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Genetic Parameters, Breeding Values and Genetic Trends for Some Productive and Reproductive Traits of Holstein Cows in Egypt

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Abstract

This study aimed to estimate the genetic parameters (heritability and genetic correlation), breeding value and genetic trends for some productive and reproductive traits of Holstein Friesian cows in Egypt with animal model statistical method. A total of 3400 lactation records collected from 1060 cow's progeny of 99 sires and 691 dams through the period from 1998 to 2010 were used in this study. Results of genetic correlations showed great variability from very high positive to very low negative values. High heritability estimates were recorded for all studied traits with the exception of days in milk, calving interval and days open which revealed low estimates. The ranges of cows breeding values have been found to be higher than either sires or dams for all studied traits. Genetic trends were positive for 305-day milk yield (2.68 kg), age at first calving (0.020), fat yield (0.031kg), fat% (0.001%) and protein % (0.002%), but were negative for protein yield (-0.098 kg) and days open (-0.219). In conclusion, higher range of the cow breeding values than either sires or dams revealed a wider genetic variation and a good opportunity for selecting the superior cows. Positive genetic trends for 305-day milk yield, age at first calving, fat%, fat yield and protein% indicated that there was a genetic improvement in these traits in desirable direction, but negative genetic trends for days open and protein yield indicating a decrease in mean breeding value for these traits over the study period.

Keywords: Holstein, Calving interval, Breeding value, Genetic trend, Animal model.

Introduction

Two decades ago, Holstein cattle has been entered to Egypt and reared in commercial farms characterized by intensive housing, feeding and high level of good veterinary management to relatively approach the animal welfare level to avoid stress conditions. Several researchers have investigated the effect of genetic and non-genetic factors on productive and reproductive traits of Friesian cows under Egyptian conditions [1-3]. The profitability of dairy cattle operations could be effectively improved by the genetic improvement of economically important traits, especially milk yield [4]. This mainly depends upon genetic differences that a population encountered which could be measured by heritability estimate of a trait in a certain environment [5].

The efficiency of selection procedures could be visualized by determination of genetic trend as well as it is useful tool in the quantification of the genetic changes of the traits under selection over time. In addition to this, any mistakes in the direction of selection could be corrected [6]. Also, interpretation of genetic trend estimates is of value in monitoring the efficacy of the genetic improvement programs and ensures that the selection procedures directed toward the economically important traits. The objectives of this study were to estimate some genetic parameters (heritabilities and genetic correlations), breeding values and genetic trends for some productive (days in milk, total milk yield, 305-days milk yield, fat percentage, protein percentage, fat yield and protein yield) and reproductive traits (services per conception, days open, age at first calving and calving interval).

Material and Methods

Herd management

A herd of Holstein-Friesian cattle that belongs to a private farm (Alexandria-Copenhagen dairy farm), 76 km Alexandria-Cairo desert road was used for production and reproduction data collection from 1998 to 2010. About 3400 lactation records of 1060 dairy cows (99 sires and 691 dams). Shaded open yards with a cool spraying system during the high atmospheric temperature were

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constructed for animals housing. Cows were grouped according to milk production and fed total mixed ration (TMR) all over the year. The access for feed was based on the productive and physiological status [7]. Animals have a free access to water. When the heifers have reached a live body weight of 350 kg they were artificially inseminated for the first time and rectally palpated about 60 days post insemination. Heat was detected visually by heat detectors (30 minute a.m. and p.m.) near predicted estrus. About day 60 postpartum, the cows in estrous were artificially inseminated. Cows were machine milked three times daily at 06.00 h, 14.00 h and 22.00 h in herringbone parlor Alfa Lafal 40 point. Afikim and Dairy Comb 305 computer recording systems were used for data recording. Milk yield was recorded three times/days, then daily and weekly milk averages were calculated for each cow. Calves suckled colostrum of their dams for 3 days and then they were separated. A dry period of two months between two successive lactations has been established.

Traits recorded

Traits recoded could be divided into:

a) Productive traits which include the following traits:-

Total milk yield (TMY) which is the total amount of milk produced after yielding the colostrums until the end of lactation; 305-days milk yield (305-DMY) represents the amount of milk produced by the cow during the first 305 days of lactation; Days in milk (DIM) which is the number of days during lactation that a cow has been milked; Dry period (DP) or the non-lactation period; Fat yield which is the amount of fat per kilogram in the total milk yield; Fat percentage that is the percentage of fat in the total milk yield; Protein yield which is the amount of protein per kilogram in the total milk yield and Protein percentage which is the percentage of protein in the total milk yield.

b) Reproductive traits which include the following traits:-

Age at first calving (AFC); Service per conception (S/C) which is the number of services required for the cow to be conceived; Days open (DO) that is the period per days between calving and conception and calving interval (CI) represents the average time interval per days between successive calving.

Statistical analysis

Restricted maximum likelihood (REML) procedures of the MTDFREML program [8] was used to estimate heritability, genetic correlations and breeding values of studied traits using the following model:

$$y = Xb + Zu + e$$

Where: y: a vector of observations, b: a vector of fixed effects with an incidence matrix X, u: a vector of random animal effects with incidence matrix Z, and e: a vector of random residual effects with mean equals zero and variance σ^2_e.

Genetic trends were estimated as the regression of mean estimated breeding values of cows on their birth or calving dates for cows born between 1998 and 2010 using the following equation:

$$Yi = a + b\ Xi$$

Yi: estimated breeding value of trait, b: genetic trend, Xi = Year of calving and a = Genetic gain. First, breeding values of any trait was estimation, and then averages of breeding values of animals for that trait of that year were calculated. Finally, Regression analysis was used to determine the significance of genetic trend using SPSS (16.0).

Results and Discussion

Genetic parameters

Genetic correlation

Results of genetic correlations for some milk production and reproduction traits in Friesian cows were represented in Table 1. High positive genetic correlations were detected between TMY and 305-DMY (0.9) which was consistent with those reported previously [5, 9] Furthermore, TMY showed high positive genetic correlations between fat and protein yields (0.84 and 0.89, respectively). These results are in agreement with the results of other researchers [10, 11]. High positive genetic correlation between milk and fat yields (0.96) was previously recorded [12]. In addition, genetic correlation between TMY and DIM was high and positive (0.59) that was similar to Mariz [3]. These results indicated that production traits in Holstein-Friesian cows were influenced by the same sets of genes and selection for improvement in one trait will automatically improve the other.

Low negative and desirable genetic correlations were recorded between TMY and fat and protein percentages (-0.04 and -0.10, respectively) that are comparable with others [13, 14]. A negative genetic correlation of -0.32 between milk yield and fat percentage in Moroccan Holstein-Friesian cows has been recorded [12]. The genetic correlation of TMY with DP was negative (-0.52) which was disagreed with Salem *et al*. [1]. However, these estimates were agreed with those reported previously [3, 15]. A negative genetic correlation of milk yield with DP (-0.96) was reported by Ahmed *et al*. [9]. On the other hand, the genetic correlations between TMY and CI were positive and moderate (0.34), which are in agreement with those recorded by other authors [11, 16]. Ahmed *et al*. [9] reported a negative genetic correlation between milk yield and CI (-0.56).

Table 1: Genetic correlation (above the diagonal) and heritability (the diagonal) for milk production and reproductive traits in Holstein-Friesian cows

	TMY	305-DMY	DIM	Fat %	Fat yield	Protein %	Protein yield	DP	S/C	CI	DO
TMY	**0.33 ±0.020**	0.90	0.59	-0.04	0.84	-0.10	0.89	-0.52	-0.25	-0.34	0.18
305-DMY		**0.33 ±0.020**	0.64	-0.36	0.58	-0.38	0.64	-0.61	-0.39	0.35	0.13
DIM			**0.11 ±0.018**	-0.49	0.19	-0.48	0.27	-0.62	-0.17	0.77	0.80
Fat%				**0.38 ±0.019**	0.49	0.97	0.44	0.64	-0.67	0.52	-0.23
Fat yield					**0.37 ±0.020**	-0.41	0.99	0.25	0.09	0.39	-0.07
Protein%						**0.25 ±0.019**	0.37	0.63	-0.69	0.22	-0.18
Protein yield							**0.32 ±0.020**	-0.27	0.08	0.44	0.02
DP								**0.24 ±0.026**	0.65	0.15	-0.02
S/C									**0.43 ±0.010**	overestimate	0.37
CI										**0.03 ±0.018**	overestimate
DO											**0.06 ±0.015**

TMY, total milk yield; 305-DMY, 305-days milk yield; DIM, days in milk; DP, dry period; S/C, service per conception; CI, calving interval; DO, days open.

Medium negative and desirable genetic correlation was detected for TMY with S/C (-0.25). On the other hand, medium positive and undesirable genetic correlations were observed between TMY and DO (0.18). Concurrent results were confirmed by Toghiani and El-shalmani [11, 17], but controversy with Ahmed *et al*. [9], who observed a negative genetic relationship of milk yield with DO (-0.49). The genetic correlations between 305-DMYand fat and protein percentage were negative (-0.36 and -0.38), which are harmonious with those recorded by Sahebhonar [18], but its association with fat and protein yields were high and positive (0.58 and 0.64, respectively), which are in agreement with those reported previously [10, 19]. Indeed, genetic correlation between 305-DMYand DIM was high and positive (0.64) which confirmed those reported by Mariz [3]. The genetic correlation of lactation length with 305-DMY was high and positive (0.96) [9]. On the contrary, the genetic correlation between 305-DMY and DIM was low (0.16) [20].

The genetic correlations among CI and 305-day milk yield, fat%, fat yield, protein% and protein yield were moderately positive (0.35, 0.32, 0.39, 0.22 and 0.44, respectively). These results are consistent with those reported by Van-Raden *et al*. [21] and Makgahlela *et al*. [22]. By contrast, negative significant genetic correlation between CI and protein production percent (-0.27) on standardized lactation was registered by Riecka and Candrak [16]. Dry period showed highly positive genetic correlations with fat and protein percentages (0.64 and 0.63), but the genetic correlations between it and each of fat and protein yields were negative (-0.25 and -0.27). The genetic correlation that detected between fat and protein yields was high and positive (0.99) which is in parallel with those reported by others [10,23], who detected positive genetic relationships of fat% with fat yield, protein% and protein yield (0.49, 0.97 and 0.44, respectively).

Heritability estimates

Heritability estimates of some milk production and reproduction traits were summarized in Table 1. High and similar heritability estimates for each of TMY and 305-DMY (0.33±0.02) which indicated the possibility of improvement of these traits by genetic selection. These estimates were particularly similar to those obtained by El-shalmani [17] and Mostafa [24]. However, the estimates were higher than those reported by Ayied *et al*. [25] and Hammoud *et al*. [26], which could be explained by different number of animals and/or different estimation methods. Heritability estimates of fat and protein% were 0.38 and 0.25, respectively. These estimates were higher than those reported previously [27,28]. High heritability estimates for fat and protein yields (0.37 and 0.32, respectively), which are consistent with those obtained by Mashhadi *et al*. [29], but are higher than those recorded by others [30,31]. Days in milk had a medium heritability estimate (0.11), which was similar to those reported previously [32,33]. On the other hand, these estimates were much higher than those reported by Ayied *et al*. [25], but were lower than those recorded by others [5,34]. Medium estimates were recorded for DP (0.24) that were similar to the estimates reported by Goshu *et al*. [5] whereas, were higher than those registered by Salem *et al*. [1] and Ibrahim [35], but lower than those published previously [25,36].

The heritability estimate of CI was very low (0.03). Similar estimates were reported previously [27,33]. However, higher estimates were published by Islam *et al*. [37]. Very low estimate was recorded for DO (0.06). Concurrent estimates were published by others [27,38]. On the contrary, a high heritability estimate for DO (0.51) in Friesian cows under Sudanian tropical conditions was reported by Abdel-Gader *et al*. [33]. High heritability estimate was detected for S/C (0.43). Controversy results were reported previously [27,39]. However, this estimate was in the same line of that obtained by Osman *et al*. [40]. Age at first calving had a high heritability estimate (0.40), which was consistent with that reported by Ayied *et al*. [25] and Ghiasi *et al*. [38]. In contrast, low heritability estimates were mentioned previously [41,42]. The low heritability of fertility traits (DO and CI) indicated that the influence of herd management and other environmental factors were greater than genetic background. Also, the possibility of improvement through direct selection was difficult. Whereas, medium heritability estimates for DP and protein percent indicated possibility of improvement through both genetic selection and by good managerial and environment conditions. However, high heritability estimate for TMY, 305-DMY, fat percent, fat yield, protein yield, AFC and S/C indicated the possibility of improvement of through direct selection.

Breeding values

Minimum, maximum, range and standard errors of cow, sire and dam breeding values for some milk production and reproduction traits were presented in Table 2. The breeding values for TMY, 305-DMY and DP of cows ranged between -4463 and 4969, -3854 and 3086 kg and between -22.22 and 123.91days, respectively while the corresponding values for dams were between -2535 and 3034, -2598 and 1709 kg, and between -15.92 and 57.13 days, respectively. Moreover, the corresponding values for sires between -4754 and 3972, -3736 and 2151 kg and between -24.08 and 110.01 days, respectively. The range of breeding values for 305-DMY were higher than those reported by Atil and Khattab [43]. The range of predicted sire breeding values for single trait analyses ranged from -391 to 700 kg for 305-DMY [44]. Also, the range was between -656 and 455 for sire, between -186 and 386 kg for cows was reported by Katok and Yanar [45]. The range of breeding values for TMY and 305-DMY for cows was between -8857 and 10253, and between -5662.1 and 2817 kg, respectively and between -372.2 and 399.7 for sire and between -455.9 and 337.7 kg, respectively for cows. While, dam breeding values for these traits ranged between -344.7 and 724.5 and between -895.8 and 604.2 kg, respectively [26]. Higher range for TMY (-442 and 1265 kg) were depicted by Rehman and Khan [46]. The range for TMY (6006 kg and 10280 kg) for single-trait and multi-trait analyses respectively was stated in previous studies [47].

Table2: Range of predicted breeding values of Holstein-Friesian cows, sires and dams for some productive and reproductive traits when using records of all lactations

Traits	Minimum ± SE	Maximum ± SE	*Range
Cows breeding value			
TMY (kg)	-4463±0.80	4969±1.48	9432
305-DMY (kg)	-3854±0.60	3086±1.06	6940
Fat%	-0.98±0.14	1.23±0.26	2.21
Fat yield (kg)	-138.5±2.58	205.76±4.69	344.26
Protein%	-0.57±0.11	0.73±0.18	1.3
Protein yield (kg)	-105.32±2.16	137.2±3.75	242.52
DIM (day)	-70.82±2.60	86.27±3.46	157.09
DP(day)	-22.22±1.22	123.91±1.95	146.13
AFC (month)	-7.90±2.80	10.17±3.39	18.07
CI(day)	-14.43±1.20	15.58±1.35	30.01
DO(day)	-27.27±1.69	37.49±2.05	64.76
Sires breeding value			
TMY (kg)	-4754±0.61	3972±1.75	8726
305-DMY (kg)	-3736±0.44	2151±1.25	5887
Fat%	-0.57±0.11	1.574±0.32	2.14
Fat yield (kg)	-121.17±1.92	175.65±5.66	296.82
Protein%	-0.38±0.08	0.93±0.21	1.31
Protein yield (kg)	-84.86±1.54	113.53±4.39	198.39
DIM (day)	-69.31±1.73	62.98±3.67	132.29
DP (day)	-24.08±0.91	110.01±2.17	134.09
AFC (month)	-8.46±1.58	7.36±3.82	15.82
CI (day)	-16.55±1.02	12.65±1.37	29.20
DO (day)	-28.51±1.22	29.80±2.12	58.31
Dams breeding value			
TMY (kg)	-2535±1.23	3034±1.81	5569
305-DMY (kg)	-2598±0.88	1709±1.30	4307
Fat%	-0.56±0.22	0.97±0.33	1.53
Fat yield (kg)	-84.90±3.91	95.17±5.86	180.07
Protein%	-0.25±0.15	0.50±0.21	0.75
Protein yield (kg)	-61.83±3.11	73.14±4.55	134.97
DIM (day)	-37.97±3.04	65.02±3.75	102.99
DP (day)	-15.92±1.68	57.13±2.21	73.97
AFC (month)	-5.75±2.99	5.09±3.89	10.84
CI (day)	-5.92±1.30	10.56±1.37	16.48
DO (day)	-16.05±1.89	21.11±2.215	37.16

TMY, total milk yield; 305-DMY, 305-days milk yield; DIM, days in milk; DP, dry period; AFC, Age at first calving; CI, calving interval; DO, days open;*Range is calculated as maximum minus minimum of the breeding value.

For DP, the range was higher than those reported by El-Arian *et al*. [48] and Hatem and Ismail [49]. Sire breeding value for DP was ranged between -15.95 to 49.60 days [25]. The range was between -78 and 116 was recorded by Rehman and Khan [46]. Also, the range of sire breeding value for DP (34.62 day), for dams (29.35 day) and (53.71day) for cows was reported by Mariz [3]. The values for fat%, fat yield, protein% and protein yield of cows ranged between -0.98 and 1.23%, -138.5 and 205.76 kg, -0.57 and 0.73%, and between -105.32 and 137.2 kg, respectively while, the corresponding values for dams were between -0.56 and 0.97%, -84.9 and 95.17 kg, -0.25 and 0.50%, and between -61.83 and 73.14 kg, respectively. Moreover, the corresponding values for sires were between -0.57 and 1.574%, -121.17 and 175.65 kg, -0.38 and 0.93%, and between -84.86 and 113.53 kg, respectively. The average of sire breeding values for fat and protein yields were 26.6 kg/lactation and 15.7 kg/lactation, respectively [50]. The mean of breeding values of sires were 3.7, 2.3, -0.036 and -0.028 for fat and protein yields, percent of fat and protein, respectively [29]. The range of predicted sire breeding values for single trait analyses ranged from -14.74 to 22.06 kg for 305 day fat yield and from -11.09 to 21.80 kg for 305 day protein yield [44]. The estimated sire breeding value for fat yield varied from 17.6 5 to -21.6 kg and cow breeding value for the same trait varied from 16.57 to -7.35kg [45].

Cow, sire and dam breeding values for DIM in the present study were ranged between (-70.82 and 86.27 days), (-69.31 and 62.98 days) and (-37.97 and 62.02 days), respectively. The range of DIM obtained in the present study was higher than those published in previous studies [43,49]. The range between -5.44 and 6.30 days for sire was reported previously [25]. The range between (-303.4 and 350.8 days), (-7.1 and 5.7 days) and (-2.4 and 3.2 days) for cow, sire and dam, respectively was mentioned by Hammoud and Salem [26]. The breeding values for CI and DO of cows ranged between -14.43 and 15.58 and between -27.27 and 37.49 days, respectively while, the corresponding values for dams were between -5.92 and 10.56 and between -16.05 and 21.11 days, respectively. Moreover, for sires they were between -16.55 and 12.65 and between -28.51 and 29.80 days, respectively. The cow, sire and dam breeding values for CI ranged between (-1.00 and1.03), (-1.23and 0.95) and (-0.54 and 0.59), respectively [3]. The range from -8.14 to 11.91 days for sires was stated by Ayied *et al*. [25]. Cows breeding value for DO ranged from -278.8 and 495 days [26]. While, for dams varied from -10.2 and 16.5 days and for sires -16.4 and 29.7. The values for cow, sire and dam ranged between (-50.13 and144.30), (37.59 and 170.46) and (-24.42 and 66.31), respectively [3].

Cow, sire and dam breeding values for AFC in the current study were ranged between (-7.90 and 10.17 months), (-8.46 and 7.36 months) and (-5.75 and 5.09 months), respectively and these were higher than those reported previously [49,51]. The range from -2.10 to 2.28 months, for sires was recorded by Ayied *et al*. [25]. The range from -3.47 to 2.68 months was estimated by Moawed [52]. The range of the cow breeding values for a trait in a given herd indicated the amount of genetic variation among cows. The wider the range is the wider the genetic variation and this gives the opportunity for improving the considered trait through selection according to the superiority of the cow breeding value.

Genetic trends

Genetic trends of some milk production and reproduction traits were presented in Figure 1 and Figure 2 (A). Figure 1 (A) showed that the genetic trend of 305-DMY was positive throughout the period from 2002-2006, then declined till 2008 and rose again till 2010 and estimated to be 2.68 kg/year. The positive values of regression coefficient suggest genetic improvement in the farm for 305-DMY and right selection procedures. On the other hand, a declined trend in 305-DMY was observed throughout the period from 1998-2002. The present results are in disagreement with those reported by Hammoud and Salem [26] and Effa *et al*. [53], but in accordance with findings of others [45,54,55].

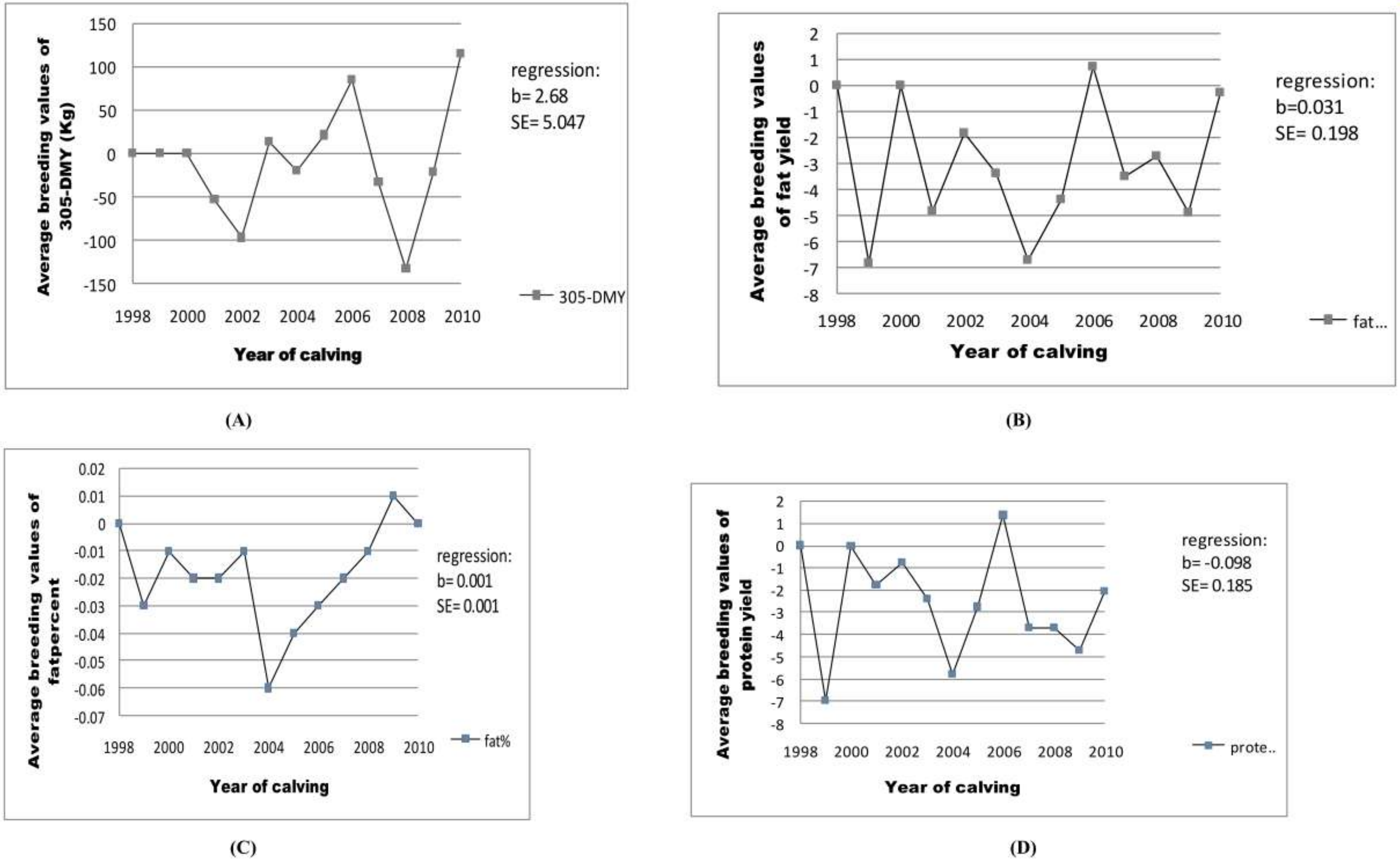
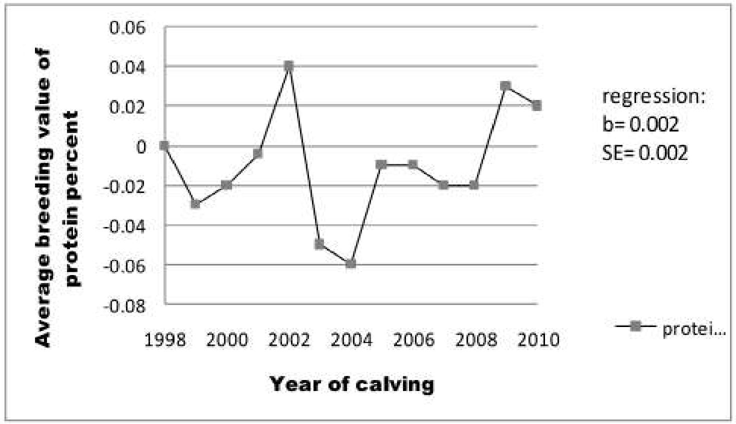
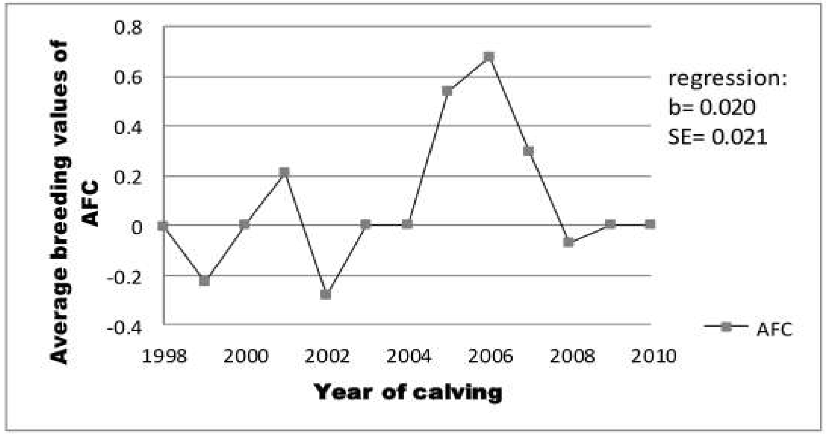


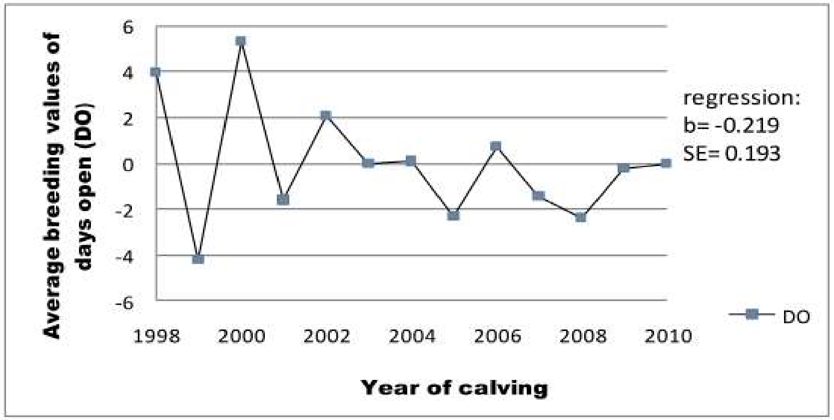
Figure 1: Genetic trend for some productive traits in Holstein-Friesian cows in Egypt
(A): genetic trend for 305-day milk yield **(B): genetic trend for fat yield**
(C): genetic trend for fat% **(D): genetic trend for protein yield**



(A)



(B)



(C)

Figure 2: Genetic trend for protein percent and some reproductive traits of Holstein-Friesian cows in Egypt
(A): Genetic trend for protein percent **(B): Genetic trend for age at first calving**
(C): Genetic trend for days open

Figures 1 (B-D) and Figure 2 (A) showed the genetic trends of fat yield, fat%, protein yield and protein%, respectively. All of the annual genetic trends were positive and estimated as 0.031 kg/year, 0.001%/year and 0.002%/year for (fat yield, fat% and protein %, respectively). In contrast, they were negative for protein yield (-0.098). The current results were in agreement with those recorded by others [6,45,56], but controversy with Khanzadeh *et al*. [28], Abdullahpour *et al*. [57] and Hossein-Zadeh [58]. The high positive genetic trends for fat and protein yields ensured the strong relationship between milk yield and these traits genetically as compared to percentage traits. Figure 2 (B) showed a positive genetic trend for AFC (0.020 month/year), which was in agreement with those reported by others [53,59], but in disagreement with those previously reported [58,60]. Figure 2 (C) showed a negative genetic trend for days open. Regression coefficient for this trait was -0.219 days/year, which was parallel with those reported by El-shalmani [17] and Solemani-Baghshan *et al*. [59] and inconsistent with Hammoud and Salem [26]. Positive genetic trends for 305-DMY, AFC, fat%, fat yield and protein% indicated that there was a genetic improvement in these traits in the desirable direction over the year, but negative genetic trends for DO and protein yield indicated a decrease in mean breeding value over the study period.

Conclusion

The genetic correlations between the studied traits showed great variability from very high positive to very low negative values. Strong heritability estimates were recorded for all studied traits with the exception of days in milk, calving interval and days open which revealed low estimates. Higher range of the cow breeding values than either sires or dams revealed a wider genetic variation and a good chance of selecting the superior cows. Positive genetic trends for 305-day milk yield, age at first calving, fat%, fat yield and protein% indicated that there was a genetic improvement in these traits in desirable direction over the year, but negative genetic trends for days open and protein yield indicated a decrease in mean of breeding values for these traits over the period of the current study.

Conflict of interest

The authors have no any conflict of interest.

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الملخص العربى

المعالم الوراثية، القيم التربوية والإتجاهات الوراثية لبعض الصفات الإنتاجية والتناسلية لأبقار الهولشتاين فى مصر

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هدفت هذة الدراسة لقياس المعالم الوراثية والتى تشمل المكافئ الوراثى والإرتباط الجينى وكذلك القيم التربوية والإتجاهات الجينة لبعض الصفات الإنتاجية والتناسلية لأبقار الهولشتاين- فريزيان فى مصر بإستخدام نموذج الحيوان الإحصائى. وقد تم الأستعانة بعدد ٣٤٠٠ سجل لبن مجمعة من ١٠٦٠ بقرة إبنة والأتية من ٩٩أب و٦٩١ أم خلال الفترة من ١٩٩٨-٢٠١٠. وشهدت الإرتباطات الجنية بين الصفات المدروسة تنوعا كبيرا من إيجابى وعالى جدا إلى سلبى ومنخفض جدا. سجلت مكافئات وراثية قوية لكل الصفات المدروسة فيما عدا عدد أيام الحليب، الفترة بين ولادتين متتاليتين والفترة ما بين الولادة والتلقيح المخصب. سجلت القيمة التربوية للأبقار مدى أعلى من القيمة التربوية للاباء والأمهات لكل الصفات المدروسة. سجلت إتجاهات وراثية موجبة لإنتاج اللبن المتحصل علية خلال ٣٠٥ يوم (٢.٦٨ كجم) وكذلك العمر عند أول ولادة (٠.٠٢٠ شهر) وإنتاج الدهن (٠.٠٣١ كجم) ونسبة الدهن (٠.٠٠١%) ونسبة البروتين (٠.٠٠٢%) ولكن كانت الإتجاهات الوراثية سالبة لكل من البروتين (- ٠.٠٩٨ كجم) والفترة ما بين الولادة والتلقيح المخصب (-٠.٢١٩يوم). نستخلص من هذة الدراسة ان المدى الواسع للقيم التربوية للأبقار مقارنة بالاباء والأمهات تدل على التنوع الوراثى العالى وبالتالى فرصة أعلى لإنتخاب الأبقار الجيدة. الأتجاهات الوراثية الموجبة لإنتاج اللبن المتحصل علية خلال ٣٠٥ يوم وكذلك العمر عند أول ولادة وإنتاج الدهن ونسبة الدهن والبروتين تدل على التحسن الوراثى عبر كل السنوات ولكن الإتجاهات الوراثية السالبة لكل من إنتاج البروتين والفترة ما بين الولادة والتلقيح المخصب فتدل على إنخفاض فى متوسط القيم التربوية لهذة الصفات عبر السنوات التى قد تم تجميع فيها هذة السجلات.