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GENETIC PARAMETERS AND ANNUAL GENETIC TRENDS FOR PRE-WEANING TRAITS OF HOLSTEIN MALE CALVES IN EGYPT

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ABSTRACT: *The data obtained from Safi Masr farm (Safi Masr for Developing the Animal Resources), located at the North of Nile Delta (Dakahlia, Egypt); these data included 2307 of male Holstein calves from 46 sires and 1362 dams within 2004 to 2011 year. Data were analyzed using the mixed model involving the effects of sire as a random effect, calving season, parity and year of calving as fixed effects. Studied traits were body weights at birth, 30, 60, 90 days of age and average daily gain from birth to 90 days of age.*

The means and standard deviations of body weights at birth, 30, 60 and 90 day-old, and average daily gain were 38.18 ± 4.345, 47.52 ± 4.136, 67.55 ± 4.043, 95.78 ± 4.107 and 0.656 ± 0.048 kg, respectively. Season of calving had no significant effects, but sire, parity of cow and year of calving had significant effects on studied traits.

Heritability estimates were 0.30, 0.41, 0.31, 0.20 and 0.20 for body weights at birth, 30, 60, 90 days of age and average daily gain from birth to 90 days of age, respectively. Most estimates of rG and rP among body weight and daily gain traits were positive. Genetic trends and breeding values were estimated for body weights at birth, 30, 60 and 90 day-old, and average daily gain.

Key words: *Genetic parameter - annual genetic trends- pre-weaning traits - holstein.*

INTRODUCTION

In cattle breeding, especially, birth weight and other pre-weaning growth traits are the most important traits for the description of breed characteristics. Growth is routinely measured as the change in live weight or mass (Owens *et al.*, 1995).

Birth weight is an important performance factor in beef and dairy cattle and has been studied by many researchers (Swali and Wathes, 2006; Shahzad *et al.*, 2010 and Segura-Correa *et al.*, 2012). Birth weight is used as a first measure of growth performance in animals and it is the easiest and most reliable measure of growth during the pre-natal period and postpartum period. Birth weight of calves is often considered in genetic improvement programs for many reasons: 1) it is easily measured and 2) it is correlated with a number of other performance traits (Sahin *et al.*, 2012). Therefore, the aim of the present study is to estimate the genetic and phenotypic parameters of pre-weaning growth traits of male Holstein calves and its annually genetic trend.

MATERIALS AND METHODS

The data obtained from Safi Masr farm (Safi Masr for Developing the Animal Resources), located at the North of Nile Delta (Hafir Shehab El-Din District, Al-Marazia Village, Belqas, Dakahlia Governorate, Egypt). Data were collected from the records of Holstein herd (2307 records of 46 sires and 1362 dams) during the period from the years 2004 to 2011. These records involved the effects of sire, calving season (Cold season from November to April and Hot season from May to October), parity of cow (1st, 2nd, 3rd, 4th and 5th) and year of calving (2004 to 2011). Body weights at Birth (W0), 30 days of age (W30), 60 days of age (W60), 90 days of age (W90) and average daily gain from birth to 90 days of age (ADG).

Feeding and management:

Calves were produced via artificial insemination (imported semen of Holstein sires). After calving, birth weight, sex and pedigree of calves were recorded. Calves were born around the year. Body weights of calves were recorded in the morning before feeding. Calves were allowed to receive the colostrum for the first 4 days of life. Colostrum was offered 3 times daily at a rate of 10% of body weight of calf. From the 5th day of age, calves were fed on natural whole milk and there after the milk substitute (18% protein) and hay were offered based on the weight of the calf. Water was available all the time except an hour before suckling.

Statistical analysis:

The linear mixed models with fixed effects of calving year (2004 to 2011), season of calving (cold and hot) and parity of dam (from 1st to ≥5th) were used in the statistical analysis of data in present study. Sire was assumed as random effect. Descriptive statistics, GLM and Duncan's multiple range tests at $P \leq 0.05$ were calculated by SPSS computer program (SPSS, 1997). The following model was used: $Y_{iknmo}=\mu+S_i+T_k+P_n+O_m+e_{iknmo}$

Where: $Y_{ijklmno}$=is the individual observation; μ= is the overall mean; S_i= is the effect of the i^{th} sire, i= 1, 2, 3..., 46; T_k=is the effect of the k^{th} season of calving, k = 1, 2 where (hot=1, cold=2); P_n=is the effect of the n^{th} parity of cow, l=1, 2, 3, 4, ≥5; O_m= is the effect of the m^{th} year of calving, m=1, 2, 3, 4, 5, 6, 7, 8; and e_{iknmo} = the error term.

Genetic parameters were estimated by derivative free REML with a simplex algorithm using the Multiple Trait Derivative-Free Restricted Maximum Likelihood (MTDFREML) programs of Boldman *et al.* (1995). The animal model in matrix notation was: $Y = Xb + Za + e$

Where: Y= the vector of observations W0, W30, W60, WW and ADG; b = the vector of fixed effects (i.e. parity, year, season of calving); a = the vector of random additive genetic direct effects; X and Z= known incidence matrices relating observations to the respective; e= vector of residual effects $(0, I\sigma_e^2)$.

RESULTS AND DISCUSSION

Descriptive statistics:

Table (1) shows the means and standard deviations of body weights W0, W30, W60 W90, ADG were 38.18 ± 4.345, 47.52 ± 4.136, 67.55 ± 4.043, 95.78 ± 4.107 and 0.656 ± 0.048 kg, respectively. The similar mean of birth weight was estimated by Gaffer *et al.* (2005; 35.3 kg). In addition, similar weaning weight mean reported by Oudah and Mehrez, (2000; 96.9 kg). Also, the present estimate of ADG agreement with this estimated by the same authors.

Table 1: Descriptive statistics and factors affecting for studied traits.

Item	Traits [a]				
	W_0(Kg)	W_{30}(Kg)	W_{60}(Kg)	W_{90}(Kg)	ADG (Kg/d)
Mean ± SD	38.18±4.345	47.52±4.136	67.55±4.043	95.78±4.107	0.656±0.048
CV%	11.38	8.7	5.99	4.29	7.26
Max.	47	62	75	102	0.756
Min.	29	41	56	80	0.489
Factors affecting studied traits					
Sire	* [b]	*	*	*	*
Parity of cows	*	*	*	*	*
Year of calving	*	*	*	*	*
Season of calving	ns.	ns.	ns.	ns.	ns.

a:W0, W30, W60, W90 and ADG Refer to birth weight, 30-day-old, 60-day-old, 90-day-old and average daily gain of calves, respectively.
b: ns. Non-Significant, and *significant at p≤0.05

Factors affecting studied traits:

Season of calving had no significant effect, but sire, parity of cow and year of calving had significant effects on all studied traits (W0, W30, W60, W90 and ADG) (Table 1). Similarly, Oudah and El-Awady (2006) showed highly significant effects of sire and year of calving on birth weight, weaning weight and average daily gain except the effect of season of calving on weaning weight of calves was not significant, but Habib *et al.* (2010) found no significant effect of sire on birth weight. Also, Simcic *et al.*, (2006), observed similar results of effects of parity on birth weight. Melaku *et al.* (2011) reported that influence of parity of dam on weaning weight of calves could be related to milking and mothering ability of the dams. Generally, the calves born from elder dams performed lower than those produced from younger one. This might be due to the fact that aged dams produced lower milk yield and that affects the birth weight and subsequent growth performance of calves.

Genetic parameters:

Table (2) presented estimates of heritability (h^2), genetic correlations (r_g) and phenotypic correlations (r_P) among different pre-weaning growth traits. Estimates for W0, W30, W60, W90 and ADG of Holstein calves were 0.30 ± 0.05, 0.41 ± 0.04, 0.31 ± 0.06, 0.20 ± 0.06 and 0.20 ± 0.05, respectively. These estimates are moderate and are in agreement with that reported by Oudah and El-Awady (2006) for birth weight, weaning weight and average daily gain in Holstein calves in Egypt. Higher heritability estimate for weaning weight was reported by Maarof *et al.* (1988) working on Friesian calves. He reported that the estimate of h^2 for weaning weight was 0.43. While the lower estimate of h^2 for weaning weight was reported by Lengyel *et al.* (2001). Faidallah (2010) reported lower heritability estimate for body weights of calves at 60 days of age (0.31) but higher for 90 days of age (0.40) than in the present study. According to the present results, the moderate estimates of h^2 of the pre-weaning growth traits may refer to the possibility of genetic improvement for such traits through selection. In this regard, El-Awady (2003), Oudah and El-Awady (2006) and Faidallah (2010) obtained similar conclusions on Friesian calves.

Table (2) presents direct genetic and phenotypic correlations among the studied traits. As can be observed, birth weight had significant and high genetic correlations with W30 (0.89) and W60 (0.82) but had low genetic correlations with W90 (0.12) and ADG (-0.01); the corresponding phenotypic correlations between W0 and W60, W30, W90 and ADG were 0.95, 0.81, 0.59 and -0.08, respectively. Weaning weight had a significant and high genetic correlation (0.62) with the pre-weaning daily weight gain. Genetic correlations between weaning weight and the three traits were low with W0 (0.12) and W30 (0.06) and high with W60 (0.58) and ADG (0.62). The moderately high genetic correlations between weaning weight and the pre-weaning daily weight gain (0.62), and between weaning weight and W60 (0.58), may indicate that selection to improve W60 or pre-weaning daily weight gain would be expected to have a positive effective correlated response in this respect.

Table 2: Estimates of heritability (diagonal), genetic correlations (below) and phenotypic correlations (above) for pre-weaning growth traits

Traits [a]	W0(Kg)	W30(Kg)	W60(Kg)	W90(Kg)	ADG(Kg/d)
W0	0.30±0.05	0.81	0.95	0.59	-0.08
W30	0.89	0.41±0.04	0.74	0.44	-0.16
W60	0.82	0.75	0.31±0.06	0.55	-0.08
W90	0.12	0.06	0.58	0.20±0.06	0.66
ADG	-0.01	0.25	0.23	0.62	0.20±0.05

[a]:W0, W30, W60, W90 and ADG Refer to birth weight, 30-day-old, 60-day-old, 90-day-old and average daily gain of calves, respectively.

In agreement with the present results, El-Awady (2003) found positive genetic and phenotypic correlations between birth weight and weaning weight of calves. He also found that direct genetic correlation between birth weight and weaning weight was 0.49, while phenotypic correlation between the same two traits was 0.56 of Friesian calves. He also reported that the negative genetic and phenotypic correlations between birth weight and average daily gain were -0.14 and -0.22, respectively.

In a later study, Oudah and El-Awady (2006) estimated the genetic and phenotypic correlations among different traits of growth in Friesian calves; these correlations were positive except the genetic and phenotypic correlations between birth weight and average daily gain of calves which were negative. They also concluded that positive genetic and phenotypic correlations between birth weight and weaning weight and between birth weight and average daily gain of calves may indicate that selection for birth weight would be associated with genetic and phenotypic improvement in the growth traits from birth to weaning. They also stated that the positive genetic correlation between birth weight and weaning weight refers to positive genetic linkages between pre-and postnatal growth traits in beef cattle.

In the present study, the positive genetic correlation estimated between W0 and W90 might be an indication to a positive genetic relationship between both traits in Friesian calves, as previously concluded by Koots *et al.* (1994). According to the moderate to high h^2 estimates and positive genetic and phenotypic correlations, reported in the present study, it could be concluded that the genetic improvement for pre-weaning growth traits could be achieved through direct or indirect selection.

The expected breeding values showed large differences among sires for different traits (W0, W30, W60, W90 and ADG). The highest expected breeding values (1.804, 1.992, 2.026, 2.158 and 0.126) were recorded for the sires banded 6, 2, 2, 64 and 83 with regard to W0, W30, W60, W90 and ADG, respectively. In harmony with the present results, Atil *et al.* (2005) reported that sire breeding values for birth weight and weaning weight were – 3.40 to 2.99 kg, and – 2.50 to 4.47, respectively. They indicated high potential for rapid genetic improvement in birth and weaning weights through selection. They also concluded that selection for birth weight to get the best sires will increase weaning weight of calves in the next generation. Also, Zülkadir *et al.* (2010) reported that breeding value for Brown Swiss sires ranged from –1.130 to 0.884 in Turkey.

Annual genetic trend:

The annual genetic trend for W0 of calves is given in Figure 1. These annual genetic changes were positive during the first five years of study and ranged from 0.065 (2007) to 3.151 (2006); and zero (2011); but were negative for the years2009 and 2010, being -0.596 and -0.205, respectively. The corresponding annual genetic trend for W30 is presented in Figure 1. These annual genetic changes were positive during the first three years of study and ranged from 1.036 (2005) to 2.290 (2006); but were negative for the last five years of the study and ranged between -1.329 (2009) and -0.300 (2008). In terms of W60, the annual genetic trend of calves is shown in Figure 1. These annual genetic changes were positive during the first three years and fifth year of study and ranged from 0.462 (2008) to 2.171 (2006); but were negative for the last three years and fourth year of the study and ranged between -0.706 (2009) and -0.262 (2007). The corresponding annual genetic trend for W90 is given in Figure 1. These annual genetic changes were positive during all years of the study and ranged from 0.038 (2009) to 1.213 (2006). In terms of ADG, annual genetic trend is given in Figure 1. These genetic changes were positive during all years of the study and ranged from 0.036 (2008) to 0.220 (2009).

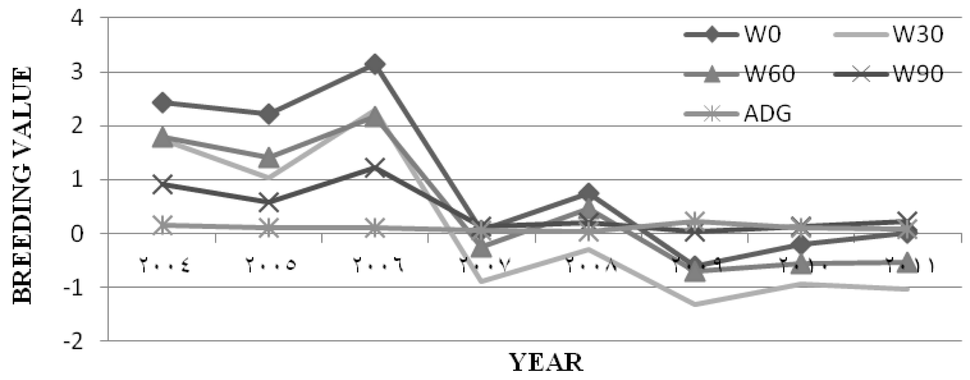

Fig.(1) Genetic trends for body weights and avrage daily gain

Sahin *et al*. (2012) estimated genetic trends for birth weight of calves using regression of breeding values on years. They observed irregular increases and decreases in birth weight of breeding values of calves according to years. Genetic trend for birth weight of calves was estimated to be −0.01 kg/year and was not different from zero. Breeding values for birth weight were negative in some years, whereas they were positive in others.

CONCLUSION:

Heritability estimates were 0.30, 0.41, 0.31, 0.20 and 0.20 for body weights at birth, 30, 60, 90 days of age and average daily gain from birth to 90 days of age, respectively. Most estimates of r_G and r_P among body weight and daily gain traits were positive. Genetic trends and breeding values were estimated for body weights at birth, 30, 60 and 90 day-old, and average daily gain.

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المعالم الوراثية والاتجاهات الوراثية لصفات ما قبل الفطام في عجول هولشتين الفرزيان في مصر

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الملخص العربى

تم الحصول على البيانات المستخدمة فى هذه الدراسة من مزرعة صافى مصر لتنمية الثروة الحيوانية والتى تقع فى شمال دلتا النيل فى مصر(محافظة الدقهلية – جمهورية مصر العربية) ، وهذه البيانات تضمنت ٢٣٠٧ سجلا لعجول الهولشتين الناتجة من ٤٦ ذكرا و١٣٦٢ بقرة خلال الفترة من عام ٢٠٠٤ إلى عام٢٠١١. وتم تحليل تلك البيانات بإستخدام النموذج المختلط والذي تضمن تأثير الأب (كتأثير عشوائي)، وفصل الولادة وترتيب الولادة ، وسنة الولادة (كتأثرات ثابتة). وفى هذه الدراسة قد تم تقييم صفات النمو لمرحلة ما قبل الفطام لأوزان عجول الفريزيان عند الولادة، وكذلك عند أعمار ٣٠، ٦٠، ٩٠ يوما علاوة على متوسط الزيادة اليومية في الوزن للعجول من الميلاد وحتى عمر ٩٠ يوما.

كانت متوسطات صفات الوزن عند الميلاد لعجول الفريزيان وكذلك أوزان الجسم عند أعمار٣٠ و٦٠ و٩٠ يوما ومتوسط الزيادة اليومية في الوزن هي ٣٨.١٨± ٤.٣٤٥، ٤٧.٥٢±٤.١٣٦، ٦٧.٥٥±٤.٠٤٣، ٩٥.٧٨±٤.١٠٧ و٠.٦٥٦±٠.٠٤٨ كيلو جراما على التوالى.

لم يكن لفصل الولادة تأثير معنوى على الصفات محل الدراسة بينما حقق الأب وترتيب الولادة وسنة الولادة تأثيرا معنويا على الصفات المدروسة لمرحلة ما قبل الفطام (الأوزان عند الميلاد وعند عمر ٣٠ و٦٠ و٩٠ يوما ومتوسط الزيادة اليومية في الوزن).

كانت قيم المكافئ الوراثي لأوزان عجول الفريزيان عند الميلاد وعند عمر ٣٠ و٦٠ و٩٠ يوما ومتوسط الزيادة اليومية في الوزن هي ٠.٣٠±٠.٠٠٥، ٠.٤١±٠.٠٠٤، ٠.٣١±٠.٠٠٦، ٠.٢٠±٠.٠٠٦، ٠.٢٠±٠.٠٠٥ على التوالى. كانت معظم الإرتباطات الوراثية و المظهرية موجبة مابين الصفات المدروسة (الأوزان عند الميلاد وعند عمر ٣٠ و٦٠ و٩٠ يوما ومتوسط الزيادة اليومية قي الوزن). كما تم تقدير القيم الوراثية والاتجاهات الوراثية لصفات ما قبل الفطام (الأوزان عند الميلاد وعند عمر ٣٠ و٦٠ و٩٠ يوما ومتوسط الزيادة اليومية في الوزن).