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Nutritional status influences reproductive seasonality in Creole goats: 1. Ovarian activity during seasonal reproductive transitions

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ABSTRACT

The objective was to determine the effect of body energy stores, evaluated by a body mass index (BMI), and food intake (FI), on the length of the anovulatory period and ovarian activity during the seasonal reproductive transitions in Creole goats. Non-pregnant, non-lactating Creole goats ($n = 28$) were fed to induce two different BMI conditions: Greater (GBMI; $n = 15$), and Lesser (LBMI; $n = 13$). Each BMI group was divided into two sub-groups, which were either feed restricted (FR) or non-feed restricted (NFR). Goats in the NFR groups received a diet containing 100% of the daily maintenance requirements (basal diet), while restricted goats were subjected to alternated periods, receiving 100% (11 d) and 60% (10 d) of the basal diet, during the entire experimental period. The experiment started after does were treated to synchronize time of estrus. Serum progesterone was determined in samples obtained twice a week, and used as a criterion for determining ovulations. During the transition to the anovulatory period three transrectal ovarian ultrasonographic scans were performed in a sub-group of 12 goats

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($n = 3$ for each treatment combination). The diameter of the largest follicle (LFD) and the total number of antral follicles ≥2 mm (TAF) were recorded. Ultrasonographic ovarian scans were performed at 21, 42 and 63 days after the beginning of the experiment, concurrently with the end of each feed restriction period. The variables of response associated with ovulation were not influenced by BMI or BMI × FI interaction. However, FI influenced length of anovulatory season, as the anovulatory period was 30 d longer ($P < 0.05$) in the FR group as compared with the NFR group. Independently of treatments, TAF and LFD decreased from the first to the third ultrasonographic ovarian scan (13.2, 10.8 and 4.4 follicles; 3.7, 2.7 and 2.3 mm). Nevertheless, in PER 1 the number of TAF was greater ($P < 0.05$) in the FR as compared with NFR group and the GBMI group had a larger LFD ($P < 0.05$) as compared to the LBMI group. It is concluded, that temporal restriction in feed intake could affect the time of cessation and initiation of ovulations during the periods of transition to seasonal anestrus and return to estrous activity, and increase the length of the anovulatory period. In addition, ovarian follicular development during transition into the anovulatory period is differentially influenced by food intake and the status of body energy stores.

1. Introduction

Reproductive seasonality limits the reproductive efficiency in goat production systems (Shelton, 1991). This seasonal reproductive pattern evolved in goats in a manner that time of parturition and lactation coincides with season of greatest feed availability and favorable temperatures (Martin et al., 2004). In domestic goats, reproductive season starts between the summer and fall and ends between the winter and spring, depending on both breed and geographic latitude (Shelton, 1978). At tropical latitudes, Mexican Creole goats with similar genetic compositions and geographic location have wide variations (up to 4 months) in the duration of the anestrous and/or reproductive seasons (Gutiérrez, 1979; Valencia et al., 1990; Esquivel et al., 1992; Flores et al., 1996).

The yearly reproductive cycle of the Creole goat is primarily controlled by an endogenous reproductive rhythm, which is synchronized by the day length (i.e., photoperiod) (Delgadillo et al., 2004). In tropical latitudes, the duration of anestrus can also be modulated by nutritional and socio-sexual factors in sheep and goats (Martin et al., 1999; Forcada and Abecia, 2006). Improved nutrition in goat males and females (Walkden-Brown et al., 1994; Zarazaga et al., 2005), and improved body condition in ewes with limited seasonality (Carrillo, 2005) reduce the length of the anestrous season, and, in sheep, promote larger ovarian follicular development and increased ovulation rate during the transition into and out of seasonal anestrus (Carrillo, 2005; Abecia et al., 1993). Nutritional status, therefore, affects timing of cessation and initiation of ovulations and follicular development during the periods of transition to anestrus and return to estrus.

Goats have traditionally been raised in regions with major fluctuations in feed availability throughout the year (Silanikove, 2000), which can result in variations in the quantity and quality of food intake and, therefore, affect body condition. Reproductive function is influenced by the animal's nutritional condition, particularly the energy status (Imakawa et al., 1986; Schillo, 1992), which includes amount of body energy stores and energy obtained from food consumption on a daily basis (Schneider, 2004). Both components of energy status generate, respectively, long- and short-term signals. Signals, in turn influence, either independently or interactively, secretion of GnRH and LH (Archer et al., 2002) and the ovarian function including follicular development and ovulations (Scaramuzzi et al., 2006).

The present study was designed to determine the effects of body energy stores and daily feed intake on the length of the anovulatory period, and on the timing of cessation in initiation of ovulations and follicular development during the periods of transition to anestrus and return to estrus. The experimental hypothesis was that follicular development and timing of cessation and initiation of ovulations