Behavioral indicators to detect ovarian phase in the dromedary she-camel

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ABSTRACT

This pilot study was conducted to test the hypothesis that female camels behave differently in various ovarian phases in the presence of a restrained male camel. The aim was to identify behavioral patterns which could be used as indicators to detect ovulatory phase by visual observation in the presence of a restrained virile bull. Twenty-four healthy, nonpregnant, and nonlactating adult females were used. Transrectal ultrasonography was performed for each animal once a week over a 3-week period to determine the phase of the ovarian cycle. Females were considered to be in the ovulatory phase (O) when there was at least one preovulatory follicle ($12<\emptyset<19$ mm) protruding from the ovarian surface, and in the nonovulatory phase (NO), when growing follicles, regressing follicles, or corpora lutea were detected. Immediately after examination, each female was freely exposed to a restrained bull for 15 minutes, and her behaviors were filmed. The videos were analyzed through a focal animal-sampling ethogram (states: looking at the male; looking outside; standing close to the male; searching; and lying down; events: interaction with the male; urination; defecation; sound emission; and steps). A score for tail position (tail score: 1 = close to the vulva, 2 = horizontal, 3 = vertical) and for interest in the bull (male time score: from 1 to 5; 1 = <20% of observation period spent near the bull; 5 = more than 80%) were recorded. Ovulatory phase camels showed higher interest in the male than nonovulatory phases: they stood close to the male for longer periods (P = 0.0159), interacted with the male more frequently (P = 0.0004), and tended to lie down in front of him (P = 0.1202). Moreover, ovulatory phase had a significant effect on male time score (P < 0.01), mature follicular ovarian phase being associated with higher scores. Seeking the male has already been proposed as a behavioral indicator of estrus in camels, this has now been confirmed using a standardized ethogram. The present results clarify that camels behave differently in different ovarian phases and that monitoring their behavior in the presence of a restrained bull could help detect their ovulatory phase. This would have profound implications for enhancing fertility in dromedary camels by improving timing of mating or artificial insemination.

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1. Introduction

Estrus detection can have great impact on a farm's profitability [1]. Because the lack of estrus detection has been identified as a major limiting factor for reproductive

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performance in modern dairy herds, many estrus detection methods have been developed in dairy cows [2]. These methods are on the basis of the effect of estrus cycle on dairy physiology, endocrinology, and behavior [3]; they comprise recording body temperature [4], tracking cow locomotory activity using a pedometer [5], visual observation of behavioral signs [6], and using infrared thermography [7]. In spontaneous ovulators, estrus detection by visual observation to identify the ovulation period (i.e., best timing for mating/artificial insemination) is currently well understood, and reliable behavioral patterns have been identified both in cows [2] and in the sow [8].

Female dromedaries are induced ovulators [9], hence, the changes in their ovarian follicular dynamics are usually described as a "follicular wave pattern". Each follicular wave is divided into four phases, namely recruitment, growth, maturity, and regression [10,11]. The recruitment phase corresponds to the start of a new follicular wave; about 12 follicles (range, 8–34) can be recruited in this phase [12]. During the growth phase, 3 to 6 follicles grow until they reach approximately 8 mm in diameter, whereas the mature phase starts when one or two growing follicles become dominant and continue to develop into preovulatory follicles measuring 12 to 18 mm in diameter [12]. If mating or ovulation-inducing treatment occurs during this phase, the mature follicle will ovulate and a CL will develop. In the absence of mating or ovulation-inducing treatment, the mature phase is followed by a follicular regression phase, in which regressing or large anovulatory follicles (20–40 mm in diameter and with free-floating echogenic strands) can be observed [13].

During the mature ovarian phase, high levels of estradiol-17β have been detected in camels [14], and estrogen levels are reported to be highly correlated (r = 0.97, P < 0.001) with follicular size [15]. It is suggested that these high levels of estrogen (E2) stimulate behavioral estrus during the mature phase, in which the female becomes receptive to mating and exhibits estrus behavioral patterns [16]. However, little is known about the behaviors of the she-camel during the different ovarian phases, and results of previous works on this topic are often conflicting and misleading because the behavioral data have not been sampled properly.

One of the earliest studies on estrus cycle and estrus behavior in camels, conducted in 1978 by Musa and Abusinena [17], concluded that external signs of heat are less evident than that in cows and mares, being manifested by restlessness, swelling of the vulva, and slight vulval discharge. However, only five animals were monitored and nothing is reported about how behavioral patterns were recorded. The same year, Joshi et al. [18] monitored the behavior of six young females and used an estrus intensity score. They disagreed with Musa and Abusinema, reporting that estrus behavior in camels was intense. Later, Homeida et al. [19] reported that high serum estrogen levels during the 5 days of mature follicular development stimulated estrus behavior such as straddling of the hind legs and urination and receptivity to the male. These behaviors were evaluated in later studies [20], which concluded that these behavioral indicators cannot be reliably used to decide on mating timing in camels compared to the conventional

identification of the mature phase via trans-rectal ultrasonography [9]. In the United Arab Emirates, close veterinary monitoring of follicular activity by ultrasonography raised the pregnancy rate to 85%; however, worldwide, the fertility indices in camels are very low. Indeed, pregnancy rate seems to be strongly affected by the nutritional and health status of the animals and by the husbandry: in traditional herds, it varies from 12% (Sudan) to 40% (Kenya) [21]. In developing countries, the use of ultrasonography is rarely applied because it is money- and time-consuming, and reproductive management is still on the basis of natural mating, with males free in the herd, given that this still ensures a higher pregnancy rate than in herds where hand mating is practised [21]. Thus, better identification of estrus using a behavioral test could enhance fertility rates in camels.

A receptivity score was recently related to different ovarian structures by Swelum and Alowaimer [22], who reported different acceptance of the male when she-camels had mature follicles. However, these authors used progesterone-releasing intravaginal devices to synchronize breeding time, and the behavior was analyzed only in terms of a receptivity score. The same score was also used by Ghoneim et al. [23], confirming the greater acceptance of the male during the mature ovarian phase.

However, none of the above trials recorded female camel behavior using an appropriate behavior sampling method, i.e., an ethogram [24]. To the best of our knowledge, indeed, no studies have focused on detecting the mature follicular phase, also named ovulatory phase, by visual observation of the she-camel's behavioral repertoire, recording her behavior through a standardized ethogram. Thus, the aim of this pilot study was to document the effect of different reproductive phases on the behavioral repertoire of she-camels in the presence of a restrained virile male using a standard ethogram, and to identify behavioral indicators to detect the ovulatory phase. The hypothesis of this trial was that the behavior of a female camel in the ovulatory phase would be different compared to the behavior of a she-camel in the other ovarian phases in the presence of a restrained camel bull, as recorded by a standard ethogram.

2. Material and methods

2.1. Animals and housing

This investigation was carried out during the breeding season (January–February) on 24 adult non-lactating camels, *Camelus dromedarius*, with an average body weight of 420 ± 17.3 kg, good body condition score (2.5 ± 0.5 arbitrary units; range from 0–5 [25]) and aged 6 to 13 years. The animals were housed in an open paddock with a fenced area belonging to the Artificial Insemination Laboratory, Mariout Research Station (Latitude 31° 00′ N; Longitude 29° 47′ E), Desert Research Center, Egypt. The camels were allowed to graze daily from 8.00 AM to 2.00 PM, and then, Egyptian clover (*Trifolium alexandrinum*) hay was offered *ad libitum*. Fresh water was presented once daily after returning from the pasture. Before conducting the experiment, all animals were clinically examined and were found to be free of any disease or reproductive disorders.