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# Multivariate Analysis on Reproductive and Productive Traits of Egyptian Buffaloes

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## Abstract

Reproductive indices including age of first calving (AFC), calving interval (CI), days open (DO), and number of services per conception (S/C) have vital role in assessing the breeding efficiency. Moreover, productive traits including milk yield and lactation period are significantly affected by reproductive indices. Therefore, the study was design to illustrate the variations in reproductive and productive traits of Egyptian buffaloes using multivariate analysis. Records of 887 Egyptian buffalo were gathered from a study farm in Egypt's Ismailia Province. Using version 26 of the statistical package for social science software, all data were subjected to multivariate analysis of variance (MANOVA) (SPSS V. 26.0). Our findings indicated that Egyptian buffaloes who calved in the winter produced more milk (2250.09 kg) than those that calved at other times of the year, but that the summer calvers produced the least milk (2117.58 kg). The buffaloes with CI >15-month (2290.76 kg), DO between 201-300 days (2300.57 kg), and three or more services (2411.73 kg) had the highest MY. Animals with DP < 167 days had the largest milk output (2260.9 kg), whereas those with DP <167 days had the lowest AFC (28.54 month), CI (13.57 month), and DO (150.49 days). Furthermore, highly milk producer buffaloes more than 3000 Kg had prolonged CI and DO. In conclusion, reproductive traits adversely affect the milk production that was distinguished via the retardation of breeding efficiency traits in highly milk producers' Egyptian buffaloes. Therefore, attention should be paid to overcome the economic losses to improve this industry.

KEYWORDS
Calving season, Egyptian buffaloes, Fertility traits, MANOVA, Productive traits

## INTRODUCTION

In African and Mediterranean nations, including Egypt, the water buffalo is one of the most common dairy animals (Hernández-Castellano *et al*., 2019; Eldawy *et al*., 2021). Due to their favorable traits as a bovine species, such as their value as a source of meat and milk with palatable flavor, resilience to hot climates, draught ability, and acceptable growth performance, buffaloes are primarily used in developing countries (Mondal *et al*., 2007; ShafiK, 2017).

Seasonal temperature variations have an impact on buffalo performance (Marai *et al*., 2009; Hassanat *et al*., 2017; Hernández-Castellano *et al*., 2019). Effectively influencing lactation length (LL) and milk production (MY) is the calving season. LL is longer for summer calves compared to winter calves. Moreover, MY exhibits an inverse tendency in relation to lactation length (Bashir *et al*., 2015).

Reproductive indices such as calving interval (CI), days open (DO), and number of services per conception (S/C) play crucial roles in judging the breeding efficiency (Cady *et al*., 1983). Calving interval depends mainly on breeding season and farm management (Parlato and Zicarelli, 2016). Besides, there is a negative correlation between DO and MY (Easa *et al*., 2022). Lowered S/C and DO are related to extended productive life of the animal as well as the number of calves (Ali *et al*., 2011).

Several earlier research assessed the quantity and quality of milk produced in the northeast region, but studies focusing on buffaloes are still infrequent. The study of milk production parameters required the use of multivariate analysis due to the multidimensional nature of the bovine data (Cavalcante *et al*., 2020). Hence, the aim of the current study was to clarify the variations in reproductive and productive traits of Egyptian buffaloes using multivariate analysis.

## MATERIALS AND METHODS

*Ethical approval*

Scientific Research Ethics Committee of Faculty of Veterinary Medicine, Suez Canal University approved all the procedures of the study (no: 2023019).

*Data collection and herd management*

The current study's data were gathered from the reproductive and productive records of 887 Egyptian buffaloes kept on a


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study farm in Egypt's Ismailia Governorate. Animals were housed in shaded, partially open yards. In accordance with the animals' degree of output, body weight, reproductive health, and maintenance needs, a balanced meal was provided. Wheat straw and clover were provided once daily, whereas animals were fed a concentrate combination twice daily. Water was available at ad libitum. Milk harvested from lactating animals twice a day.

The survey data were obtained for productive and reproductive parameters. The available data kept in the records were season of calving, age at first calving (AFC), calving interval (CI), days open (DO), and number of services per conception (S/C), dry period (DP), milk production (MY) and lactation length (LL).

*Studied traits*

Reproductive indices affecting production traits (MY, and LL)

Data regarding the calving season, AFC, CI, DO, S/C as well as DP were obtained from the records for all the studied buffaloes.

Productive traits affecting reproductive indices (AFC, CI, DO, and S/C)

Buffaloes' records were investigated for the levels of milk production as well as the dry period data.

*Statistical data analysis*

The data were subjected to multivariate analysis of variance (MANOVA) using SPSS version 26.0, a statistical tool for social science research (SPSS V. 26.0) (Ibm, 2019). Duncan's multiple range tests were used as post hoc analyses to look into the significance of the variance in the levels of the non-genetic components in connection to the researched traits (Duncan, 1955). Wilks lambda test was used to examine the vectors of means of factors evaluated by the reproductive and productive attributes using multivariate analysis of variance (MANOVA) (Morrison, 1976).

A column vector of values for each dependent variable is utilized since there are several dependent variables in MANOVA (Cooley and Lohnes, 1971;, Overall and Klett, 1972; Morrison, 1976; Dunteman, 1984; Tabachnick *et al.*, 2013).

$$Y_{i...n} = \begin{bmatrix} a_1 \\ b_1 \end{bmatrix} \begin{bmatrix} a_2 \\ b_2 \end{bmatrix} \begin{bmatrix} a_3 \\ b_3 \end{bmatrix} \cdots \begin{bmatrix} a_n \\ b_n \end{bmatrix}$$

The column vector for independent variable (IV) levels, which consists of the means of the dependent variables (DVs).

$$IV_1 = \begin{bmatrix} \bar{X}_1 \\ . \\ . \\ . \\ \bar{X}_n \end{bmatrix} IV_2 = \begin{bmatrix} \bar{X}_1 \\ . \\ . \\ . \\ \bar{X}_n \end{bmatrix} \ldots IV_m = \begin{bmatrix} \bar{X}_1 \\ . \\ . \\ . \\ \bar{X}_n \end{bmatrix}$$

*Test statistics for MANOVA*

The pooled ratio of error variance to both effect variance and error variance (ratio of determinants) is known as Wilks' statistic.

$$\Lambda = \frac{|S_{error}|}{|S_{effect} + S_{error}|}$$

The pooled variance of the effect variance to error variance is known as Hotling's trace statistic.

$$T = \sum_{i=1}^{s} \lambda_i$$

Pillai-Barlett criterion statistic is the pooled effect variance:

$$V = \sum_{i=1}^{s} \frac{\lambda_i}{1+\lambda_i}$$

Roy's largest root equals to the largest eigen value.

First model

To analyze factors affecting milk yield and lactation length in the current investigation. The following model was assumed:

$$Y_{ijklmn} = \mu + S_i + AFC_j + CI_k + Do_l + S/C_m + DP_n + \varepsilon_{ijklmn}$$

Where: - $Y_{ijklmn}$: the observed value; (i.e., milk yield, and lactation length), µ: the overall mean, $S_i$: The effect of i[th] season of calving; (i= 1, 2, 3, and 4, whereas 1= winter, 2= summer, 3= autumn, and 4= spring), $AFC_j$: The effect of j[th] age at first calving; (j= 1, 2, and 3, whereas 1= <30-months, 2= 30-35 months, and 3= >35-months), $CI_k$: The effect of kth calving interval; (k= 1, 2, and 3, whereas 1= <12-month, 2= 12-15 month, and 3= >15-month), $DO_l$: the effect of l[th] days open; (l= 1, 2, 3, and 4, whereas 1= <100 days, 2= 100-200 days, 3= 201-300 days, and 4= >300 days), $S/C_m$: The effect of mth number of services per conception; (m= 1, 2, and 3, whereas 1= one service, 2= two services month, and 3= three or more services), $DP_n$: The effect of nth dry period; (l= 1, 2, and3, whereas 1= <167 days, 2= 167-285 days, 3= >285 days), and $\varepsilon_{ijklmn}$: Random error.

Second model

This model used to analyze the effect of the level of production, and dry period on fertility traits in this study, and the following model was assumed:

$$Y_{ijk} = \mu + L_j + DP_k + \varepsilon_{ijk}$$

Where: - $Y_{ijk}$: the observed value; (i.e., age at first calving, calving interval, days open, and number of services per conception), µ: the overall mean, $L_j$: The effect of j[th] level of production; (j= 1, 2, and3, whereas 1= <2000 kg, 2= 2000-3000 kg, 3= >3000 kg), $DP_n$: The effect of nth dry period; (l= 1, 2, and 3, whereas 1= <167 days, 2= 167-285 days, 3= >285 days), and $\varepsilon_{ijklmn}$: Random error.

# RESULTS

*Reproductive indices affecting production traits*

The multivariate analysis of variance (MANOVA) illustrated significant differences between vector of means, Table, 1. Thus, it can be inferred the presence of significant differences between the levels of the reproductive traits (AFC, CI, DO, S/C, and DP) based on the evaluated traits of production (MY, and LL). However, the multivariate tests showed non-significant differences between vector of means associated with levels of season of calving based on the studied production traits (MY, and LL).

*Milk yield*

Calving season exhibited significant (P<0.05) influences on MY as well as LL. Egyptian buffaloes calved in winter season produced more milk (2250.09±31.96 kg) as compared with other seasons. However, summer season showed the lowest quantity of MY than other seasons (Table, 2).

Egyptian buffaloes with AFC from 30-35 month, CI more than 15 month, DO from 201-300 days, conception after three or more services, and DP less than 167 days produced more (P<0.05) MY (2217.14±47.12, 2290.76±35.42, 2300.57±45.57, 2411.73±98.09, 2260.90±22.15 kg, respectively) than others. On the other hand, buffaloes with AFC more than 35-month, CI less than 12 month, DO less than 100 days, conceived with only one service, and with DP more than 285 days showed the lowest (P<0.05) levels of ML (2038.57±79.86, 2006.49±84.61, 1790.29±69.51, 2056.94±25.54, and 1891.09±65.82 kg, respectively). (Table 2).

*Lactation length*

Regarding LL, winter and summer revealed more prolonged (P<0.05) LL (253.24±2.66, and 246.45±4.39 days) than autumn and spring (Table 2).

Lactation length increased significantly (P<0.05) in buffaloes with AFC less than 30 month, CI more than 15 month, DO more than 300 days, 2 or 3 S/C and DP less than 167 days. While the shortest LL were for buffaloes with AFC more than 35-month, CI less than 12 month, DO less than 100 days, one S/C, and DP more than 285 days (Table 2).

*Productive traits affecting reproductive indices (AFC, CI, DO, and S/C)*

All multivariate test statistics showed significant (P<0.001) effects of the levels of production, and DP on the studied reproductive traits (AFC, CI, DO, and S/C), as shown in Table 3.

*Age of first calving*

The different levels of production had no significant (P>0.05) effects on the AFC of Egyptian buffaloes. However, buffaloes with DP less than 167 days and 167-285 days revealed less (P<0.05) AFC than those buffaloes of DP more than 285 days (28.54±0.18 and 28.93±0.22 vs 32.61±0.94 month, respectively), Table 4.

*Calving interval*

The CI shortened significantly (P<0.05) in buffaloes of milk production less than 2000 and 2000-3000 kg as compared with those of milk production more than 3000 kg. Additionally, buffaloes with DP less than 167 days had fewer CI (P<0.05) than others (Table 4).

*Days open*

Buffaloes of milk production less than 2000 and 2000-3000 kg had less (P<0.05) period from calving till conception as compared with those of milk production more than 3000. Besides, DO decreased significantly (P<0.05) when DP less than 167 days as compared with other levels of DP (Table 4).

Table 1. Multivariate tests for equality of the vector of means of reproductive indices affecting milk yield and lactation length.

| Effect | | Value | F | Degree of freedom | Significance |
|---|---|---|---|---|---|
| Calving Season | Pillai's Trace | 0.01 | 1.50 | 6 | 0.18 |
| | Wilks' Lambda | 0.99 | 1.498[b] | 6 | 0.18 |
| | Hotelling's Trace | 0.01 | 1.50 | 6 | 0.18 |
| | Roy's Largest Root | 0.01 | 1.905[c] | 3 | 0.13 |
| AFC | Pillai's Trace | 0.01 | 2.35 | 4 | 0.05 |
| | Wilks' Lambda | 0.99 | 2.345[b] | 4 | 0.05 |
| | Hotelling's Trace | 0.01 | 2.34 | 4 | 0.05 |
| | Roy's Largest Root | 0.01 | 3.055[c] | 2 | 0.05 |
| CI | Pillai's Trace | 0.06 | 13.14 | 4 | <0.001 |
| | Wilks' Lambda | 0.94 | 13.315[b] | 4 | <0.001 |
| | Hotelling's Trace | 0.06 | 13.49 | 4 | <0.001 |
| | Roy's Largest Root | 0.06 | 26.521[c] | 2 | <0.001 |
| DO | Pillai's Trace | 0.08 | 11.95 | 6 | <0.001 |
| | Wilks' Lambda | 0.92 | 12.062[b] | 6 | <0.001 |
| | Hotelling's Trace | 0.08 | 12.17 | 6 | <0.001 |
| | Roy's Largest Root | 0.07 | 20.787[c] | 3 | <0.001 |
| S/C | Pillai's Trace | 0.10 | 22.30 | 4 | <0.001 |
| | Wilks' Lambda | 0.90 | 22.764[b] | 4 | <0.001 |
| | Hotelling's Trace | 0.11 | 23.23 | 4 | <0.001 |
| | Roy's Largest Root | 0.10 | 44.473[c] | 2 | <0.001 |
| DP | Pillai's Trace | 0.22 | 52.80 | 4 | <0.001 |
| | Wilks' Lambda | 0.78 | 56.297[b] | 4 | <0.001 |
| | Hotelling's Trace | 0.28 | 59.81 | 4 | <0.001 |
| | Roy's Largest Root | 0.27 | 119.424[c] | 2 | <0.001 |

AFC: Age at first calving; CI: Calving interval; DO: Days open; S/C: Number of services per conception; DP: Dry period.

Table 2. Effect of calving season and reproductive indices on productive traits (milk yield and lactation length).

| Factor | Level | N | MY/kg | LL/days |
|---|---|---|---|---|
| Calving season | Winter | 283 | 2250.09$^{a}$±31.96 | 253.24$^{a}$±2.66 |
| | Summer | 183 | 2117.58$^{b}$±44.27 | 246.45$^{ab}$±4.39 |
| | Autumn | 199 | 2139.97$^{b}$±41.54 | 243.02$^{b}$±3.60 |
| | Spring | 221 | 2139.84$^{b}$±35.10 | 243.27$^{b}$±3.16 |
| AFC | <30 month | 674 | 2173.04$^{a}$±21.09 | 248.69$^{a}$±1.88 |
| | 30 -35 month | 147 | 2217.14$^{a}$±47.12 | 244.75$^{ab}$±4.18 |
| | >35 month | 65 | 2038.57$^{b}$±79.86 | 235.28$^{b}$±7.50 |
| CI | <12 month | 41 | 2006.49$^{b}$±84.61 | 235.56$^{b}$±5.74 |
| | 12 - 15 month | 563 | 2122.19$^{b}$±22.47 | 240.40$^{b}$±1.79 |
| | >15 month | 282 | 2290.76$^{a}$±35.42 | 262.02$^{a}$±3.66 |
| DO | <100 days | 59 | 1790.29$^{b}$±69.51 | 215.08$^{d}$±5.56 |
| | 100 - 200 days | 588 | 2159.76$^{a}$±21.69 | 242.75$^{c}$±1.79 |
| | 201 - 300 days | 173 | 2300.57$^{a}$±45.57 | 261.84$^{b}$±4.23 |
| | >300 days | 66 | 2264.98$^{a}$±75.62 | 275.23$^{a}$±8.56 |
| S/C | One service | 462 | 2056.94$^{b}$±25.54 | 232.37$^{c}$±2.17 |
| | Two services | 380 | 2280.61$^{a}$±27.27 | 258.37$^{b}$±2.32 |
| | three or more services | 44 | 2411.73$^{a}$±98.09 | 303.45$^{a}$±9.08 |
| DP | <167 days | 539 | 2260.90$^{a}$±22.15 | 255.25$^{a}$±1.72 |
| | 167 - 285 days | 278 | 2064.54$^{b}$±36.38 | 237.83$^{b}$±3.56 |
| | >285 days | 69 | 1891.09$^{c}$±65.82 | 220.16$^{c}$±7.61 |

Means with different superscript letters are significantly different (P<0.05).
MY: Milk yield, LL: Lactation length; AFC: Age at first calving; CI: Calving interval; DO: Days open; S/C: Number of services per conception; DP: Dry period.

Table 3. Multivariate tests for equality of the vector of means of productive traits affecting reproductive indices (age of first calving, calving interval, days open and number of services per conception).

| Factor | | Value | F | Degree of freedom | Significance |
|---|---|---|---|---|---|
| Level of production | Pillai's Trace | 0.11 | 13.04 | 8 | <0.001 |
| | Wilks' Lambda | 0.89 | 13.365$^{b}$ | 8 | <0.001 |
| | Hotelling's Trace | 0.13 | 13.69 | 8 | <0.001 |
| | Roy's Largest Root | 0.12 | 26.338$^{c}$ | 4 | <0.001 |
| DP | Pillai's Trace | 0.55 | 82.50 | 8 | <0.001 |
| | Wilks' Lambda | 0.46 | 104.287$^{b}$ | 8 | <0.001 |
| | Hotelling's Trace | 1.17 | 127.61 | 8 | <0.001 |
| | Roy's Largest Root | 1.16 | 253.431$^{c}$ | 4 | <0.001 |

DP: Dry period

Table 4. Effect of milk production and dry period on reproductive indices

| Factor | Level | N | AFC (month) | CI (month) | DO (days) | S/C |
|---|---|---|---|---|---|---|
| Level of Milk production | <2000 kg | 342 | 29.01$^{a}$±0.27 | 14.43$^{b}$±0.14 | 171.31$^{b}$±4.58 | 1.44$^{b}$±0.03 |
| | 2000-3000 kg | 488 | 28.88$^{a}$±0.20 | 14.83$^{b}$±0.12 | 183.56$^{b}$±3.58 | 1.57$^{b}$±0.03 |
| | >3000 kg | 57 | 29.65$^{a}$±0.48 | 15.63$^{a}$±0.38 | 209.11$^{a}$±10.70 | 1.93$^{a}$±0.10 |
| DP | <167 days | 540 | 28.54$^{b}$±0.18 | 13.57$^{c}$±0.06 | 150.49$^{c}$±2.09 | 1.51$^{a}$±0.03 |
| | 167-285 days | 278 | 28.93$^{b}$±0.22 | 15.74$^{b}$±0.14 | 207.73$^{b}$±5.16 | 1.59$^{a}$±0.04 |
| | >285 days | 69 | 32.61$^{a}$±0.94 | 19.72$^{a}$±0.42 | 305.39$^{a}$±13.37 | 1.61$^{a}$±0.09 |

Means with different superscript letters are significantly different (P<0.05).
AFC: Age at first calving, CI: Calving interval, DO: Days open, S/C: number of services per conception, DP: Dry period.

*Number of services per conception*

The levels of milk production and DP affected significantly (P<0.05) on S/C that was declared in decreased S/C in the buffaloes of milk production more than 3000 kg. On the other hand, DP showed non-significant (P>0.05) effect on S/C of the studied buffaloes (Table 4).

# DISCUSSION

The current study was conducted to investigate the variations in reproductive and productive traits of Egyptian buffaloes. Regarding the reproductive indices affecting production traits, the multivariate statistical tests showed the non-significant effect for season of calving on MY, and LL. These findings were in consistent with those of Badran *et al.* (2002) in Egyptian buffaloes, and Sarkar *et al.* (2006), and Chakraborty *et al.* (2010) in Murrah buffaloes, who found that calving season had a neglected effect on milk production. The winter calvers were found to produce larger amount of milk (2250.09 kg) with prolonged lactation period (253.24 days) than summer calvers (2117.58 kg and 246.45 days, respectively). Similarly, ShafiK (2017) and Eldawy *et al*. (2021) mentioned that the total milk yield (TMY) recorded for buffalo cows calved in winter (2600.54±44.19 and 1650.48±16.30 kg, respectively), was greater than those calved in summer season (2441.52±40.45 and 1217.67±20.128 kg, respectively). Additionally, According to Bashir *et al*. (2015) the winter season has the highest TMY for Nili-Ravi buffaloes (1865 kg), followed by spring (1803 kg), autumn (1761 kg), and summer (1754 kg). According to the similar tendency, Bajwa *et al*. (2004) noted that summer calvers produced 184 kg less milk than winter calvers (1361 vs. 1545 kg). Asseged and Birhanu (2004) noted that cows' milk production peaked in the fall (359.48 kg) and declined in the summer (3249.36 kg). Due to the abundance of high-quality green fodder in the late winter and early spring, so Egyptian buffaloes that calve during these seasons produce a lot of milk, while its scarcity throughout the summer months and the increase in ambient temperature that had adverse impacts on the productivity of Egyptian buffaloes.

The AFC is a crucial economic specialty reproductive feature. The drop in AFC, however, will ultimately result in a reduction in the expense of keeping the animal until it reaches its productive life, which would then increase the annual genetic gain (Kumar *et al*., 2015). The results of the multivariate analysis demonstrated that AFC had a substantial impact on MY, with a tendency for younger heifers (those aged between 30 and 35 months) to record the highest MY. These results are in line with those of Ramadan (2018), who discovered that heifers with AFCs under 34 months produce more milk than those with larger AFCs. Also, Eldawy *et al*. (2021) said that a 35-month AFC was the best for maximizing milk output. The previous results disagreed with the finding of Thiruvenkadan *et al*. (2010); Sohail and Qureshi (2010) and ShafiK (2017) who denoted buffaloes of AFC more than 35 months produce more TMY.

Many fertility indicators could be applied to assess the reproductive performance of dairy animals including CI, DO, S/C (El-Tarabany and El-Bayoumi, 2015). The results of the multivariate analyses indicated that CI, DO, and S/C had extremely significant effects (P≤0.01) on productive attributes, including MY and LL. The largest MY was found in the current study in buffaloes with CI>15 months (2290.76±84.61 kg), DO ranged from 201 to 300 days (2300.57±45.57 kg), and conception after three or more services (2411.73±98.09 kg). These outcomes corroborated Eldawy *et al*. (2021) which stated that MY was significantly improved in buffaloes with CI>15 months and DO>160 days. Eldawy *et al*. (2021) looked into Egyptian buffaloes with the maximum lactation yield that had conceived after four or more services (2529.8 kg).

DP is a non-productive period in which the udder tissues tend to be repaired. Dry period obtains a direct fundamental effect on the productive life of the animal. Meanwhile, short duration of the DP is correlated positively to increased MY (Kumar *et al*., 2019). The findings in the current study clarified that buffaloes with DP >167 days had the highest milk yield (2260.9 kg). This was in consistent with the findings of ShafiK (2017) who observed that animals with DP less than 170 days recorded the highest MY (2624.1 kg). Also, Ramadan (2018) reported that the maximum MY was recorded for buffaloes with DP less than 167 days. Moreover, Panja and Taraphder (2011), and El- wakeel *et al*. (2013) showed that the optimum MY were gained with DP ranged between 51-70 and 60-90 days, respectively.

The findings of the Wilks lambda, Pillai's Trace, and Hotelling's Trace tests for the productive qualities affecting reproductive indices revealed that the amount of milk production in the current study had a non-significant effect on AFC. On the other hand, milk production had a big impact on CI, DO, and S/C fertility characteristics. In comparison to other buffaloes, those that produced a lot of milk (>3000 kg) had longer CI, DO, and S/C values. The poor producer buffaloes (>2000) had shorter CI, DO, and less S/C needed for conception, nevertheless. Our findings came in harmony with those of Ramadan (2018) who pronounced that high milk production buffaloes had lower reproductive performance as evidenced by longer CI and DO as well as an increase in the number of services needed to conceive an animal, which ensured a highly significant relationship between milk production levels and reproductive traits. According to ShafiK (2017), high-yield buffaloes (>3000 kg/season) had the longest CI and DO (14 month and 111.8 days, respectively), whereas low-yield buffaloes (<2000 kg/season) had the fewest services per conception (1.76). These results concurred with those of Atashi *et al*. (2013) and Němečková *et al*. (2015), as well. The prolonged CI and DO accompanied with high milk production in buffaloes may attributed to the fact that The dairy animals encounter metabolic and hormonal changes (Çolakoğlu *et al*., 2019) via decreased concentrations of insulin growth factor-1 which is an essential factor in regulation of negative energy balance (NEB) as well as being a fundamental factor linked with reproductive disorders (Elsayed *et al*., 2019). Whereas, NEB adversely affect the endometrial immunity and ovarian functions either steroidogensis (Roche *et al*., 2000) and/or folliculogensis (Vanholder *et al*., 2006). Therefore, the highly producer buffaloes suffer from imbalance in reproductive hormones that subsequently interfere with the normal reproductive performance exhibited by prolonged CI and DO.

The results of the current investigation revealed that whereas DP had no significant effects on S/C, it significantly affected AFC, CI, and DO (P≤0.01). AFC (28.54 months), CI (13.57 months), and DO (150.49 days) were the bare minimum for animals with DP fewer than 167 days. Ramadan (2018) cited similar findings when he discussed the highly substantial impact on CI, DO, and S/C. Buffaloes with DP less 167 days exhibited superior reproductive performance measured in shorter CI (13.29 month), DO (65.87 days), and minimum S/C (1.44) compared to those with DP beyond 285 days with longer CI (14.70 month), DO (164.39 days), and increased S/C. (1.85). Our findings were validated by Eldawy *et al*. (2021) who discovered that buffaloes with DP less than 90 days had lower DO (165.60±5.88 days), and CI (16.97±0.16 months) while animals with DP greater than 150 days had higher DO and CI reported.

## CONCLUSION

Reproductive traits adversely affect the milk production that was distinguished via the retardation of breeding efficiency traits in highly milk producers' Egyptian buffaloes. Therefore, attention should be paid to overcome the economic losses to improve this industry.

## CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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