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Productive and Reproductive Characterization, Breeding Season and Calving Season in Reference with the Effect of Parity Order on Milk Production of Camel in Egypt

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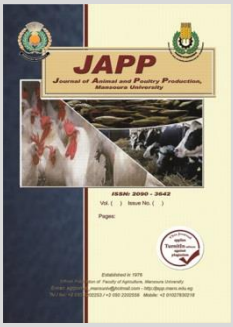

ABSTRACT

This study aimed to characterize productive and reproductive performances, breeding season, and calving season of Maghrabi camels in reference with the effect of parity order on milk production in Egypt. Data were collected from camel herd raised at the Studies and Development of Camel Production Station, Animal Production Research Institute, Egypt. Means of parity order, age at 1st mating (year), number of services/conception, age at 1st calving (year), gestation period (d), days open, calving interval (d), sex ratio, and calf weight (kg) were 3.33, 7.68, 2.27, 8.71, 379.6, 169.1, 548.7, 35.6: 65.4, and 29.08, respectively. Means of total (TMY) and daily milk (DMY) yields were 1559 and 4.69 kg, respectively. Lactation (LP) and dry (DP) periods were 364.40 and 184.20 d, respectively. Breeding season lasted from November to Apile, while out of season lasted from May to October. Calving rates were during the interval from January to April with a peak in july. Average TMY increased ($P<0.05$) by avancing parity, being the lowest at the 1st parity and the highest at the 10th one. LP ranged between 348.2±34.17 d at the 6th parity and 423.6±34.87 d at the 7th parity, while DMY ranged between 4.05±0.156 kg at the 1st parity and 5.15±0.401 kg at the 6th parity, but the differences were not significant.In conclusion, the obtained information on Maghrabian camels raised in Egypt may be useful in different genetic breeding programs and optimal managerial applications for camel herds to increase their productive and reproductive performance in Egypt.

Keywords: Camel, reproductive traits, milk yield, parity order

INTRODUCTION

The Camelidae family originated and developed in western North America, spread by way of land bridges into Asia and South America and finally became extinct in its original homeland (Younas and Iqbal, 2001). This family includes sub-family Camelinae with genera, *Camelus* and species *Camelus* dromedaries, one-humped dromedary camels (Wardeh, 2004). In the Arab World, camel population represents >12 million heads (Hermas, 1998), and 150 thousand camels were found in Egypt (FAO 1989).

Camels are multipurpose animals which were used for transportation, meat and milk production, and wool and hides as by–products (Aboul-Ela and El-Agawany, 1991). She-camel produces milk with less fat content and more sugar than in cow milk. In Egypt, the content of fat, protein and lactose was 3.8, 3.5 and 3.9 percent in milk of camel, respectively (El-Bahay, 1962). The dressing percentage of camel varied from 56-70% and the meat of these camels resembles beef in taste. The protein content of the meat was about 74% and the hump fat represented 2 to 5% of the dressed carcass (Kulaeva, 1964). Considerably, it may be use to combat the growing desertification and to feed millions of people living in the desert lands as milk and beef producers. Also, it is capable to produce more milk for longer period compared to other domestic dairy animals (Al-Owaimer *et al.*, 2014). In Egypt, 20 thousand metric tons are consumed annually from camel meat, and camel meat quality differs according to age, sex and feeding system, and the range of dressing percentage (Shalash, 1979). Camel hair is used for making blankets, certain clothing materials and other textiles.

Maghrebian camels found in most coastal zones of the North African territories that extend from Egypt to Morocco. The Maghrebian camel is a camel of several strains that vary in size, body conformation and color. It is believed to be a mixture of the Sudani, Egyptian, Libyan and Tunisian camels (Wilson, 1984). The Maghrabian camel is a seasonal breeder, and the breeding season varies in the different climatic zones of the world (Wilson, 1989) according to the geographical conditions, so the environmental factors affect temporally patterns of reproduction of this species (Gombe and Okelo, 1977). In Egypt, the breeding season of camel lasted from December to March (Yasin and Wahid, 1957), from December to May (Shalsh and Nawito, 1964), or during winter and spring (Nawito *et al.*, 1967). Total milk yield of Maghrebi she-camels was recorded to be 1500 kg (Mustafa, 2008), or 1240 kg (Abdalla *et al.*, 2015), and ranged between 437.4and 496.0 kg (Mostafa *et al.*, 2018).

There are several environmental, nutritional and physiological factors, with their effective roles, affecting on controlling the dairy camel production in Egypt. Number of season (perity order) is one of the most factors affecting milk production in camels as well as other factors (Almutairi *et*

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al., 2010 a,b). The information on the productivity of Maghrabi camels in Egypt are scar. Also, there are confused results on the effect of parity order on milk yield in relation with reproductive traits in Maghrebian camels under the Egyptian condition. Till now the camel did not get much desired attention in Egypt due to many reasons and lack of awareness about its attributes relating to its meat, milk production and their products.

Therefore, the present study aimed to characterize the productive and reproductive performances, breeding season, and calving season of Maghrabian camels in reference with the effect of parity order on milk production under the climatic condition in Egypt.

MATERIALS AND METHODS

The present study was conducted by Animal Production Department, Faculty of Agriculture, Tanta University in cooperation with Camel Research Division, Animal Production Research Institute (APRI), Agricultural Research Center, Ministry of Agriculture and Land Reclamation, Dokki, Giza, Egypt.

Animals and data collection:

Data of reproductive and productive performance of she-camel used in this study were collected from camel herd raised at the Studies and Development of Camel Production Station belonging to APRI and located in Marsa Matrouh City, Matrouh Governorate in the Northwest of Egypt, (about 500 km from Cairo, 31° 18' 10.4 "N 27°05'45.5"E).

Camels were loosely housed in open sheds and were kept under controlled system of feeding and management practiced in the station for intensive production.

Records of Maghrebi she-camels (345 records) of 42 animals at different lactations (1-10) were collected during the period from 2015 to 2018. Records of she-camels concerning different reproductive factors including age at first mating, age at first calving, number of services per conception, days open, gestation period length, calving interval, lactation period, dry period, and sex and weight of born calves were collected.

Feeding system

Each female camel was daily fed on the following:

During milking: 4 kg concentrate feed mixture (CFM) containing 16% protein + 2.5 kg berseem hay (BH) during summer or 5 kg fresh berseem *(*FB, *Trifolium Alexandrinum)* during winter + 4 kg rice straw (RS).

During early pregnancy (<10 months): 2.5 kg CFM (16% CP) + 2.5 kg BH during summer or or 5 kg FB during winter + 4 kg rice straw.

During late pregnancy (>10 months): 1.5 kg CFM (16% CP) + 1 kg berseem hay during summer or 5 kg FB during winter + 4 kg rice straw.

Ingredients of the CFM used in the feeding was composed of 25% wheat bran, 25% yellow corn, 9% uncorticated cotton seed meal, 20% barely, 15% rice brain, 3% molasses, 2% premix and 1% common salt.

Daily allowances were offered in amounts to cover the animal requirements according to their milk production, live body weight and the reproductive status as recommended by APRI. Feeds were offered to animals twice daily at 8 a.m and 5 p.m, while drinking clean fresh water was offered freely all day time. Chemical analysis of CFM, BH and RS are shown in Table 1.

Table 1. Chemical composition (on dry matter basis) of concentrate feed mixture (CFM), rice straw and berseem hay to she camels

Feedstuff	DM	OM	CP	CF	EE	NFE	Ash
CFM	89.1	91.55	16.30	11.46	3.32	60.47	8.45
Rice straw	88.46	82.24	2.53	29.69	1.52	49.5	16.76
Breseem hay	89.74	84.62	13.25	28.61	1.74	41.02	15.38

CFM: Concentrate feed mixture. DM: Dry matter. OM: Organic matter. CP: Crude protein. CF: Crude fiber. NFE: Nitrogen free extract

Milking

All used camels were healthy and had udder quarters free of mastitis. Lactating camels were hand-milked twice daily at 8 a.m. and 8 p.m. without calf suckling until drying off, and milk yield was recorded daily to the nearest 0.1 kg. Milk yield was measured after born calves were allowed to suckle colostrum from their dams for the first seven days.

Calves were penned separately from their dams during the full day and fed alfalfa hay and concentrate *ad libitum*, then bringing individually to their dams and allowing them to suckle only the two right teats of the udder, whereas the two left teats were hand milked.

Mating and reproductive management:

Natural mating was practiced and bulls were assigned to females at random. Mostly the farm-bred bulls were used for breeding. In primiparous animals (the 1st parity), she-camel were mated for the first time at 48 months of age or 350-400 kg live body weight. In multiparous animals, she-camels were almost mated on 60 days post parturition. Pregnancy was detected by rectal palpation 60 days after the last mating.

Physiological factors studied:

- Age at 1st mating: Interval (year) from birth ate up to date of the 1st mating.
- Age at first calving: Interval (year) from birth date up to date of the 1st calving.
- Number of services per conception: The number of services required for successful conception.
- Days open: interval (month) from calving to the followed conception.
- Gestation period length: Time (day) elapsed from the ate of the successful mating up to calving ate.
- Parity order: Number of lactation seasons or number of calvings.
- Calving interval: Days elapsed between two successive calvings.

Calving interval = lactation period + dry period or = Days open + gestation period

Productive factors studied:

- Sex and weight of born calves
- Lactation period: Interval from calving up to drying off
- Dry period: Interval from drying off to initiation of lactation (new calving).

Variables studied:

- Total milk yield: the amount of milk (kg) produced by a she-camel during normal lactation period.
- Average daily milk yield: Total milk yield (kg)/ Lactation period (day)
- Lactation period (LP, days), days in milk starting 7 days after parturition to drying off.

8. Statistical analysis:

Program SAS was used to the statistical analyses according to the following model:

$$E_{ij} = \mu + F_i + e_{ij}$$

Where,

μ is the overall mean, F_i the fixed effect of parity order (1…..10) on total and daily milk yield and e_{ij} = a random error. Duncan's Multiple Range Test was used to set the significant differences among means at P<0.05.

Pearson correlation coefficients within the SAS program with different probability values were also performed between parity order and each of productive and reproductive parameter. In addition trend line of the regression between parity orders and each productive parameter and R^2 values were cleared on the illustrated figures.

RESULTS AND DISCUSSION

Reproductive performance parameters:

Results in Table 2 showed that mean parity number (PN) was 3.33 with high standard deviation (SD) values because PN ranged between 1 and 10 in studied camel herd. The recent results of Ismail (2020) revealed that PN was 3.98±0.139 parity with a coefficient of variation (CV) of (33.42%). However, the present PN was higher than a parity of 2.74 reported by Almutairi *et al.* (2010a) in pure breeds and their crosses in Kingdom of Saudi Arabia.

Age at 1st mating (AFM) averaged 7.68 yr and ranged between 3 and 18 yr (Table 1). Number of services/conception (NSC) ranged between 1 and 5 with an average of 2.27 (Table 1). These results indicated that she-camel requires excessive number of services per conception. The present NSC is within a range from 1 to 3 for different zones of Rajasthan (Saini *et al.*, 2007). Within the same range, NSC of camel was one mating per conception (Arthur *et al.*, 1985 a & b; Abdel-Aziz *et al.*, 2016b) or averaged 1.8±0.1 (Hermas and Sharieha, 1991). In near similarity with the present study, NSC was found to be 2.17 (Ismail, 2020), 2.33 in Jaisalmeri camels (Deen, 2013), 2.40 (Abdel-Aziz *et al.*, 2016b). Meanwhile, lower NSC, being 1.84 (Melaku and Gebreah, 2001), 1.84 (Keskes *et al.*, 2013b), 1.63 (Keskes *et al.*, 2013a), 1.70-1.74 (Mohamed and Makkawi, 2016), 1.47 (Abd Allah, 2016) were reported under semi intensive system. In Iraq, averages of the NSC in she-camels ranged from 1.64 to 1.84 (Al-Fatlawi and Al-Hamedawi, 2017). The NSC was 1.84, 1.64, and 1.72 services following the 1st, 2nd and 3th parities, respectively (Al-Fatlawi and Al- Hamedawi, 2017) in Iraqi she-camels. On the other hand, higher NSC values were reported by Musa *et al.*, (2000) and Deen (2013) with Kachchi camels, being 5.36 and 3.83 services, respectively. Number of natural services or artificial inseminations required for the successful conception is one of the economical indicators of dairy farms and the most useful parameter of reproductive measurements (Gidey, 2001). Camels, as seasonally polyestrus animals (Arthur, 1992) with short breeding season Minoia *et al*., 1992) and long follicular cycle (Nawito *et al*., 1967), require excessive number of services per conception. Age at 1st calving (AFC) averaged 8.71 yr and ranged between 4 and 19 yr (Table 1). Average of AFC in camels ranged between 36 and 85 mo (Almutairi *et al.*, 2010b) for Malhah, Wadhah, Hamrah and Safrah camels, and averaged 54.39 mo for dromedary camels in Saudi Arabia, while ranged between 60 and 84 mo for one humped camel in Egypt (Musaad *et al.*, 2010).

Table 2. Characterization of reproductive performance parameters of she-camel.

Variable	N	Mean	Std. Dev.	Minimum	Maximum
Parity order	344	3.33	2.198	1	10
Age at 1st mating (year)	344	7.68	3.308	3	18.42
Number of services/conception	344	2.27	1.077	1	5
Age at 1st calving (year)	344	8.71	3.313	4	19.42
Gestation period length (day)	344	379.6	12.92	324	400
Days open	344	169.1	126.90	14	721
Calving interval (day)	344	548.7	127.58	381	1108
Calf sex ratio (male: female)	344	35.6: 65.4	0.499	0	100
Calf weight (kg)	344	29.08	5.031	16	47

In Sudan, age at 1st calving was recorded to be 59.28-64.2 mo (Abd Alla, 2016), or 45.84-52.2 mo (Mohamed and Makkawi, 2016). In comparing with other results, Ismail (2020) reported lower AFC, being 5.23 yr with a coefficient of variation of 10.69%. Also, AFC was 5.17 yr (Kalla *et al.*, 2008), 5.18 yr (Keskes *et al.*, 2013b), and 4.76 years (Abdussamad *et al.*, 2011). Meanwhile, the present mean was higher than 4.57 yr (Musaad *et al.*, 2010), 4.55 yr (Abdussamad *et al.* 2011), 4.37 yr (Mayouf *et al.*, 2014), and 4.94 yr (Abd Allah, 2016) in camel under intensive system, while AFC was 4.76 yr under nomadic system (Fazal *et al.*, 2017). Camels are slow reproducers, a female camel is sexually mature at the age of 4.0±0.5 years (Rolf *et al.*, 2001). In camel herd, age at 1st calving is an important factor which allow the start time of both productive and reproductive abilities.

The recorded gestation period length (GPL) in the present study is in agreement with 380 days as reported by Schmidt (1973) in dromedary camels. The GPL in Magarabian camels averaged 379.23±0.89 days and range from 365 to 395 days (Hermes, *et al*., 1990; Arthur, 1992). Nearly similar GPL (375 days) was reported by Arthur *et al*. (1989). However, the present GPL was shorter than 390±2 days in Indian camels (Mehta *et al*., 1962), 440 days (Grzimek, 1968), or 390 days (El-Wishy *et al*., 1981; Ghoneim, 1985 and Ismail, 1987) in dromedary camels. On the other hand, shorter GPL of 370 days (Williamson and Payne, 1978), and 403-405 days (Ram *et al*., 1977) were reported. The difficulty in estimating GPL of camel lies in determining the time of fertilization because of the number of copulation which occurs during the mating season (Novoa, 1970). The variations recorded in the gestation period mainly to the prominent effects of the previous parturitions and month of calving (Mustafa, 2008).

Days open (DO) of Maghrabian camels averaged 169.1 d, ranging between 14-721 d with wide individual variation (±SD of 126). Averages of DO interval of she-camels are different according to breed, country, experimental conitions and authors. Values of DO of some experimental data in Maghrabi camels were lower, averaging 286.80±12.70 d (Hermas *et al*., 1990). This interval ranged between 318 and 317.61 d for Malhah, Wadhah, Hamrah and Safrah camels (Almutairi *et al.*, 2010b) and Dromedary camels (Mohammed and Al-

Mutairi, 2012) in Saudi Arabia. However, it was 212.06 d (Abd Allah, 2016), 150.1-279.57 d (Abdel-Aziz *et al.*, 2016b), 212.06-279.57 d (Mohamed and Makkawi, 2016) in Sudan, and 94.13-153.57 day (Al-Fatlawi and Al-Hamedawi, 2017) in Iraq. Generally, the interval from parturition to first acceptance of the male is variable in the dromedary camel and should not be used as a criterion to evaluate ovarian activity and postpartum fertility. Accidental mating as early as 2 days after parturition has been observed, but the normal conception cannot be expected until the uterus is completely involuted and ovarian function is restored. The time from parturition to the establishment of these conditions is not known with precision. However, pregnancies have been obtained in several females as early as 45 days postpartum. Others have reported no conception in females mated 12 and 40 days after parturition and suggest that low conception rate is to be expected if breeding occurs before 50 days postpartum because uterine mucosa has not yet returned to its normal status before this stage (Elias, 1990; Yagil, 2006).

Calving interval (CI) averaged 548.7±127.58 d (15.3 mo), ranging between 381 an 1108 d. The CI is considered as the best reproductive trait of dairy cows. In camel, mean of calving interval was 23.8 mo. Average of CI seems to increase more than 900 days or to be lower than 457.5 days (Abdussamad *et al.*, 2011). The present CI values are within this range. In dromedary camels CI was 595 d (Mohammed and Al-Mutairi, 2012), or 457.5 d (Ali *et al.*, 2018) in Saudi Arabia. Others are in accordance with the present results, being 510- 780 d (Bakheit *et al.*, 2012), 531.0-562.0 d (Abdel-Aziz *et al.*, 2016b), 547.2-634.5 d (Abd Allah, 2016), 510-840 day (Bakheit *et al.*, 2016), and 547.2-634.5 day (Mohamed and Makkawi, 2016). It is of interest to note that CI is in association with DO in our study. As the interval of DO prolonge, a marked increase in CI was reported.

Results in Table 1 showed that sex ratio of camel calves was 45.6%, and average live boy weight of camel calves was 29.08±5.031 kg. There is a lacke on the information of sex ratio in camels, but birth weight of Saudi camel calves averaged 40.1 kg for males and 38.3 kg for females (Ismail and Al-Mutairi, 1994).

Lactation performance:

Data in Table 3 revealed that total milk yield (TMY) was 1559.0±228.589 kg averaging 4.69±1.433 kg/d for a lactation period of 364.40±118.934 d and dry period of 184.20±65.641. Wide variation was found in the averages of total milk yield (TMY) in different countries. In Egypt, TMY of Maghrebi she-camels was recorded to be 1500 kg (Mustafa, 2008), which came in nearly similarity with the present results. However, lower TMY (1240 kg) was reported by Abdalla *et al.* (2015). In dromedary camels, several authors reported also lower average TMY, being 1207 kg (Musaad *et al.*, (2013a), 1450 kg, (Musaad *et al.*, 2013b) in Saudi Arabia, and range 907.00-3009.6 kg (Bakheit *et al.*, 2015; Enaam *et al.*, 2015; Sallam *et al.*, 2016; Ishag *et al.*, 2017) in Sudan. The average milk production is about 20-30 lb per day and 6000-8000 lb per lactation in good feeding conditions (Shalash, 1979). The daily production in Bikaneri camels ranged 2.66-4.19 kg/day. The corresponding range in Jaisalmeri camels was 2.02-3.72 kg/day (Sahani *et al.*, 1998).

The major target of the camel producers is milk production (Faye, 2004). Knowledge of the extent to which various physiological factors affecting the milk yield is therefore important. As affected by season of theyear, TMY of camels in Ethiopia.was 1334 L in the wet season and 902 L in the dry season, while averaged 11.18 L/day for the two seasons (Wako, 2015). It is worthy noting that lactation period was found to be the main factor affecting TMY.

In dromedary camels, lactation period was 7-8 months (Sharma and Bhargava, 1963). In Pakistan, lactation period lasted from 16 to 18 months (Yasin and Wahid, 1957). The dromedary milk was produced during 9 months under desert conditions and 16 to 18 months under better feeding conditions (Iwema, 1960). The lactation period lasted from 7 to 18 months depending on the feeding condition (Hira, 1947). In Pakistan, the milk yield of dromedary varies, according to feeding conditions, from 1350 to 3600 kg (Leupold , 1968). As affected by season of the year, Musaad *et al.* (2013b) attained that camels calving in winter (November to February) had longer lactation length, whereas camels that calved in summer (April to June) had shorter lactation. Bekele *et al.* (2002) suggested that camels calved during the long dry season (winter) had longer lactation period (409±32 days), while camels that calved in the short rainy season (March - April) or in the short dry season (May -June) had a shorter lactation period (292±51 and 287±31 days, respectively). Therefore, they reflected that the shorter lactation period in camels that calved in the hot months may be linked to their pregnancy status because of interval Lactation curves and factors of variation (parity, season, individual performances "weight and milk yield").

Table 3. Characterization of productive traits of she-camel.

Variable	N	Mean	Std. Dev.	Minimum	Maximum
Total milk yield (kg)	344	1559.0	228.589	475.5	2000
Daily milk yield (kg/h/d)	344	4.6900	1.43300	1.740	7.970
Lactation period (day)	344	364.40	118.9340	224.0	630.0
Dry period (day)	344	184.20	65.6410	114.0	808.0

Breeding and calving seasons:

Results of mating rate illustrate in Fig. 1 showed that breeding season in Egypt starts from November to Aprile, while out of season lasted from May to October, with low mating rate. It is of interest to note that the peak of mating rate was in January, while the lowet mating rate was recorded during July and August.

Concerning the calving rate, results presented in Fig. 2 showed higher calving rates during the interval from January to April, an peaked in July as compared to other months of the year. It is of interest to note that the lowest calving rate was observed in September.

These results reveale inconsistant relationship between mating and calving rates. Camels are seasonal breeder, long days open and calving intervals can occur even each of female or male camels resumed the sexual activity during the breeding season. The present results may indicate the effect of climatic factors such as ambient temperature, photopeiod on resumption of ovarian activity of male and

females only in breeding season. In mammals, the photoperiod length is an environmental key factor for synchronization of the reproductive activity with the season and the daylight length which considered as the primary stimulus for seasonality in reproduction (Petitclerc *et al*., 1983). According to the present results, breeding season was during months with shorter day length and lower ambient temperature. The lack of a well defined breeding season in many domesticated animals, presumably the selective pressures for seasonal breeding have been minimized, suggested that the neuro-endocrine events controlling seasonal cyclicity have been bred out of these animals (Lodge *et al*., 1970).

Although the dromedary camel (*Camelus dromedarius*) is a seasonal breeder, the breeding season varies in the different climatic zones of the world (Wilson, 1989). The breeding season of camel varies geographically as the environmental factors affect temporally patterns of reproduction in this species (Gombe and Okelo, 1977). Camels are seasonal breeders, but the extent to which season interferes with feed supply to affect ovarian activity is varied according to each location (Sghiri *et al*., 1999). In accordance with the present results, the breeding season of camel lasted from December to March by increasing day length in Egypt (Yasin and Wahid, 1957; Shalash and Nawito, 1964), and also this is the rutting period of the male camel.

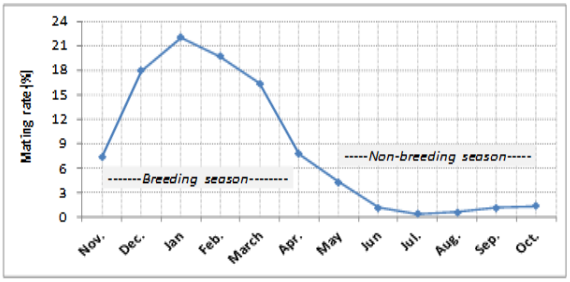

Fig. 1. Mating rate of she-camel during different months of the year in Egypt.

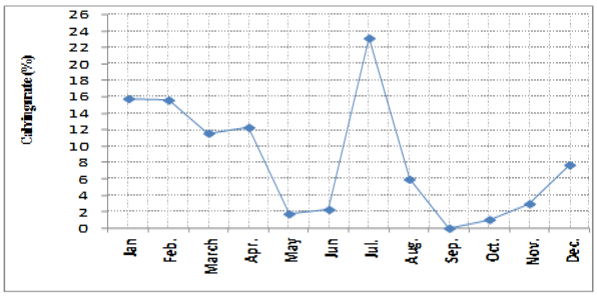

Fig. 2. Calving rate of she-camel during different months of the year in Egypt.

Female camel shows a stronger tendency to be a seasonal breeder than breeding the entire year as most of the ovarian activity occurs from December to May with a sudden drop during February (Shalash, 1965) with a significant increase in both serum hormones level and the animal behavior patterns during rutting season (Hamada and Fouda, 1995). However, Nawito *et al.* (1967) suggested increased ovarian activity in femal camel during winter and spring. So, it is proposed that the length of daylight plays a prominent cue in influencing the seasonal hormonal changes which, in turn, affect the behavior of camels (Hamada and Fouda, 1995).

Generally, there are wide differences in the determination of breeding season of she-camels in different countries, being November to April in Tunisia (Burgemeister, (1975), October to March in Morocco (Sghiri and Driacourt, 1999), December to March in Saudi Arabia (Alfuraiji, 1999), Jun to September in Australia (Snow *et al*., 1988), and November to March in India (Rai *et al*., 1993, 1995*;* Agarwal *et al*., 1995; Kataria *et al*., 2001).

Effect of parity order on lactation performance:

Data presented in Table 4 revealed that only total milk yield (TMY) was significantly (P<0.05) affected by the parity order, while lactation period (LP) and daily milk yield (DMY) was not affected by parity order. Average TMY showed significantly (P<0.05) gradual increase by advancing parity order, being the lowset at the 1st parity and the highest at the 10th one. Length of LP ranged between 348.2±34.17 d at the 6th parity and 423.6±34.87 d at the 7th parity, while DMY ranged between 4.05±0.156 kg at the 1st parity and 5.15±0.401 kg at the 6th parity, but the differences were not significant.

Table 4. Effect of parity order on lactation performance parameters of she-camels.

Parity	Lactation period (day)	Total milk yield (kg/h)	Daily milk yield (kg/h/d)
1	392.0±14.57	1423.5±19.73^{d}	4.05±0.156
2	348.3±13.62	1504.8±21.34^{dc}	4.70±0.146
3	358.5±16.70	1568.2±30.60^{dc}	4.78±0.202
4	387.4±18.08	1621.0±30.48^{c}	4.56±0.219
5	354.7±21.56	1658.9±38.98^{bc}	5.07±0.265
6	348.2±34.17	1584.8±43.74^{c}	5.15±0.401
7	423.6±34.87	1651.0±50.55^{bc}	4.23±0.456
8	395.8±30.63	1637.0±62.07^{bc}	4.16±0.459
9	387.2±51.36	1785.1±54.77^{ab}	4.95±0.520
10	422.3±36.75	1911.4±52.49^{a}	4.71±0.431

$^{a, b, c, d:}$ **Means with different superscripts within the same column are significant (P<0.05).**

The significant increase in TMY by advancing parity order indicated a linear relationship between camel parity order and TMY and the regression equation was Y= 40.683x + 1410.8, where Y = TMY and x = parity order with R^2 = 81% (Fig. 3).

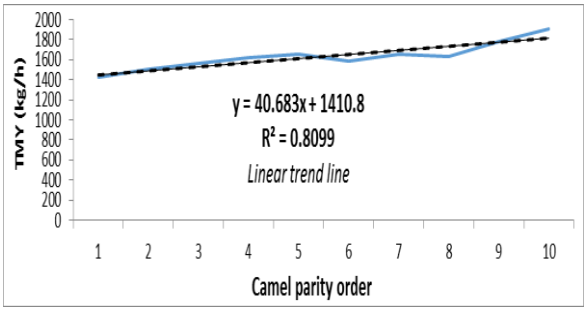

Fig. 3. Total milk yield (TMY) of camels at consecutive parity orders from the 1st up to 10th parity.

Also, the correlation coefficients between parity order and TMY was 0.464 (P<0.05). The relationship between parity order and LP (Fig. 4) was polynomial, indicating no correlation between parity order and LP (Table 5). Although the relationship between parity order and DMY was polynomial (Fig. 5), the correlation between them was significantly weak (r=0.242, P<0.001, Table 5).

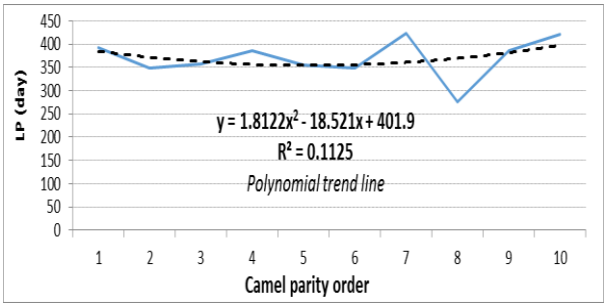

Fig. 4. Lactation period (LP) length of camels at consecutive parity orders from the 1st up to 10th parity.

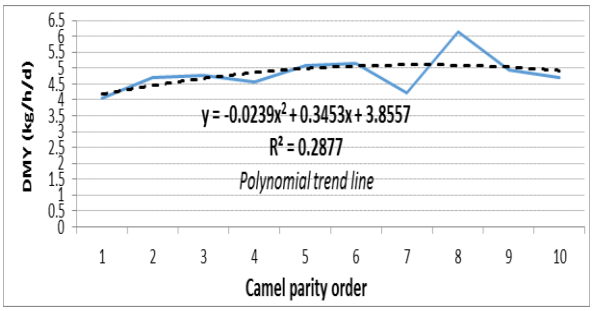

Fig. 5. Daily milk yield (DMY) of camels at consecutive parity orders from the 1st up to 10th parity.

The correlation coefficients of parity order and different reproductive traits indicated strong and significant (P<0.001) correlation with age at 1st mating and 1st calving was significantly strong (r=0.969). This fining may indicate the close relationship between AFM and AFC in relation to parity order. On the other hand, parity order did not correlate with NSC, weight and sex of calves, GPL, DO, and CI (Table 5).

Table 5. Correlation coefficients of parity order with productive and reproductive traits of she-camels.

Parameter	Parity order		
	r-value	P-value	Significance
Lactation period (LP)	-0.050	0.3490	ns
Total milk yield (TMY)	0.464	0.0001	***
Daily milk yield (DMY)	0.242	0.0001	***
Age at 1st mating (AFM)	0.969	0.0001	***
Number of services /conception(NSC)	-0.019	0.7189	ns
Age at 1st calving (AFC)	0.969	0.0001	***
Calf sex (CX)	-0.024	0.6479	ns
Calf weight (CW)	0.035	0.5167	ns
Gestation period length (GPL)	-0.056	0.2932	ns
Days open (DO)	0.038	0.4790	ns
Calving interval (CI)	0.032	0.5500	ns

ns: not significant. * Significant at P<0.001.**

In accordance with the present correlation, Bissa (2002) found non-significant effect of the parity on NSC. However, parity was reported to be the major non-genetic effect on NSC. In Sudan, Abdel-Aziz *et al.* (2016b) indicated significant influence of camel parity on the mean NSC, being 1.0, 2.82 and 2.6 services at the 1st, 2nd and 3rd parity, respectively. Also, non-signiicant effect of parity on DO was recorded by Almutairi *et al.* (2010b) and Abdel-Aziz *et al.* (2016b). Moreover, Almutairi *et al.* (2010b) showed non-significant effect of parity on CI.

Parity order plays an important role in productive performance of camels. The present study inicated gradual increase in TMY with advancing psrity order in camel. In Egypt, Mostafa *et al.* (2018) reported that parity showed highly significant effect on total milk yield of dairy Maghrebi she-camels (*Camelus dromedarius*). Total milk yield showed remarkable increase under farm system by advancing parity order from the 1st to th 8th parity. Also in Saudi Arabia, Musaad *et al.* (2013b) found that TMY significantly increased to the maximum values at later parities (the 6th and 8th parities) as compared to the minimal values at the 1st. However, Bekele *et al.* (2002) revealed that the higher daily milk between the 3rd and 5th parities, being the highest at the 5th parity, while the lowest milk yield was recorded at the 1st parity and after the 7th parity. In addition, the present results indicate the lowest TMY at the 6th parity, which is in agreement with Zeleke (2007), who reported that the lowest milk yield was recorded at the 6th parity. Raziq *et al.* (2008) observed increasing camel milk production at the 5th and 3rd parities. However, milk production significantly less at the 1st parity than the following parities (2nd, 3rd and the 4th lactation). Al-Saiady *et al.* (2012) recorded the highest total milk yield of camels at the 3rd and 6th parities as compared to other parities. Abdalla *et al.* (2015) showed that TMY of camel was significantly maximized at the 6th parity and minimized at the 1st one.

The obtained results are in harmony with Abdel-Aziz *et al.* (2016a), who revealed non-significant effect of parity order on LP. However, Bekele (2010) observed that parity showed significant effect on LP length. She-camels showed the longest lactation period during the 6th parity (406 d) and shortest period during the 7th and 8th parities (291 d).

In conclusion, the obtained information on Maghrabian camels raised in Egypt may be useful in different programs of genetic breeding and application of the optimal managerial factors for camel herds to increase their productive and reproductive performance in Egypt

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الخصائص الأنتاجية والتناسلية وموسم التزاوج والولادة بخصوص تأثير ترتيب موسم الولادة على أنتاج اللبن فى الجمال فى مصر

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هدفت هذه الدراسة إلى توصيف الأداء الإنتاجي والتناسلى، وموسم التكاثر ، وموسم الولادة للإبل المغربية بالإضافة إلى تأثير ترتيب موسم الحليب على إنتاج اللبن تحت تأثير الظروف المناخية في مصر. تم جمع البيانات من الإبل التي تمت تربيتها في محطة دراسات وتطوير إنتاج الإبل ، معهد بحوث الإنتاج الحيواني، مصر. بلغ متوسط كل من ترتيب موسم الحليب، العمر عند أول تلقيحة (السنة)، عدد التلقيحات المخصبة اللازمة لحدوث الحمل، العمر عند أول ولادة (سنة) ، طول فترة الحمل (يوم) ، طول فترة التلقيح المخصب (يوم)، طول الفترة ما بين ولادتين (يوم)، جنس ووزن المولود (كجم) 3.33، 7.68، 2.27، 8.71، 379.6، 169.1، 548.7، 35.6: 65.4 و 29.08 على التوالي. بلغ متوسط إنتاج اللبن الكلى (TMY) واليومى (DMY) 1559 و4.69 كجم على التوالى. بلغ متوسط طول موسم الحليب (LP) وطول فترة الجفاف (DP) 364.40 و 184.20 يوم على التوالى. يمتد موسم التناسل من نوفمبر إلى إبريل، بينما تكون خارج الموسم من مايو إلى أكتوبر. كانت معدلات الولادة خلال الفترة من يناير إلى أبريل وذروتها في يوليو. يزداد متوسط إنتاج اللبن الكلىTMY (P <0.05) بالتقدم فى موسم الحليب، الأقل فى الموسم الأول والأعلى في الموسم العاشر. تراوح طول موسم الحليب LP ما بين 348.2 ±*الخلاصه:*

قد تكون المعلومات التي تم الحصول عليها عن النوق المغربى التي يتم تربيتها في مصر مفيدة في برامج التربية الوراثية المختلفة والتطبيقات الإدارية المثلى لقطعان الإبل لزيادة أدائها الإنتاجي والتناسلي في مصر.