

Reproductive behaviour of Saint Croix and Suffolk rams at medium latitudes (19° N) during long days while being exposed to Suffolk ewes in seasonal anestrus

Actividad reproductiva de carneros Santa Cruz y Suffolk en latitudes medias (19° N) durante días largos mientras son expuestas ante hembras Suffolk en anestro estacional

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RESUMEN

En las razas de origen templado, la conducta sexual disminuye durante los días largos, mientras que en los carneros tropicales se observa poco este efecto. Sin embargo, los cambios en la conducta sexual entre estas dos razas no se han comparado, y tampoco se han considerado para su análisis otros factores ambientales que pudieran estar involucrados, diferentes a la longitud del día. El propósito de este estudio preliminar fue el de evaluar la conducta sexual de carneros Santa Cruz y Suffolk a latitudes medias (19° N), durante días largos, durante su exposición a borregas Suffolk en anestro estacional, con el fin de evitar la retroalimentación sexual de las hembras. En el primer grupo (T1), tres machos Suffolk se expusieron de manera continua por 13 días a las hembras, mientras que en el segundo grupo (T2) se utilizaron tres machos Santa Cruz. Los machos Santa Cruz realizaron más ($P < 0,05$) vocalizaciones y olfateos que los Suffolks ($60,6 \pm 12,4$ vs. $26,8 \pm 5,4$ y $141,9 \pm 17,1$ vs. $62,5 \pm 11,2$, frecuencias/h, respectivamente). La actividad sexual disminuyó ($P < 0,01$) en los carneros Suffolk a medida que el experimento transcurrió ($y = -1,72x + 42,76$; $P < 0,05$), sugiriendo una habituación a largo plazo hacia las hembras. Además, la actividad sexual también disminuyó durante el mediodía en un patrón altamente relacionado ($r = -0,8$; $P < 0,05$) con la luz solar, mientras que los machos Santa Cruz mantuvieron un patrón más homogéneo de actividad sexual entre y dentro de los días. Se concluye que a latitudes medias (19° N) la menor actividad sexual de los carneros Suffolk en comparación con los Santa Cruz durante los días largos se ve exacerbada por el efecto de la radiación solar y la habituación a hembras sexualmente inactivas.

Key words: Saint Croix, Suffolk, sexual behaviour, seasonal reproduction.

Palabras clave: Santa Cruz, Suffolk, conducta sexual, reproducción estacional.

INTRODUCTION

Behaviour variation between breeds has been previously reported. Finn rams tend to be more active than Suffolk rams (Schanbacher and Lunstra 1976), while the later completed more mounts per unit of time when compared to Texel and Dorset Horn rams (Boland *et al* 1985).

Independently of these variations, male behavioural and physiological activity tends to decrease during the period of female anestrus (Dufour *et al* 1984, Hanif and Williams 1991).

According to the literature the breeds from temperate climates or high latitudes ($> 35^\circ$ N) are seasonal breeders and the annual variation in daily photoperiod is responsible for timing the annual reproductive cycle (Avdi *et al* 2004), even when living in mid latitudes (Fuentes *et al* 1997).

On the other hand, hair sheep, a breed originated in the tropics, have been reported to be almost or completely aseasional (Rosa and Bryant 2002, Aguirre *et al* 2007, Arroyo *et al* 2007), and no comparisons have been made with woolled breeds regarding their mating activity.

Both tropical and temperate breeds are found at mid-latitudes (19° N). This situation offers the possibility to compare mating activity between these two breeds. In addition, even though day length has been identified as the main responsible factor for seasonal changes, no further analysis has been made of other environmental aspects involved.

This preliminary study aimed to evaluate the sexual behaviour of Saint Croix and Suffolk rams at medium latitudes (19° N), during long days while being exposed to Suffolk ewes in seasonal anestrus, assessing its relation with sunlight and habituation to females.

MATERIAL AND METHODS

The study was carried out at the University of the State of Morelos, Mexico, located at $18^\circ 37'$ N and $99^\circ 19'$ W,

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899 m above sea level. The average annual rainfall is 800 mm and the average temperature is 23 °C.

The experiment was performed during the summer, a period of decreased sexual activity in Suffolk rams at this latitude (Arroyo *et al* 2007, De Lucas-Tron *et al* 1997).

Three sexually experienced Saint Croix (70.0 ± 3.0 kg, mean \pm standard error) and three Suffolk (110.1 ± 4.4 kg) rams aged four-years were used. The animals were housed in two separate pens according to breed, without visual, olfactory or auditory contact between them.

In addition, 21 multiparous Suffolk ewes, aged two to four years and weighing 80.8 ± 0.5 kg (mean \pm se) were assigned to one of two groups: in the first group (T1), Suffolk males were exposed continuously for 13 days to females ($n = 9$), while in the second group (T2) Saint Croix rams were used. Each group was housed in a different pen without visual, olfactory or auditory contact with groups in the other pens.

It was decided to use Suffolk females firstly because at this time of the year, ewes were in anestrus and no sexual stimulation from the females would be perceived by the males, and secondly because a significant difference in sexual activity favouring Saint Croix rams under this conditions would offer the possibility to use them to induce the “male effect” (Martin *et al* 1986) in females from a temperate origin, at this latitude.

During January, all animals were fed rations consisting of *ad libitum* oat hay and 0.5 kg / animal / day of a 14% commercial concentrate (Nu3®). Animals had unlimited access to mineral salt and water.

At the beginning of May, one male from each breed was introduced to the housing pen (10 X 5 m enclosures) of the females for 24 h starting at 08:00 h. Rams from the same breed were rotated daily to avoid the negative effect of ewe and ram preferences, and to stimulate novelty.

Behavioural events used to assess ram sexual behaviour included: a) sniffing the urine or perineal region of the ewes; b) Flehmen response; c) vocalizations associated with courtship (Vielma *et al* 2008); d) nudging, alone or in combination with foreleg kicking, rubbing of the ram’s head and shoulders along or under the ewe’s flank; and e) following the ewe (McClelland 1991, Lynch *et al* 1992).

During the 13-days period, the sexual behaviour of the rams was recorded by two observers outside the pen. From 08:00 to 08:15, continuous observation was performed to record the occurrence of the above described behaviours. From 08:30 to 17:00 h, a five min period of occurrence recording (Fraser and Broom 1998) was performed every 30 min, only registering if males were sexually active when they performed at least one of the above described behaviours. All observers were trained to follow the same procedure and to detect the different activities uniformly.

Daily solar radiation data recorded from 8:00 to 17:00 h at 30 min intervals during the experiment were obtained from the nearest space/weather/tracking station, located at 18° 58’ N and 99° 16’ W.

STATISTICAL ANALYSIS

The sexual activity displayed by the rams between breeds was compared through Chi-square test (Infante and Zárate 1990), using the total number of activities displayed by each breed during the first 15 min after male introduction, each day. In addition, correlation coefficients between the sexual activity and solar radiation were calculated by using the Spearman rank-order correlation coefficients (Siegel and Castellan 1988) with average data from the 13 days. Regression equations were obtained from the sexual behaviour observed daily and throughout the experiment, and the slopes of the regression lines were tested under the hypothesis that the slope was significantly different from zero (Dretzke 2005).

RESULTS AND DISCUSSION

During the first 15 min after introduction of the rams, frequencies/h of sniffing (141.9 ± 17.1 vs. 62.5 ± 11.2), vocalization (60.6 ± 12.4 vs. 26.8 ± 5.4) and following (115.4 ± 15.5 vs. 65.2 ± 12.3), were higher ($P < 0.01$) for Saint Croix when compared to Suffolk rams. Saint Croix rams displayed a more intense sexual activity than Suffolk rams, even though they were exposed to females from a different breed. According to Tilbrook and Cameron (1989), if rams have a choice they will prefer to mount ewes from their own breed. However, if they have no choice, they could end up mounting females from different breed, as reported in this study. In addition, no differences ($P > 0.05$) were found in nudging (31.4 ± 6.4 vs. 28.6 ± 6.3) and the Flehmen response (29.5 ± 13.7 vs. 26.2 ± 4.0), between breeds, perhaps because high rates of nudging have been associated with low sexual efficiency (Casteilla *et al* 1987), and are also expressed towards non-estrus ewes (Tomkins and Bryant 1974). In contrast, Saint Croix rams sniffed and followed more frequently than Suffolk rams, probably because of their higher sexual motivation. The number of investigations that rams display toward ewes is associated with their sexual performance scores (Price *et al* 1996).

Sexual activity among the rams each day was highest within the first 15 min after they were introduced to the pen of the females, then the sexual activity in Suffolk males decreased ($P < 0.01$) throughout the morning, and arising again to morning levels at 17:00 h. This pattern was inversely correlated ($r = -0.8$; $P < 0.05$) with solar radiation. In contrast, Saint Croix males maintained similar levels of sexual activity throughout the day (figure 1A). In addition, sexual activity in Suffolk rams declined ($y = -1.72x + 42.76$; $P < 0.05$) throughout the experiment, while no decrease ($y = -0.32x + 65.38$; $P > 0.05$) was observed in Saint Croix rams (figure 1B).

The results obtained in this study agree with those previously described, suggesting that hair breeds are not or only scarcely affected by the photoperiod (Arroyo *et al* 2007, Rosa and Bryant 2002), whereas breeds from

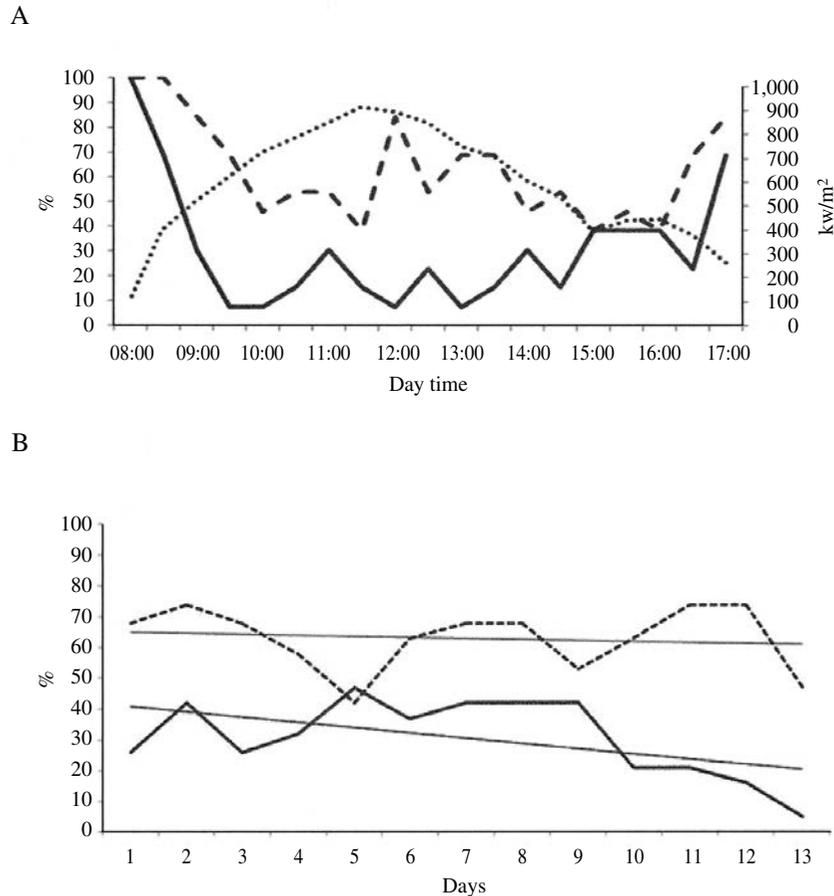


Figure 1. A: Solar radiation (.....) and percentage of sexual activity displayed by Saint Croix (-----) and Suffolk (—) rams during diurnal observation. B: Percentage of daily sexual activity of Saint Croix (-----) and Suffolk (—) rams during the 13 days period of continuous exposure to anestrous Suffolk ewes. Straight lines represent slope of the sexual activity over days.

A: Radiación solar (.....) y porcentaje de actividad sexual mostrada por carneros Santa Cruz (-----) y Suffolk (—) durante observación diurna. B: Porcentaje de actividad sexual diaria de carneros Santa Cruz (-----) y Suffolk (—) durante un período de 13 días de continua exposición a borregas Suffolk anéstricas. Las líneas rectas representan la tendencia de la actividad sexual durante los días.

tempered regions are in a restricted reproductive condition at this time of the year (Dufour *et al* 1984, Hanif and Williams 1991, Rosa and Bryant 2002). According to Fitzhugh and Bradford (1983), a tropical (Caribbean) breed such as Saint Croix is fertile throughout the year at mid latitudes (19° N), whereas Suffolk breed has a restricted reproductive season (De Lucas-Tron *et al* 1997). Unlike woolled sheep that have evolved in temperate regions, hair sheep show no evidence of a photoperiodic effect on fertility at tropical latitudes (Fitzhugh and Bradford 1983). Furthermore, Godfrey *et al* (1998) observed that under tropical conditions, Saint Croix rams display full reproductive activity during June. This breed adaptation to photoperiod and temperature explain why Suffolk males displayed a decrease in their daily sexual activity during the mid-day hours, when there is an increase in solar radiation,

unlike the more stable sexual activity of Saint Croix rams. A similar process occurred as the experiment progressed, where the frequencies of the sexual behaviours in Suffolk rams decreased. However, Simitzis *et al* (2006) suggested that rams become familiar with the group of ewes and get used to them (Fabre-Nys *et al* 1993, Thwaites 1982), a situation more likely to occur in animals that are not highly sexually motivated, particularly during long days and receiving no feedback from the ewes. This explanation is reinforced by the fact that the elements that form the repertoire of male sexual behaviour in Suffolk rams, were displayed at a greater extent during the first 15 min of female exposure, revealing that ewes were perceived as new stimuli after 24 h of female deprivation.

It is concluded that even though photoperiod is the main factor reducing sexual activity in rams during long

days, this effect is enhanced in the Suffolk breed at mid latitudes (19° N) by solar radiation and habituation to the females when compared to Saint Croix rams. Further investigations involving larger sample sizes are needed.

SUMMARY

Sexual behaviour decreases in sheep breeds of temperate origin during long day length, while tropical rams have been reported to be almost aseasonal. However, changes in sexual behaviour have not been compared between these two breeds, and besides day length no further analysis has been made for other environmental factors. The purpose of this preliminary study was to evaluate the sexual behaviour of Saint Croix and Suffolk rams at medium latitudes (19° N) during long day length, while being exposed to Suffolk ewes in seasonal anestrus, to avoid sexual feedback from the females. In the first group (T1), three Suffolk males were exposed continuously to females during 13 days, while in the second group (T2) three Saint Croix rams were used. Saint Croix rams displayed more ($P < 0.05$) vocalizations and sniffs than Suffolks (60.6 ± 12.4 vs. 26.8 ± 5.4 and 141.9 ± 17.1 vs. 62.5 ± 11.2 , frequencies/h, respectively). Sexual behaviour decreased ($P < 0.01$) in Suffolk males as the experiment progressed ($y = -1.72x + 42.76$; $P < 0.05$) suggesting habituation to the females. In addition, sexual activity also decreased during noon hours in a pattern that was highly correlated ($r = -0.8$; $P < 0.05$) with sunlight, while Saint Croix rams maintained a more constant pattern of sexual activity among and within days. It is concluded that at medium latitudes (19° N), sexual behaviour in Suffolk compared to Saint Croix rams during long days decreases as a consequence of the solar radiation and habituation to the anestrus ewes.

REFERENCES

- Aguirre V, A Orihuela, R Vázquez. 2007. Effect of semen collection frequency on seasonal variation in sexual behaviour, testosterone, testicular size and semen characteristics of tropical hair sheep (*Ovis aries*). *Trop Anim Health Prod* 39, 271-277.
- Arroyo LJ, J Gallegos-Sánchez, A Villa-Godoy, JM Berruecos, G Perera, J Valencia. 2007. Reproductive activity of Pelibuey and Suffolk ewes at 19° north latitude. *Anim Reprod Sci* 102, 24-30.
- Avdi M, G Banos, K Stefanos, P Chemineau. 2004. Seasonal variation in testicular volume and sexual behavior of Chios and Serres rams. *Theriogenology* 62, 275-282.
- Boland MP, AA Al-Kamali, TF Crosby, NB Haynes, CM Howles, DL Kelleher, I Gordon. 1985. The influence of breed, season and photoperiod on semen characteristics, testicular size, libido and plasma hormone concentrations in rams. *Anim Reprod Sci* 9, 241-252.
- Casteilla L, P Orgeur, JP Signoret. 1987. Effects of rearing conditions on sexual performance in the ram: practical use. *Appl Anim Behav Sci* 19, 111-118.
- De Lucas-Tron J, PE González, RL Martínez. 1997. Actividad reproductiva en ovejas de cinco razas en el altiplano central mexicano. *Tec Pecu Mex* 35, 25-31.
- Dretzke BJ. 2005. *Statistics with Microsoft® Excel*. 3rd ed. Pearson Prentice Hall, New Jersey, USA, Pp 227-237.
- Dufour JJ, MH Fahmy, F Minvielle. 1984. Seasonal changes in breeding activity, testicular size, testosterone concentration and seminal characteristics in rams with long or short breeding season. *J Anim Sci* 58, 416-422.
- Fabre-Nys C, P Poindron, JP Signoret. 1993. Reproductive behavior. In: King GJ (ed). *Reproduction in domesticated animals*. University of Guelph, Guelph, Canada, Pp 147-194.
- Fitzhugh HA, GE Bradford. 1983. Productivity of hair sheep and opportunities for improvement. In: Fitzhugh HA, Bradford GE (eds). *Hair sheep of Western Africa and the Americas: a genetic resource for the tropics*. Westview Press, Boulder, Colorado, USA, Pp 23-49.
- Fraser AF, DM Broom. 1998. *Farm animal behaviour and welfare*. 3rd ed. CAB International, Oxford, UK, Pp 437.
- Fuentes V, V Sánchez, H González, P Fuentes, A García, R Rosiles. 1977. La función endócrina del testículo en el carnero criollo mexicano durante las diferentes épocas del año y su control opioidérgico durante el anestro. *J Vet Med* 44, 259-263.
- Godfrey RW, JR Collins, ML Gray. 1998. Evaluation of sexual behavior of hair sheep rams in a tropical environment. *J Anim Sci* 76, 714-717.
- Hanif M, HL Williams. 1991. The effect of melatonin and light treatment on reproductive performance of yearling Suffolk rams. *Brit Vet J* 147, 49-56.
- Infante GS, LGP Zárate. 1990. *Métodos Estadísticos: Un enfoque interdisciplinario*. 2^a ed. Trillas, México.
- Lynch JJ, GN Hinch, CB Adams. 1992. *The behavior of sheep. Biological principles and implications for production*. CSIRO Publications, Melbourne, Australia.
- Martin GB, CM Oldham, Y Cognie, DT Pearce. 1986. The physiological response of anovulatory ewes to the introduction of rams - a review. *Livest Prod Sci* 15, 219-247.
- McClelland BE. 1991. Courtship and agonistic behaviour in Mouflon sheep. *Appl Anim Behav Sci* 1-4, 67-85.
- Price EO, R Borgwardt, MR Dally, PH Hemsworth. 1996. Repeated matings with individual ewes by rams differing in sexual performance. *J Anim Sci* 74, 542-544.
- Rosa HJD, MJ Bryant. 2002. Review. The 'ram effect' as a way of modifying the reproductive activity in the ewe. *Small Ruminant Res* 45, 1-16.
- Schanbacher BD, DD Lunstra. 1976. Seasonal changes in sexual activity and serum levels of LH and testosterone in Finnish Landrace and Suffolk rams. *J Anim Sci* 43, 644-650.
- Siegel S, NJ Castellan. 1988. *Nonparametric statistics for the behavioral sciences*. 2nd ed. McGraw-Hill, New York, USA.
- Simitzis PE, SG Deligeorgis, JA Bizelis. 2006. Effect of breed and age on sexual behaviour of rams. *Theriogenology* 65, 1480-1491.
- Thwaites CJ. 1982. Development of mating behaviour in the prepubertal ram. *Anim Behav* 30, 1053-1059.
- Tilbrook AJ, AWN Cameron. 1989. Ram mating preferences for woolly rather than recently shorn ewes. *Appl Anim Behav Sci* 24, 301-312.
- Tomkins T, MJ Bryant. 1974. Estrus behaviour of ewe and influence of treatment with progestagen. *J Reprod Fertil* 41, 121-132.
- Vielma J, A Terrazas FG Véliz, JA Flores, H Hernández, G Duarte, B Malpoux, JA Delgadillo. 2008. Las vocalizaciones de machos cabríos no estimulan la secreción de LH ni la ovulación en las cabras anovulatorias. *Tec Pecu Mex* 46, 25-36.