



RESPONSE TO THE MALE EFFECT IN NUBIAN AND ALPINE GOATS MAINTAINED UNDER TROPICAL PHOTOPERIOD

[RESPUESTA AL EFECTO MACHO EN CABRAS NUBIAS Y ALPINAS MANTENIDAS BAJO FOTOPERIODO TROPICAL]

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SUMMARY

In order to determine the extent of response to the male effect in two breed of goats, previously observed to express a similar pattern of reproductive seasonality under tropical photoperiod (22°N), 17 Nubian and 15 Alpine female goats were exposed to sexual active males at May 15th. A higher proportion of Nubian vs. Alpine does ovulated in response to the male effect (76.5 vs 33.3%; $P < 0.02$). Two peaks of P_4 at 4 and 19 day after male introduction were observed, being more evident in Nubian does. Eight Nubian does showed P_4 increases $> 0.5 \text{ ng ml}^{-1}$ within the first four days after male introduction, whilst Alpine does maintained basal P_4 levels during the same period ($\leq 0.04 \text{ ng ml}^{-1}$). The higher proportion of Nubian does ovulating due to the male effect, indicate that female goats of this breed, maintained under tropical photoperiod, are more responsive than Alpine does to non-photoperiodic external stimuli, such as the presence of sexual active males.

Key words: Goats; male effect; Nubian; Alpine; tropical photoperiod.

RESUMEN

Con el objetivo de determinar el grado de respuesta al efecto macho en cabras de dos razas que previamente habían mostrado un patrón similar de estacionalidad reproductiva bajo condiciones de fotoperiodo tropical (22° N), 17 hembras caprinas Nubia y 15 Alpina se expusieron a machos sexualmente activos el 15 de mayo. Una mayor proporción de cabras Nubia vs Alpina ovularon en respuesta al efecto macho (76.5 vs. 33.3%; $P < 0.02$). Se observaron dos picos de P_4 los días 4 y 19 después de la introducción de machos, los cuales fueron más evidentes en las cabras Nubia. Ocho cabras Nubia mostraron incrementos de $P_4 > 0.5 \text{ ng ml}^{-1}$ en los primeros cuatro días después de la introducción del macho, mientras que las cabras Alpina mantuvieron niveles basales de P_4 durante el mismo periodo ($\leq 0.04 \text{ ng ml}^{-1}$). La mayor proporción de cabras Nubia ovulando debido al efecto macho indica que las hembras en esta raza, mantenidas bajo un fotoperiodo tropical, son más sensibles que las cabras Alpina a estímulos externos no foto-periódicos tales como la presencia de machos sexualmente activos.

Palabras Clave: Cabras; efecto macho; Nubian; Alpina; fotoperiodo tropical.

INTRODUCTION

Under some circumstances, it might be necessary to mate female goats during any season of the year. However, reproductive seasonality which restricts continual ovulatory activity to the autumn and winter months (Duarte et al., 2008; De Santiago et al., 2009; Rivera et al., 2011), constitutes an impediment to obtain high conception rates during the spring and

summer months (seasonal anestrous). Stimulation of ovulatory activity through the introduction of sexually active bucks has been used to counteract this impediment (Veliz et al., 2002; Luna-Orozco et al., 2012). With this method, the percentage of female goats showing estrus increases, however, responses are considerably variable (Delgadillo et al., 2002; Urrutia et al., 2003; Rivas-Muñoz et al., 2007). It has

been proposed that this variability depends on the depth of anestrus experienced by the female goats when the male effect is attempted (Chemineau, 1987), condition which is related in part to the season of the year (proximity or remoteness to the reproductive season), and also apparently to the inherent seasonal reproductive characteristics of each particular goat breed. Recently, it has been reported that basal ovulatory activity in Nubian and Alpine does is much the same at a tropical latitude (Rivera *et al.*, 2011), and limited to the months of September through February. Similar results were reported in temperate latitude conditions (Amoah *et al.*, 1996). These findings, however, are in contrast with results reported by other authors who observed kidding throughout the whole year in Nubian (Mellado *et al.*, 1991; 2006) and Alpine flocks (Silva *et al.*, 1998), in which accordingly, a year round pattern of estrus and ovulatory activity was also probably expressed. These contrasting results, suggest that even if the basal seasonal ovulatory activity could be similar among Alpine and Nubian breeds, their responsiveness to non-photoperiodic modulatory effects as the male effect might defer significantly, possibly reflecting also differences in the depth of seasonal anestrus experienced by each breed (Chemineau, 1987). Mellado *et al.* (1991, 2006) and Silva *et al.* (1998) included only one of these breeds in their studies, thus no differences in patterns of reproductive seasonality among breeds could be inferred. Under the assumption of existing differences in the depth of seasonal anestrus between Alpine and Nubian female goats, the aim of this study was to evaluate their response to the male effect during the seasonal anovulatory period (Rivera *et al.*, 2011) in the Mexican tropic (22° N).

MATERIALS AND METHODS

The study was conducted at the Goat Reproduction and Breeding Improvement Centre of San Luis Potosi State, México, located in the municipality of Soledad de Graciano Sanchez at 22° 11' N. Seventeen Nubian and fifteen Alpine female goats, 2 to 3 years old, free of clinical reproductive problems and of infectious diseases were used. Does were kept in confinement and fed with a diet based on alfalfa hay and cereal grains formulated to meet their maintenance requirements (NCR 1981). Isolation of buck contact was assured for the experimental does from August to initiation of experimental procedures on May 7th. In parallel, a group of 6 bucks (3 Nubian and 3 Alpine), were subjected to photoperiodic activation of sexual behavior (Delgadillo *et al.*, 2002). Photoperiodic activation procedure was as follows: exposure to 17 h of daylight from January 15th to March 31st (complementary artificial light was supplied by incandescent bulbs which generated 300 lux light

intensity at bucks eye height); return to natural photoperiod after March 31st (12 h light:12 h dark). Once on the reduced photoperiod, bucks were monitored 2 h a day for odor and sexual behavior. Five days after daylight length reduction, a characteristic odor of sexual active male started to be perceived, and after 2 to 7 days more, all the bucks began to show active sexual behavior. Two bucks in each breed, those with the highest grading on a sexual behavior test (10 min exposure to an estrus induced doe), were selected and used for doe bio-stimulation and mating in the next part of the experiment. On May 15th, each breed group of does was placed in contact with one of the two sexually activated bucks of its same breed, and thereafter, a 24 h rotation of the 2 bucks per breed was performed throughout a 21 day mating period. Body Condition Score (BCS) at initiation of mating was 3.18 ± 0.43 for Nubian and 3.17 ± 0.45 for Alpine female goats (scale 1 to 4; Honhold *et al.*, 1991). During the mating period, breed groups were located in completely separated barns thus sensory contact was not allowed.

On days -7, -4, 0, +4, +7, +11, +14, +19 y +26 from buck introduction, blood samples were obtained in all the female goats by jugular venipuncture using vacuumed tubes with no anticoagulants. Blood samples were maintained at room temperature for 4 h to allow clotting and then centrifuged at 3000 rpm x 15 min for serum separation. Serum was frozen and kept at -20 °C until progesterone concentrations were determined through a solid phase RIA (Coat-a-Count; DPC, Los Angeles, CA, USA). RIA sensitivity was 0.05 ng ml⁻¹ and the intra and inter-assay coefficients of variation were 8 and 12%, respectively. Serum progesterone concentrations were used to determine doe ovulatory activity before and after male bio-stimulation; it was considered that a female goat had ovulated when a serum sample showed progesterone concentration ≥ 1.0 ng mL⁻¹. Supervision of experimental female goats was maintained until kidding and the number of kids born per pregnant doe was registered.

The response variables were the proportion of does that ovulated within the 0 to 7 and 0 to 26 day period from buck introduction, the proportion which get pregnant within the mating period, the proportion that kidded, and the percentage of kids born as related to female goat exposed to the male bio-stimulation. Statistical analyses were performed using Fisher and Yeates Exact Test for small samples or Chi Square Test, as appropriate (Castilla y Cravioto, 1991).

RESULTS

The percentage of goats showing progesterone concentrations indicative of luteal activity during the 26 d period after male bio-stimulation was higher

($P < 0.02$) in the Nubian (76.47%) as compared to the Alpine breed (33.33%). Serum progesterone concentrations, before and after introduction of sexual active bucks, are shown for both breeds in Figure 1. Serum progesterone concentrations remained below 0.2 ng ml⁻¹ during the period prior to the introduction of males, indicating that irrespective of breed, all female goats were in anovulatory state during this period.

After the introduction of bucks, two peaks of serum progesterone concentration were observed; one occurred around day 4 and the other one around day 19, being more evident in the Nubian breed. Regarding the first rise in progesterone on the 4th day

after male introduction (Figure 2), 8 Nubian does showed concentrations above 0.5 ng ml⁻¹ (1.0 ± 0.47 ng ml⁻¹), while all the Alpine doe showed concentrations below 0.4 ng ml⁻¹ (0.072 ± 0.042 ng ml⁻¹) ($P < 0.05$). One Alpine doe presented a small rise in P4 on the day of male introduction (0.34 ng ml⁻¹), but in the previous and posterior serum samples P4 levels were basal. After the first P4 peak, during the 7 to 26 d post male introduction period, 76.47% of Nubian females showed concentrations above 1 ng ml⁻¹ in more than two consecutive samples, while only 33.33% of the Alpine females did.

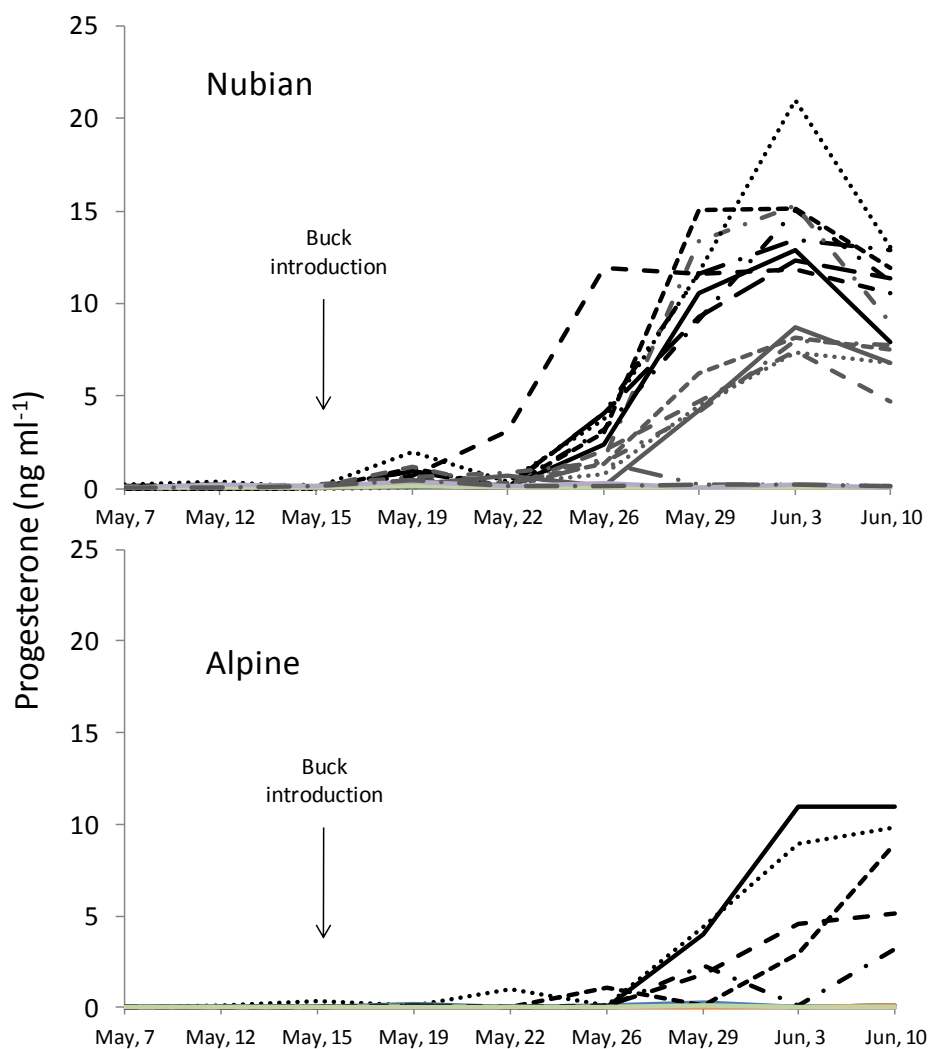


Figure 1.- Serum progesterone concentrations in Nubian and Alpine female goats exposed to sexual active bucks for 26 days, beginning on May 15th. The bucks were previously exposed to a light regime of 17 h d⁻¹ from January 5th to March 15th and then returned to natural photoperiod (12 h light:12 h dark). The percentage of goats that showed a progesterone increase, indicative of luteal activity, was higher ($P < 0.02$) in Nubian (76.5%) than in Alpine does (33.3%).

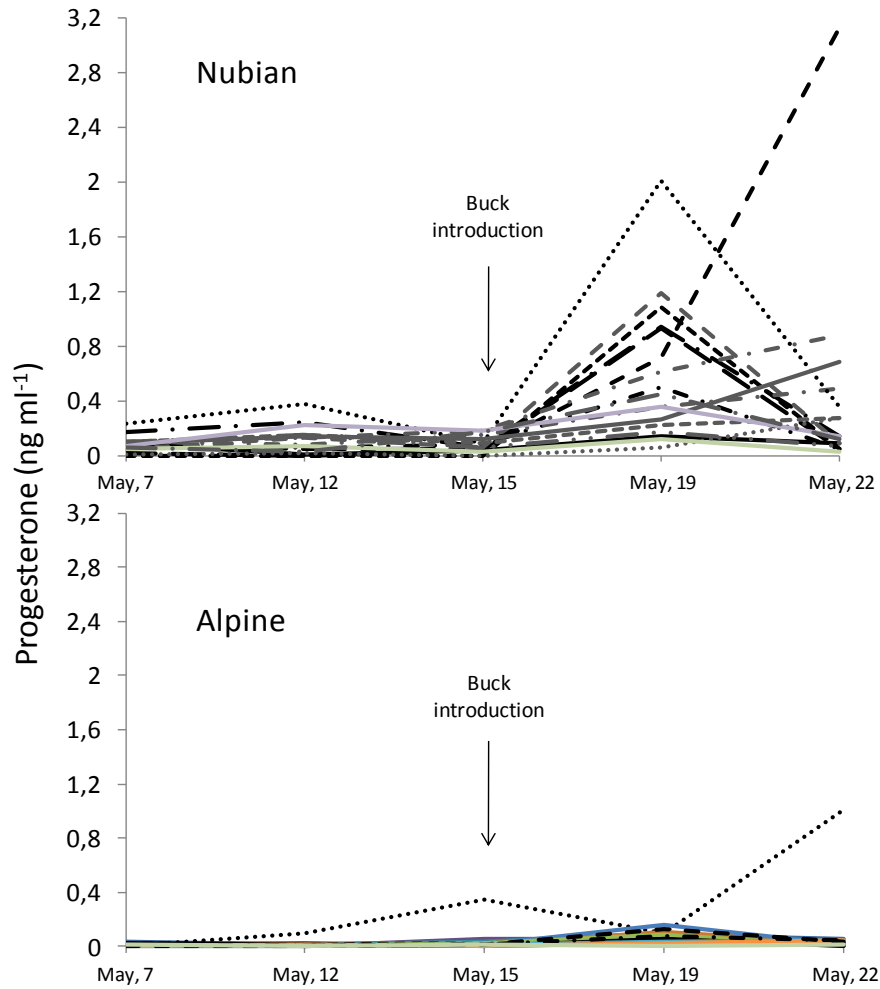


Figure 2. – Serum progesterone concentrations in Nubian and Alpine female goats during the first seven days after introduction of sexual active bucks, beginning on May 15th. The percentage of does that presented a progesterone rise above 0.4 ng ml⁻¹ during this period was higher ($P<0.01$) in Nubian (47.06%) than in Alpine does (0%).

The higher response to male bio-stimulation observed in Nubian as compared to Alpine does was reflected as a greater percentage pregnant (58.8 vs 0%, $P<0.001$) and kidding (35.3 vs 0; $P<0.02$), and in the total number of kids born (52.9 vs 0; $P<0.01$).

DISCUSSION

The present study was designed with the aim to evaluate Nubian and Alpine doe response to the male effect, during the period considered to be the seasonal anovulatory period for these breeds in the Mexican Tropic. The higher response to sexually active buck bio-stimulation observed in the Nubian as compared to the Alpine female goats, could be a reflection of differences in the depth of anestrous experienced by does in each breed (Corteel, 1977; Restall, 1992).

Under photoperiodic conditions at subtropical latitudes, and in the presence of sexually active bucks,

Nubian female goats present a wider active ovulatory period than Alpine does (Amoah et al., 1996). However, without external non-photoperiodic stimuli such as changes in feeding level, or presence of sexually active males, the patterns of seasonal reproductive activity are similar in both breeds (Rivera et al., 2011). This contrasting results, suggest that even if the basal seasonal ovulatory activity could be similar in both breeds, the responsiveness to external non-photoperiodic stimuli such as the buck presence might differ, probably due to breed differences in the depth of anestrous. Corteel (1977) introduced the concepts of “deep anestrous” and “transitional period” to name the stages of the anovulatory period in which female goats do not or do respond to the male effect, respectively. Afterwards, Restall (1992) suggested that the annual reproductive rhythm of the female goat could be divided in three phases; the active phase and the responsive phase which together make up the

breeding season, and the phase of sexual rest which corresponds to the non-breeding or anovulatory season. During the responsive phase, does can ovulate or not, depending on the intensity of non-photoperiod external stimuli received, mainly those associated with the presence of sexually active bucks. Taken together, results obtained by Rivera et al (2011) and those in the present study, confirm the existence of breed differences in seasonal reproductive patterns between Nubian and Alpine does. In the present study, a difference in the depth of anestrus between these breeds is demonstrated.

It is known that a decreasing photoperiod pattern, which begins after Summer Solstice, constitutes the primary stimulus for initiation of ovulatory activity in the female goat, whilst an increasing photoperiod pattern, starting after the Winter Solstice, constitutes the stimulus to its ending (Mori et al., 1987; Chemineau et al., 1988). This suggests that the moment in which the ovulatory activity would be more reduced and the anestrus would be deeper, should be around the longest day of the year, during the Summer Solstice. In the current study, Nubian does responded to the male stimulus before the Summer Solstice, suggesting that during the anestrus period, females of this breed are sensitive to non-photoperiodic external stimuli such as the presence of sexually active males. In contrast, Alpine does showed a reduced responsiveness to the male presence, suggesting that female goats of this breed experiment a deeper anestrus condition as compared to Nubian does.

CONCLUSIONS

The higher response to the male effect showed by Nubian as compared to Alpine does, confirms the existence of breed differences in their seasonal reproductive pattern, particularly regarding to the depth of anestrus. Results also indicate that in Nubian does, manipulation of reproduction is possible by taking advantage of the male effect. This manipulation in turn, would allow attending market demands of goat meat as “cabrito” throughout the entire year in Mexico.

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