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Research Article

Effect of Birth Season, Parity Order, and Calf Sex on Reproductive and Lactation Performance Parameters of Maghrabian She-Camels Raised in Egypt

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Abstract:

The objective of this paper was to study the effect of birth season and parity of Maghrabian she-camels as well as sex of their calves on their reproductive and lactation performances under Egyptian condition. Records of 252 she-camels (1-7 parities) were collected during the period from 2014 to 2020. These records including reproductive and milk yield records. Out of 252 records, birth season of 145 animals were in winter and 107 animals in summer . Camel herd raised at the Studies and Development of Camel Production Station, Animal Production Research Institute, Egypt. Results showed that averages of age at conception (AAC) and at calving (AAV) were longer ($P<0.05$), while average calf weight at birth (CWAB) was lower ($P<0.05$) in winter than in summer animals. Number of matings per conception (NMC), days open (DO), gestation period length (GPL), and calving interval (CI) did not differ significantly between winter and summer animals. Lactation period (LPL), and total (TMY) and daily milk yield (DMY)) were not affected significantly by birth season. Averages of AAC, AAV gradually increased ($P<0.05$) by advancing parity, being the shortest at the 1st parity and the longest at the 7th parity. NMC was the lowest ($P<0.05$) at the 1st parity (2.21 matings), moderate at the 2nd – 4th parity (2.74-3 matings), and the highest at the 5th – 7th parity. DO, GPL, CI, CWAB, TMY, and DMY were not affected by animal parity. CWAB was higher ($P<0.05$) in males than in females. However, other reproductive and lactation performance parameters were not affected by calve sex. 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.

1. Introduction

The dromedary camel (*Camelus dromedarius*) is an important livestock species and most abundant in the arid lowlands of Africa, the Middle East and Western Asia. Camels have several products, in terms of meat, milk, and wool production as well as a draft animal for agriculture and transport (El Harrak et al., 2011). Production of milk or meat from camel is an important source of animal proteins (Alhebabi and Alluwaimi, 2010). Dromedary camels have the ability to survive under harsh climatic conditions and have the potential to enhance pastoral household livelihoods under this distressful environment (Mahamed et al., 2015).

According to the FAO (2017) statistics, the total heads of dromedary camels represent 89% of worldwide (about 34.82 million). Over 80% of the world's camel dromedary population is found in Africa with the highest density in North East Africa (FAO, 2013; Hussein et al., 2013; Sisay and Awoke, 2015). In the Arab World, camel population represents >12 million heads (Hermas, 1998), while in Egypt, dromedary camels represent a subset of major livestock resources with the population estimated to be 150,000 camels, mainly raised for meat production in the desert and arid regions (FAO 1989).

In Egypt, milk is considered a secondary product and is usually consumed locally as an animal protein (Hammadi et al. 2006), and also in other parts of the world (Al Kanhal, 2010). Over recent decades, rising market demand for camel milk has been worldwide observed due to its potential health-promoting properties (Al Kanhal 2010). She-camel produces milk with less fat content and more sugar than in cow milk. In Egypt, the content of fat, protein and lactose in milk of camel was 3.8, 3.5 and 3.9%, respectively (El-Bahay, 1962). Camel is capable to produce more milk for longer period compared with other dairy animal species (Al-Owaimer et al., 2014). In Egypt, camel meat quality and dressing percentage were affected by animal age, anima sex, and feeding system. About 20,000 tons were consumed annually from camel meat (Shalash, 1979).

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 (environmental factors) that effect on temporally patterns of reproduction of camel (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).

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). Total milk yield of Maghrebian she-camels/season was 1500 kg (Mustafa, 2008), or 1240 kg (Abdalla et al., 2015), ranging from 437.4 to 496.0 kg (Mostafa et al., 2018). Continuous monitoring the yield and composition of

camel milk during lactation period is important for a more detailed characterization of camel milk potential and a better understanding of its factors of variation. In this concern, many studies on camel milk yield and composition have been reported in different countries, showing that the main factors of variation were the stage of lactation (Konuspayeva et al. 2010; Musaad et al. 2013a), camel parity (Aljumaah et al. 2012; Ahmad et al. 2012), season (Haddadin et al. 2008; Nagy et al. 2017), geographical origin (Konuspayeva et al. 2009), managerial system (Aljumaah et al. 2012; Ayadi et al. 2018), feeding system (Al-Saiady et al. 2012; El-Hatmi et al. 2004), calf sex and year, and camel breed (Aljumaah et al. 2012; Nagy et al. 2017).

In Egypt, there are several environmental, feeding and physiological factors, with their effective roles, affecting the control of the production of dairy camels. In camels, some factors, such as number of seasons (parity order), is one of the most factors affecting reproductive performance and milk production in camels (Almutairi et al., 2010 a, b). The available data on the lactation performance and reproductive parameters of camels raised in Egypt as affected by birth season of she-camels and sex of their calves are rare, however, there is a confliction in the results concerning the effect of camel parity under the Egyptian environmental conditions.

Therefore, the objective of this paper was to study the effect of birth season and parity of Maghrabian she-camels as well as sex of their calves on their reproductive and lactation performances under Egyptian condition.

2. Materials and Methods

This study was conducted on the records of Maghrabian camels raised at Camel Research Division, Animal Production Research Institute (APRI), Agricultural Research Center, Egypt according to the scientific frame between APRI and Department of Animal Production, Faculty of Agriculture, Tanta University.

2.1. Location of camel station:

Data used in this study included the reproductive and lactation performance parameters of she-camels taken from camel herd kept at the Studies and Development of Camel Production Station, belonging to APRI. Camel center is located at the Northwest of Egypt (500 km from Cairo) in Marsa Matrouh City, Matrouh Governorate. The latitude of Mersa Matruh is 31.354343, and the longitude is 27.237316 with the gps coordinates of 31° 21' 15.6348" N and 27° 14' 14.3376" E.

2.2. Camel management:

In the station, camels were loosely housed in open sheds and they were managed the same conditions of nutritional and managerial factors for camel production. She-camels were fed on concentrate feed mixture (CFM), berseem (*Trifolium alexandrinum*) in fresh (FB) or hay (BH) form, and rice straw (RS). The amounts of feeds were differed according to the physiological stage of each animal. Lactating camels were fed four kg CFM (16% protein), 2.5 kg BH in summer or five kg FB in winter plus four kg RS according to milk yield and LBW. Also, camels differed in their amounts of feed according to the reproductive status, being 2.5 kg CFM and 2.5 kg BH in summer or five kg FB in winter plus four kg RS during early pregnancy (<10 months). However, camels at late pregnancy (>10 months) were fed on 1.5 kg CFM, one kg BH or five kg FB plus four kg RS. All daily allowances were recommended by APRI.

The CFM contained wheat bran (25%), yellow corn (25%), uncorticated cotton seed meal (9%), barely (20%), rice brain (15%), molasses (3%), premix (2%), and common salt (1%). Camels were received their amounts of feeds twice a day at 8 a.m and 5 p.m, while drinking clean fresh water was free all day time.

All lactating camels were healthy with udder quarters free of mastitis. They were milked manually twice/day at 7 a.m. and 5 p.m. without calf suckling until drying off. Newborn calves were allowed to suckle colostrum from their dams during the 1st wk of postpartum period, then daily milk produced was estimated up to the end of lactation period or drying off.

Calves were penned separately from their dams during the full day and brought individually to suckle only the right half of the udder of their dams, whereas the milk yield of the left half was milked and doubled as a milk yield.

During breeding season at the beginning of December, she-camels were naturally mated with camel bull assigned to females at random. Mostly the farm-bred bulls were used for matting. During the 1st parity, she-camel were mated at age of 47-50 mo or LBW of 350-400 kg. During the later parities, she-camels were mated on 60-day of postpartum period. Pregnancy was diagnosed on Day 60 post the last mating by rectal palpation.

2.3. Data recorded:

Experimental factors:

This study included the effect of three factors (Birth season, parity order, and calf sex) or their effects on reproductive and lactation performance parameters of she-camels. Records of 252 she-camels (1-7 parities) were collected during the period from 2014 to 2020. These records including reproductive and milk yield records. Out of 252 records, birth season of 145 animals were in winter and 107 animals in summer, representing 57.5 and 42.5%, respectively (Fig. 1). Out of total camels (n=252), 63, 62, 41, 37, 22, 15, and 12 animals were in parities from 1 up to 7, respectively (Fig. 2). During different parities, number and percentage of she-camels that produced female or female calves are presented in Fig. 3.

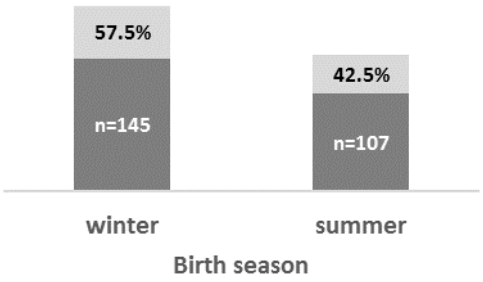

Fig. 1. Number and percentage of she-camels born in winter and summer.

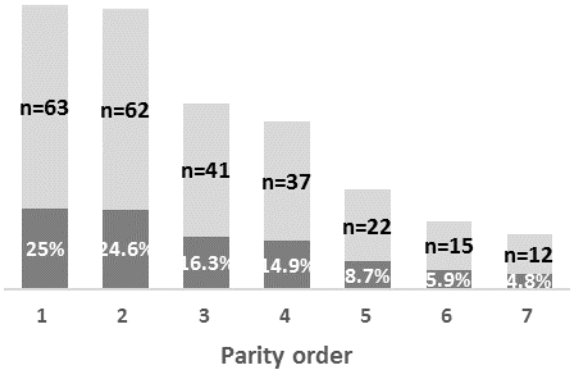

Fig. 2. Number and percentage of she-camels with different parity orders.

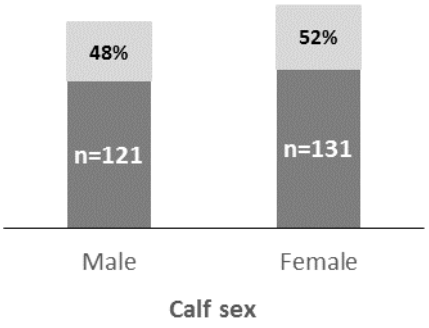

Fig. 3. Number and percentage of she-camels produced male or female calves.

Reproductive variables studied:

- Age at conception: Age of animal (month) at each conception (ACC).
- Number of matings/conception: Number of matings required for conception (NMC).
- Days open: Period (days) from calving to the followed conception (DO).
- Gestation period length: Period (days) from the successful mating up to calving (GPL).
- Age at calving: Age of animal (month) at each calving (AAV).
- Calving interval: Period (days) from calving to the next calving (CI).
- Birth weight of calves (kg).

Lactation performance variables studied:

- Lactation period: Days in-milk from parturition to drying off.
- Total milk yield: Milk yield (kg) during the lactation period.
- Daily milk yield: Total milk yield (kg)/days in milk.

2.4. Statistical analysis:

SAS program (2002) was used to the statistical analyses of data. A factorial design ANOVA (2 birth seasons x 7 parity order x 2 calf sex) was used to study the effect of birth season, parity order, calf sex of she-camels, and their interaction on different reproductive and lactation performance variables above mentioned. Only the significant differences among means of the effect of parity order were tested by Duncan's multiple range test (Duncan, 1955). Data were analyzed using the following General Linear Model (GLM) procedures: $Y_{ijkl}=\mu+P_j+S_k+C_l+E_{ijkl}$ Where: Y_{ijkl}= dependent variables, μ = overall mean, P_j = the effect of the j^{th} parity of the i^{th} camel, S_k = effect of the k^{th} birth season, C_l= effect of the l^{th} calf sex, and E_{ijkl} = random error associated with Y_{ijkl} observation.

3. Results

3.1. Reproductive parameters

3.1.1. Analysis of variance:

Analysis of variance of the effect of birth season, animal parity, or calf sex on reproductive parameters of she-camels (Table 1) revealed that average age at conception (AAC) and average age at calving (AAV) were affected significantly by birth season and animal parity ($P<0.001$). Number of matings per conception (NMC) was affected significantly ($P<0.001$) by animal parity. Average calf weight at birth was affected significantly ($P<0.05$) by birth season and calf sex. The effect of interaction was significant for birth season x animal parity ($P<0.01$) or birth season x calf sex ($P<0.05$) on NM/C, while the interaction effect of birth season x animal parity x calf sex was significant on AAC and AAV ($P<0.05$).

3.1.2. Effect of birth season of she-camels:

Results presented in Table 2 showed that averages of age at conception and at calving were significantly ($P<0.05$) longer, while average calf weight at birth was significantly ($P<0.05$) lower for she-camels born in winter than those born in summer. However, number of matings per conception, days open, gestation period length, and calving interval did no differed significantly between winter and summer born animals.

Table 1. Analysis of variance of different reproductive parameters of she-camels as affected by their birth season (BS), parity (AP), calf sex (CS), and their interactions.

S.O.V.	d.f.	P-value						
		AAC	NMC	DO	GPL	AAV	CI	CWB
BS	1	0.0001***	0.288	0.75	0.134	0.0001***	0.87	0.017*
AP	6	0.0001***	0.001***	0.53	0.397	0.0001***	0.59	0.915
CS	1	0.6911	0.339	0.48	0.449	0.6734	0.53	0.050*
BS*AP	6	0.1777	0.008**	0.71	0.221	0.1509	0.64	0.638
BS*CS	1	0.3387	0.050*	0.45	0.551	0.2956	0.49	0.769
AP*CS	6	0.6628	0.679	0.94	0.937	0.6561	0.94	0.153
BS*AP*CS	6	0.0157*	0.284	0.73	0.767	0.0161*	0.70	0.103

AAC: Age at conception. NMC: Number of matings per conception. DO: Days open. GPL: Gestation period length. AAV: Age at calving. CI: Calving interval. CWB: Calf weight at birth. * Significant at P<0.05.

3.1.3. Effect of parity order:

As expected, averages of age at conception and at calving showed significantly (P<0.05) a gradual increase by advancing animal parity, being the shortest at the 1st parity and the longest at the 7th parity. It is of interest to note that number of matings per conception was affected significantly (P<0.05) by animal parity, being the lowest at the 1st parity (2.21 matings), insignificantly increased to be moderate at the 2nd – 4th parity (2.74-3 matings), and the highest at the 5th – 7th parity. However, days open, gestation period length, calving interval, and calf weight at birth were not affected by animal parity (Table 3).

Table 2. Reproductive parameters of she-camels as affected by their birth season.

Reproductive Parameter	Birth season		P-value
	Winter	Summer	
Age at conception (month)	86.51±2.68b	90.01±3.62a	0.0001***
Number of services/conception	2.61±0.13	3.27±0.24	0.2886NS
Days open (day)	144.2±10.32	163.8±12.21	0.7500NS
Gestation period length (day)	379.98±0.89	378.40±1.48	0.1347NS
Age at calving (month)	98.85±2.68b	102.10±3.63a	0.0001***
Calving interval (day)	524.20±10.45	542.19±12.17	0.8700NS
Birth calf weight (kg)	28.68±0.39b	30.77±0.47a	0.0171*

a, b: Means with different superscripts within the same row are significant (P<0.05).
NS: Not significant. * Significant at P<0.05. *** Significant at P<0.001.

3.1.4. Effect of calf sex:

Results shown in Table 4 indicated that weight of calves at birth was affected only by calf sex, being significantly (P<0.05) heavier for male than female calves. However, calf sex did not affect ages at conception and calving, number of matings per conception, days open, gestation period length, and calving intervals of their dams

3.2. **Lactation performance parameters**

3.2.1. Analysis of variance:

Analysis of variance of lactation performance parameters of she-camels as affected by birth season, animal parity, or calf sex (Table 5) showed that only milk yield, as a total or daily, was affected significantly (P<0.001) by animal parity. However, the effect of birth season, calf sex, or their interactions was not significant on all lactation performance parameters of she-camels.

3.2.2. Effect of birth season:

All lactation performance parameters, including lactation period and milk yields (Total and daily) of she-camels were not affected significantly by their birth season, but there was a tendency of lower total and daily milk yield for she-camels born in winter than those born in summer season (Table 6).

3.2.3. Effect of parity order:

Effect of parity order of she-camels on lactation performance parameters is shown in Table 7. Results indicated that lactation period ranged from 373 days (6th parity) to 381.2 days (1st parity) for seven parities, showing unobvious trend of change and insignificant differences. Milk yield, as total and daily, showed similar trend of changes at different parities as a result of nearly similarity in lactation period at various parity orders.

Milk yield showed a gradual increase by advancing parity order, being significantly (P<0.05) the lowest at the 1st parity and the highest at the 7th parity. It is of interest to observe that milk yield showed significant (P<0.05) increase at the 3rd parity, then was constant without significant changes up to the 7th parity (Table 7).

3.2.4. Effect of calf sex:

Results in Table 8 showed that all lactation performance parameters, including lactation period and total and daily milk yields of she-camels were not affected significantly by sex of their calves. It is worthy noting that milk yield (total and daily) was slightly higher for she-camels calved males than those calved females (Table 8).

Table 3. Reproductive parameters of she-camels as affected by parity order.

Parity order	Age at conception (mo)	Number of services/ conception	Days open (day)	Gestation period (day)	Age at calving (mo)	Calving interval (day)	Birth calf weight (kg)
1	52.4±1.21^{g}	2.21±0.11^{b}	168.1±16.64	381.2±1.72	64.4±1.23^{g}	549.4±16.47	29.27±0.64
2	70.3±1.45^{f}	2.74±0.23^{ab}	141.1±15.54	380.3±1.81	82.7±1.45^{f}	521.4±15.59	29.36±0.62
3	90.5±2.04^{e}	3.30±0.41^{ab}	144.6±18.10	379.8±1.66	102.8±2.03^{e}	524.4±18.17	29.90±0.73
4	108.1±2.70^{d}	3.00±0.33^{ab}	181.2±19.37	376.3±2.00	120.4±2.67^{d}	557.5±19.81	30.13±0.70
5	130.9±4.11^{c}	3.85±0.59^{a}	110.7±23.56	380.3±2.95	143.2±4.15^{c}	491.0±24.27	29.79±1.20
6	142.1±4.03^{b}	3.80±0.52^{a}	157.0±39.84	373.0±2.93	154.2±4.01^{b}	530.0±41.67	30.35±1.40
7	165.8±5.84^{a}	3.83±0.67^{a}	141.3±40.05	376.5±2.78	178.1±5.95^{a}	517.8±39.50	28.04±1.27
P-val.	0.0001***	0.0010***	0.5300^{NS}	0.3970^{NS}	0.0001***	0.5900^{NS}	0.9175^{NS}

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

Table 4. Reproductive parameters of she-camels as affected by sex of calves born.

Reproductive Parameter	Sex of calves		P-value
	Male	Female	
Age at conception (month)	92.41±3.09	83.88±3.03	0.6911^{NS}
Number of matings/conception	2.95±0.18	2.83±0.18	0.3392^{NS}
Days open (day)	157.7±11.75	147.8±10.63	0.4800^{NS}
Gestation period (day)	378.2±1.15	380.4±1.14	0.4496^{NS}
Age at calving (month)	104.68±3.09	96.07±3.03	0.6734^{NS}
Calving interval (day)	535.8±11.89	528.2±10.62	0.5300^{NS}
Birth calf weight (kg)	30.35±0.42^{a}	28.84±0.44^{b}	0.0500*

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

Table 5. Analysis of variance of different lactation performance parameters of she-camels as affected by their birth season (BS), animal parity (AP), calf sex (CS), and their interactions.

Source of Variance	d.f.	P-value		
		Lactation Period	Total milk yield	Daily milk yield
Birth season (BS)	1	0.13	0.37	0.22
Animal parity (AP)	6	0.39	0.0001***	0.0001***
Sex of calf (CS)	1	0.44	0.73	0.59
BS*AP	6	0.22	0.25	0.48
BS*CS	1	0.55	0.74	0.88
AP*CS	6	0.93	0.19	0.26
BS*AP*CS	6	0.76	0.58	0.71

*** Significant at P<0.001.

Table 6. Lactation performance parameters of she-camels as affected by their birth season.

Birth Season	Lactation period (day)	Total milk yield (kg/h)	Daily milk yield (kg/h/d)
Winter	379.98±0.89	1481.87±19.77	3.90±0.05
Summer	378.40±1.48	1554.66±20.04	4.11±0.05
P-value	0.13^{NS}	0.37^{NS}	0.22^{NS}

^{NS}: Not significant.

Table 7. Lactation performance parameters of she-camels as affected by parity order.

Parity Order	Lactation period (day)	Total milk yield (kg/h)	Daily milk yield (kg/h/d)
1	381.24±1.72	1399.43±27.68^{c}	3.67±0.07^{c}
2	380.30±1.81	1479.11±29.23^{bc}	3.89±0.07^{bc}
3	379.81±1.66	1559.68±36.29^{ab}	4.11±0.09^{ab}
4	376.34±2.00	1611.30±35.30^{ab}	4.28±0.09^{a}
5	380.30±2.95	1550.91±31.37^{ab}	4.08±0.09^{ab}
6	373.00±2.93	1594.34±39.17^{ab}	4.27±0.10^{a}
7	376.50±2.78	1659.33±41.57^{a}	4.41±0.12^{a}
P-value	0.39^{NS}	0.0001***	0.0001***

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

Table 8. Lactation performance parameters of she-camels as affected by sex of their calves.

Calf Sex	Lactation period (day)	Total milk yield (kg/h)	Daily milk yield (kg/h/d)
Male	378.18±1.15	1530.36±20.84	4.05±0.05
Female	380.36±1.14	1496.39±19.77	3.93±0.05
P-value	0.44^{NS}	0.73^{NS}	0.59^{NS}

^{NS}: Not significant at P>0.05.

4. Discussion

The current study aimed to investigate the impact of birth season and parity of Maghrabian she-camels as well as sex of their calves on their reproductive and lactation performance parameters under Egyptian condition.

4.1. Effect of birth season:

In this respect, we compared the reproductive and

productive parameters of she-camels born in winter with those born in summer. Regard to the reproductive parameters, the analysis of variance revealed that birth season significantly affected the averages of age at conception and at calving (P<0.001) of she-camels as well as the average birth weight of their calves (P<0.05). The obtained results indicated that animals born in winter had significantly early ages at conception and calving with lighter calves than summer-animals (86.51 and 98.85 vs. 90.01 and 102.10 mo). The early age at conception and calving (as average values) of winter-animals was in association with early age at 1st conception during the breeding season. Camels, as seasonally polyestrus animals (Arthur, 1992). The breeding season of camel is within an interval (December – May) as reported by Yasin and Wahid (1957) and (Shalsh and Nawito, 1964), or in winter and spring season (Nawito et al., 1967). Recently, Mervat et al. (2020) showed that breeding season in Egypt starts from November to April and mating peak interval was in winter, while the lowest mating rate was recorded in summer. For the same animals, calving season was from January to April. Average age at 1st conception was 104.5 ± 36.3 mo. The earlier age at conception in winter than in winter animals was related to delaying in summer animals to have ovarian activity (puberty) with a proper LBW versus winter animals which have an early puberty during the breeding season. In the same context, there is a relationship between age at 1st conception and that at calving. In our study, calf weight was 28.86 kg for winter animals and 30.77 kg for summer animals in comparing with 29.08±5.03 kg as average calf camel weight at birth reported by Mervat et al. (2020). The observed heavier calves in summer than winter animals may be due to increasing LBW of their dams as compared to winter animals. On the other hand, birth season of she-camels had insignificant effect on number of matings/conception, days open, gestation period length, and calving interval, as reproductive parameters, as well as lactation period, total milk yield, and daily milk yield, as productive performance parameters. In contrast to our results, camel milk yield was higher in the wet season and lower in the dry season in Ethiopia. (Wako, 2015). Also, camels calved in winter were characterized by longer lactation length than in summer-animals (Musaad et al., 2013 b). Camels calved in winter increased lactation period compared with those calved in spring or summer season. This may be linked to their pregnancy status according to parity, season, LBW, and milk yield (Bekele et al. (2002).

4.2. Effect of parity order:

When we studied the effect of parity order, regardless other factors, the analysis of variance showed significant effects (P<0.001) on average ages at conception and at calving, and number of matings per conception, as reproductive parameters, however, significantly (P<0.001) affected total and daily milk yield, as lactation performance parameters. The present results indicated a gradual increase (P<0.001) in ages at conception and calving as well as number of matings per conception by advancing parity order. Increasing ages at conception and calving was expected, but increasing number of matings per conception may be attributed to many reasons because it is well known that reproductive performance increases by increasing parity orders, then decreases at later parities. It is of interest to note that she-camels are sexually mature at around four years of age (Rolf et al., 2001) and age at 1st conception and consequently at calving is an important factor which allow the start time of both productive and reproductive activities. Age at 1st calving is limited by Age at 1st conception, so camels at early age at 1st conception have an earlier age at conception (Mervat et al., 2020). According to our results, age at 1st parity (calving) was 64.4 mo, being within a range of 36-85 mo (Almutairi et al., 2010 b; Mervat et al., 2020) and 59.28-64.2 mo in Sudan (Abd Alla, 2016), and nearly similar to average of 62.76 mo 5.23 (Ismail, 2020). However, it was higher than 45.84-52.2 mo as reported by Mohamed and Makkawi (2016). Number of matings per conception was reported to range from 1 to 5 (averaged 2.27 matings (Mervat et al., 2020), which may indicate that camel females are required to be pregnant by more than one mating. The obtained number of matings per conception for all camel parities in our study ranged from 2.21 to 3.85 matings in comparable with a range of 1.64-1.84 matings (Al-Fatlawi and Al- Hamedawi, 2017). In consistent with the present results, parity was reported to be the major non-genetic effect on number of matings per conception. In this line, Abdel-Aziz et al. (2016 b) found a significant impact of parity order on the number of matings per conception in camels. It was 1.0, 2.82 and 2.6 services at the 1st, 2nd and 3rd parity, respectively. However, non-significant effect of camel parity on number of matings per conception was reported by Bissa (2002). Generally, Also, number of matings per conception averaged 1.84, 1.64, and 1.72 following the 1st, 2nd and 3rd parities, respectively (Al-Fatlawi and Al- Hamedawi, 2017). In Egypt, number of matings per conception in camels was 2.17 (Ismail, 2020), 2.40 (Abdel-Aziz et al., 2016 b), or 1.70-1.74 (Mohamed and Makkawi, 2016). In accordance with the present trend of change in number of matings per conception in camels, Goshu et al. (2007) found that number of matings/ conception in cattle was lower during the first two parities (1.365-1.404 matings), then significantly (P<0.05) increased with advancing parity to be the highest (2.058 matings at the 7th parity. Similar trend was reported by Nega and Sendrose (2000) at the Holeta state farm that first parity cows had less number of matings compared to two and above parity cows. In contrast, other authors showed that the effect of parity on number of matings per conception was not significant in cattle (Mekonnen and Goshu, 1987; Asseged and Birhanu, 2004). Number of natural services or artificial inseminations per conception is one of the economic parameters of the reproductive performance in dairy farms (Gidey, 2001). The reason of the low number of matings required to conception in younger cows was not clear and whether that was due to physiological or differential treatment needs to be established (Goshu et al. (2007).

Camel parity order had no effect on days open,

ranging between 110.7 and 168.1 days. Similarly, the effect of camel parity on days open was not significant (Almutairi et al., 2010 b; Abdel-Aziz et al., 2016 b; Mervat et al., 2020). In Maghrabian camel, days open averaged 169.1 d, ranging from 14 to 721 days with ±SD of 126 (Mervat et al. (2020), 286.80±12.70 d (Hermas et al., 1990), 317.61 days in Dromedary camels (Mohammed and Al-Mutairi, 2012), 212.06 days (Abd Allah, 2016), and 94.13-153.57 day (Al-Fatlawi and Al- Hamedawi, 2017). The obtained gestation period length in our study was 376.5-381.2 days without significant effect of parity, being similar to 379.23±0.89 days (365-395 days) in Magarabian camels (Hermas, et al., 1990; Arthur, 1992). The interval between calving in our study ranged 491- 557.5 days without significant differences among different parities. Several authors found that the effect of camel parity on calving interval was not significant (Almutairi et al., 2010 b; Mervat et al., 2020). This interval is depending on length of days open length and considered as the best reproductive trait of females. In camel, this interval was reported to range from >457.5 to <900 (Abdussamad et al., 2011). In dromedary camels, calving interval recorded 595 days (Mohammed and Al-Mutairi, 2012) or 457.5 days (Ali et al., 2018). In the current study, average LBW of calves at birth was not affected by camel parity, ranging from 28.04 to 30.35 kg. Similar weights (29.08±5.031 kg) were reported by Mervat et al. (2020). Higher LBW of camel calves at birth was reported, being 40.1 kg for male and 38.3 kg for female calves (Ismail and Al-Mutairi, 1994).

4.3. Lactation performance:

Regarding the effect of camel parity on lactation performance parameters, total milk yield and consequently daily milk yield was significantly affected by parity because the differences in lactation period was not significant. Milk yield showed significantly a gradual increase by advancing parity up to the 7th parity, showing the maximal milk yield as a total or daily values. In agreement with our results, Mervat et al. (2020) found that camel parity had a significant effect on milk yield as total values, but lactation period and milk yield as daily values were not affected significantly by parity order. They reported that total milk yield increased (significantly, $P<0.05$ and gradually) by increasing parity order. It was the minimal at the 1st parity and the maximal at the 10th parity with a lactation period, ranging from 348.2 to 423.6 days. Camel parity had a significant effect on total milk yield; total milk yield markedly increased by increasing animal parity between 1-8 parities in Maghrebian she-camels (Mostafa et al. (2018), showed the highest yield at 6-8 parities and the lowest yield at the 1st parity (Musaad et al., 2013b; Abdalla et al., 2015). The parity of total milk yield was at 3-6 parities compared with other parities (Al-Saiady et al., 2012) and milk production showed significant reduction in primiparous camels as compared to multiparous ones (Raziq et al., 2008). In addition, our results are in agreement with different authors regarding the insignificant effect of camel parity lactation period length (Abdel-Aziz et al., 2016 a).

As overall results, milk yield in our study averaged 1560 kg as a total and 4.69 kg as a daily with lactation period of 364.40±118.934 days (Mervat et al., 2020), and total milk yield was about 1500 kg (Mustafa, 2008), in Maghrabian camels in Egypt. In dromedary camels, total milk yield was 1207 kg (Musaad et al., 2013a), 1450 kg (Musaad et al., 2013b) in Saudi Arabia, and ranged from 907 to 3010 kg (Enaam et al., 2015; Ishag et al., 2017) in Sudan. On the other hand, the present results indicated that parity had no effect on lactation period. Lactation period length in dromedary camels was 201-240 days (Sharma and Bhargava, 1963), 480-540 days (Yasin and Wahid, 1957), or 270 days at desert conditions (Iwema, 1960).

4.4. Effect of calf sex:

According to the obtained results, calf sex had insignificant effect on reproductive performance parameters including age at conception, calving, number of matings per conception, days open, gestation period length, and calving interval as well as lactation performance parameters involving lactation period, and milk yields. However, calf sex affected only LBW of calves, being higher for males than females. This trend was in agreement with Mervat et al. (2020), who found that LBW of camel calves averaged 29.08 kg, being higher in males than females. Higher weight was reported in Saudi camel, calf weight averaged 38.3 kg in females and 40.1 kg in males (Ismail and Al-Mutairi, 1994).

5. Conclusions

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. In this context, the obtained results of the reproductive performance parameters including age at conception and at calving, number of matings per conception are unsatisfied and need to be improved. Heat detection in camels required several studies to indicate a proper mating time to reduce days open, number of matings per conception, and calving interval. The DO and CI had extended lengths thus affected the period of productive life and the number of calving. With a better efficient heat detection, timely insemination, postpartum reproductive health management and feeding, it is possible to improve the conception rate from first service and increase the percentage of days open and calving interval that fall within the accepted limits. Attention should also be given to early heifer management and arriving higher LBW at puberty, maturation and 1st age at mating/conception/calving.

Data Availability Statement: All data associated with this article is embedded and presented

Conflicts of Interest: the authors declare that there is no confect of interest.

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