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Short communication

Effect of the length of the suckling period and dietary energy intake in lactation on the duration of postpartum anestrus in Creole goats

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ABSTRACT

The objective of this study was to determine the effect of the length of the suckling period and the dietary energy level on the duration of postpartum anestrus in Creole goats. Twenty-eight multiparous pregnant goats (bodyweight BW 39.9 ± 6.4 kg; mean ± SEM) each bearing a single fetus were used in a 2 suckling period (30 vs. 60 d) × 2 levels of energy intake (low (L) vs. high (H)) factorial design. Kids were separated from their dams 3 d after birth and then suckled twice per day until weaned at 30 or 60 d postpartum. Dams weaned at 30 d postpartum were hand milked for the next 30 d. Goats were individually fed chopped alfalfa hay + balanced concentrates (45:55 DM basis) at 3% of BW in the last month of pregnancy and at the same level to the L goats in the postpartum period when the H goats were fed at 4% of BW. Energy balance was estimated by difference between energy intake and calculated energy requirements. Duration of postpartum anestrus was estimated by determining the occurrence of ovulation from changes in blood progesterone concentrations. There were no significant lengths of suckling x energy intake level interactions. Goats on all treatments lost weight until 45 d postpartum with more weight loss on the low than the high energy intake level (L 4.06 ± 0.43 vs. H 1.99 ± 0.64 kg; $P < 0.05$). The daily 4% FCM production was similar for all treatments (overall mean 1.10 ± 0.01 kg). The difference between the postpartum anestrus period between low (129 d) and high (128 d) dietary energy levels was not significant but no goat ovulated while in negative energy balance. The effect of suckling on the resumption of ovarian activity was highly significant ($P < 0.001$) with goats weaned 30 d postpartum resuming ovulation 102 d after parturition compared to 155 d for those weaned 60 d postpartum. This study illustrates the importance of the bond between the doe and its kid in the prolongation of the anestrus period in goats.

1. Introduction

The reproductive activity of goats has a seasonal pattern which is related to the annual variations of photoperiod, mainly in goats of high and middle latitudes (Fatet et al., 2011). However, many authors have shown that in sheep and goats the effect of photoperiod on sexual activity can be modulated or completely overridden by factors such as maternal nutrition and kids nursing (or suckling) (Delgadillo et al., 1998; Scaramuzzi et al., 2006).

It is well known that nutrition is an important factor affecting reproductive function and influencing the onset of ovarian cyclicity in postpartum ewes and goats (Fatet et al., 2011). Several studies have shown that reproductive performance is related to body weight changes, indicating that body weight increase shortens the duration of postpartum anestrus. These changes can be obtained through supplementation with high energy and/or high protein diets (Meza-Herrera and Tena-Sempere, 2012). Another way to assess the effect of nutrition on reproduction is through energy balance. When the animal's total energy requirements are more than the total energy intake, animals are in "negative energy balance". The effect of negative energy balance on reproduction is characterized by anovulation and anestrus (Scaramuzzi et al., 2006).

The presence of the offspring and suckling are other factors that influence ovarian activity. It has been shown that suckling prolongs postpartum anestrus in cows (Stagg et al., 1998; Sinclair et al., 2002; Montiel and Ahuja, 2005), ewes (Schirar et al., 1990) and goats (Takayama et al., 2010). However, other studies have shown that

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ovulation may occur during the suckling period (Delgadillo et al., 1998).

To develop management methods that enable producers to shorten the period of postpartum anestrus, breed animals all year round and stabilize production, it is necessary to have a deeper knowledge of the factors that control the annual reproductive cycle of goats and their interactions. However, in spite of all the background information, there are no studies on the effect of dietary energy level and its interaction with the effect of natural suckling on the duration of postpartum anestrus in Creole goats. Accordingly, the objectives of this study were: 1) to determine the effect of suckling length and dietary energy level on postpartum anestrus; and 2) to establish which factor is the main regulator of the resumption of postpartum ovarian activity in Creole goats. We hypothesize that a high energy intake and a reduction of the suckling period will decrease the duration of postpartum anestrus. And also that between both factors, dietary energy will be the main factor regulating the resumption of ovarian activity, so goats with higher energy intake will ovulate first regardless of the weaning time of their kids.

2. Material and methods

2.1. Animals, management and treatments

All experimental procedures and animal care practices were in agreement with the Guide for Care and Use of Agricultural Animals in Research and Teaching (FASS, 2010). Experimental trials were conducted in the facilities of the Argentinean Institute of Arid Land Research located in the Scientific Technological Center CONICET Mendoza, Argentina.

In September 2012, approximately 30 days before parturition, a herd of adult female Creole goats from the farming establishment "El Empeño" (Malargüe, Mendoza, 35° 57′ 57″ S, 68° 46′ 15.4″ W) was examined by trans-abdominal ultrasonography. Twenty-eight multiparous adult goats between the third and sixth birth, carrying a single pregnancy (one fetus) in the last month of gestation were selected. During the last month of pregnancy (adaptation period) all goats were individually fed with a daily ration composed of chopped alfalfa hay and balanced pelleted feed (45% and 55%, respectively on a dry matter basis) at a rate of 3% of body weight (BW). All animals were treated for internal and external parasites with ivermectin (0.2 mg kg^{-1} BW). Clean drinking water and mineral licks were always available *ad libitum* (Paez Lama et al., 2014).

At the beginning of parturition, goats were assigned to four experimental groups (n = 7) balanced for body weight (BW 39.9 ± 6.4 kg; mean ± SEM) and body condition score (BCS 1.82 ± 0.22; mean ± SEM, scale 1–5). All goats gave birth between 1st and 31st of October 2012. The experiment had a 2 × 2 factorial design with two levels of dietary energy level (high and low, H and L groups respectively) and two lengths of suckling period (60 and 30 days long groups). All goat kids were separated from their dams at 3 days of age. Thereafter, goat kids were allowed to suckle milk from their respective dams for about 30 min twice daily at 0730 and 1930 h. In the long suckling groups (H60 and L60) kids suckled milk until the end of dam lactation period (at 60 postpartum days). In the short suckling groups (H30 and L30) kids were weaned at 30 postpartum days and then the dams were hand milked (at 0730 and 1930 h) until 60 postpartum days. Short suckling groups were hand milked to prevent that the weaning of kids decreased the energy requirements of goats and produce an overlap between the effect of suckling length and energy balance. Immediately after weaning, kids were moved to a farm located 19 km away, to avoid any kind of interaction with the mother. A daily ration composed of chopped alfalfa hay (40% on DM basis) and balanced pelleted diet (60% on DM basis) was individually offered to dams at a rate of 3% and 4% of BW (at 2 postpartum days) in the groups of low (L30 and L60 groups) and high energy intake (H30 and H60 groups), respectively. Alfalfa hay and pelleted diet were offered twice a day (at 0800 and 2000 h) in separate containers. Refusals were collected and weighed before offering rations. The rations were calculated in order to allow high energy groups leave the negative energy balance before weaning the kids (while low energy after the weaning), based on the nutritional requirements according to CSIRO (2007) and information obtained from previous trials on goats of the same breed (Paez et al., 2001). The experimental diet was offered steadily from the beginning of parturition (October 1, 2012) until the end of the trial when all goats ovulated (April 1, 2013).

Table 1
Chemical composition (on DM basis) of milk produced and of ration offered to goats during trials.

Composition (%)	Milk[a]	Balanced pelleted	Alfalfa hay	Ration[b]
Dry matter	13.8	92.5	92.9	92.7
Crude or milk protein	4.2	14.0	15.1	14.4
NDF		21.6	42.7	30.0
ADF		9.3	31.6	18.2
Ether extract or milk fat	5.1	3.2	1.9	2.7
Ash	0.8	6.2	11.2	8.2
ME MJ/kg[c]	3.5	10.0	9.0	9.6

[a] Composition expressed per kg of fresh milk. Average values for the whole assay and groups.
[b] Ration composed by 40% alfalfa hay and 60% balanced pelleted on a DM basis.
[c] Estimated as: MJ/kg = 1.4694 + (0.4025 x milk fat%) (Nsahlai et al., 2004).

2.2. Sampling and analyses

Every week, the intake, body weight and milk production were individually measured during three consecutive days and then averaged as a weekly value. During the suckling period, milk production was determined through milk consumption of kids (difference between the weight of kids before and after suckling, digital hanging scale with accuracy 10 g). During the milking period the milk production was determined by weighing the milk container. Every week individual milk samples (50 ml) were taken. During suckling period a composite sample was formed from subsamples taken at the beginning, middle and before finishing suckling. While during milking period the sample was taken from the container at the end of milking. Blood samples were taken by jugular venipuncture twice a week from day 3 to day 170 postpartum. The samples were placed into tubes containing anticoagulant (EDTA) and then centrifuged at 3000 rpm for 5 min. The plasma was stored at −20 °C until analysis.

The chemical composition of goat milk was determined in the Laboratory of Food Quality, EEA INTA Salta Argentina, using a precalibrated automatic analyzer (Lactostar, Funke Gerber); and alfalfa hay and balanced pelleted diet were analyzed in the Laboratory of Nutrition and Forage Quality Assessment, EEA INTA Balcarce Argentina (Table 1). The production of 4% fat-corrected milk (FCM), was calculated according to the following formula: 4% FCM (kg d^{-1}) = 0.4 × kg milk yield + 15 × kg fat yield (Haenlein, 2007). The blood progesterone concentration was determined using solid-phase radioimmunoassay with a commercial kit (Progesterone Coat-A-Count RIA kit, Siemens, USA). To validate the use of this kit for goat plasma, some representative plasma samples were extracted twice with ether, evaporated to dryness and reconstituted in one volume of PBS (Phosphate-buffered saline), pH 7.4. Different volumes of unextracted and extracted plasma from the same samples were run in parallel to determine linearity of the assay and interference of plasma proteins in the assay. We found similar values for extracted and unextracted samples and that serial