattle Raised in Egypt

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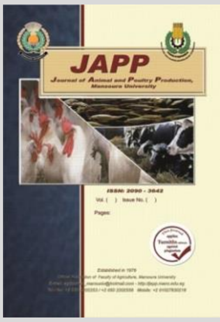

ABSTRACT

This study armed to estimate of non-genetic and genetic parameters that affecting Study traits including lactation length (LL), total milk yield (TMY), and 305 day milk yield (305d-MY). The number of records used were 1630 lactation records over a period of 10 years of pure Friesian cows raised at the commercial station in northern Egypt. Analysis was performed using SAS (To estimate non-genetic factors) In addition to the animal model (estimate genetic parameters). The most important results of the study that have been reached are summarized as follows: All non-genetic factors were significant for all the study traits. The overall mean for (LL), (TMY) and (305d-MY) was 358.3 days; 8675.3 and 7387.7 kg, respectively. Heritability values for were 0.13 ± 0.027, 0.28 ± 0.031, and 0.35 ± 0.030 for trait) f (LL), (TMY), and 305d-MY) respectively. Present results recommended the productive performance of Friesian cows can be improved through the adoption of appropriate management, nutrition, and breeding programs achieved through the selection program.

Keywords: Friesian, milk traits, non-genetic factor, Heritability, Egypt.

INTRODUCTION

The importance of increasing milk production in dairy cattle farms is due to its impact on obtaining the highest economic return and increasing income from good dairy cattle projects(Krpálková *et al*., 2014);The highest return can be obtained by increasing production by improving environmental conditions and good management (Birhanu *et al*., 2015). In general, Cattle population in Egypt is continuously increasing and is estimated to be about 5.02 million heads. They produce about 3.21 million metric tons of milk and about 53.88 % of the total milk production (FAO, 2010). The selection of Friesian cattle contributed to the spread of this breed around the world during the previous period, so the importance of raising Friesian cows in Egypt for the production of milk was indicated, and this resulted in an increase in commercial and governmental farms in the last period as a general case in the whole world and as a special case in Egypt because of its investigation high profitability and increased economic return (Shalaby *et al*., 2001).Friesian breed has high production of milk and this This encouraged tropical countries to pay more attention to the dairy industry (Abubakar *et al*., 1986). As the productivity of cows of milk and the lactation length were less compared to countries with low or moderate temperatures due to the difference in the genetic and environmental factors of the cows raised in those countries(Rege, 1998). Both non-genetic and genetic factors affect the MY of Friesian cows, non-genetic factors include nutrition, temperatures, optimum environmental conditions, season and year of calving, number of lactations, and management conditions. Also improving genetics (Alpan and Aksoy, 2015). The importance of estimating the heritability of predicting the response to selection is attributed to helping breeders choose an appropriate breeding system with the aim of improving the herd in future generations (Cassell, 2001). Moreover, the heritability explains the difference among individuals associated with genetic variance (Ali *et al*., 2019). The aim of this study was to genetic evaluation and estimated of non-genetic factor for TMY, 305d-MY, and LL milk production traits in a herd of Friesian cows raised in Egypt.

MATERIALS AND METHODS

Data used in this investigation were collected from 1630 lactation records of pure Friesian cows raised at the station of in Gharbawy commercial farm located in El-Sharkia Governorate. The records collected to represent 465 cows (daughters of 426 dams and 170 sires) and covered the period from 1998 to 2007.

Animal nutrition depends on good quality concentrate feed Mixture (CFM), corn silage and wheat straws all year round. In addition to the Egyptian clover was provided in winter, while par seem hay and hay or maid were In the summer the cows were fed a concentrated mixture of fodder twice daily depending on (body weight, production status of the cow).

All cows were machines – milked 4 times per day, Milk yields were individually recorded once a week to the headrest Kilogram. Cows were artificially inseminated by reaching the 2nd month post-partum. Heifers were served when reaching 18 month of age or 305 kg of live body weight. Disposal of cows from the farm of the study if any was done because of injury due to accidents, reproductive failure. Udder disorders and disease conditions, i.e was

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done involuntary. Traits investigated in this study were (LL), (TMY) and (305 DM).

Statistical analysis

The General liner Model (GLM) was utilized for variance analysis of MY traits (**SAS 2008**). Significance differences among sub-class means were tested by Duncan's.

Data were analyzed by a adopting the fixed Model:

$$Y_{ijkl} = \mu + P_i + R_j + S_k + e_{ijkl}$$

Where

Y_{ijkl} = on observation on TMY, 305 day MY and LL.
μ = general mean, common element to all observations.
P_i = the fixed effect for parity (i = 1-6),
R_j = the fixed effect for year of calving (j =1 - 10),
S_k = the fixed effect of the season (k = 1, 2, 3, and 4, 1=winter, 2=summer 3= spring and 4 = autumn),
e_{ijkl} = random error distributed with mean zero and variance δ2e.

Heritability, variance and covariance components using the program MTDFREML by Boldman *et al* (1995).

To estimate heritability for the traits studied. The animal model used was as follows:

$$Y= Xb + Za +Zpe +e$$

where:

y = Vector of milk traits X = matrix for fixed effects; b = overall mean and fixed effects; Za = matrix for random effects; a = Vector of direct genetic effects ; pe= a random permanent environmental effect and e = random errors. and e = random errors.

RESULTS AND DISCUSSION

The descriptive statistics; means, standard deviation (SD) and coefficients of variation (CV%) for studied milk traits are showed in Table.1 average and the coefficient of variability for LL in the present study lies within the range of the studies by Hammoud (2013), and Faid (2015) in Egypt who indicated that LL for Holstein cows in Egypt was found to vary from 286 to 407 days and the CV% of LL ranged from (5 to 31.74%) ,respectively. Means of (TMY), 305d-MY and (LL) were (8675.26 , 7387.70 kg and 358.25 days respectively).

Table 1. Actual means, standard deviations (SD) and coefficients of variation (CV%) for study trait s in Friesian cows raised in Egypt .

Variable	Mean	SD	CV %
LL(day)	358.25	2.30	25.98
TMY(Kg)	8675.26	68.94	32.08
305d-MY(Kg)	7387.70	37.22	20.34

These values were higher than those previously reported as 4592 and 4107 kg by El-Khashab (1993), 2422 and 2351 kg by El-Sheikh (1995) for TMY and 305d-MY, respectively, and 4348.0, 4229 kg and 314 days by Allam (2011), 5387.0, 5387 kg and 327 days by Taha (2013) and 7208.7, 6384.9 kg and 332 days by Faid (2015) for TMY, 305d-MY and LL, respectively. On the other hand, the values of TMY and 305-DMY were lower than those previously reported as (9710 and 8366 kg, respectively) and the values of LL were similar 357 days as reported by El-Attar (2009). The difference in milk traits among different authors may be attributed to genetic potentiality of the different herds or referring to management practices and variability of climatic changes. Higher estimates may be due to good management or to select cows depending on milk production through the use of selection programs and this requires attention to good care and management.

LSM for the effects of non-genetic factors (year, season of calving and parity) on traits of milk production were shown in Table (2). Observed that highly significant effects were found for the calving year ($P < 0.01$) on (TMY), 305d-MY and (LL). Also, parity had highly significant effects ($P < 0.01$) on (TMY) and (LL). But, it had significant ($P < 0.05$) on 305d-MY. Calving season had highly significant ($P < 0.01$) on the lactation length (LL) and 305d-MY, and significant ($P < 0.05$) on (TMY).

The highest values of TMY were recorded for animals which calved in the years (2002 and 2004) (9551.71 and 9061.22kg, respectively), while the least values were recorded in the years (1998 and 2007) (7105.96 and 6102.54 kg, respectively). This may be due to the availability of green forage and difference in climatic conditions of the years in TMY observed Abdel-Gader *et al* (2007), El-Attar (2009) and Allam (2011).

The highest ($p < 0.01$) TMY were observed in the fourth parity (8720.67 kg). Significantly and highly significant among parities in TMY observed by Gabr 2005; Abdel-Gader *et al*., 2007; Afzal *et al*., 2007; Usman *et al*., 2012 and Nigm *et al*., 2015).

Table 2. Least-squares means (LSM) and their standard errors (SE) of the factors affecting for traits study in Friesian cows.

Factor	LSM ± SE		
	LL	TMY	305d-MY
Year of calving			
1998	336.90 ± 14.71	7105.96± 456.24	6394.68±237.55
1999	350.18 ± 8.55	7308.18±265.05	6268.31±138.00
2000	339.34 ± 7.10	7807.68 ±220.33	6991.87±114.72
2001	349.51±6.18	8489.02±191.75	7308.87±99.83
2002	369.50±6.22	9551.71±192.88	7814.15±100.43
2003	351.37± 7.05	8671.07±218.54	7487.66±113.78
2004	385.55± 6.84	9061.22±212.27	7102.16±110.52
2005	368.82± 6.91	8690.60±214.42	7074.63±111.64
2006	354.72± 7.52	8541.10±233.21	7184.48± 121.42
2007	217.88±9.67	6102.54±299.80	8705.89± 156.09
	**	**	**
Season of calving			
Winter	349.88±4.12	8369.01±127.93	7271.51±66.61
Spring	349.95±8.21	7761.33±254.61	6692.60±132.57
Summer	340.83±5.81	8367.62±180.24	7474.69±93.84
Autumn	328.85±4.07	8033.68±126.25	7494.27±65.73
	**	*	**
Parity			
1	364.67±4.93	8467.55±152.96	7129.96±79.64
2	357.21± 4.71	8446.73±146.00	7257.21±76.01
3	336.89±5.79	8209.18±179.59	7457.50±93.51
4	357.88±6.88	8720.67±213.30	7423.85± 111.06
5	332.32±8.96	7844.15 ±277.78	7164.39±144.63
6	305.28± 9.88	7109.18± 306.50	6966.70± 159.58
	*	**	*

[**]significant at (P<0.01), [*]significant at (P<0.05)

Cows which calved in winter had higher ($p < 0.05$) total milk yield (8369.01) than those that calved in other seasons. These results in agreement with Abdel- Gader *et al*., 2007, Lateef *et al*., 2008 and M΄hamdi *et al*., 2012. indicated that winter season was highest in TMY. Animals which calved in the years (2004) had highest ($P<0.01$) values of LL (385.55 days) in comparison with the animals calved in the other years. Mustafa and Serdar (2009) noticed that year of calving had significant effect on LL for

Holstein cow. This result is in close agreement with reports by Hussain *et al*., (2006), Wondifraw *et al*., (2013) and Hassan and Khan (2013). The highest LL were observed in the fourth parity (8720.67) then decreased thereafter. El-Attar (2009), Lakshmi *et al*. (2009), Allam (2011) and M'hamdi *et al*.,(2012) found that parity had a highly significant effect on LL.

The winter and spring season had higher ($P<0.01$) lactation length (349 days) Lakshmi *et al.* (2009) found that cows calved in fall had comparatively low LL due to better feeding of cows; the probable reason for longer LL may be, improper timely insemination.. In agreement with these results, significant season of calving effect was reported on length of lactation period (M´hamdi *et al*., 2012; Usman *et al*., 2012 and Rehman *et al*., 2014).

The highest values of 305d-MY were recorded for animals which calved in the years (2007 and 2002) (8705.89 and 7814.25 kg, respectively), while the least values were recorded in the years (1999 and 1998) (6268.31 and 6394.68 kg, respectively). Similar results were obtained by Abdel-Gader *et al* (2007), El-Attar (2009) and Allam (2011) who found that year of calving had significant effect on 305d-MY. The differences between years may be due to the management factor and its effect on milk production traits. The highest Parity recorded ($p < 0.05$) for 305d-MY were observed in the third parity (7457.50 kg). Many of authors reported significant ($P<0.01$) effect of parity on 305d-MY, Amimo *et al*.,(2007), in Ayrshire cattle, and M'hamdi *et al*., (2012) in Tunisian Holstein. Lakshmi *et al*., (2010) observed significant effect of parity of animal on 300 days milk yield. Significant ($P<0.01$) effect of parity on 305d-MY observed by Katok and Yanar, (2012) and Poonam *et al*., (2016).

Season of calving was highly significant effect on 305d-MY cows which calved in autumn had higher TMY (7494.27 kg) than those that calved in other seasons. Significant effect season of calving was observed by Atil *et al*., 2001; M'hamdi *et al*., 2012 and Ratwan *et al*., 2016 of (HF cattle, Tunisian Holstein and Jersey crossbred cattle, respectively). Katok and Yanar, (2012) and Poonam *et al*., (2016) also reported significant ($P<0.05$) effect of season of calving on 305d-MY.

Genetic parameters

Estimates of variance component for LL,TMY, 305d-MY of Friesian cows were found in table 3. Estimates of additive genetic variance (σ^2a) for LL, TMY, 305d-MY were 1137.76, 2377.03 and 694.69 respectively, for Friesian cows. Table 3 shows variance estimates showed increasing in the TMY and 305d-MY but decreased in LP. In addition, the values of phenotypic variance σ^2p for the study of the same traits were 9041.73, 8390.85 and 1965.71, respectively, for Friesian herd under study.

Heritability values for all studied traits (LL, TMY, and 305d-MY) were 0.13 ± 0.027, 0.28 ± 0.031, and 0.35 ± 0.030, respectively. The heritability (h^2) estimates for study traits similar results Adbel-Moez (2007) working on Holstein Friesian in Egypt, This estimate was lower than those found by Gabr (2005) and This estimate was higher than those reported by Allam (2011)and Safaa (2016) working on Friesian cattle in Egypt. Usman *et al* (2012) showed that h^2 estimates for TMY and 305d-MY were 0.26 and 0.27 respectively. While, EL-Attar (2009) found that h^2 estimates for TMY and 305d-MY were 0.23 and 0.12, respectively.

Differently reported high h^2 values for these study traits in different breeds of cattle. The present estimates of h^2 for TMY and 305d-MY indicated that genetic change for trait is possible by selecting that most productive animal. While, the h^2estimates for LL indicated that the genetic variation among individuals may be due to feeding policy and environmental condition. The present estimates of $h^2$of the LL were extremely superior to those obtained by Allam (2011) and Taha (2013) working on Friesian cattle in Egypt.

Table 3. Estimates of (σ2 a), (σ^2P_e), (σ^2e) , (σ^2p), heritability (h^2), relative permanent and environmental variance (P^2_e) and error (e^2) in Friesian herd.

Parameter	Traits		
	LL	TMY	305d-MY
σ^2_a	1137.76	2377.03	694.69
σ^2p_e	2.17	59.937	0.4895
σ^2_e	7901.80	5953.88	1270.54
σ^2p	9041.73	8390.85	1965.71
h^2	0.13±0.027	0.28±0.031	0.35±0.030
p^2_e	0.00024±0.10	0.0071±0.089	0.00025±0.092
e^2	0.87±0.10	0.71±0.095	0.65±0.097

σ^2 a = direct additive genetic variance, σ^2p_e = maternal permanent environmental variance, σ^2 e = residual (temporary environmental variance), σ^2 p = phenotypic variance, h^2 = direct heritability, p^2_e = fraction of phenotypic variance due to maternal permanent environmental effects and e^2 = residual effects.

The difference heritability was estimated among traits studies for the same trait. This is due to differences in statistical model in the methods of analysis, number of records used. . Also good management will lead to difference heritability were estimated values.

The permanent environment (P^2_e) for LL, TMY, and 305d-MY were 0.00024±0.10, 0.0071±0.089 and 0.00025±0.092 respectively, for Friesian herd under study.

CONCLUSION

Dairy farm evaluation depends mainly on performance traits of dairy cows especially milk production, Also the importance of evaluation appears clearly in selection programs and to compare among cows in the herd. Under the Egyptian conditions, Friesian cows should be exploited and more attention. Parities, year of calving had significant effects on MY. Thus, improvement of environmental conditions may a sound impact on improving productive traits. The productive performance of pure Friesian cows could be improved by adoption of proper management, modern feeding policy and breeding programs. Also herd health. The present results concluded that both of management and selection can play important roles for improving these traits.

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التقييم الوراثي لصفات إنتاج اللبن في قطيع من أبقار الفريزيان المرباه في مصر

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تناولت هذه الدراسة تقييم المعالم الوراثية لصفات إنتاج الحليب (غير الوراثية والوراثية) التي تؤثر على بعض الصفات الإنتاجية وتضمنت البيانات علي طول فترة الحليب (LL) ، وإنتاج الحليب الكلي (TMY) ، وإنتاج الحليب 305 يومًا (305d-MY). تم جمع البيانات المستخدمة في هذا البحث من السجلات اشتملت الدراسة علي 1630 سجلا على مدى 10 سنوات لأبقار الفريزيان النقية في احدي المحطات التجارية بشمال مصر . تم إجراء التحليل باستخدام برنامج SAS لتقدير التأثيرات الثابتة للعوامل الغير وراثية (السنه ، الموسم ، ترتيب موسم الولادة). بالإضافة إلى ذلك ، تم استخدام نموذج الحيوان (MTDFREML) لتقدير المعالم الوراثية. وتتلخص النتائج المتحصل عليها كالاتي : كانت جميع العوامل الغير وراثية معنوية لجميع صفات الدراسة فكان لسنة الولادة وموسم الحليب وترتيب موسم الولادة تأثير عالي المعنوية على جميع صفات الدراسة (طول فترة الحليب (LL) ، وإنتاج الحليب الكلي (TMY) ، وإنتاج الحليب 305 يومًا) . كان المتوسط العام للصفات لطول فترة الحليب (LL) وإنتاج الحليب الكلي (TMY) وإنتاج الحليب 305 يومًا) كان 358.3 يومًا ؛ 8675.3 كجم و 7387.7 كجم على التوالي. بلغت قيم المكافئ الوراثي لجميع الصفات المدروسة 0.13±0.027 و 0.28±0.031 و 0.35 ± 0.030 بالنسبة لصفة (طول فترة الحليب (LL) ، وإنتاج الحليب الكلي (TMY) ، وإنتاج الحليب 305 يومًا) علي التوالي. من النتائج المتحصل عليها من هذه الدراسة يتضح أنه يمكن عمل تحسين وراثي لصفات أنتاج اللبن من خلال الانتخاب نظرا لقيم المكافئ الوراثي تراوحت بين متوسطة الى مرتفعة للصفات تحت الدراسة كما خلصت الدراسة الي أنه يمكن تحسين الأداء الإنتاجي لأبقار الفريزيان من خلال اعتماد برامج الإدارة والتغذية والتربية المناسبة.

الكلمات الرئيسية: ماشية الفريزيان ، صفات إنتاج اللبن ، العوامل الغير وراثية والوراثية ، المكافئ الوراثي , مصر.