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SELECTION INDICES FOR IMPROVING WEANING WEIGHT OF FRIESIAN MALE CALVES IN EGYPT

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ABSTRACT

The main purpose of this paper is to construct different selection indices (general index, and reduced indices) to improve weaning weight at 90 days of age for Friesian male calves in Egypt by using collected data from 1400 records during 10 years (1995-2004) for body weights at birth (BW) and for 30 (W30), 60 (W60) and 90 (W90) days of age at the experimental farm of Faculty of Agriculture, Minufiya University. The secondary objective is to evaluate and predict genetic parameter estimates of the previous traits. Overall means for the previous traits were 33.82, 42.08, 55.21 and 82.98 kg respectively. Heritability estimates for the previous traits were 0.28, 0.31, .40 and 0.16, respectively. Significantly estimates of genetic correlations (rG) and phenotypic correlations (rP) among previous traits were positive. Fifteen selection indices were constructed, index (I4) gave high (RIH) and (RE) values comparing with general index (I1). From this study, it could be concluded that genetic improvement for weaning weight of Friesian male calves could be achieved through multiple trait selection index. Therefore, it could be suggested using (I1 and I4) to improve weaning weight in Friesian male calves under the large scale.

Key Words: Weaning weight, Genetic parameters, Selection indices

INTRODUCTION

Beef produced in Egypt is generated as a by-product of milk production with dairy breeds, the minority of which is pure-bred Friesian herds. Some beef production traits have long been included in the breeding programs of dairy cattle, but the selection pressure on these beef traits has remained weak. Recently dairy cattle breeders became concerned with beef production traits in their breeding programs. Friesian cattle are the most reputed dairy cattle in Egypt and they are potential dual-purpose animals **(Abdel-Glil and Elbanna, 2001)**. Growth in dairy cattle has not been studied so extensively, particularly the genetic component of growth **(Coffey et al., 2006)**.

Selection for many traits simultaneously saves time and effort. 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**).

This study was carried out to evaluate the genetic parameters of beef traits during suckling period of Friesian male calves in Egypt, and construct different selection indices to improve their weaning weight.

MATERIALS AND METHODS

Data used for this study obtained through the period from 1995 to 2004 for body weights at birth, 30, 60 and 90 days of age in Friesian male calves. Data collected from Experimental and Researches Unit of Animal Production in Tokh Tanbisha, in the middle Nile Delta, Egypt, which belongs to Faculty of Agriculture, Minufiya University. Calves were mainly produced through artificial insemination (imported frozen semen of Friesian sires) rather than by natural service. Data consisted of 1400 calves' records. The management and rearing of these calves were described by **Ghoneim et al., (2006)**.

The 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 (BW, W30, W60 and W90),
- b= the vector of fixed effect (Year, season of birth),
- a= the vector of random additive genetic direct effects;
- X and Z=Known incidence matrices relating observations to the respective
- e= fixed and random effeets with Z augmented with columns of zeros for animals without records; and the vector of residual effects.

Selection Index Program (**Wagenaar, et al., 1995**) and Matlab program (**Matlab, 2002**) were used to set up and construct the selection indices. The four traits studied were used in different combinations to construct fifteen selection indices.

$$I = b_1P_1 + b_2P_2 + ..b_nP_n = \sum^{n}_{i=1} biPi$$

Where : = selection index. bi = index weights for each trait in the index,

Pi= phenotypic measurement for each trait in the index.

The general index was obtained in terms of heritability, phenotypic and genetic correlations among the studied traits by solving the following equations given in matrix expression according to Cunningham (1969):

$Pb = GV$ to give $b = P^{-1} GV$

Where : P = Phenotypic variances and covariances matrix.

- G = Genetic variances and covariances matrix.
- V = Economic weights column vector.
- b = Weighting factors column vector, which is going to be solved.

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

The standard deviation of the index = σI = b'Pb

The standard deviation of aggregate genotype = σT = V'GV

The correlation between the index and the aggregate genotype = R_{IH}= $\sigma I/\sigma T$

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, 2003)**:

$$\Delta Gi = (i\ b'\ Gi)/\ \sigma I.$$

Where: i = Selection differential in standard deviation units.

σI = Standard deviation of the index.

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

The reduced selection index can be developed by omitting one or more traits from the original index. In relation to the original index the efficiency of the new index, the reduced one, is expected to be decreased depending on the value of the omitted trait in the original index. The breeder can decide whether such traits can be included or not in selection index to save time, cost and effort depending on the relative importance of the omitted trait in the original index and the cost of including such trait in the index.

The relative economic values (V) were calculated by estimating the expected change in the weaning weight (W90= 1) per kg as a marketing weight that determine the profit depends on one unit change per kg in the trait (BW= 0.636, W30=0.484 and W60=0.313) by using the regression method. Thus the relative economic values for BW, W30, W60 and W90 according to these estimates were 0.636: 0.484: 0.313: 1.00

RESULTS AND DISCUSSIONS

Table (1) shows the overall means and standard deviation of BW, W30,W 60 and W90 which are 33.82 ± 4.43 kg, 42.08 ± 4.84, 55.21± 5.52 and 82.98 ± 4.47 kg . respectively. The BW average of Friesian male calves obtained in the present study is not so far from 35.3 kg **(Gaffer et al., 2005)**, but lower than 43.0, 45.0 and 42.8 kg **(Akayezu et al., 1994; Diaz, et al., 2001** and **Baumgard et al., 2002)**, respectively. The present study shows average of W90 is lower than 97.24 kg at 105 days of age **(Gaffer et al., 2005)** and higher than 75.83 kg at 90 days of age **(Abdel-Glil and Elbanna, 2001)**.

Estimates of heritability (h^2) as well as genetic correlations (r_G) and phenotypic correlations (r_P) among different body weight traits are presented in table (2). Heritability estimates for body weights at birth, 30, 60 and 90 days of age were 0.28, .31, .40 and 0.16, respectively. These estimates are moderate and in agreement with those estimates obtained by **Oudah** and **El-Awady (2006)** (0.24 and 0.28 for birth weight and weaning weight in Friesian calves, Egypt, respectively). **Oudah** and **Mehrez (2000)** (0.24 and 0.27), and **El-Awady (2004)** (0.28 and 0.24) for birth weight and weaning weight in Friesian calves, Egypt, respectively.

According to the present moderate h^2 estimates, it could be concluded that the genetic improvement for weaning weight can be achieved through selection. **El-Awady (2003)** and **Oudah** and **El-Awady (2006)** came to the same conclusion on Friesian calves.

Estimates of genetic and phenotypic correlations among different traits studied were positive (Table 2). **Abdel-Gill** and **El-Banna (2001)** arrived to the same conclusion. **Similarly, Abdel-Moez (1996)** and **El-Awady (2003)** reported that there were positive genetic and phenotypic correlations between birth weight and weaning weight. **El-Awady (2003)** using another set of data of Friesian calves, found that genetic and phenotypic correlation between birth and weaning weights were 0.49 and 0.56, respectively. The present genetic correlation coefficient between BW and W90 indicating a positive genetic correlation between pre-and postnatal effects. This conclusion was confirmed previously by **Koots et al. (1994)**.

General and Reduced selection indices are shown in table (3). The general index is considered as the main index due to its properties, whereas this index is assumed to contain all traits under selection program without any reducing or restrictions. Furthermore, the general index is used as a standard efficient index to determine the relative effeiencies of the other types of seleetion indices.

Fifteen selection indices were constructed (Table 3). The original selection index (I_1) which included BW, W30, W60 and W90 was suggested to be used for improving the aggregate genotype of weaning weight at 90 day of age. The expected genetie change per generation (EG) in each trait assuming the selection intensity of 1.00 is given in table (3). The expected genetic change per generation (EG) ranged between 1.171 to 1.203 kg for BW, 1.244 to 1.501 kg for W30, 1.686 to 2.208 kg for W60 and 0.718 to 1.693 kg for W90.

The comparisons of the various selection indices indicate that the general index (I_1) which incorporated BW, W30, W60 and W90 is the most efficient (RIH=0.55) and it is recommended for improving weaning weight (W90) in Friesian male calves in Egypt.

The least accuracy (RIH =0.35 (I_{15}), 0.46 (I_{14}), 0.47 (I_{13}) and 0.49 (I_{12})) would result from any sub index in present study. Furthermore, the selection index (I4) gave high (RIH) and (RE) values compared with general index (I_1). **Oudah and El-Awady (2006)** in their study on Friesian calves in Egypt concluded that the selection indices which incorporated birth weight, weaning weight and ADG were high in RIH (0.50 to 0.52).Therefore, it could be suggested using of I_1 and I4 to improve weaning weight in Friesian male calves under the large scale.

The expected genetic gain after one generation through the general index (I_1) will be (1) increase in BW by 1.194 kg, (2) inerease in W30 by 1.244 kg, (3) increase in W60 by 1.686 kg, (4) increase in W90 by 0.848 kg. This index is very simple and easy to construct, therefore, its use is recommended for selection for weaning weight in Friesian male ealves

The positive relationship was found between BW and W90 (Table 2). **MacNeil et al., (1998)** showed that it is necessary to select against the inerease of BW due to it is positive relationship with dystocia.

Table 1 : The overall means and standard deviations of BW, W30, W60 and W90 in Friesian male calves.

Trait	No of calves records	Mean (kg)	±	S.D (kg)
BW	1400	33.82	±	4.43
W30		42.08	±	4.84
W60		55.21	±	5.52
W90		82.98	±	4.47

Table 2: Heritabilities, genetic (r_g) and phenotypic (r_p) correlations for BW, W30, W60 and W90 in Friesian male calves.

Trait	BW	W30	W60	W90
BW	**0.28**	0.801	0.596	0.588
W30	0.700	**0.31**	0.731	0.487
W60	0.567	0.709	**0.40**	0.358
W90	0.892	0.607	0.420	**0.16**

Heritabilities are on the diagonal, Genetic Correlations below; Phenotypic Correlations are above the diagonal.

Table 3: Selection indices for BW, W30, W60 and W90 for Friesian male calves.

Selection index	Trait								R_{IH}	RE
	BW		W30		W60		W90			
	b1	EG	b2	EG	b3	EG	b4	EG		
I_1	0.305	1.194	0.039	1.244	0.218	1.686	0.100	0.848	0.55	100
I_2	0.364	1.187	0.043	1.250	0.217	1.711			0.53	0.97
I_3	0.313	1.179	0.214	1.249			0.098	0.877	0.51	0.95
I_4	0.328	1.203			0.231	1.213	0.101	1.693	0.54	0.99
I_5			0.223	1.389	0.223	1.784	0.173	0.744	0.52	0.95
I_6	0.372	1.171	0.219	1.256					0.51	0.94
I_7	0.392	1.197			0.232	1.719			0.53	0.97
I_8	0.498	1.248					0.104	0.937	0.50	0.92
I_9			0.306	1.470	0.223	1.886			0.50	0.92
I_{10}			0.408	1.410			0.174	0.769	0.49	0.90
I_{11}					0.348	1.927	0.232	0.718	0.50	0.92
I_{12}	0.564	1.242							0.49	0.90
I_{13}			0.492	1.501					0.47	0.86
I_{14}					0.4203	2.208			0.46	0.84
I_{15}							0.376	0.765	0.35	0.64
V	0.636		0.484		0.313		1.00			

Index weights for each trait in the index (bi), Expected genetic change per generation (EG) in each trait, correlation of index with aggregate genotype (R_{IH}) and the efficiency (RE) of different indices relative to original index (I_1), Economic weights column vector (V).

CONCLUSION

Results show that it is possible to improve weaning weight of Friesian male calves in Egypt. The BW, W30, W60 and W90 are moderate heritable and the genetic correlation among BW, W30, W60 and W90 are also generally significant and high.

Fifteen selection indices were constructed, index (I_4) gave high (RIH) and (RE) values compare with general index (I_1). From this study, it could be concluded that genetic improvement for weaning weight of Friesian male calves could be achieved through multiple trait selection index. Therefore, it could be suggested that I_1 and I_4 were used to improve weaning weight in Friesian male calves under large seale.

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الملخص العربى

تحسين وزن الجسم عند الفطام فى ذكور ماشية الفريزيان فى مصر باستخدام أدلة إنتخابية مختلفة

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الهدف الرئيسى من هذا البحث هو بناء أدلة إنتخابية مختلفة (دليل عام - أدلة مختزلة من الدليل العام) واستخدامها فى تحسين وزن الجسم عند الفطام فى ذكور الفريزيان وذلك بالاستعانة ببيانات ١٤٠٠ سجل مجمعة على مدار ١٠ سنوات من سنة ١٩٩٥ إلى ٢٠٠٤ لصفات وزن الجسم عند الميلاد وعند عمر ٣٠ و ٦٠ و ٩٠ يوم من الميلاد (وزن الفطام) وذلك بالمزرعة البحثية لكلية الزراعة بجامعة المنوفية، الهدف الآخر كان للتقييم والتنبؤ بالمعايير الوراثية لصفات وزن الجسم عند الميلاد وعند عمر ٣٠ و ٦٠ و ٩٠ يوم من الميلاد (وزن الفطام).

وأوضحت هذه الدراسة أن متوسطات أوزان الجسم السابقة كانت ٣٣٫٨٢ و ٤٢٫٠٨ و ٥٥٫٢١ و ٨٢٫٩٨ على التوالى، بينما قيم المكافىء الوراثى لنفس الأوزان كانت ٠٫٢٨ و ٠٫٣١ و ٠٫٤٠ و٠٫١٦ على التوالى، وقد وجد أن كل الارتباطات الوراثية والمظهرية بين هذه الأوزان كانت موجبة ومعنوية.

وقد تم بناء خمسة عشر دليل إنتخابى وقد وجد أن الدليل الرابع أعطى أعلى قيمة لدقة الدليل (RE) والكفاءة النسبية للدليل بالنسبة للدليل العام (R_{IH}) وذلك مقارنة بالدليل العام (I_1) وبالتالى فإننا نقترح إستخدامه مع الدليل العام لتحسين وزن الجسم عند الفطام فى ذكور الفريزيان على نطاق واسع.