OVARIAN STEROID CONCENTRATIONS AND FOLLICLE DEVELOPMENT IN THE FEMALE CAMEL (*Camelus dromedarius*)

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ABSTRACT

The main objective of the present study was to investigate the changes in ovarian oestradiol and testosterone concentrations as follicles develop in the camel. Ovaries were collected from 15 non-pregnant females from a slaughter house. All follicles ≥4.0 mm diameter were dissected from each ovary, follicle size was recorded and follicular fluid was aspirated from each follicle and analyzed for its oestradiol and testosterone contents. A bi-modal distribution of follicles was observed when frequency was plotted against oestradiol:testosterone ratio. On this basis, individual follicles were classified as oestrogenic or non-oestrogenic if they had follicular fluid oestradiol:testosterone ratio of ≥ 6:1 or < 6:1, respectively. The total number of follicles did not differ between the two ovaries (right 56.9%; left 43. 1 %). Similarly, the number of oestrogenic and non-oestrogenic follicles was similar between the two ovaries. Moreover, no difference was observed between the percentage of oestrogenic and non-oestrogenic follicles within the right or the left ovaries. In addition, there was no difference in the diameter of oestrogenic and non-oestrogenic follicles. The results suggest that in the camel, both ovaries are equally capable of producing normal preovulatory follicles.

INTRODUCTION

The rapid increase in human population in the developing countries has led to a high demand for meat production. The one-humped camel most probably, is a better provider of food in desert and semi-desert areas than cows which are severely affected by heat and scarcity of water and feed (Sweet, 1965). The camel industry constitutes around 20.66% of the livestock market in Saudi Arabia. Its importance is on the rise and semi-intensive farming systems have been introduced recently into the Kingdom.

The dromedary camel is a seasonally polyestrous breeder and an induced ovulator (Shalash, 1965; Musa and Abusineina, 1978). Reproductive problems appear to be the main factor that limits the total number of off springs that can be obtained per camel. Even though twin ovulations are around 14%, twin births are only 0.4%. In twin ovulation cases, the embryo in the right horn of the uterus dies during early pregnancy (Musa, 1969). Furthermore, 99.24% of pregnancies were found to be in the left horn of the uterus (Shalash, 1965).

The limited information available about steroid concentrations in plasma and the ovarian follicular wave patterns indicates the presence of variations in plasma oestradiol concentrations between the breeding and the non-breeding seasons (Elias *et al.*, 1984). However, little attempt has been made to determine steroid concentrations in the follicular fluid. Khalil (1989) showed a parallel increase in follicle size and intrafollicular oestradiol and testosterone concentrations, with highest concentrations found in preovulatory follicles. However, neither oestradiol:testosterone ratio has been calculated (an indication of the oestrogenic activity) nor it was related to the ovarian side they came from. Skidmore *et al.* (1965) have studied the follicular wave pattern in the camel, using transrectal ultrasonography. However, it does not provide any information whether a follicle is potentially ovulatory or an atretic one.

The main objective of this study therefore, was to determine steroid concentrations in the ovarian follicular fluid of the non-pregnant female camel. An attempt has also been made to relate the follicular steroid concentrations with the stage of follicular development.

MATERIALS AND METHODS

Normal looking ovaries from 15 non-pregnant female camels were collected from the slaughter house during the breeding season. They were transferred to the laboratory in physiological saline solution on ice within one hour of slaughter. All follicles ≥ 4 mm diameter were dissected free of connective tissue and their diameter recorded. The follicular fluid was then aspirated from each follicle and its volume recorded before being stored at -20°C for the determination of oestradiol and testosterone concentrations.

Radioimmunoassay

Oestradiol concentrations in the follicular fluid were determined without prior extraction by the method of Foxcroft *et al.* (1987). Serial dilutions of camel follicular fluid when assayed, showed parallelism with the oestradiol standard curve, indicating the technique was suitable for the determination of oestradiol concentrations in the camel follicular fluid. The intra and inter assay coefficients of variation were 5.7 and 7.3% respectively, while the sensitivity of the assay was 20 pg/ml.

The assay used for the measurement of testosterone in the follicular fluid was based on the method described by Purvis *et al.* (1974) but without prior extraction. The samples assayed at different volumes showed parallelism with standard curve. The intra and inter assay coefficients of variation were 4.5 and 6.1% respectively, while the sensitivity of the assay was 0.03 ng/ml.

Statistical analysis

Individual follicles were classified as oestrogenic or non-oestrogenic if they had follicular fluid oestrogen:testosterone ratio of $\geq$ 6:1 or $<$ 6:1, respectively. Analysis of variance was used to compare follicle size between oestrogenic and non-oestrogenic follicles. Chi-square analysis was used to compare the differences in the total number of follicles or the percentage of oestrogenic and non-oestrogenic follicles between or within right and left ovaries.

RESULTS

A bi-modal distribution of follicles was observed when their frequency was plotted against oestradiol:testosterone (E:T) ratio. This clearly showed two main groups of follicles, either oestrogenic (E:T ratio $\geq$ 6:1) or non-oestrogenic (E:T ratio $<$ 6:1, Fig. 1). The mean diameter of oestrogenic and non-oestrogenic follicles was 8.17 $\pm$ 0.75 and 8.06 $\pm$ 0.69 mm, respectively, the difference was non significant. The difference in the percentage of total number of follicles, irrespective of their physiological status, collected from the right (56.9%) and the left (43. 1%) ovaries was non significant. Furthermore, no differences were found in the percentage of oestrogenic follicles collected from either side (right ovary, 54.1% left ovary, 46.4%), nor was there any difference in the percentage of non-oestrogenic follicles between the right (45.9%) and the left (53.6%) ovaries. The total number of oestrogenic and non-oestrogenic follicles collected from each ovarian side was also not significantly different (right ovary, oestrogenic follicles, 54.1%, non-oestrogenic follicles, 45.9%; left ovary, oestrogenic follicles, 46.4%, non-oestrogenic follicles, 53.6%) (Table 1).

DISCUSSION

The absence of any significant differences between the right and the left ovaries regarding either the total number of follicles or the number of oestrogenic or non-oestrogenic follicles as well as the lack of difference between the number of oestrogenic and non-oestrogenic follicles within each ovary (right or left) suggests that in the female camel both the ovaries are equally functional as far as the follicle development is concerned. Therefore, the presence of pregnancies only in the left horn (Shalash, 1965) may not be due to a differential follicle development between the right and the left ovaries. These findings are in line with those found in the Alpacas in which the ovarian activities were found to be equally distributed (Bravo and Sumar, 1989). However, in camels, it has been reported to alternate between the two ovaries (Musa and Abusineina, 1978; Bravo and Sumar 1989 ; EL- Wishy, 1992).

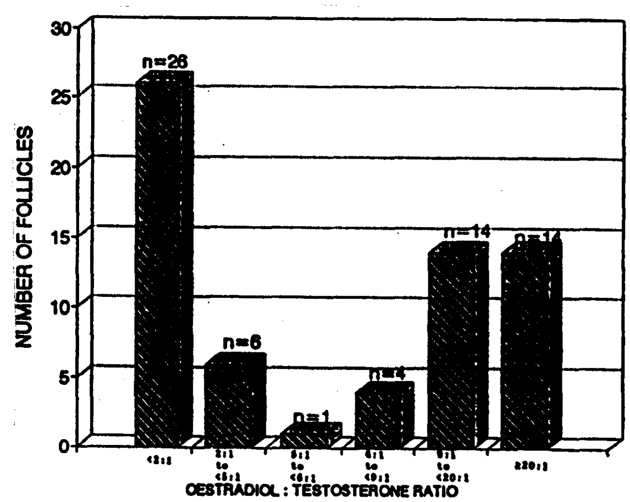

Fig. 1: Frequency distribution of follicles against oestradiol: testosterone ratio.

Table 1: Total number of oestrogenic and non-oestrogenic follicles in the right and the left ovaries of the female camel

	Right ovary	Left ovary	Total
Total number of follicles	37 (56.9%)	28 (43.1%)	65
Number of oestrogenic follicles	20 (54.1%)	13 (46.4%)	33
Number of non-oestrogenic follicles	17 (45.9%)	15 (53.6%)	32

Information on follicle development is important in addressing the problem of reproductive failure in any species. Using transrectal ultrasonography, follicular wave pattern in the camel has been studied (Skidmore *et al.* 1995) which was entirely based on the sizes of follicles. Although size has been shown to be positively related to the oestrogenic status of follicles in sheep (Basiouni, 1995), in camel, it is not the size but the physiological status of the follicle which determines whether it is potentially ovulatory or not. This is apparent from the results obtained in the present study, as there was no difference between the diameter of oestrogenic (potentially ovulatory) and non oestrogenic follicles, once the oestrogenic status was determined on the basis of ovarian aromatase system. Whether it is a simple species difference or a difference which may prevail between spontaneous (sheep) and induced (camel) ovulators, is not clear and would need further studies. Nevertheless, it is emphasized that any data on follicular development in the camel using the technique of transrectal ultrasonography should be interpreted carefully.

In conclusion, in camels both ovaries are equally capable of producing preovulatory follicles. However, more studies are needed to investigate the process of preovulatory follicle selection in a species like camel which is an induced ovulator.

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