Assessment of Genetic Relationships between Growth Traits and Milk Yield in Egyptian Buffaloes

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ABSTRAK

Abu El-Naser IAM. 2019. Analisis kekerabatan genetik antara sifat-sifat pertumbuhan dan produksi susu Kerbau Mesir. JITV 24(4): 143-150. DOI: http://dx.doi.org/10.14334/jitv.v24i4.2034

Data dalam penelitian ini diperoleh dari catatan bobot hidup dan produksi susu dari kerbau Mesir dalam status tiga laktasi pertama yang dipelihara di Balai Penelitian dan Produksi Ternak Mahallet Mousa dari sebanyak 987 catatan selama 16 tahun. Data tersebut dianalisa untuk menentukan estimasi parameter genetik menggunakan *animal model*. Nilai rataan (dalam kg) untuk BW; WW; W18; WFC; 1stMY; 2ndMY dan 3rdMY secara berturut-turut adalah 36,56; 96,95; 322,02; 462,09; 1561,53; 1755 dan 1837,71. Nilai heritabilitas *additive* langsung (h^2a) untuk sifat-sifat di atas secara berturut-turut adalah 0,31; 0,22; 0,24; 0,27; 0,23; 0,23 dan 0,17. Perhitungan yang tepat untuk heritabilitas *maternal* (h^2m) untuk sifat yang sama adalah 0,39; 0,34; 0,22; 0,40; 0,29; 0,31 dan 0,21. Nilai korelasi genetik antara semua sifat yang diamati adalah positif yang berkisar antara 0,02 hingga 0,55. Keakuratan nilai PBV's bervariasi mulai dari 62 hingga 76, 62 hingga 83 dan 41 hingga 77% untuk pejantan, induk dan anak secara berturut-turut. Nilai ini menunjukkan bahwa perbaikan genetik dapat dicapai dengan memanfaatkan nilai PBV's tersebut. Semakin timnggi nilai heritabilitas langsung dan maternal untuk BW dan WFC, semakin tinggi pula korelasi genetik antara produksi susu periode tiga laktasi pertama dan WW serta W18. Oleh karena itu, menjadi hal yang tepat untuk menseleksi anakan kerbau betina pada sifat bobot badan saat lahir dibandingkan bobot badan pada usia lainnya.

Kata Kunci: Nilai Pemuliaan, Kerbau Mesir, Parameter Genetik, Sifat-Sifat Pertumbuhan, Produksi Susu

ABSTRACT

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Data in this study were collected from live body weight records and milk yield for the first three lactations of Egyptian buffaloes maintained at the Mahallet Mousa Experimental Station of Animal Production Research Institute, relying on 987 records of Egyptian buffaloes spread over 16 years. These data were analyzed to estimate genetic parameters using animal model. Overall means in kilograms of BW, WW, W18, WFC, 1stMY, 2ndMY and 3rdMY were 36.56, 96.95, 322.02, 462.09, 1561.53, 1755 and 1837.71, respectively. Direct additive heritability (h^2a) for mentioned traits were 0.31, 0.22, 0.24, 0.27, 0.23, 0.23 and 0.17, respectively. Corresponding computation of maternal heritability (h^2m) for same traits were 0.39, 0.34, 0.22, 0.40, 0.29, 0.31 and 0.21, respectively. Evaluation of genetic correlations among different all studied traits were positive and ranged from 0.07 to 0.83, while phenotypic correlations were positive and ranged from 0.02 to 0.55. Accuracy of (PBV's) varying from 62 to 76, 62 to 83 and 41 to 77% for sires, cows and dams, successively; pointing out the genetic improvement could be achieved through any pathway of them. Higher direct and maternal heritability for BW and WFC and genetic correlations between first three lactations milk yield and each of BW and WFC higher than genetic correlations between first three lactations milk yield and WW and W18. Therefore, it is appropriate to select buffalo female calves for live body weight at birth than for live body weights at other ages.

Key Words: Breeding Values, Egyptian Buffaloes, Genetic Parameters, Growth Traits, Milk Yield

INTRODUCTION

Buffalo is the more important dairy cattle in Egypt. Buffalo is adapted animal to the small-holder conditions and is raised under semi-extensive production systems. Therefore, it plays an important role in Egyptian agriculture. The Egyptian buffaloes are nearly to 3.9 million. Where contribution to milk production nearly 45.5% of total milk in Egypt (FAOSTAT 2013). The genetic parameters of growth efficiency traits will support in delicacy selection to improve the genetic ability of the breed for meat production in Murrah buffaloes (Thiruvenkadan et al. 2009). In Egyptian buffaloes Awad & Afify (2014) cleared that all growth traits from birth until weight at year and half age effectual for improvement through direct genetic selection. In early period of rearing increased growth rate can decrease the expense of rearing the animal and thus raise greater economical to agriculturist. Environmental factors and maternal effects influencing birth weight and early growth rate of animals (Mandal et al. 2006). Estimate of heritability for weight at first calving was moderate so fortify essential genetic response through selection framework in Egyptian buffaloes (El-Bramony 2014). Birth weight and information on body weight at early ages in farm animal used in early selection criterion (Eyduran et al. 2009; Karakus et al. 2010). Akhtar et al. (2012) indicated that year and season of birth and weight of dam were significant (P<0.05) effect on birth weight, weaning weight and yearling weight in heifers of Nili-Ravi buffaloes. Genetic appraisement programs and culling or selection might used the weaning weight (Guidolin et al. 2012). In Holstein heifer, Van De Stroet et al. (2016) shown that milk yield in later life associated with pre weaning growth. And added that were not significantly associated with calf higher growth rates and future milk yield, while higher birth weight in lactating cows were associated with higher odds of survival to first lactation.

The aims of this present investigation were to estimate the genetic relationship between milk yield in first three lactations and weights at different ages from birth to first calving and breeding values for these traits in Egyptian buffaloes.

MATERIALS AND METHODS

Data collected from weight records and milk production in first three lactations of lactating Egyptian buffalo herds maintained at the Mahallet Mousa Experimental stations of Animal Production Research Institute (APRI), Ministry of Agriculture, using the records of 16 consecutive years from 2001 to 2016. The data comprised 987 lactation records of 395 dams and 113 sires. Traits considered in the study were birth weight (BW, kg), weaning weight (WW, kg), weight at eighteen months (W18, kg), weight at first calving (WFC, kg), first lactation milk yield (1^{st}MY, kg), second lactation milk yield (2^{nd}MY, kg) and third lactation milk yield (3^{rd}MY, kg).

After birth, calves were sucking colostrum for the first three days of their life, and then, housed individually in calf pens bedded with rice straw until weaning (at fifteenth weeks of age). During this period calves were artificially suckling via natural milk, bring in pails depending on their weight. Moreover, bring calf starter at third week of their age up to the 15^{th} weeks of rearing suckling, and berseem hay (*Trifolium alexandrinum*), water and mineral mixture were available freely to calves. After weaning, the animals involved in this study were kept under the same system of feeding and management in the stations. Lactating buffaloes were milked by hand or machine twice daily during the lactation period, and milk production was recorded daily. The animals were fed on Egyptian clover (*Trifolium Alexandrinum*) during (December to May) with concentrate mixture and rice straw. During (June to November), animals were fed on concentrate mixture, rice straw and limited amount of clover hay or silage. Buffaloes were feed according to their live weight, milk production and pregnancy status. Water is available for buffaloes at all times of the day in water troughs. Multi mineral licking blocks were available free for animals in the stalls. Buffaloes were inseminated during heat after 60 days postpartum, while heifers were inseminated when attained 350 kg of live body weight or 18-24 months of age.

Statistical analysis

Firstly, least squares means and analysis of variance of fixed effects on traits under investigation to calculate by using least squares analyses of variance by Mixed Model program of Harvey (1990).The following fixed model was used:

$$Y_{ijkl} = \mu + M_i + Y_j + F_k + e_{ijkl}$$

Where:

Y_{ijkl}	=	observation value
μ	=	overall mean
M_i	=	fixed effect of i^{th} month of birth
Y_j	=	fixed effect of j^{th} year of birth
F_k	=	fixed effect of k^{th} farm, and
e_{ijkl}	=	random error term

Secondly, data were analyzed by animal model using multiple-trait derivative-free restricted maximum likelihood (MTDFREML) suite of programs (Boldman et al. 1995) to expectation the (co)variance components and genetic and phenotypic parameters for t studied traits. The subsequent model utilized:

$$Y = X\beta + Za + Mm + Wpe + e$$

Where:

Y	=	a vector of observations
β	=	a vector of fixed effects
a	=	a vector of additive genetic effects
m	=	a vector of maternal genetic effects
M	=	the incidence matrix relating records to maternal genetic effect
pe	=	a vector of environmental effects contributed by dams to records of their progeny (permanent environmental)

Table 1. Means, standard deviation (SD) and coefficient of variation (CV %) for studied traits in Egyptian buffaloes**.**

Traits	Mean	SD	CV%
WB	36.56	5.12	0.14
WW	96.95	15.52	0.16
W18	322.02	38.64	0.12
WFC	462.09	60.07	0.13
1^{st}MY	1561.53	529.71	0.34
2^{nd}MY	1755.00	577.11	0.33
3^{rd}MY	1837.71	511.40	0.28

WB= birth weight, WW= weaning weight, W18=weight at eighteen months, WFC= weight at first calving, 1^{st}MY=first lactation milk yield, 2^{nd}MY=second lactation milk yield and 3^{rd}MY= third lactation milk yield.

Table 2. Significance levels of some environmental factors affecting on studied traits under investigation.

Traits	F- Value and significance		
	Month of birth	Year of birth	Farm
WB	1.61^{ns}	3.2**	17.76**
WW	1.46^{ns}	5.57**	15.00**
W18	1.31^{nS}	3.02**	4.73**
WFC	2.95**	4.54**	10.25**
1^{st}MY	10.62**	21.23**	37.38**
2^{nd}MY	8.16**	14.64**	53.15**
3^{rd}MY	16.05**	16.32**	46.33**

**= significant at P<0.01, n.s= non significant, number of records =987, month of birth =12, year of birth = 16 and farm =3.

W = the incidence matrix relating records to permanent environmental effects

e = a vector of the residual effects. X and Z are incidence matrices relating records to fixed and genetic effects

Estimated breeding values via MTDFREML program for calculated best linear unbiased perdition (BLUP) of all animals' pedigree file for multi-traits analysis.

RESULTS AND DISCUSSION

Descriptive statistics

Means for WB, WW ,W18,WFC, 1^{st}MY, 2^{nd}MY and 3^{rd}MY were 36.6, 96.95,322.02, 462.09, 1561.53, 1755 and 1837.71, kg, successively are presented in Table 1. The coefficient of variation for traits under study were varying from 0.12 to 0.34 %. Estimation of means for WW, WW, W18 in current study were slightly higher those reported by Awad & Afify (2014) in Egyptian buffaloes (36.30, 91.31 and 301.56 kg), successively. As well for birth weight in Murrah buffaloes estimated by Thiruvenkadan et al. (2009) (32.4 kg) and Salces et al. (2013) in water buffalo (35.10 kg). Likewise, the actual estimation of weight at first calving higher than (397.11) that obtained by El-Bramony (2014) in Egyptian buffaloes. The present means of 1^{st}MY, 2^{nd}MY and 3^{rd}MY were higher than these 1175, 1552 and 1635 Kg found by El-Bramony (2011) in Egyptian buffaloes for 1^{st}MY, 2^{nd}MY and 3^{rd}MY, respectively and 1347.2 kg for 1^{st}MY estimated by Ahmad et al. (2013) in Nili-Ravi buffaloes.

While the actual mean for WFC was lower than reported by Yadav & Singh (2016) in Murrah buffaloes (503.73kg). In addition, 1^{st}MY also was lower (1702.44 kg) than estimated by Yadav & Singh (2016) in Murrah buffaloes. Table (2) indicted that the effects of month and year of birth and farm had highly significant (P< 0.01) on studied traits except effect month of birth on BW, WW and W18 was not significant The present results agree with obtained by Awad & Afify (2014) with relation to effect of farm on (BW, WW and W18) and influence of month of birth on WW. Contrariwise, for the affected WB, WW and W18 by month and year of birth. The current results agree with that obtained by El-Bramony (2011) for effect of farm on (1^{st}MY), (2^{nd}MY) and (3^{rd}MY) and don't agree with present results for effect year of birth on mentioned traits.

Levels of birth weight

The present results indicated the highest milk yield in buffalo cows for first three lactations observed when level of birth weight were 36-40 kg for them, following by (41-45 kg), (46-50kg), (31-35 kg) and (25-30 kg). While the lowest milk yield of buffalo cows through three first lactations observed whereas, birth weight were >50 kg as in Table 4. It follows consider best birth weights for selection animals were ranged from 36-40 kg. Karakus et al. (2010) on Norduz kids shown that the life time yields in farm animals affected by birth weight characteristic raised in Bulgarian.

Genetic parameters

Heritability

Direct heritability (h^2_a) of WB, WW, W18, WFC, 1^{st}MY, 2^{nd}MY and 3^{rd}MY were moderate, being 0.31, 0.22, 0.24, 0.27, 0.23, 0.23 and 0.17, respectively.

Estimation of h^2_a for BW in the current investigation was lower than those obtained by Fooda (2005) (0.40) for Egyptian buffaloes, Gupta et al. (2015) (0.349) in Murrah buffaloes and Awad & Afify (2014) for Egyptian buffaloes (0.32). While was higher than estimated by Kaygisiz et al. (2012) for BW (0.15) on Holstein Friesian. The current h^2_a estimate for WW was lower that calculated by Awad & Afify (2014) for Egyptian buffaloes being 0.40. In addition, h^2 estimate for W18 lower than, those perceived by Gupta et al. (2015) Murrah buffaloes (0.252) and Agudelo-Gómez et al. (2015) Colombia buffaloes (0.44). The present value of h^2 for WFC was higher than that estimated by Yadav & Singh (2016) in Murrah Buffaloes (0.08). The actual h^2 for 1^{st}MY, 2^{nd}MY and3^{rd}MY in (Table 4) were higher than noticed by El-Bramony (2011) in Egyptian buffaloes for these traits (0.22, 0.16, 0.13), respectively and Yadav & Singh (2016) for 1^{st}MY in Murrah Buffaloes (0.22) but was lower than that obtained by Gupta et al. (2015) for 1^{st} MY (0.243) in Murrah buffaloes. The h^2_m for WB, WW, W18, WFC, 1^{st}MY, 2^{nd}MY and 3^{rd}MY were moderate (0.39, 0.34, 0.22, 0.40, 0.29, 0.31 and 0.21), respectively. The present result for BW was lower than that stated by Kaygisiz et al. (2012) Holstein Friesian (0.56), while the current estimate of h^2_m for BW, WW and W18 were higher than those reported by Awad & Afify (2014) in Egyptian buffaloes 0.38, 0.26 and 0.09, respectively.

Correlations

Estimates of r_{am} in traits under current study were negative and varying from (-0.02 to-0.01) are presented in Table 4. The actual results agreement with those stated by Falleiro et al. (2013) in Mediterranean buffaloes, Awad & Afify (2014) in Egyptian buffaloes and Chud et al. (2014) in Nellore beef cattle. The estimation of genetic correlations (r_g) among body weight at different ages from birth to first calving ranged between 0.07 and 0.49. The highest value found between BW and WFC while the lowest between BW and W18. The present r_g between BW and WW was

Table 3. Effect of different birth weight levels of female calves on first, second, third lactations milk yield in Egyptian buffaloes.

Level of birth weights	N	Traits		
		1^{st}MY	2^{nd}MY	3^{rd}MY
		Mean ± SE	Mean ± SE	Mean ± SE
25-30 kg	83	1367.37±62.62	1515.5 ±43.94	1631.38 ±60.42
31-35 kg	89	1447.88±55.73	1730.5±67.10	1697.00 ±73.92
36- 40 kg	425	1783.04±45.78	1946.32 ±75.99	2029.35 ±54.88
41-45 kg	324	1553.00±59.07	1935.53 ±60.75	1948.56 ±72.80
46-50 kg	48	1465.23±85.13	1759.73 ±53.81	1698.95 ±42.96
>50 kg	18	1243.76±76.541	1481.03 ±40.37	1584.46 ±43.75

1^{st}MY=first lactation milk yield, 2^{nd}MY=second lactation milk yield and 3^{rd}MY= third lactation milk yield

Table 4. Estimation of direct and maternal heritability and direct maternal genetic correlation for studied traits.

Estimate	Traits						
	WB	WW	W18	WFC	1stMY	2ndMY	3rdMY
h^2_a	0.31	0.22	0.24	0.27	0.23	0.23	0.17
h^2_m	0.39	0.34	0.22	0.40	0.29	0.31	0.21
r_{am}	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.02
c^2	0.23	0.24	0.35	0.20	0.15	0.17	0.22
e^2	0.07	0.20	0.19	0.13	0.33	0.29	0.40

h^2_a= direct heritability, h^2_m= maternal heritability, r_{am}= direct maternal genetic correlation, c^2 = fraction phenotypic variance to permanent environmental and e^2= fraction phenotypic variance due to residual effects.

Table 5. Correlations among studied traits in present investigation in Egyptian buffaloes**.**

Trait	Correlations					
	$Trait_2$	r_{a1a2}	r_{p1p2}	r_{e1e2}	r_{pe1pe2}	r_{m1m2}
WB	WW	0.15	0.45	0.51	0.27	0.30
	W18	0.07	0.09	0.21	-0.14	0.23
	WFC	0.49	0.33	-0.06	-0.48	0.54
	1stMY	0.58	0.28	0.03	0.28	0.11
	2ndMY	0.33	0.25	-0.53	0.43	0.18
	3rdMY	0.45	0.38	-0.03	0.18	0.28
WW	W18	0.12	0.11	0.04	-0.14	-0.26
	WFC	0.40	0.14	0.66	-0.67	0.10
	1stMY	0.22	0.24	-0.47	0.31	0.18
	2ndMY	0.25	0.12	-0.14	0.09	0.10
	3rdMY	0.26	0.22	0.08	-0.07	0.32
W18	WFC	0.41	0.14	-0.13	0.12	0.08
	1stMY	0.11	0.02	0.02	-0.013	-0.06
	2ndMY	0.18	0.04	-0.16	-0.08	0.01
	3rdMY	0.15	0.03	0.08	0.04	-0.14
WFC	1stMY	0.50	0.23	-0.26	0.39	0.07
	2ndMY	0.38	0.26	0.01	0.28	0.15
	3rdMY	0.42	0.29	0.32	0.19	0.15
1stMY	2ndMY	0.63	0.55	0.26	0.37	0.23
	3rdMY	0.82	0.23	0.19	0.03	0.45
2ndMY	3rdMY	0.83	0.37	0.18	0.13	0.23

r_{a1a2} = genetic correlation between trait1, 2 and so on, r_{p1p2} = phenotypic correlation between traits 1, 2 and so on, r_{e1e2} = residual environmental ratio between traits 1, 2 and so on and r_{pe1pe2} = permanent environmental ratio between traits 1, 2 and so on r_{m1m2}= maternal genetic correlation between traits1, 2.

Table 6. Expected of breeding values for sires, cows and dams and accuracies %, for studied traits in Egyptian buffaloes.

Traits	Breeding Values			
	Minimum ± SE	Maximum ± SE	Accuracy, %	Range
Buffalo sires (EBV's)				
BW, kg	-2.95±0.97	2.90±0.89	62 – 76	5.85
WW, kg	-11.14±1.50	8.77±1.54	68 – 76	19.91
W18, kg	-38.81±1.59	44.13±1.65	70 – 73	81.94
WFC, kg	-63.14±1.55	74.18±1.52	73 – 75	137.27
1^{st}MY, kg	-254.41±1.30	279.05±1.33	73 – 75	533.46
2^{nd}MY, kg	-377.50±1.46	346.50±1.47	65 – 66	724.00
3^{rd}MY Y, kg	-260.06±1.24	229.49±1.61	64 – 72	559.52
Buffalo cows (EBV's)				
BW, kg	-4.42±0.71	4.74±0.77	71-.72	9.16
WW, kg	-15.11±1.36	15.10±1.35	76 – 78	30.21
W18, kg	-40.19±1.34	53.32±1.21	81- 83	93.51
WFC, kg	-60.5±1.81	63.03±1.81	67 -73	123.53
1^{st}MY, kg	-227.72±1.73	349.62 ±1.52	62 –70	577.34
2^{nd}MY, kg	-336.81±1.64	300.92±1.60	66 – 77	637.37
3^{rd}MY, kg	-251.22±1.24	456.93±1.24	69 – 71	708.15
Buffalo dams (EBV's)				
BW, kg	-2.61±0.95	3.24±0.95	47 - 48	5.85
WW, kg	-12.10±1.57	8.25±1.57	41 - 51	20.35
W18, kg	-44.76±2.06	54.32 ±2.08	43 - 45	99.08
WFC, kg	-64.48±1.53	63.74±1.52	73 - 74	128.22
1^{st}MY, kg	-290.26±1.35	410.30±1.33	73 - 74	700.56
2^{nd}MY, kg	-363.66±1.44	378.26±1.46	66 - 69	741.92
3^{rd}MY, kg	-356.14±1.28	430.08±1.11	67- 77	786.22

WB= birth weight, WW= weaning weight, W18=weight at eighteen months, WFC= weight at first calving, 1^{st}MY=first lactation milk yield, 2^{nd}MY= second lactation milk yield and 3^{rd}MY =third lactation milk yield.

nearest to that obtained by Chud et al. (2014) in Nell Nellore beef cattle (0.14) and lower than that obtained.

Agudelo-Gómez et al. (2015) noticed that, r_g between WW and W18 being positive and high (0.72) in Colombia buffaloes and Gupta et al. (2015) clarified that r_g between BW and 1^{st}MY was 0.30. In contrary El-Bramony (2014) obtained lower and negative correlation between 1^{st}MY and WFC (-0.22). The phenotypic correlations (r_p) among WB, WW, W18, and WFC ranged from 045 to 0.09 and from 0.37 to 0.55 among 1^{st}MY, 2^{nd}MY and 3^{rd}MY as in Table 5. In Egyptian buffaloes, El-Bramony (2011) estimated the phenotypic correlations among 1^{st}MY, 2^{nd}MY and 3^{rd}MY ranging 0.23 to 0.44. Awad & Afify (2014) estimated the phenotypic correlations among BW, WW and W18 as from 0.44 to 0.71. The maternal correlations (r_m) among traits were positive except the correlation between W18 and each of WW, 1^{st}MY and 3^{rd}MY. in Table 5. Awad & Afify (2014) obtained the r_m among WB, WW and W18 were ranged from (0.45 to 0.91) in Egyptian buffaloes. Genetic correlations as in table (5) showed that r_g between BW and WW was smaller (0.15), indicating that postnatal growth performances can be improved without increasing birth weight. El-Awady et al. (2005) came to the same correlation. They stated that the r_g between BW and WW was smaller than 50% and was between BW and daily gain negative that indicted the postnatal growth can be increased without increasing BW. Additionally the present results between growth traits and milk yield in first three lactations were taken the previous same trend.

Breeding values

Breeding values consider best measurement able to discern the genotype best animals and it's bring about accurately selection. Accuracy of breeding values, varying from 0.62 to 76, 62 to 83 and from 41 to 77% for sires, cows and dams, in succession. As a result genetic improvement could be realized through whoever sires or cows or dams. The sires breeding values (Kg) for WB, WW, W18, WFC, 1stMY, 2ndMY and 3rdMY ranged from -2.95 to 2.90, -11.14 to 8.77, -38.81 to 44.13, -63.14 to 74.18 and -254.41 to 279.05, -377.50 to 346.50, and -260.06 to 229.49, respectively. Corresponding value (Kg) for cows ranged between -4.42 to 4.74, -15.11 to 15.10, -40.19 to 53.32, -60.5 to 63.03, -227.72 to 349.62, -336.81 to 300.92 and -251.22 to 456.93 kg, for the same above traits, consecutively. In this facet, breeding values (Kg) for the aforementioned traits for dams were -2.61 to 3.24, -12.10 to 8.25, -44.76 to 54.32, -64.48 to 63.74, -290.26 to 410.30, -363.66 to 378.26 and -356.14 to 430.08, respectively in Table 6. Sanghuayphrai et al. (2013) cleared that the breeding values use as base to genetic selection, although high accurate EBV appropriate phenotypic data for weaning weight of swamp buffaloes.

El-Awady et al. (2005) showed that the range of breeding values for BW and WW were 4.9 and 22, 8.19 and, 26 and 5 and 26 kg, for sire, cow and dam respectively, and noticed that the cows breeding values having high accuracy (over 80%) in Egyptian buffalo calves.

CONCLUSION

The current results indicated that the influence of direct and maternal heritability for BW and WFC were high efficiency. Additionally, a moderate genetic correlations between each of BW and WFC and milk yield in the first three lactations and higher than relations between each of WW and W18 and those lactations milk yield. It is indicating that female calves can be selected to milk production from birth based as birth weight, which will lead to buffalo cows with longer productive lives and higher profitability.

Moreover, higher ranges and accuracies of estimated breeding values through any pathway of sires or cows or dams cleared that increased genetic divergence among individuals are founding, therewith genetic improvement could be achieved.

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