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Serum testosterone and progesterone levels and ovarian activity as indicators for seasonal breeding in dromedary camels in Sudan

Babiker, E. A[1], Ahmed, A. I[1], Husna M. E[2] and Abdel-Aziz B. E[2]

[1]Faculty of Veterinary Medicine, University of Al-Butana, Tamboul, Sudan
[2]Tamboul Camel Research Centre, Ministry of Animal Resources, Sudan

Abstract

The present work was done to investigate the effect of season on level of testosterone, progesterone hormone and ovarian activity in Arabian dromedary camels. Over a period of one year (July 2009–June 2010), jugular blood samples were collected monthly from 7 mature male camels and 12 females at late pregnancy to detect the levels of testosterone and progesterone hormones. A total of 900 ovarian follicles were measured in the slaughterhouses of Tamboul and Um-Elgura to define the effect of season on ovarian activity. The obtained results showed that plasma testosterone levels greatly varied among months of the year. It increased during July and August and decreased during the period from September to February. The level started to increase again during March and remained high until the end of the study in June. Plasma progesterone level was high during July, while it dropped at parturition during August. The level of progesterone remained low during the period from September to February, before it started to rise again in March and remained high until the end of the study in June. The rise of progesterone level in females coincided with the rise of testosterone in males. Ovarian activity was observed throughout the different seasons with a maximum activity during autumn. According to the hormonal findings and ovarian activity, there is a clear breeding season in Arabian dromedary camel in the Butana area, northeast of Sudan extending throughout summer (March – June) and autumn (July–October).

Key words: Season, Testosterone, Progesterone, Ovarian Activity, Camels

Introduction

The reproductive efficiency of camels under natural conditions is generally regarded to be low due to relatively short breeding season, a longer prepubertal period, a long gestation period and a prolonged period of lactation-related anoestrus of 8–10 months, leading to a long inter-calving interval (Skidmore, 2005; Bhakat et al., 2005). Short breeding season is an important factor for the low reproductive performance of dromedary camel. It remains as a major obstacle to the growth of population of dromedaries (Marai et al., 2009). Male and female camels are both seasonal breeders. They breed only during certain times of the year. Contradictory results concerning the beginning and duration of the sexual activity in dromedary camel were found. It has been reported to occur from December to April in Egypt, March to August in Sudan, April to May in Somalia and October to December in Saudi Arabia (Musa and Abusineina, 1978; Hegazy et al., 2004; Ghazi, 2007).

Testosterone hormone is synthesized in the testes. It is responsible for the development and maintenance of the male secondary sex characteristics. Testosterone hormone level in the male camel is important to determine the *libido* and sexual behaviour (Deen, 2008). On the other hand, progesterone hormone level in females is a very useful tool to monitor pregnancy in camels (Alfuraiji, 1998). The primary source of progesterone in the female camel is the corpus luteum (CL). The placenta does not contribute to progesterone secretion, and all camelids depend entirely on progesterone from the CL to maintain their pregnancy (Skidmore, 2005). Camels are induced ovulators and exhibit follicular cycles with follicles developing and regressing successively. Plasma progesterone level remains very low throughout the follicular wave in the absence of mating and ovulation (Ismail et al., 1998). Progesterone concentration starts to rise after mating and during pregnancy and falls just before parturition. Outside the breeding season, mating activity ceases and the ovaries are inactive or only have a few small follicles (Zeidan, 2011).

The objective of the present study was to investigate the ranges of testosterone hormone levels in the male, the levels of progesterone hormone in the female and the ovarian activity to determine the breeding season of the Arabian dromedary camel under climatic conditions in Sudan.

Materials and Methods

This study was carried out at Butana area, northeastern Sudan. The area lies between Latitude 13^0 $40^{'}$ and 17^0 $50^{'}$ North and Longitude 32^0 $40^{'}$ and 36^0 $00^{'}$ East. It is bounded by the Main River Nile on its northwestern border, the Blue Nile on its southwestern edge, the Atbara River in the northeast and by the railway connecting Kassala and Sennar on the south.

Seven mature males and 12 late pregnant females were used in this study. The animals (Arabian dromedary camels) were 5–10 years of age. They were selected from two private and traditionally reared herds around Tamboul area. The animals were left grazing during wet season, while they were supported by dry fodder (sorghum stalks) during the dry summer. The animals were watered once a week at watering points in the area.

A total of 224 blood samples, each of 10 ml were taken from the animals by jugular vein puncture. The samples were taken from each animal at monthly intervals throughout the study period (July 2009–June 2010). Plasma was immediately separated and stored at -20 ^{0}C in the Faculty of Veterinary Medicine in Tamboul until hormonal analysis. Enzyme immunoassay (EIA) was done at the department of Radio Isotope Laboratory (Soba Centre/Khartoum). Testosterone and Progesterone concentrations in serum samples were measured using the Enzyme Immunoassay kits which were provided by Immunometrics Company, London, UK.

A total number of 900 ovarian follicles were measured to study the activity of ovaries throughout the year. The ovaries were obtained in Tamboul and Um-Elgura slaughter houses. Directly after slaughter, the sizes of the follicles were measured using a measuring tape and recorded in cm. According to Ismail et al. (1998), follicles measuring < 0.5 cm in diameter were considered small follicles, while those measuring > 2.5 cm in diameter were considered large cyst-like follicles. Those in between were considered medium or growing follicles.

Statistical analysis

The data were subjected to analysis of variance using Statistical Package for Social Sciences. Comparison of means were made using Duncan multiple range test.

Results

The testosterone levels in blood plasma of 7 dromedary male camels are shown in Fig 1. The average concentration of testosterone hormone was relatively high ($P<0.05$) during July (1.65 ng/ml) and August (1.31 ng/ml). The level of testosterone hormone started to drop at September and remained low at a level between 0.15 ng/ml and 0.56 ng/ml throughout October, November, December, January and February. The level started to increase again at March (0.96 ng/ml) and remained high until the end of the study at June (1.13 ng/ml).

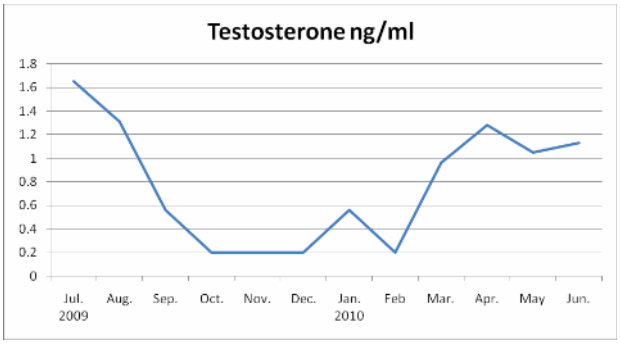

Fig 1: Testosterone profile in male dromedary camels in Sudan

The average concentration of progesterone hormone in the 12 late pregnant female camels is shown Fig 2. The highest progesterone level (13.75 ng/ml) was recorded during July which was the last month of pregnancy, while the lowest value (0.19 ng/ml) was recorded after parturition at August. The level remained low throughout September, October, November, December, January and February. Progesterone hormone concentration started to rise again at March (6.46 ng/ml) and remained high during April, May and June.

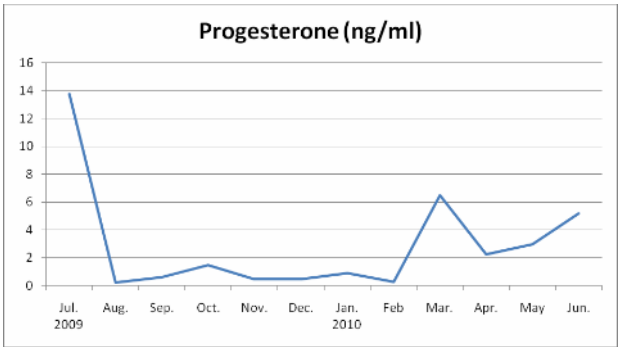

Fig 2: Progesterone profile in dromedary she-camels in Sudan

Table 1: Ovarian follicles (%) in relation to season in dromedary she-camel in Butana area under Sudan conditions

Season	No. of samples	Small follicle	Medium follicles	Large follicles
Summer	200	33.55[a]	57.65[b]	8.80[ab]
Autumn	250	8.80[b]	73.05[a]	18.15[a]
Winter	450	52.36[a]	45.63[b]	2.00[ab]
Overall	900	31.57	58.77	9.65

Means bearing different letters in the same column, differ significantly (P<0.05); summer (March–June); autumn (July–October); winter (November–February).

Ovarian Follicles in relation to season of the year are shown in Table 1. The results revealed significant difference of ovarian follicular growth due to season. The highest percentage (52.36) of small follicles (in active ovaries) was observed during winter (November –February), while the lowest percentage (8.80) of in active ovaries was recorded during autumn (July–October). Medium size (growing and mature) follicles were observed throughout the year, although the highest value was observed during autumn (73.05%), while the lowest value (43.63%) was recorded during winter. The highest number of large cyst-like follicles (18.15%) was recorded during autumn, while the lowest (2%) was observed during winter. Moderate measurements were recorded during summer.

Discussion

Testosterone hormone level in the male camel is important to determine the *libido* and sexual behaviour. The level increases during the breeding season (Bhakat et al., 2005; Deen, 2008). The level of testosterone hormone in the present study greatly varied among months of the year. Higher levels of circulating testosterone were recorded during March to August. These data indicated a hormonal surge of testosterone during this period. Minimal basal levels of testosterone were found during the period between September and February indicating that sexual activity of the camel during this period is quiescent. Factors responsible for the onset and cessation of sexual activity in camels under natural conditions are unknown. Environmental factors, in addition to visual and olfactory stimulation could be of influence via the central nervous system (Deen, 2008). Camels breed during the warmest months of the year (Sumar, 2000)

In the 12 late pregnant she-camels in this study, progesterone hormone concentration recorded the highest level at July. The concentration declined to the basal level after parturition during August. Progesterone hormone level is a very useful tool to monitor pregnancy in camels. It was found to be high during pregnancy and fall just after expulsion of the foetus (Alfuraiji, 1998; Skidmore, 2005).

The level of progesterone for all she-camels studied remained low during the period from September to February before it started to rise again at March and remained high until the end of the study at June. The primary source of progesterone in the female camel is the corpus luteum. Since the camel is an induced ovulator, which ovulates only in response to mating stimuli, level of progesterone remains low in the absence of mating and ovulation (Ayoub et al., 2003; Skidmore, 2005; Ghazi, 2007).

Increase of progesterone levels in female camels in this study coincided with the rise of testosterone hormone levels in the males indicating a period of breeding between March and August. The present findings are similar to those of Musa and Abusineina (1978). Male and female camels are both seasonal breeders affected by long daylight during the warmest months of the year (Chen and Yuen 1979; Sumar, 2000).

The ovarian activity in the present study was observed throughout the whole year, although values recorded during autumn months are higher than those observed during winter months (non-breeding season). Moderate values were recorded during summer months. Similar results were observed by Hussein et al. (2008) and Zeidan et al. (2011) in Egypt. Maintaining adequate nutrition level may shorten the days open and achieve conception outside the breeding season (Marai *et al*., 2009). Incidence of high percentages of small follicles was observed throughout winter months which correspond to the non-breeding season in Sudan. Small follicles secrete oestrogen, but not in amounts sufficient to induce the ovulatory surge of LH (Deen, 2008). Large cyst-like follicles in the present study were observed almost throughout the whole year with variable percentages, although higher value was observed during autumn. Similar results were observed by Hegazy et al. (2004) in Saudi Arabia. The over growth of the follicles occurs due to failure of ovulation (Hussein et al., 2008).

From the present study it could be concluded that:

1. The breeding season in dromedary female camels in Sudan as indicated by the level of circulating progesterone hormone coincided with the level of testosterone hormone in the males indicating a period of breeding between March and August.
2. According to the growth of ovarian follicles, the breeding season can be extended throughout summer and autumn (March–October). However, more studies are required to determine factors affecting breeding of camels under Sudan conditions.

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