RESTRICTED, MULTI-SOURCE AND DESIRED GAIN SELECTION INDICES FOR PRE-WEANING BODY WEIGHTS IN FRIESIAN HEIFERS IN EGYPT

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ABSTRACT

This study was carried out to expect genetic gain and possibility of genetic improvement of pre-weaning growth traits of Friesian heifers. Records of 1748 progeny of 61 sires and 846 dams were collected from 1995 to 2010. That belongs to the Experimental and Researches Unit of Animal Production in Tokh Tanbisha, in the middle Delta. This belongs to Faculty of Agric., Minoufiya Univ., Egypt. Analysis was carried out by SAS (SAS, 2002) to test the significance of factors affecting studied traits and MTDFREML program (Boldman *et al*., 1995) with the mixed model used including sires, dams as random effects and parity, year and season of birth as fixed effects to estimate the variance components. Furthermore, Selection Index Program (Wagenaar *et al*., 1995) and Matlab program (Matlab, 2002) were used to construct the selection indices. It is using multi-source multi-trait selection index methods which include general, restricted indices at different levels of restrictions on increase in birth weight, multi-source index and selection index with desired genetic gain. Estimates of variance components for body weight at birth, 30, 60 and 90 days of age were computed and used to construct selection indices to improve studied traits in Friesian heifers.

The general index incorporating weights of birth $_{(W0)}$, 30 $_{(W30)}$, 60 $_{(W60)}$ and 90 $_{(ww)}$ days of age had the highest correlation with aggregate breeding value (R_{ih}=0.5051). The correlation fell to 0.321 when body weight at birth was restricted by 100% from the index. Furthermore, Using multi-source of information will enhance correlation with aggregate breeding value (R_{ih}= 0.5208) and the expected genetic gain for all studied traits and will be useful in case of missing data for selected animals and/or weight at 90 day. The highest expected genetic gain in W90 was 1.021 kg at (*i*=1) and 0.3574 kg at (*i*=0.35) per generation with multi-source index ($I_{6\text{-multi}}$); this decreased to 0.740 kg/generation when body weight at birth with full restricted strategy ($I_{5\ (100\%)}$).

From the present results, it could be using ($I_{6\text{-multi}}$, I_1,and $I_{8\text{-desired}}$) to improve pre-weaning body weights in Friesian heifers and using ($I_{4\ (75\%)}$) under restriction strategy in case of population that have already not reached optimal W_0 but in case of population that have already reached optimal W_0 using completely restriction index ($I_{5\ (100\%)}$).

Keywords: Body weight, Genetic parameter, Selection index, Multi-Source, Restriction, Desired gain, Friesian heifers.

INTRODUCTION

Heifers with a high growth rate produce more meat and begin to produce milk and reproduce at an earlier age. Friesian heifers of high growth performance show decreased time to conception and better milk yield during the first lactation as compared with those of low or average growth performance (Shemeis *et al*., 2006). On the other hand, MacNeil *et al*. (1998)

showed that it is necessary to select against the increase of birth weight due to it is positive relationship with dystocia.

Various methods have been developed to estimate variance components used extensively for estimation of heritability and of genetic, phenotypic correlations, for construction of selection indices (Güler et al., 2010). The most widely known of these methods are Henderson's I, II, III methods and (REML) restricted maximum likelihood, (MINQUE) minimum variance quadratic unbiased estimation and (ML) maximum likelihood. Many researchers have used these methods to estimate unbiased variance components for many important yield traits in livestock (Aksakal et al., 2012).

Selection index was developed by Hazel and Lush (1942) and Hazel (1943) as a method of selection for more than one trait at the same time. This method helps breeders to rank and evaluate the individuals on their total breeding values by condensing and summarizing the breeding values of the different economic traits in one total score for each one. Multiple trait selection requires the definition of a breeding goal including individual traits weighted according to their relative contribution to efficiency of production as expressed by economic values (Hazel, 1943). Osborne (1957) reported that An individual's phenotypic values (own-performance) are not only the source of information for predicting its breeding value but also reflects the performance of its relatives such as full-and half -sibs and described the procedures of ranking the individuals as per the information available on the individual itself and its full- and half -sibs with respect to one trait. Multiple trait selection indexes with multiple source of information is expected to have the advantages of both methods described above and using traits like carcass traits in selection index for live animals. Liljedahl et al. (1979) documented that similar procedures could be used for selection of more than one trait with more than one source of information.

This study was mainly carried out to estimate the genetic parameters of pre-weaning body weights of Friesian heifers in Egypt, and construct different selection indices to improve their pre-weaning body weights using multi-source of information to get highest accuracy for predicted genetic gain, using restriction on increase in birth weight and selection index with desired genetic gain.

MATERIALS AND METHODS

Experimental Units

Data on 1748 progeny of 61 sires and 846 dams were used for this study obtained from the Experimental and Researches Unit of Animal Production in Tokh Tanbisha, in the middle Delta, which belongs to Faculty of Agriculture, Minoufiya University, Egypt; through 16 years from 1995 to 2010 for body weights at birth, 30, 60 and 90 days of age in Friesian heifers.

Genetic and non genetic factors affecting:

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

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

Where: Y_{ijklmn} = The individual observation,
μ = Overall mean,
S_i = Effect of i^{th} sire, i= 1,…., 61,
D_j = Effect of j^{th} dam, j= 1,…., 846,
p_k = Effect of k^{th} parity of dam, l=1,…,5, ≥6,
t_l = Effect of l^{th} year of birth, m=1,…, 16,
o_m = Effect of m^{th} season of birth, k =1,.,4, Where: 1= winter, 2= spring, 3= summer, 4= fall
e_{ijklmn} = Error term NIID (0, $\sigma^2 e$).

Genetic parameters

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

The animal model in matrix notation was**:**

$$\mathbf{Y = Xb + Za + e}$$

Where: **Y**= the vector of observations (W_0, W_{30}, W_{60} and WW);
b= the vector of fixed effects (i.e. parity, year and season of birth);
a = the vector of random additive genetic direct effects (i.e. sire and dam);
X and **Z**=Known incidence matrices relating observations to the respective;
e= vector of residual effects (0, $I\sigma_e^2$).

Selection Index:

General Selection Index:

Selection Index Program (Wagenaar *et al*., 1995) and Matlab program (Matlab, 2002) were used to construct the selection indices. Studied traits were used to construct eight selection indices. Selection index obtained by solving the following equation:

$$I = b_1P_1 + b_2P_2 + \cdots b_nP_n = \sum_{i=1}^{n} biPi$$

Where: **I** = selection index, **bi** = index weights for each trait in the index;

$\mathbf{P_i}$= phenotypic measurement for each trait in the index.

The general index was obtained by solving the following equations given in matrix expression according to Cunningham (1969):

$$\mathbf{P*b = G*a \quad to\ give \quad b = P^{-1} *Ga}$$

Where: **P**= Phenotypic variances (cov.) matrix; **G**= Genetic variances (cov.) matrix;

a= Economic weights column vector; **b**= Weighting factors column vector.

Restricted Selection Index:

The general idea of the restricted index is to keep a particular trait from

changing genetically, and permit optimum genetic gains in other traits in the index from generation to generation of selection. According to Cunningham *et al*. (1970) for each completely restriction (i.e. zero change) of a particular trait a dummy variable was added to the general index; a row and column were added to the original P matrix to get P*, the row consists of genotypic co-variances of the other variables with the trait being restricted to zero change, the column is the transpose of the row and the diagonal element is zero. A row of zeros was added to the original G matrix to get G* matrix and zero economic value attaches to every restricted trait. The weighting factors (b*) of completely restricted index could be obtained by solving the following equation**:**

$$\mathbf{b^* = P^{*-1} G^* a}$$

Properties of the selection index:

Furthermore, according to Cunningham (1969), the other different properties of the selection index were calculated as following:

1- Standard deviation of the index (σi) **=** $\sqrt{}$b'Pb,

2-Standard deviation of the aggregate genotype (σt) **=** $\sqrt{}$a'Ga

3-Correlation between the index and the aggregate genotype (R_{IH})= $\sigma i/\sigma t$

4-Value of each trait in the index = Vt

$$Vt = 100 - \sqrt{\frac{b'Pb - b_i / W_{ii}}{b'Pb}} \times 100$$

Where: **Vt**= Value of each trait in the index **P** = Phenotypic variances (cov.) matrix;

b = Weighting factors column vector. $\mathbf{w_{ii}}$ = a diagonal element of p^{-1}

Expected genetic change (ΔG)**:**

The expected genetic change (ΔG) for each trait, after one generation of selection on the index (*i* = 1) was obtained by solving either of the following equations (Van der Werf and Goddard, 2003):

$$\mathbf{\Delta Gi = (\mathit{i}\ b'\ Gi)/\sigma i}$$

Where: ***i*** = Selection intensity; **σi** = Standard deviation of the index;

Gi = the i^{th} column of the G matrix.

Desired genetic gain selection index:

Selection indices were constructed according to Yamada et al. (1975). The indices were evaluated in terms of number of generations required to achieve the pre-defined/ desired gains and correlated responses. Furthermore, desired genetic changes for various traits (Q) were calculated as the difference between desired and observed means. Intended performances/improvement and hence desired gains/genetic changes for studied traits (Lwelamira and Kifaro, 2010).

Dzama et al. (2001) reported that the overall selection intensity on a selection index through generation was computed as:

$$\mathbf{\mathit{i}_I = y * \sqrt{}\ b'Pb\ /t}$$

where: **y** = the average generation interval in years. **t** = the time in years.

$$b = P^{-1}G(G'P^{-1}G)^{-1}Q \rightarrow (G'P^{-1}G)^{-1} = (P^{-1}G)^{-1}G^{-1} \rightarrow b = G^{-1}Q.$$

Where: Q = an m x 1 vector containing the desired relative genetic changes,

The selection index strategies:

The four studied traits (W_0, W_{30}, W_{60}, and WW) were used to construct eight selection indices grouped under four strategies as follow:

(1) General,

(2): Restriction indices on increase in W_0 via different degrees of restrictions (25, 50 and 75% as partially restriction indices and 100% restriction on increase in W_0 as completely restriction index),

(3): Multi-Source of information as own-performance and paternal half-sibs to increase the accuracy of the index and the predicted genetic gain and

(4): Selection index with desired genetic gain. The Selection criterion and objectives are the same.

The relative economic value (Rev):

The relative economic values (Rev) were calculated by multiple linear regression model. Regression (Beta) method as reported according to Faid-Allah and Ghoneim (2012) depends on standardized coefficients (beta) in case of WW is dependent variable as a main target and W_0, W_{30} and W_{60} as independent variables.

RESULTS AND DISCUSSION

1- Descriptive statistics and factors affecting:

Table (1) shows the descriptive statistics of W0, W30, W60 and WW which are 32.74, 40.71, 49.08 and 82.47 kg as arithmetic means, respectively.

The birth weight average of Friesian heifers obtained in this study is agree with Gaffer *et al*. (2005) (32.81 kg) , but lower than 37.8, 39.2 and 37.7 kg obtained by Bar-Peled *et al*. (1997), Baumgard *et al*. (2002) and Segura-Correa et al. (2012), respectively. Furthermore, The weaning weight average of heifers at the present study is lower than that revealed by Gaffer *et al*. (2005) who reported 94.97 kg at 105 days of age and greater than 73.89 kg that showed by Abdel-Glil and Elbanna (2001). The coefficient of phenotypic variability decreased with growing from birth to weaning (Table 1).

Table (1) indicates that the pre-weaning body weights were significant affected by sire, parity and year ($P< 0.05$) in agreement with Abdel-Glil and Elbanna (2001) in Holstein calves. Gaffer et al (2005) reported that season of birth affected birth weight significantly ($P<0.01$) as noted in table (1).

Table 1: Mean, standard deviation $_{(SD)}$, coefficient of variability $_{(CV)}$, relative economic values $_{(REV)}$ and factors affecting pre-weaning body weights in Friesian heifers.

Body weight at:	*№ of records*	*Mean, kg*	*SD, kg*	*CV, %*	REV
Birth (W0)	1748	32.74	3.79	11.58	0.581
30 day (W30)	1309	40.71	4.32	10.61	0.403
60 day (W60)	1309	49.08	4.61	9.39	0.539
90 day (WW)	1748	82.47	5.07	6.15	1
Factors affecting:	**Sire**	**Dam**	**Parity**	**Year**	**Season**
W0	***	ns	***	**	*
W30	***	ns	**	*	*
W60	**	ns	**	*	*
WW	***	ns	**	*	*

ns= Non Significant, *=sig. at 0.05, **sig. at 0.01

2-Genetic parameters:

Estimates of heritability (h^2), genetic correlations (r_G) and phenotypic correlations (r_P) among different body weights are presented in table (2). Heritability estimates for body weights at birth, 30, 60 and 90 days of age were 0.23, 0.30, 0.28 and 0.21, respectively.

These estimates are moderate and in agreement with many literatures as following; heritability estimates for birth weight were 0.23± 0.02 in Czech Charolais cattle, 0.21 in Brown Swiss, 0.09+0.07 in Bali cattle, 0.23 in Braunvieh cattle, 0.24 in Friesian calves, 0.28 in Friesian calves, and 0.16 and 0.33 were reported in Santa Gertrudis and Brahman cattle calves, 0.28 in Zebu cattle and 0.24 in Friesian calves, as reported by Vostry et al.,(2014); Segura-Correa et al. (2012); Gunawan and Jakaria 2011); Cucco *et al*. (2009); Oudah and El-Awady (2006); El-Awady,(2004); and Please et al.,(2002), Albuquerque (2001) and Oudah and Mehrez (2000), respectively. Furthermore, heritability estimates for weaning weight were 0.33+0.09 in Bali cattle, 0.28 in Friesian calves, , 0.24 in Friesian calves, 0.27 in Friesian calves calves as reported by Gunawan and Jakaria (2011); Oudah and El-Awady (2006); El-Awady,(2004), and Oudah and Mehrez (2000), respectively.

High values of heritability for birth weight (0.57, 0.59, 0.62 and 0.65) via different arithmetic methods obtained by Aksakal et al. (2012). According to the present moderate h^2 estimates,

It could be concluded that the genetic improvement of weaning weight can be achieved through selection and will be more effective and efficient in improving the genetic merit in Friesian cattle. Gunawan and Jakaria (2011) and Oudah and El-Awady (2006) came to the same conclusion in Bali and Friesian cattle, respectively.

In this respect, Haile et al. (2011) reported estimates of heritability for body weights at birth and weaning (90d) in Ethiopian Boran cattle were 0.25 ± 0.05 and 0.43 ± 0.04, whereas that values in its crosess with Holestien cattle were 0.33 ±0.06 and 0.34 ± 0.05, respectively. Schenkel et al. (2002) reported heritabilities for body weights at 84, and 112 day of age for thirteen beef breeds were 0.37 and 0.39, respectively. Aziz et al. (2005) also reported heritabilities for weights at birth, 90 and 120 day of age for Japanese Black to be 0.38 ± 0.06, 0.53 ± 0.07 and 0.65 ± 0.07 respectively.

Abera et al. (2011) reported heritability estimates via six statistical models for birth weight of Ethiopian Horro cattle and their Holstein crosses were 0.62±0.042, 0.51±0.54, 0.48±0.054, 0.71±0.09, 0.51±0.054 and 0.68±0.09 and for weaning weight were 0.40±0.052 0.37±0.058 0.37±0.063 0.53±0.097 0.37±0.059 0.52±0.1

Table 2: Heritability$_{(\pm SE)}$ estimates $_{(diagonal)}$, genetic $_{(below\ diagonal)}$ and phenotypic $_{(above\ diagonal)}$ correlations among studied body weights in Friesian heifers.

Body weight at:		W0	W30	W60	WW
Birth	**(W0)**	**0.23±0.19**	0.647	0.519	0.626
30 day	**(W30)**	0.629	**0.30±0.13**	0.723	0.539
60 day	**(W60)**	0.495	0.616	**0.28±0.21**	0.654
90 day	**(WW)**	0.753	0.625	0.519	**0.21±0.27**

Significantly estimates of phenotypic (r_P) and genetic (r_G) correlations among previous traits were positive (Table 2). Gunawan and Jakaria (2011) and El-Awady (2003) reported that there were positive genetic and phenotypic correlations between birth weight and weaning weight. El-Awady (2003) on Friesian calves, found that genetic and phenotypic correlation between birth and weaning weights were 0.49 and 0.56, respectively. Weaning weight was significantly and positively correlated with all traits under study imply that the W0 could be increased as a result of selection for the heavier WW (r_g =0.629, table 2; 0.65, Shemeis *et al*., 2006; 0.60, Bourdon and Brinks, 1982 and 0.50, Koots *et al*., 1994).

3-Selection index:

General, partially, completely restricted, multi-source and desired genetic gain selection indices are shown in table (3). The general index is considered as the main index due to its properties, whereas, this index was contain all traits in this investigation without any reducing or restrictions. Furthermore, the general index is used as a standard efficient index to determine the relative efficiencies of the other types of selection indices.

Eight selection indices were constructed divided according four strategies as follow: (1) include general index, (2) includes four restricted indices, (3) includes multi-source selection indices and (4) includes selection indices with desired genetic gain as shown in Table 3.

The original selection index (I_1) which included W_0, W_{30}, W_{60} and WW was suggested to be used for improving pre-weaning body weights. The comparisons of the various selection indices indicate that using multi-source index (I_6) achieved to the higher relative efficiency value (R_{IH}=0.5208, RE=103.11) than general index (I_1, R_{IH}=0.5051). Then, multi-source index (I_6) is recommended for improving pre-weaning body weights in Friesian heifers in Tokh Tanbisha population that have already not reached optimal birth weight. The least accuracy was noticed for restricted indices (I_5, R_{IH} =0.321) and its relative efficiency was RE=63.55 compared to general index (I_1).

The positive relationship was found between birth weight and weaning weight (Table 2). MacNeil *et al*. (1998) showed that It is necessary to select against the increase of birth weight due to it is positive relationship with dystocia. So that the present results suggest using restricted strategy (partially or completely restriction on increase in W0) in case of population that have already reached optimal W_0. Strategy two that include four indices, the best restricted index was $I_{4\ (75\%)}$ that get high efficient value (R_{IH} = 0.410; RE=81.17). It could be suggested using I_4 to improve weaning weight in Friesian heifers under restriction strategy, In case of populations that have already reached optimal W_0, it could be using completely restriction index ($I_{5\ (100\%)}$) to get zero genetic gain in W_0.

Selection indices with desired genetic gain strategy were includes two selection indices $I_{7\text{-desired}}$ and $I_{8\text{-desired}}$ that aimed to get previously set of genetic gain values for selected objectives by breeder. The desired gains for $I_{7\text{-desired}}$ were 1, 1.5, 1.75 and 2 kg for W_0, W_{30}, W_{60} and WW, respectively; and the number of generations required to attain the goal were 2.071 generation (*i*=1) and 5.91 generation (*i*=0.35). The desired gains for $I_{8\text{-desired}}$ were 1, 1.5, 1.5 and 2 kg for W0, W30, W60 and WW, respectively; and the number of generations required to attain the goal were 1.931 generation (*i*=1) and 5.5171 generation (*i*=0.35). So, it could be using $I_{8\text{-desired}}$ to save time and efforts for genetically improvement for pre-weaning body weights.

4-The expected genetic gain:

The expected genetic gain per generation for each trait is presented in table (3). The expected genetic gains per generation for the general index were 0.678, 1.184, 1.009, and 0.9891 kg at **(*i* =1)** and 0.2373, 0.4144, 0.3532, and 0.3462 at **(*i* =0.35)** for W_0, W_{30}, W_{60} and WW, respectively. Likewise, **(*i* =1)** in restriction indices, ranged between zero to 0.358 kg for W_0, 0.882 to 1.019 kg for W_{30}, 0.800 to 0.890 kg for W_{60} and 0.740 to 0.853 kg for WW. In addition, the expected genetic gains per generation **(*i* =1)** in multi-source indices were 0.7018, 1.214, 1.039, and 1.021 kg at **(*i* =1)** for W_0, W_{30}, W_{60} and WW, respectively. While, the expected genetic gains per generation **(*i* =1)** in desired gain indices, were 0.483 and 0.518 kg for W_0, 0.724 and 0.777 kg for W_{30}, 0.845 and 0.777 kg for W_{60} and 0.966 and 1.036 kg for WW.

The expected genetic gain after one generation through the multi-source index (I_6) will lead to increase W_0 by 0.7018 kg, W_{30} by 1.214 kg, W_{60} by 1.039 kg, and WW by 1.021 kg. This index was very simple and easy to construct. Therefore, it is recommended for using selection for weaning weight in Friesian heifers in case of no restriction for birth weight.

CONCLUSION

Results show that using multi-source of information to construct selection indices will enhance genetic improvement progress of pre-weaning body weights in Friesian heifers in Egypt. It could be suggested;

1- Using either ($I_{6\text{-multi}}$) to improve pre-weaning body weights in case of no restriction on birth weight or ($I_{4\ (75\%)}$) under restriction strategy in case of population that have already not reached optimal birth weight
2- Using completely restriction index (I_5) to get zero genetic gain in birth weight in case of population that have already reached optimal birth weight.
3- Using selection index with desire**d** genetic gai**n** ($_{I8}$) in case of previously set target of genetic gains for pre-weaning body weights in the dairy heifers as selected objectives.

The following conclusions can be driven from results of this study in case of using multi-source information to construct selection indices lead to enhance genetic improvement progress for pre-weaning body weights of Friesian heifers in Egypt.

Table 3: Weighing factors $_{(b\text{-values})}$, standard deviation of the index $_{(\sigma i)}$), efficiencies of selection in absolutes $_{(Rih)}$, relative efficiency $_{(RE)}$ and expected genetic gains per generation at (i = 1 & 0.35) for selection indices used to improve pre-weaning body weights in Friesian heifers.

Selection index	b-values				σi	R_{Ih}	Re	Expected genetic gain (kg) (i = 1).				Expected genetic gain (kg) (i = 0.35).			
	W0	W30	W60	WW				W0	W30	W60	WW	W0	W30	W60	WW
General Index															
I_1	0.0424	0.331	0.0638	0.1745	2.4038	0.5051	100	0.678	1.184	1.009	0.9891	0.2373	0.4144	0.3532	0.3462
Restricted Indices															
$I_{2\text{-}(25\%)}$	-0.333	0.283	0.062	0.202	1.738	0.365	72.26	0.188	0.948	0.841	0.794	0.0658	0.3318	0.2944	0.2779
$I_{3\text{-}(50\%)}$	-0.271	0.291	0.062	0.198	1.865	0.392	77.61	0.291	0.990	0.870	0.829	0.1019	0.3465	0.3045	0.2902
$I_{4\text{-}(75\%)}$	-0.226	0.297	0.063	0.194	1.951	0.410	81.17	0.358	1.019	0.890	0.853	0.1253	0.3567	0.3115	0.2986
$I_{5\text{-}(100\%)}$	-0.427	0.271	0.062	0.209	1.527	0.321	63.55	0.000	0.882	0.800	0.740	0.0000	0.3087	0.2800	0.2590
Multi-source of information (I_6)															
Own-Perf	0.0416	0.3207	0.0632	0.1713	2.478	0.5208	103.11	0.7018	1.214	1.039	1.021	0.2456	0.4249	0.3637	0.3574
Pat-Halfsibs	0.0325	0.0871	0.0304	0.0656											
Selection Index with Desired Genetic Gain								**Desired Genetic Gain per kg**							
I_7 desired	-0.021	-0.068	0.194	0.318	2.071	0.4352	86.16	1	1.5	1.75	2	1	1.5	1.75	2
								0.483	0.724	0.845	0.966	0.169	0.254	0.296	0.338
Number of generations required to attain the goal =								2.1				5.9			
I_8 desired	-0.020	0.003	0.096	0.326	1.932	0.4060	80.38	1	1.5	1.5	2	1	1.5	1.5	2
								0.518	0.777	0.777	1.036	0.181	0.272	0.272	0.363
Number of generations required to attain the goal =								1.9				5.5			

Own-Perf= own-performance, Pat-half sibs= Paternal half-sibs, ***i***=selection intensity,

REFRENCES

a H.; S. Abegaz and Y. Mekasha (2011). Genetic parameter estimates of pre-weaning weight of Horro (Zebu) and their crosses with Holstein Friesian and Jersey cattle breeds in Ethiopia. Inter. J. Livestock Prod. 2(6): 84.

querque, G. L. (2001). Estimates of direct and maternal genetic effects for weight from birth to 600 days of age in Nelore cattle. J. Anim. Breed. Genet.118: 83.

l-Glil, M. F. and M. K. Elbanna (2001). Genetic and non-genetic analysis for body weight traits of calves in a herd of Friesian cattle in Egypt. Minufiya J. Agric. Res. 26 (1): 99.

kal, V.; B. Bayram; M. Yanar and O. Akbulut (2012). Estimation of variance components and heritability of birth weight through different methods in Swedish Red and White cattle. J. Anim. Plant Sci., 22(1): 39.

M. A.; S. Nishida; K. Suzuki and A. Nishada. (2005). Estimation of direct and maternal genetic and permanent environmental effects for weights from birth to 356 days of age in a herd of Japanese Black cattle using random regression. J. Anim. Sci. 83: 519.

Peled, U.; B. Robinzon; E. maltz; H. Tagari; Y. Folman; I. Bruckental; H. Voet; H. Gacitua and A. R. Lehrer (1997). Increased weight gain and effects on production parameters of Friesian heifer calves that were allowed to suckle from birth to six weeks of age. J. Dairy Sci., 80:2523.

ngard, L.H.; W.J. Weber; G.W. Kazmer; S.A. Zinn; L.B. Hansen; H.C. Jones and B.A. Crooker (2002). Effects of selection for milk yield on growth hormone response to growth hormone releasing factor in growing Friesian calves. J. Dairy Sci., 85:2529.

man, K. G.; L. A. Kriese; L. D. Van Vleck and S. D. Kachman (1995). A manual for use of MTDFREML. A set of programs to obtain estimates of variances and covariances. ARS, USDA, Washington, D. C.

:o, D.C.; J.B.S. Ferraz; L.F.B. Pinto; J.P. Eler; J.C.C. Balieiro and E.C. Mattos (2009). Genetic parameters for pre-weaning traits in Braunvieh cattle. Genetics and Molecular Res., 8 (1): 291.

ıingham, E. (1969). Animal Breeding Theory. Landbrukshofhandelen, Laget Univ., Vollebek, Oslo.

ıingham, E.; R. Moon and T. Gjedrem (1970). Restriction of selection indexes. Biometrics, 26: 67.

na K.; J.P. Walter; F. Ruvuna; J.O. Sanders and M. Chimonyo (2001). Index selection of beef cattle for growth and milk production using computer simulation modeling. South African J. Anim. Sci., 31(2) 65.

wady, H. G. (2003). Maternal components as related to direct components for some growth traits of Friesian calves in Egypt. J. Agric. Sci., Mansoura Univ., Egypt, 28: 3393.

wady, H. G. (2004). The influence of maternal effects on the efficiency of selection index for growth traits of Friesian calves from birth to weaning. J. Agric. Res. Tanta Univ., 30: 559.

-Allah, E. and E. Ghoneim (2012) Comparing different methods for estimating economic values in selection index for pre-weaning body weights of Friesian heifers in Egypt. Egyptian J. Anim. Prod., 49 Supp:73.

er, H.M.A.; A.A. Shitta and E. A. Omer (2005). Probiotic supplementation for suckling Friesian calves 1- Productive performance. Egyptian J. Nutrition and Feeds 8: 163.

r, O.; M. Yanar and O. Akbulut (2010). Variance component estimation for heritability of gamma lactation curve traits of Holstein Friesian cattle. Indian Vet. J., 87:35.

awan, A. and Jakaria (2011). Genetic and non genetics effect on birth, weaning and yearling weight of Bali cattle. Med. Pet.,34: 93.

, A.; B.K. Joshi; W. Ayalew; A. Tegegne and A. Singh (2011). Genetic evaluation of Ethiopian Boran cattle and their crosses with Holstein Friesian for growth performance in central Ethiopia. J. Anim. Breed. Genet. 128: 133.

l, L.N. (1943). The genetic basis for constructing selection indices. Genetics, 28: 476.

l, L.N. and J. Lush (1942). The efficiency of three methods of selection. J. Heredity 33: 393.

s, K.R., J.P. Gibson and J.W. Wilton (1994). Analyses of published genetic parameter estimates for beef production traits. 2- Phenotypic and genetic correlations. Anim.

Breed, Abst, 62: 825.
dahl, L. E.; Klostad, N.; Sorensen, P. and Maijala, K., (1979). Scandinavian selection and crossbreeding experiment with laying hens. I. Background and general outline. Acta. Agric. Scand. 29: 273.
amira J. and G. C. Kifaro (2010). Desired-gain selection indices for improving performance of two Tanzania local chicken ecotypes under intensive management. African J. Agric. Res. 5 (2): 133-141.
Neil, M.D.; J.J. Urick and W.M. Snelling (1998). Comparison of selection by independent culling levels for below average birth weight and high yearling weight with mass selection for high weight in line 1 Hereford cattle. J. Anim. Sci., 76: 458.
ab (2002). The Language of technical computing. ver 13. The MathWorks.
orne, R. (1957). Family selection in poultry: the use of sire and dam family average in choosing male parents. Proc. Roy. Soc., B66: 374.
ah, E.Z.M. and H. G. El-Awady (2006). Selection indexes for genetic improvement of preweaning growth traits in Frisian calves in Egypt. Pakistan J. Biol. Sci., 9 (4):723.
ah, E.Z.M. and A.F.A. Mehrez (2000). Genetic and some non-genetic factors affecting preweaning body weight and growth rate of Friesian calves in Egypt. Proc. of the 3rd All Africa Conf. on Animal Agric. and 11th Conf. Egyptian Soc. for Anim.Prod., Alex., Egypt, 6-9 Nov: 689.
, (2002) Statistical Analysis System. Ver. 9, SAS Institute Inc., Cary, NC, USA.
enkel, F. S.; S. P. Miller; J. Jamrozik, and J. W. Wilton (2002). Two-step and random regression analyses of weight gain of station-tested beef bulls. J. Anim. Sci. 80:1497.
neis, A.R.; M.H. Sadek and N. A. Shalaby (2006). Selection indexes for improving growth rate in Friesian heifers with minimum concomitant increase in birth weight. Egyptian J. Anim. Prod., 43(2):83.
ura-Correa, J.C.; R.C. Chin-Colli; J.G. Magaña-Monforte and R. Núñez-Domínguez (2012). Genetic parameters for birth weight, weaning weight and age at first calving in Brown Swiss cattle in Mexico. Trop. Anim. Health Prod. 44:337.
der Werf, J. and M. Goddard (2003). Models and Methods for Genetic Analysis. Armidale Animal Breeding, Summer course, New England Univ.
ry, L.; Z. Vesela; A. Svitakova; H. Vostravydrova (2014). Comparison of models for estimating genetic parameters and predicting breeding values for birth weight and calving ease in Czech Charolais cattle. Czech J. Anim. Sci., 59 (7): 302.
enaar, D.; J.Arendonk; M. van, Kramer (1995). Selection Index Program (SIP), User manual. Animal Breeding Dep., Wageningen Agric. Univ., NL.
ada Y.; K. Yokouchi and A. Nishida (1975). Selection index when genetic gains of individual traits are of primary concern. Japanese J. Genet. 50: 33.

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الملخص العربي

تهدف هذه الدراسة إلى تقدير العائد الوراثى المتوقع، وإمكانية التحسين الوراثى لأوزان الجسم لمرحلة ما قبل الفطام لعجلات الفريزيان. جمعت سجلات ١٧٤٨ عجلة من ٦١ طلوقة و٨٤٦ بقرة خلال الفترة من ١٩٩٥ إلى ٢٠١٠ من وحدة بحوث وتجارب الإنتاج الحيوانى بطوخ طنبشا بوسط الدلتا-التابعة لكلية الزراعة جامعة المنوفية-مصر. تم باستخدام أدلة انتخابية مختلفة والتى تشمل الدليل العام، أدلة مختزلة تحت مستويات مختلفة محددة لزيادة وزن الميلاد لتجنب مخاطر عسر الولادة وأدلة متعددة مصادر المعلومات وأدلة ذات عائد وراثى مرغوب تم تحديده مسبقاً.

وقد أجري التحليل الإحصائى باستخدام برنامج SAS لاختبار معنوية العوامل التي تؤثر على الصفات المدروسة وبرنامج MTDFREML مع النموذج المختلط وفيه الطلوقة والأم كتأثيرات عشوائية، وموسم الحليب والسنة وموسم الولادة كتأثيرات ثابتة لتقدير مكونات التباين. فضلاً عن استخدام برنامج SIP و Matlab لبناء الأدلة الانتخابية.

كما قدرت مكونات التباين الوراثية والمظهرية للوزن عند الميلاد والوزن عند ٣٠ يوم، ٦٠ يوم ٩٠ يوم، و تم استخدامها لاشتقاق ٨ أدلة انتخابية باستخدام الصفات المدروسة للتحسين الوراثى لأوزان الجسم فى مرحلة ما قبل الفطام لعجلات ماشية الفريزيان في مصر.

وقد تضمن الدليل العام الذي يشمل جميع الصفات المدروسة، صفات الوزن عند الميلاد والوزن عند ٣٠ يوم، ٦٠ يوم و٩٠ يوم وكانت قيمة دقة الدليل (R_{lh}= 0.5051)، وقد انخفضت قيمتها الى(R_{lh}= 0.321) عند استخدام الدليل المحدد بنسبة ١٠٠ %. أما باستخدام المصادر المختلفة من المعلومات فى الدليل الانتخابى فقد أدى ذلك إلى ارتفاع قيمة دقة الدليل إلى (R_{lh}= 0.5208).

وقد أعطى الدليل متعدد المصادر ($I_{6\text{-}multi}$) أعلى عائد وراثى متوقع لصفات أوزان الجسم فى مرحلة ما قبل الفطام. حيث وجد أن العائد الوراثى المتوقع لوزن الفطام 1.021 كجم/جيل عند شدة انتخاب =١، فى حين بلغ 0.3574 كجم/جيل عند شدة انتخاب =0.35 ، وانخفض إلى 0.740 كجم/جيل عند تطبيق الدليل المحدد ($I_{5\ (100\%)}$).

وقد توصلت الدراسة الحالية إلى أنه يمكن استخدام الدليل الأول والسادس والثامن لتحسين وزن الفطام فى عجلات الفريزيان تحت الإستراتيجية الأولى، وذلك فى حالة عدم وجود تقييد لوزن الجسم عند الميلاد، مع إمكانية استخدام الدليل الرابع تحت الإستراتيجية الثانية، وذلك فى حالة عدم وصول وزن الميلاد للحد الأمثل. أما فى حالة وصوله للحد الأمثل فيقترح استخدام الدليل الخامس.