

REPRODUCTIVE ABNORMALITIES IN FEMALE CAMEL (*Camelus dromedarius*) IN ALGERIA: RELATIONSHIP WITH AGE, SEASON, BREED AND BODY CONDITION SCORE

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ABSTRACT

Reproductive tract abnormalities have a high impact on sexual activity and fertility. Knowledge of factors related to reproductive disorders is important towards understanding the variability prevalences and features of these anomalies. The relationship between season, age, breed, and the body condition score, and the prevalence of reproductive abnormalities in female dromedary camels were analysed in an observational study on 740 dromedary females. Data were obtained from 2 abattoirs in southeast Algeria from 2011 to 2013. The associations between reproductive abnormalities and the different factors were determined using a chi-square test. Various abnormalities with different degrees of severity were observed in 213 (28.8%) cases. Reproductive abnormalities were significantly associated with age group and season. The percentages of reproductive abnormalities recorded did not differ significantly among breeds and abattoir location. The findings indicated a significant relationship between reproductive disorders and the body condition score. The prevalence of overall reproductive abnormalities significantly varied between the wet and dry seasons. Abnormalities were significantly more frequent during the wet seasons (autumn, winter) than during the dry seasons (spring, summer). Based on these findings, the increased prevalence of reproductive disorders was associated with dry season, older age, and low body condition.

Key words: Age, Algeria, dromedary camel, reproductive abnormalities, season

The reproductive patterns of female camels (seasonal breeding, reproductive delays, prolonged calving interval, poor expressions of estrus signs, etc.) are considered as constraints for the improvement of reproductive efficiency (Tibary and Anouassi, 1997). Also, the reproductive performances are affected by the lack of selection and proper management particularly nutrition and preventive health and treatment (Kaufmann, 2005; Tibary and Anouassi, 1997). The reproductive efficiency of camels is adversely affected by diseases and infections of the reproductive system which may cause many complications, resulting in infertility or poor reproductive performance. These, in turn, are adversely affecting the productivity (El-Wishy, 1989; Al-Ani *et al.*, 1992; Tibary and Anouassi, 1997). Generally, in large farm animals, the highest incidence

of infertility resulted in decreased milk production, treatment costs, extra labour and increased rate of culling. Several studies showed that the dynamics of any animal population depend largely on the reproductive losses which are generally estimated by the abortion rate, rate of culling for infertility reason, and rate of neonatal mortality (Tibary and Anouassi, 1997). For this reasons more information about the abnormal reproductive conditions in female dromedary camels are needed for proper management and breeding of this important animal.

Reproductive diseases are considered as an important contributor to the decline in fertility potential in the large farm animals. Indeed, the fertility rate is influenced by management and environmental factors such as age, breed, occurrence of health and reproductive disorders, and quality of

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reproductive management (Francos and Mayer, 1988; Gröhn *et al*, 1990; Scott *et al*, 1999).

Pathological conditions of female camels have been studied in many countries i.e. Saudi Arabia (Ali, 2010; Ali *et al*, 2011; Mahmoud *et al*, 2011; Al-Afaleq *et al*, 2012), Nigeria (Ribadu *et al*, 1991), UAE (Tibary and Anouassi, 2001), Egypt (Omar *et al*, 1984; El-Wishy, 1989) and Jordan (Al-Ani *et al*, 1992), but there is relatively little information about the effect of environmental and management factors, such as season, age, breed, and the body condition score. Moreover, to our knowledge, no information is available on camel reproductive disorders in Algeria. Therefore, the aim of the present study was to investigate the influence of environmental factors, season, age, breed and body condition score on the occurrence of reproductive abnormalities.

Materials and Methods

Description of the study area

The study was conducted in 2 abattoirs in the southeast of Algeria (El-Oued and Touggourt), about 600 km from the capital Algiers. The average annual rainfall is approximately 58 mm. Two different seasons were defined: dry season (1 April-30 September), wet season (1 October- 30 March). The climate along this area is arid to hyper arid, characterised by low rainfall; daily mean temperatures vary between 10°C in the winter to 40°C in the summer with August being the hottest month.

Slaughterhouse material

From the two different abattoirs, the reproductive organs of 740 females dromedary camels of local breeds were collected for the survey over a period of two years, from February 2011 to January 2013. The slaughterhouses were situated central to many herds of camels. The slaughtered animals came from different provinces of southeast of Algeria. Therefore, the animals examined could be considered as a true representative of female camel population in the area.

During the ante-mortem examination, a complete clinical examination of all the animals was carried out. Females with other general infectious diseases were not considered. Breed, age and the body condition score of each animal were recorded. The camel belonged to 2 main phenotypes common in Algeria, Targui and Sahraoui camel (Oulad Belkhir *et al*, 2013). Age was estimated by dental examination on the basis of their dental formulas and tartar deposition on the teeth, as described by Schwartz and Dioli

(1992). We categorised this variable as less than 5 years, 6-10 years, 11-15 years, and 16 or more years (Sghiri and Driancourt, 1999). The animals' body condition score (BCS) was evaluated on a scale of 0 to 5: based on visual examination and fat cover palpation over the camel's body, following the description given by Faye *et al* (2001), camels were categorised into 3 groups: Low as ≤ 2 , Normal as ≤ 3 and High as ≥ 4 . No data were available on the clinical background of animals and their breeding performance.

Immediately after slaughtering, the reproductive tracts was carefully removed and examined for gross pathological changes with particular attention to the vagina, cervix, uterus, oviducts and ovaries. The tract was examined visually and by palpation. Any gross lesions or abnormalities observed along the reproductive tract was recorded. The tract was incised along the long axis through cervix. Uterine disorders were recorded only if these were macroscopically evident for infection in the uterus or cervix. The ovaries, oviducts and bursa were examined macroscopically and abnormalities, if any were recorded.

Statistical analysis

Chi-square test was carried out to determine the association between reproductive abnormalities and the different factors (season, breed, abattoirs, age at slaughtering, and BCS). Different percentage were compared with the one-way ANOVA followed by Fisher's least significant difference (LSD) test ($P < 0.05$). A p value of less than 0.05 was considered statistically significant for all tests. All statistical analyses were performed with SPSS version 20.1 (SPSS Inc., Chicago, IL, USA).

Results

During the present study a total of 740 reproductive tracts of female camel were examined. Various abnormalities with different degrees of severity were observed in 213 cases (28.78%). Affected females were observed to have one or more genital abnormalities.

Season significantly affected the prevalence of reproductive abnormalities, which tended to be more frequent during wet season ($p < 0.01$) than during the dry season (Table 1). However, for each type of abnormalities, no significant effect of season on the frequency of reproductive abnormalities was detected (Table 2).

Although, the results of present study indicated that the relationship between breed categories and the

prevalence of the major reproductive abnormalities was not significant (Table 1), the percentage of ovarian hydrobursitis (Fig 1A) was slightly higher ($P < 0.05$) in Tergui camels than in Sahraoui breed (Table 2). Significant differences were also found among camel-age categories for the total of reproductive disorders. The recorded percentages of genital abnormalities were higher ($p < 0.05$) in camels more than 11 years old (70.4%) than in the younger age groups (29.6%) (Table 1).

Table 1. Relationships between prevalence of reproductive abnormalities and factors, such as age, season, breed, and body condition score.

	Females with normal tract (No. (%))	Females with Abnormal tract (No. (%))	X2-test
Abattoir			NS
Touggourt	138 (26.2)	55 (25.8)	
El-Oued	389 (73.8)	158 (74.2)	
Season			**
Wet	210 (39.8)	113 (53.1)	
Dry	317 (60.2)	100 (46.9)	
Breed			NS
Sahraoui	456 (86.5)	191 (89.7)	
Tergui	71 (13.5)	22 (10.3)	
Age class			*
< 5 years	87 (16.5)	16 (7.5)	
6 -10 years	116 (22.0)a	47 (22.1)	
11-15 years	179 (34.0)	79 (37.1)	
>16 years	145 (27.5)	71 (33.3)	
BSC			**
Low	241 (45.7)	121 (56.8)	
Normal	222 (42.1)	64 (30.1)	
High	64 (12.1)	28 (13.1)	
Total	527 (100)	213 (100)	

** $P < 0.01$. * $P < 0.05$.

There was no evidence of a statistically significant association between age class and ovarian cysts, cervicitis, endometritis, metritis, paraovarian cysts, peri-uterine adhesion (Fig 1C) and pyometra (Table 2). In contrast, there was a highly significant positive correlation between the prevalence of inactive ovary and pyometra and age. With increasing age, there was an increased risk of the prevalence of these 2 abnormalities (Table 2).

Reproductive diseases have a significant effect on the body conditions scores of animals 121 affected females (56.8%) have a low BCS score, versus only 92 (43.2%) have normal and high BCS ($P < 0.05$). The

Table 2. Relationships between incidence of the major reproductive abnormalities and age group, season, breed, and body condition score.

Reproductive abnormalities	BSC			Season			Age group					Breed			Total [No.(%)]
	Low [No. (%)]	Normal [No. (%)]	High [No. (%)]	Dry [No. (%)]	Wet [No. (%)]	X2-est	≤ 5 yrs [No. (%)]	6-10 yrs [No. (%)]	11-15 yrs [No. (%)]	≥ 16 yrs [No. (%)]	X2-est	Sahraoui [No. (%)]	Tergui [No. (%)]	X2-est	
	Ovarian cysts	6 (2.8)	15 (7.0)	7 (3.3)	11 (5.1)	17 (7.9)	NS	1 (0.5)	7 (3.3)	11 (5.1)	9 (4.2)	NS	26 (12.1)	2 (0.9)	
Cervicitis	9 (4.2)	6 (2.8)	-	8 (3.7)	7 (3.3)	NS	1 (0.5)	3 (1.4)	5 (2.3)	6 (2.8)	NS	12 (5.6)	3 (1.4)	NS	15 (7.0)
Endometritis	19 (8.9)	5 (2.3)	-	10 (4.7)	14 (6.5)	*	1 (0.5)	5 (2.3)	10 (4.7)	8 (3.7)	NS	22 (10.3)	2 (0.9)	NS	24 (11.2)
Ovarian hydrobursitis	10 (4.7)	11 (5.1)	11 (5.1)	18 (8.4)	14 (6.5)	***	-	8 (3.7)	13 (6.1)	11 (5.1)	NS	24 (11.2)	8 (3.7)	*	32 (15.0)
Inactive ovary	32 (15.0)	2 (0.9)	-	17 (7.9)	17 (7.9)	***	7 (3.3)	10 (4.7)	10 (4.7)	7 (3.3)	*	32 (15.0)	2 (0.9)	NS	34 (15.9)
Metritis	19 (8.9)	2 (0.9)	-	10 (4.7)	11 (5.1)	**	1 (0.5)	1 (0.5)	10 (4.7)	9 (4.2)	NS	16 (7.5)	5 (2.3)	NS	21 (9.8)
Paraovarian cysts	5 (2.3)	12 (5.6)	2 (0.9)	11 (5.1)	8 (3.7)	**	4 (1.9)	5 (2.3)	5 (2.3)	5 (2.3)	NS	18 (8.4)	1 (0.5)	NS	19 (8.9)
Peri-uterine adhesion	6 (2.8)	4 (1.9)	5 (2.3)	5 (2.3)	10 (4.7)	*	-	4 (1.9)	6 (2.8)	5 (2.3)	NS	12 (5.6)	3 (1.4)	NS	15 (7.0)
pyometra	7 (3.3)	-	1 (0.5)	5 (2.3)	3 (1.4)	NS	-	-	4 (1.9)	4 (1.9)	***	8 (3.7)	-	NS	8 (3.7)
Teratoma	3 (1.4)	4 (1.9)	-	3 (1.4)	4 (1.9)	NS	-	1 (0.5)	3 (1.4)	3 (1.4)	NS	7 (3.3)	-	NS	7 (3.3)
Vaginitis	1 (0.5)	4 (1.9)	1 (0.5)	4 (1.9)	2 (0.9)	NS	-	1 (0.5)	3 (1.4)	2 (0.9)	NS	6 (2.8)	-	NS	6 (2.8)
Pyosalpinx	1 (0.5)	2 (0.9)	2 (0.9)	1 (0.5)	4 (1.9)	NS	-	1 (0.5)	2 (0.9)	2 (0.9)	NS	3 (1.4)	2 (0.9)	NS	5 (2.3)

*** $P < 0.001$. ** $P < 0.01$. * $P < 0.05$.

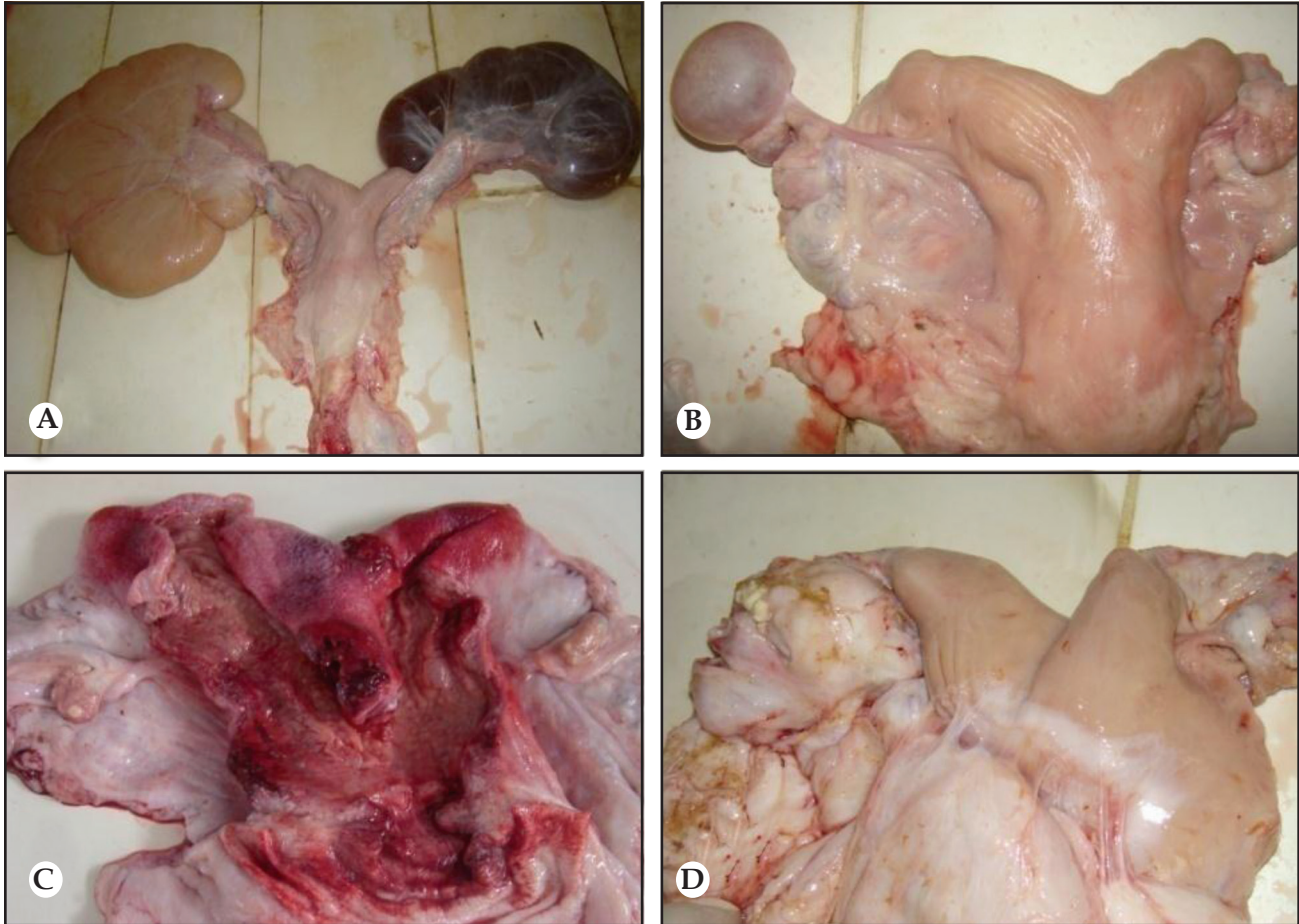


Fig 1. The major reproductive tract abnormalities. (A) Ovarian hydrobursitis; (B) Ovarian cyst; (C) Metritis; (D) Periuterine adhesions.

associations between BCS and the disease groups of ovarian cysts (Fig 1B), endometritis, metritis (Fig. 1C), inactive ovary, paraovarian cysts and ovarian hydrobursitis were calculated on the 740 observations of our study (Table 1). Ovarian cysts, paraovarian cysts and ovarian hydrobursitis were in higher frequency in affected females with normal and high score of BCS (more than 2). However, no direct relationships between cervicitis, peri-uterine adhesions (Fig 1D) and pyometra and BCS was observed, indicating that there was no apparent consequence of these abnormalities on the body condition score.

Discussion

The published reports from several abattoir surveys underline a wide range of reproductive disorders varied from 2.1 % (El-Wishy, 1989) to 44.58% (Omar *et al*, 1984), which can affect camels and may lead to fertility disturbances, decrease in reproduction and production and increase of culling rate. This variation could be attributed to the differences in breed, season, management, geographical environment and level of nutrition. The

effect of season, age, and breed on the prevalence of genital disorders in camel has not been well described among studies. In the present report, we describe several risk factors that can affect the development and the prevalence of the reproductive abnormalities.

The effect of breed group was found to be non significant for all the reproduction disorders. Also the abattoir location didn't affect the prevalence of reproductive abnormalities because of no difference in environments and husbandry conditions. In their natural habitats, camels are subjected to severe stress conditions as they are usually raised during the long dry seasons which render them susceptible to many diseases (Agab and Abbas, 1999). Additionally, Al-EknaH *et al* (2012) detected the ovarian hydrobursitis in different breeds in Saudi Arabia. Moreover, no sufficient studies are available concerning the relationship between the breeds and reproductive disorders in camels to be compared with the results of the present study. In Algeria, camel production largely depends on the traditional sector (Benaissa *et al*, 2012), where camels haven't undergone intensive genetic selection. For

this reason, no significant relationship was observed between breed types and prevalence of reproductive abnormalities. However, in other species Regassa *et al* (2003) reported a statistical significant effect of breed on the reproductive abnormalities in rams. Likewise in cattle Noakes *et al* (2002) and Rizzi *et al* (2003) suggested that breed, age, level of milk production, feeding, management, seems to be important risk factors of reproductive disorders in cattle. The effects of breeds on the prevalence of reproductive disorders in sheep and cattle can be explained by the genetic amelioration and the development of new high yielding breeds (Rizzi *et al*, 2003; Palmieri *et al*, 2011).

The effect of season on reproductive abnormalities was evident in our study ($p < 0.01$; Table 1) by the increased percentage of abnormalities in the wet season. Our results were largely in accordance with the published literature. Omar *et al* (1984) found seasonal variations in reproductive disorders of 1393 females with highest prevalence recorded within winter and summer, while the lower rate was noticed within autumn and spring. However, Waheed *et al* (2009) found a high prevalence of endometritis during autumn and the majority of pyometra cases during spring.

Concerning the prevalence of ovarian abnormalities, no seasonal variation was observed. These findings are consistent with other investigators (Omar *et al*, 1984; Mahmoud *et al*, 2011). Also, there was no association among seasonal variation and frequency of the other major reproductive abnormalities (cervicitis, endometritis, metritis, ovarian hydrobursitis, and periuterin adhesion).

The high prevalence of abnormalities observed in the wet season could be explained by the fact that this period coincides with the season of reproduction activity (Sghiri and Driancourt, 1999; Benaissa *et al*, 2012), and many factors might contribute to the predisposition of the genital tracts to infections during the dry season, due to the physiological changes in this period (Tibary and Anouassi, 1997). Seasonal variation of reproductive disorders in ruminant could be related with the seasonal or non- seasonal reproduction patterns. Authors such as Al-Afaleq *et al* (2012), Ali *et al* (2010) have studied the reproductive abnormalities in female camel. However, these authors did not investigate the seasonal effects because of the short periods of their survey; multiple years of data are required.

It was found that abnormal reproductive conditions were more present in the older age group

more than 11 years. These results are in accordance with Waheed *et al* (2009) who reported that the most findings of abnormal uterine conditions were in females aged more than 10 years. During these periods of age, females are at the peak of their reproductive performance with frequent mating, parturitions, postpartum complications and cervical adhesions. Our results are in accordance with Sghiri and Driancourt (1999) who reported that the age of camels had a highly significant effect on their fertility. Also, Tibary and Anouassi (1997) indicated that fertility rate decreases after certain age and the culling age would be around 16 years. Furthermore, in cattle, Abalti *et al* (2006) reported the same results as Farin and Estill (1993), Lopez-Gatius *et al* (2002) which they found that the occurrence of cysts in reproductive tracts tended to increase with age. Elsewhere, the similar observation has been reported by Javed *et al* (1987) and Iqbal *et al* (1992) for the sheep and goats.

In general, the relationship between reproductive abnormalities and the body condition score was significant ($P < 0.01$; Table 1). Fat or thin condition was highly related to the reproductive diseases, in agreement with Ali *et al* (2011) who reported that the body condition score was significantly affected by diseases with inflammation process (metritis, endometritis, cervicitis, pyometra). BCS in females affected with ovarian hydrobursitis was significantly higher ($P < 0.01$). This is supported by earlier findings of Tibary and anouassi (2001) and Al-Eknaah *et al* (2012) who stated that animals with ovarian hydrobursitis had a general body condition fair to good. This is because ovarian cysts, hydrobursitis and paraovarian cysts share similar characteristics, such as hormonal disorders, and don't affect the healthy status of animals. The same finding in cattle was reported by Abalti *et al* (2006) for which the cysts were found in zebu cattle with body condition score of medium and fat. This is in agreement with other studies which reported increasing occurrence of acyclic ovaries in swine when BCS decreased. On other hand, the frequency of cystic ovaries tended to increase when BCS increased (Knauer *et al*, 2007). Our findings showed that females affected by endometritis, or metritis, or inactive ovary have a low condition score. In the same line, Sghiri and Driancourt (1999) and Tibary and Anouassi (1997) also indicated that ovarian activity had a negative significant relation with BCS.

Body condition score is an indispensable tool for the management and selection to improve

reproductive performance and to assess the body fat reserves and energy (Faye *et al*, 2001; Pryce *et al*, 2000). Caldeira *et al* (2007) demonstrated that the body condition score is related to fertility and production efficiency of animals. The adverse effect of reproductive diseases on body condition scores in cattle has been described in many studies (Lopez-Gatiús *et al*, 2002; Abalti *et al*, 2006). Unlike the results of the present study, Sghiri and Driancourt (1999) reported that the body condition score had no effect on fertility in camels. To our knowledge, associations between BCS and reproductive diseases in camel have not been well studied.

Conclusion

In the present study, no influence of breed type and abattoir on the prevalence of reproductive abnormalities was detected. Age and seasonal effects as well, could influence prevalence of abnormal reproductive conditions of she- camels. Reproductive disorders prevalence increased with increasing age. Considerable knowledge gaps about modifiable factors that affect fertility in dromedary camel were still present. Further research is highly required to improve understanding of the associated factors for reproductive disorders under field conditions.

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