**Effect of Inbreeding on Preweaning Growth Traits in Egyptian Buffaloes**

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**Received: 23/7/2020**

**Abstract:** The aims of the current study were to estimate the effect of inbreeding and genetic parameters of birth weight (BW), preweaning daily gain (PDG) and weaning weight (WW) in buffalo calves. Data were collected from weight records of buffalo calves raised at Mahallet Mousa Farms belonging to the Animal Production Research Institute. It included 2015 progeny of 125 sires, through 17 consecutive years. Effect of inbreeding was highly significant for all studied traits. The overall average of inbreeding coefficient was 0.53% in whole population and 15% in the inbred animals. The means of BW, PDG and WW in non-inbred group were 37.318, 0.490 and 88.86 Kg, respectively. While, the means of the same traits in inbred group were 31.96, 0.446 and 78.82 Kg, respectively. Corresponding the inbreeding depression as overall means of levels for above traits were -0.350, -0.003 and -0.716, respectively. Direct heritability ($h^2_a$) in inbred animals for BW, PDG and WW were 0.28, 0.25 and 0.19, respectively. On the other hand, the $h^2_a$ of studied traits in non-inbred animals were 0.32, 0.30 and 0.23, respectively. The maternal heritability ($h^2_m$) for mentioned traits were 0.25, 0.26 and 0.21 within inbred animals and 0.29, 0.28 and 0.22 within non-inbred animals, respectively. Likewise, the genetic correlations ($r_g$) among studied traits were ranged from (0.12 to 0.56) in inbred animals and were ranged from (0.16 to 0.63) in non-inbred animals. As well the phenotypic correlation ($r_p$) among studied traits were ranged from (0.04 to 0.50) for inbreds and were varied between (0.04 and 0.54) for non-inbreds. The inbreeding was pronounced detrimental effects of studied traits in buffalo calves. Therefore, breeding strategies should be develop for reduce the inbreeding effects and inclusion the effects of inbreeding in genetic evaluation programs in Egyptian buffalo calves.

**Keywords:** Preweaning growth traits, inbreeding coefficient, inbreeding depression, Egyptian buffaloes

**INTRODUCTION**

Buffalo is one of the most important agricultural animals in Egypt. FAO (2007) reported that Egyptian buffaloes partake to about 5 and 14% of the world buffalo's milk and meat, successively. The total number of buffaloes in Egypt is about 3.4 million head (FAO, 2017). Egyptian Buffalo is acclimatized animal to the small-holder conditions and is raised under semi-intensive production systems. It plays an important economic role in rural areas. Abu El-Naser (2019) showed that it is suitable to select female buffalo calves by birth weight than by weight at other ages. Weights and growth rates in preweaning are an early indicator of economic profit (Ceyhan et al., 2009). Norberg and Sørensen (2007) and Barczak et al. (2009) indicted that the level of inbreeding is mightily impressed by the ratio of males to females, reproduction ability, mating system and population size. Ceyhan et al. (2011) recommended that mating should be made upon a planned system to avoid inbreeding. Increase the number of males that used in breeding strategy and raise the replacement rate would help to decrease the level of inbreeding. It is necessary to control of inbreeding to avoid the negative effects on fertility in further generations (Müller-Unterberg, et al. 2017). Mating strategy can resolve inbreeding issues on the farm, at least in the short term, but long-term inbreeding control in a dairy population needs consideration of the relationships among young bulls entering progeny test strategy (Weigeland and Lin 2002). The objectives of this study were to estimate the effect of inbreeding and genetic parameters of birth weight, preweaning daily gain and weaning weight in Egyptian buffaloes.

**MATERIALS AND METHODS**

**Data collection**

Data were collected from weight records of buffalo calves raised at Mahallet Mousa Farms belonging to the Animal Production Research Institute (APRI). It included 2015 progeny of 125 sires, through 17 consecutive years (2000-2016). Studied traits were birth weight (BW, kg), preweaning daily gain (PDG, kg) and weaning weight (WW, kg). Calves after birth, were suckling colostrum during the first three days of their life. They housed individually in calf bed until weaning (15th weeks of age). During suckling period calves were fed natural milk, based on their weight. Moreover, starter was given at the third week of their age up to weaning (15th weeks) with berseem hay (Trifolium alexandrinum). Water and mineral mixture were available freely to buffalo calves.

**Statistical analysis**

Pedigree structure of the population and inbreeding coefficient were calculated using CFC program (Sargolzaei et al. 2006). The least square means and analysis of variance were estimated for some factors of the studied traits using SAS program (SAS 2002) using the following model:

\[
Y_{ijklmno} = \mu + F_i + M_j + Y_k + P_l + H_m + G_n + \epsilon_{ijklmno}
\]

Where:

- \( Y_{ijklmno} \): Observation value, \( \mu \) = overall mean, \( F_i \) =fixed effect of i\textsuperscript{th} inbreeding coefficient, \( M_j \) = fixed *Corresponding author e-mail: ghazy@agr.suez.edu.eg*
effect of jth month of birth, Yk = fixed effect of kth year of birth, Pj =fixed effect of jth parity of dam, Hm = fixed effect of mth farm or herd and Gg =fixed effect of nth gender and eijklmno = random error term. While estimated inbreeding depression in studied traits via liner regression as recording by (Sokal 1995; Khan et al., 2007).

The (Co) variance components and genetic and phenotypic parameters for traits under study were estimated by MTDFREML suite of programs (Boldman et al. 1995). Apply the following model:

\[ Y = X\beta + Za + Mm + Wpe + e \]

Where:
- \( Y \) = a vector of observations, \( \beta \) = 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), \( W \)

RESULTS AND DISCUSSION

Descriptive statistics

The statistical analysis of pedigree showed that the overall average of inbreeding coefficient was 0.53% for the whole population and 15% for inbred animals. The number of inbred animals were 89 heads from the animals (Table 1). Ceyhan et al. (2011) shown that inbreeding average of all animals overall years was 2.25% and the rate was 17.7% in inbred Sakiz sheep lambs. The means of birth weight (BW), preweaning daily gain (PDG) and weaning weight (WW) in all animals were 37.08, 0.480 and 88.42 kg, successively (Table 1).

| Traits | All animals | Non-inbreeds | Inbreeds |
|--------|-------------|--------------|----------|
| BW, kg | 37.08±0.118 | 37.31±0.18 | 31.96± 0.51 |
| PDG, kg | 0.480±0.002 | 0.490±0.002 | 0.446±0.145 |
| WW, kg | 88.42±0.290 | 88.86±0.29 | 78.82±1.77 |
| Number of inbreds | 89 | |
| Average inbreeding coefficients in the inbreds | 15% | |
| Average inbreeding coefficients (all population) | 0.53% | |

The mean of BW in all animals was slightly higher than the means that reported by Awad and Afify (2014) and Abu El-Naser (2019) in Egyptian buffaloes (36.30 and 36.56 kg, respectively). However, the mean of WW in all animals was lower than the means that noticed by them 91.31 and 96.95 Kg, respectively. The overall mean of PDG in all animals was nearest to the value that estimated by Thevamanoharan et al. (2001) in Swamp buffalo (460.50 g). While, it was higher than estimate that found by Ahmad et al. (2002) in Nili Ravi buffalo (0.335, kg). The present results were not comparable to outcomes that observed by Khan et al. (2007) in Beetal goats. They found the means of BW, PDG and WW were better in inbreds in comparison with non inbreds. The inbred calves were appeared to ultimately reduce in proportion to 5.358, 0.04 and 10.04, kg for BW, PDG and WW, respectively (Table 1). The current results agree with outcomes of Ceyhan et al. (2011) that presented the effects of inbreeding on birth weight in Sakiz sheep. The effects of inbreeding, year of birth, parity of dam, herd and gender were highly significant (P< 0.01) on all studied traits, except the effect of parity of dam on PDG was not significant (Table 2). While the effect of month of calving was not significant on all traits. The current estimates were compatible with results that found by Abu El-Naser (2019).

Table (2): Significance levels of some factors affecting on studied traits

| Traits | F | MO | YR | H | P | G |
|--------|---|----|----|---|---|---|
| BW | 100.95** | 0.64** | 7.0** | 9.71** | 20.17** | 22.92** |
| PDG | 34.77** | 0.63** | 17.67** | 34.51** | 1.35** | 38.75** |
| WW | 74.27** | 0.47** | 16.17** | 12.79** | 3.47** | 44.49** |

No. of records 2015, inbreeding coefficient (F) = 2 (1= inbreed and 0= no inbred), month of Birth (MO) =12, year of birth (YR) = 17 and herd or farm (H) =3, parity of dam (P) =10 and gender (G) = 2 (1= male and 2= female) (** P<0.01) (n.s= non-significant).
The same results were found by Thevamanoharan et al. (2001) in Swamp buffaloes for effects year of calving and parity of dam on the same traits. Also, the results of the present study agree with Ahmad et al. (2002) for the estimates of the effect of seasons of birth and parity on birth weight in Nili Ravi buffalo.

**Inbreeding coefficient Levels**

The pedigree analysis reflected that 4 animals out of 89 animals (inbreds) had deficient inbreeding coefficient (up to 0.05) with a mean value 4.5%. There were 31 animal out of 89 animals (inbreds) had low inbreeding coefficient (0.06 to 0.10) with mean values 34.83%. Following with animal had medium inbreeding coefficient (0.11 to 0.20). The remaining calves (13.48%) had high inbreeding coefficient (0.21 to 0.25) are given in Table 3. The current results revealed that decline for BW, PDG and WW were ranged from -4.84 to -7.33, -0.03 to -0.08 and -7.17 to -11.75, respectively as a result increased inbreeding coefficient levels.

| Inbreeding categories | N  | BW       | PDG       | WW       |
|-----------------------|----|----------|-----------|----------|
|                       |    | Mean ± SE| Mean ± SE | Mean ± SE|
| Up to 0.05            | 4  | 32.21±2.54| 0.46±0.08 | 81.25±8.25|
| 0.06-0.10             | 31 | 32.00±0.99| 0.44±0.023 | 79.67±3.25|
| 0.11-0.20             | 42 | 31.21±0.70| 0.43±0.02 | 78.36±2.5 |
| 0.21-0.25             | 12 | 29.75±0.68| 0.41±0.08 | 76.67±4.89|

Inbreeding depression had perceived for all inbreeding classes and the estimated effects were highly significant (P≤0.01) for all studied traits (Table 4). Regarding, change of inbreeding coefficient 1% was deleterious for BW, PDG and WW and were ranged from 0.213 to 1.705, 0.003 to 0.031 and 0.490 to 2.407 kg, respectively with different classes of inbreeding coefficient in buffalo calves. El–Arian et al. (2008) reflected that the losses refer to inbreeding, it can be reduced by careful attention to constraint of the mating and accuracy at selection programs for mating using computer.

| Classes     | BW  | PDG  | WW   |
|-------------|-----|------|------|
|             | β ± SE | β ± SE | β ± SE |
| Up to 0.05  | -1.705±0.639** | -0.031±0.015** | -2.407±0.833** |
| 0.06-0.10   | -0.872±0.150** | -0.017±0.006** | -1.414±0.370** |
| 0.11–0.20   | -0.408±0.065** | -0.004±0.001** | -0.847±0.159** |
| 0.21–0.25   | -0.213±0.060** | -0.003±0.001** | -0.490±0.147** |
| Overall mean| -0.350±0.043** | -0.003±0.001** | -0.716±0.106** |

| β is a regression coefficient |

Khan et al. (2007) noticed that the inbreeding depression were 0.0004 kg, 0.0028 kg, and 0.202 gram for BW, WW and PDG, respectively in all population of Bettal goats. Yavarifard et al. (2014) denoted that increase in inbreeding coefficient 1%, bring about decreased BW and WW by 6.34 and 14.68g in Mehraban sheep. It can be appearing from these results that the direct effects of inbreed in the different studied traits, if not controlled them, this will lead to reduced performance for growth traits in buffalo calves in future. Depression of inbreeding is attributable to increased homozygosity of individuals. Increased homozygosis brings about lowers tenss by increase of the frequency of homozygous recessive unfavorable, and increased homozygosity for alleles at loci (Charlesworth and Willis 2009). Falconer and Mackay (1996) noticed that increasing in inbreeding leads to decrease of genetic variation by decreasing heterozygosity. Doekes et al. (2019) reflected that inbreeding depression was seen in yield traits. For yield traits and based on pedigree, they found that inbreeding through recent generations was more detrimental than inbreeding during distant generations.

**Genetic parameters**

Direct heritability ($h^2_a$) of BW, PDG and WW was 0.28, 0.25 and 0.19, respectively in inbreds and were 0.32, 0.30 and 0.23, respectively in non-bred animals.
Table (5): Estimation of direct and maternal heritability for studied traits in non-inbreds and inbreds of Egyptian buffalo calves

| Estimate | Inbreds | Non-inbreds |
|----------|---------|-------------|
|          | BW | PDG | WW | BW | PDG | WW |
| $h^a$    | 0.28 | 0.25 | 0.19 | 0.32 | 0.30 | 0.23 |
| $h^m$    | 0.25 | 0.26 | 0.21 | 0.29 | 0.28 | 0.22 |
| $r_{am}$ | -0.31 | -0.31 | -0.08 | -0.5 | -0.56 | -0.05 |
| $c^2$    | 0.29 | 0.27 | 0.33 | 0.29 | 0.30 | 0.28 |
| $e^2$    | 0.18 | 0.22 | 0.27 | 0.10 | 0.12 | 0.27 |

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

The present results showed dissimilar trend of El-Awady et al. (2012) for lifetime performance in Friesian cows. Abu El-Naser (2019) in Egyptian buffaloes indicated that the $h^a$ and $h^m$ of BW were 0.31 and 0.29, respectively and WW were 0.39 and 0.34, respectively. As well as Awad and Aify (2014) in Egyptian buffaloes indicated that $h^m_m$ for BW was 0.38 and WW was 0.26. Appreciation direct maternal genetic correlations ($r_{am}$) in studied traits were negative and contrast between -0.05 to -0.56 in inbreds, Likewise, in non-breds were negative and varied between -0.08 to -0.31 (Table 5). The present results conformed to Abu El-Naser (2019) in Egyptian buffaloes.

The genetic correlations ($r_p$) among different studied growth traits were ranged from 0.12 to 0.56 for inbreds while were ranged from 0.16 to 0.63 for non-inbreds (Table 6). Corresponding phenotypic correlations ($r_e$) among above studied traits were varied between (0.04-0.50) within inbreds and it were ranged from (0.04 to 0.54) in non-breds (Table 6).

Table (6): Correlations among studied traits in present investigation in Egyptian buffaloes

| Trait | Correlations | BW | PDG | WW | BW | PDG | WW |
|-------|--------------|----|-----|----|----|-----|----|
|       | $r_e$ | $r_p$ | $r_{pe}$ | $r_m$ | | | |
|        |        |        |        |        | | | |
| Inbreds |          |        |        |        | | | |
| BW     | P DG | 0.56 | 0.50 | -0.58 | -0.93 | 0.32 |
| PDG    | WW | 0.12 | 0.04 | -0.60 | -0.16 | 0.24 |
|        | WW | 0.31 | 0.21 | -0.46 | -0.21 | 0.45 |
| Non-inbreds |          |        |        |        | | | |
| BW     | PDG | 0.63 | 0.54 | -0.86 | -0.93 | 0.43 |
| PDG    | WW | 0.16 | 0.11 | 0.24 | 0.18 | 0.25 |
|        | WW | 0.35 | 0.04 | -0.37 | -0.18 | 0.51 |

$r_e$ = genetic correlation, $r_p$ = phenotypic correlation, $r_{pe}$ = residual environmental ratio between traits, $r_m$ = permanent environmental ratio and $r_{am}$ = maternal genetic correlation between traits.

These results disagree with El-Awady et al. (2012) in Friesian cow. The estimates of residual ratio were varied between -0.46 and -0.60 in inbreds and varied between -0.86 and 0.24 in non-breds. As well as, the permanent ratio was ranged from -0.21 to -0.93 in inbreds and was ranged from -0.93 to 0.18 in non-breds (Table 6). While the estimates of maternal genetic correlations ($r_{am}$) among traits were ranged from 0.24 to 0.45 in inbreds and were ranged from 0.25 to 0.51 in non-breds. Which, it is take the same trend of genetic correlations of studied traits (Table 5). Abu El-Naser (2019) noticed that the estimates of $r_{pe}$, $r_p$ and $r_m$ between BW and WW were 0.15, 0.45 and 30, respectively in Egyptian buffaloes.

CONCLUSION

The current study indicated that the inbreeding showed a deleterious effect on preweaning growth traits. Therefore, it is necessary to increase monitoring when designing a mating plan in order to control rates of inbreeding in the future, based on complete pedigree information supported via molecular genetics, to achieve a high rate of genetic gain in breeding programs.

ACKNOWLEDGMENT

We extend our sincere thanks and appreciation to all staff of Animal Production Research Institute (APRI) especially staff of Mahallet Mousa station for the data provided to us.
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تأثير التربية الداخلية على صفات النمو قبل الوفيات في الجاموس المصري

إبراهيم عطا أبو النصر، غالي الززعي، حمدي منير، ممدوح محمد، جمعية الزراعة، جمعية الزراعة، جامعة السويس، جامعة حلوان، جامعة قنطرة.

الهدف من الدراسة الحالية هو تدقيق تأثير تربية الداخلية والمعايير الوراثية لوزن الوليد ووزن الوفاة قبل الوفاة، ووزن الوفاة في عجلة لحمية. الدراسة تستخدم بيانات مستخدمة في الدراسة لمجموعة من محاور الوفاة في محطة الوفاة في جمعية الوفاة في عجلة. وكان تأثير التربية الداخلية على الوفاة في الوالدين ووزن الوفاة في عجلة، ووزن الوفاة في عجلة، ووزن الوفاة في عجلة، ووزن الوفاة في عجلة. وكان تأثير التربية الداخلية على الوفاة في عجلة، ووزن الوفاة في عجلة، ووزن الوفاة في عجلة، ووزن الوفاة في عجلة.

النتائج:

1. تأثير التربية الداخلية على الوفاة في عجلة: كان تأثير التربية الداخلية على الوفاة في عجلة، ووزن الوفاة في عجلة، ووزن الوفاة في عجلة، ووزن الوفاة في عجلة.
2. تأثير التربية الداخلية على الوفاة في عجلة: كان تأثير التربية الداخلية على الوفاة في عجلة، ووزن الوفاة في عجلة، ووزن الوفاة في عجلة، ووزن الوفاة في عجلة.

الモデيلات المستخدمة في الدراسة: 

- تأثير التربية الداخلية على الوفاة في عجلة، ووزن الوفاة في عجلة، ووزن الوفاة في عجلة، ووزن الوفاة في عجلة.
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الاستنتاجات: 

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الواقعيات: 

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النهاية: 

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