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The Relationship Between Days Dry, Days Open, and Milk Yield in Egyptian Buffaloes

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ABSTRACT

A total of 4,355 records of normal lactations of Egyptian buffaloes kept at Mehalet Mousa Farm, belonging to the Animal Production Research Institute (APRI) (Research Center, Ministry of Agriculture, Cairo, Egypt), during the period from 1993 to 2022 were utilised in this study to estimate the relationships between dry period and days open with milk traits. The following variables were the focus of the study: total milk yield (TMY), lactation period (LP), dry period (DP), and days open (DO). The mean values of TMY, LP, DP, and DO were 1704 kg, 212 days, 221 days, and 117 days, respectively. The least squares analysis of variance demonstrated that both the sires (bulls) and the buffalo nested within sires had a significant effect on TMY, LP, DP, and DO. The year and month of parturition, as well as parity, also had a significant influence on most of the studied variables. Furthermore, the estimates of the partial linear regression coefficients of TMY and LP on DO were statistically significant ($P < 0.01$). However, the quadratic regression coefficients were not significant, with values of 6.71 ± 0.28 kg/d and -0.0016 ± 0.0008 kg/d^2 for TMY and 1.03 d/d and -0.00004 ± 0.00005 d/d^2 for LP, respectively. The findings of this study indicate that the estimates of the linear regression coefficients of TMY and LP on DP were significant ($P < 0.01$). However, the quadratic regression coefficients were not significant, with values of -6.89 ± 0.32 kg/d and 0.0009 ± 0.0006 kg/d² for TMY and -1.02 ± 0.02 d/d and 0.00001 ± 0.0004 d/d² for LP, respectively. The findings of this study indicated that a reduction in the dry period and the number of days open would be a favourable outcome for dairy farmers. This would assist in reducing the financial expenditure associated with the rearing of breeding cows and optimising the number of lactations per cow.
Key words: Egyptian buffaloes, days dry, days open, milk yield

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1. INTRODUCTION AND LITERATURE REVIEW

Fertility traits, such as days open, play an important role in the productive life of animals. Short days open increase the productive life of animals and the number of calves produced (Basant Shafik et al., 2017).

In Egypt, buffaloes are considered the main dairy cattle, as they surpass local cows in terms of milk yield and growth rate (Easa et al., 2022).

Integrating several traits, such as days open and days dry, alongside milk yield, and understanding their relationships, is important for effectively controlling the dairy production system to maximise economic returns. Poor fertility performance increases production costs due to higher culling rates, longer calving intervals, lower milk production, and fewer calves per cow per year, ultimately resulting in decreased profits (Bagnato & Oltenacu, 1994; Helmy & Somida, 2021).

Economic traits, such as productivity and fertility, in dairy cattle are influenced by genetic and non-genetic factors. Calculating the environmental factors affecting productive and reproductive performance provides basic information for developing breeding and management programmes for genetic improvement. This information is useful for selecting cows, sires and dams with superior genetic merit (Khattab et al., 2023).

The main objective of the present study is therefore to estimate the relationships between the dry period (DP), days open (DO) and total milk yield (TMY), as well as between the dry period and lactation period (LP), for Egyptian buffaloes.

2. MATERIALS AND METHODS

2.1 Source of data

This study uses a total of 4,355 normal lactation records of Egyptian buffalo kept at the Mehalet Mousa Farm, which belongs to the Animal Production Research Institute (APRI) at the Research Centre of the Ministry of Agriculture in Cairo, Egypt, from 1993 to 2022. The variables studied were total milk yield (TMY), lactation period (LP), dry period (DP) and days open (DO). Days dry is the period during which the animal is not producing milk. The 'days open' period is the time between calving and the subsequent conception.

2.2 Feeding system

In winter, the animals were fed Berseem (*Trifolium alexandrinum*) in addition to rice straw and small amounts of concentrated feed. In the summer, the animals were fed a concentrate ration and a small amount of Berseem hay. The amount of feed given to the animals was determined according to their body weight and level of milk production. The rations were offered twice daily. Clean water was available at all times. The buffalo cows were hand-milked twice daily, at 07:00 and 16:00, throughout the lactation period. The buffalo cows were naturally mated in a group system. Rectal palpation was used to check for pregnancy 40 days after calving. Buffalo heifers were usually first mated at 18 months of age or when they reached 350 kg in body weight.

2.3 Statistical analysis

A preliminary analysis of the data was performed using the Statistical Analysis System (SAS, 2000) software. The linear mixed model included the fixed effects of month and year of parturition, dam's parity, and the linear and quadratic regression coefficients of total milk yield (TMY) and lactation

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period (LP) on dry period (DP) and days open (DO). The random effects of sires (bulls) and buffalo nested within sires were also included in the model.
The following mixed model (*Eq. 1*) was used:

Yijklmn = U + Si + Dij + Mk + Yl + Pm + B1XO + B2O2 + B3XP + B4P2 + Eijklm (1)

Where:
U = the overall mean of the traits; Si = the random effect of the i^(th) bull; Dij = the random effect of the j^(th) buffalo nested within the i^(th) bull; Mk = the fixed effect of the k^(th) month of calving (k = 1, 2, … 12); Yl = the fixed effect of the year of calving; and L = (1993, 1994, … to 2022), Pm = fixed effect of the m^(th) parity, b_(1o) = partial linear regression coefficient of TMY and LP on days dry, b_(2p) = partial quadratic regression coefficient of TMY and LP on days dry, b_(3p) = partial linear regression coefficient of TMY and LP on days open and b_(4p) = partial quadratic regression coefficient of TMY and LP on days open. e_(ijklmnopq) = random residual effect.

3. RESULTS AND DISCUSSION

The overall means of total milk yield (TMY), lactation period (LP), dry period (DP) and days open (DO) for Egyptian buffaloes are presented in *Table 1*.

Table 1: Means, stander deviation (SD), and coefficient of variation (CV%) for different variables studied on Egyptian buffaloes

Variables	Mean	SD	CV %
Total Milk yield (TMY), kg	1704	565	33.13
Lactation period (LP), d	212	48	22.88
Dry period (DP), d	221	110	49.94
Days open (DO), d	117	102	86.97

Number of records: 4355.

The coefficients of variation for TMY, LP, DP and DO were 33.13 %, 22.88 %, 49.94 %, and 86.97 %, respectively (*Table 1*). The higher estimates for DP and DO were due to greater variation between animals, which is attributed to the fact that artificial insemination is not always available. The variation in DO may also be attributed to differences in climatic extremes during different years and seasons, management practices, the presence of a teaser bull, and the ability of labourers to detect oestrus (Bashir et al., 2015).
Bulls and buffalo nested within bulls had a significant effect on TMY, LP, DP, and DO (*Table 2*), suggesting the potential for genetic improvement of these traits through sire and dam selection. Ibrahim et al. (2012), Amina Ahmed et al. (2017) and Khattab et al. (2023), working with a different set of the same herd, reported that the sire of the heifers had a significant effect on milk yield and lactation period. Conversely, Vyas et al. (2021), working with Surti buffaloes in India, found that the sire had no significant effect on DP and DO.
The least squares of variance for the factors affecting milk traits are presented in *Tables 2 and 3*. The month and year of parturition had a significant impact on TMY, LP, DP, and DO, except for the effect of the month of parturition on LP. Similar results were obtained by Aziz et al. (2001), Khattab et al. (2010), El-Arian et al. (2012), Bashir et al. (2015), Sezer et al. (2022), and Khattab et al. (2023) with different strains of buffalo.

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Parity significantly affected TMY, LP, DP, and DO (P < 0.01; see *Tables 2 and 3*). Many authors working with different buffalo strains have reported similar results (Aziz et al., 2001; Khattab et al., 2010; El-Arian et al., 2012; Bashir et al., 2015; Amina Ahmed et al., 2017; Basant Shafik et al., 2017; Ramadan, 2018; Eldawy et al., 2021; Ayad et al., 2022; Sezer et al., 2022; Khattab et al., 2023).

Table 2: Least squares analysis of factors affecting total milk yield (TMY) and lactation period (LP) in Egyptian buffaloes

S.O.V	d.f	F-value		F-value	
		TMY	Pr>f	LP	pr>f
Between bulls	226	3.30	< 0.0001	3.70	< 0.0001
Between cows: bulls	746	2.31	< 0.0001	1.95	< 0.0001
Between parity	11	6.36	< 0.0001	4.69	< 0.0001
Between month of calving	11	0.71	0.6987	0.04	0.0308
Between year of calving	31	10.3	< 0.0001	7.54	< 0.0001
Regressions					
Days open, linear	1	629.50	< 0.0001	922.9	< 0.0001
Days open, quadratic	1	10.50	< 0.0001	15.59	< 0.0001
Days dry, linear	1	460.77	< 0.0001	61.70	< 0.0001
Days dry, quadratic	1	0.33	< 0.0001	10.57	< 0.0001
Errors, MS.	3333	206501		1729	

Table 3: Least squares analysis of factors affecting dry period (DP) and days open (DO in Egyptian buffaloes

S.O.V	d.f	DP		DO	
		F-value	pr>F	F-value	pr>F
Between bulls	226	3.08	< 0.0001	3.42	< 0.0001
Between cows: bulls	746	1.77	< 0.0001	1.71	< 0.0001
Between parity	11	28.45	< 0.0001	28.25	< 0.0001
Between month of calving	11	5.55	< 0.0001	5.85	< 0.0001
Between year of calving	31	12.57	< 0.0001	13.45	< 0.0001
Errors, MS.	3333	8749		9124	

The significant effect of the month and year of parturition may be due to changes in herd size, the age of the cows, and managerial practices, which vary from year to year and are affected by weather conditions and phenotypic trends. The significant effect of parity on productive and reproductive traits is logically due to an increase in body weight and age of the animals, as well as an increase in feed intake.

The estimates of the partial linear and quadratic regression coefficients of TMY and LP on days open (DO) are presented in *Table 4*. The estimates of the partial linear and quadratic regression coefficients of TMY and LP on DO were significant for linear regression but not for quadratic regression (P < 0.10; see *Table 4*). The respective values were 6.71 ± 0.28 kg/d and -0.0016 ± 0.0008 kg/d² for TMY, and 1.03 d/d and -0.00004 ± 0.00005 d/d² for LP.

An increase in TMY and days in milk (DIM) with an increase in days open was evident. Ashmawy and Khattab (1991), working with Friesian cows, concluded that maximum production in the current lactation, including the calf crop, was achieved when cows were bred as early as possible after

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calving. An intensive programme of heat detection and efficient insemination practices would significantly reduce DO. Therefore, decreasing days open is the aim for dairy cow breeders.

Table 4: Estimates of partial linear and quadratic regression coefficients of days open (DO) and days dry (DD) on total milk yield (TMY), and lactation period (LP) in Egyptian buffaloes

Variation	Lactation period (LP), d	Total Milk yield (TMY), kg
Intercept (a)	317.09 ± 2.03 (P < 0.000)	2451.71 ± 28.83 (P < 0.0001)
Days open, linear	1.03 ± 0.018 (P < 0.0001)	6.71 ± 0.28 (P < 0.0001)
Days open, quadratic	-0.00004 ± 0.00005 (P = 0.4255)	-0.0016 ± 0.0008 (P < 0.0324)
Days dry, linear	-1.02 ± 0.02 (P < 0.0001)	-6.89 ± 0.32 (P < 0.0001)
Days dry, quadratic	0.00001 ± 0.00004 (P < 0.7111)	0.0009 ± 0.0006 (< 0.1645)

Estimates of the linear regression coefficients of TMY and LP on DD were significant (P < 0.01; see *Table 4*), whereas the quadratic regression coefficients were not significant, at -6.89 ± 0.32 kg/d and 0.0009 ± 0.0006 kg/d² for TMY, and -1.02 ± 0.02 d/d and 0.00001 ± 0.00004 d/d² for LP, respectively. Therefore, reducing the dry period and the number of days open is a desirable goal for dairy farmers as it helps to minimise the cost of raising breeding cows and maximise the number of lactations per cow.

4. CONCLUSION

The present results indicate the importance of selecting higher-lactating female buffaloes. In other words, the length of time that cows are kept dry depends on the cost of milking cows with extended lactations. Dairy breeders tend to milk their cows for as long as possible during late lactation, provided that the income generated exceeds the daily feed costs.

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A szárazonállás, a nyitott napok és a tejhozam összefüggése az egyiptomi bivaly esetében

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ÖSSZEFOGLALÁS

A tanulmányban összesen 4355 teljes laktációs adatot használtak fel a Mehalet Mousa Farmon tartott egyiptomi bivalyokra vonatkozóan. A tenyészet a Kairói Mezőgazdasági Minisztérium Állattenyésztési Kutatóintézetéhez (APRI) tartozik. A vizsgálatban az 1993 és 2022 között időszaban a kapcsolatokat elemezték a szárazon állás ideje, a nyitott napok és a tejtermelési jellemzők között. A vizsgált változók a teljes tejhozam (TMY), a laktációs időszak (LP), a szárazon állási időszak (DP) és a nyitott napok (DO). A TMY, LP, DP és DO átlagait 1704 kg-nak, 212 napnak, 221 napnak és 117 napnak számították. A legkisebb négyzetek varianciaanalízise azt mutatta, hogy a bivaly bikák szignifikáns hatással voltak a TMY, LP, DP és DO értékekre. Az ellés éve és hónapja, valamint a paritásnak statisztikailag igazolt hatását számszerűsítették a legtöbb vizsgált változóra. A TMY és LP részleges lineáris regressziós együtthatóinak becslése a nyitott napokra (DO) szignifikáns volt ($P < 0,01$), de a kvadratikus regressziós együtthatók nem voltak szignifikánsan biztosítottak: TMY (6,71 ± 0,28 kg/nap és -0,0016 ± 0,0008 kg/nap^2) és LP (1,03 nap/nap és -0,00004 ± 0,00005 nap/nap^2). A TMY és LP lineáris regressziós együtthatóinak becslése a szárazonállási időszakra (DP) statisztikailag igazolt volt ($P < 0,01$), míg a kvadratikus regressziós együtthatók nem: TMY (-6,89 ± 0,32 kg/nap, és 0,0009 ± 0,0006 kg/nap^2), LP (-1,02 ± 0,02 nap/nap és 0,00001 ± 00004 nap/nap^2). A jelen eredmények azt sugallják, hogy a szárazonállás időszak és a nyitott napok csökkentése a kívánatos tenyésztési cél, amely segít a tenyész tehenek nevelési költségeinek minimalizálásában és a tehenenkénti laktációk számának maximalizálásában.

Kulcsszavak: egyiptomi bivaly, szárazonállási napok, nyitott napok, tejhozam

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