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ORIGINAL ARTICLE

Libido and serving capacity of mature hair rams under tropical environmental conditions

Libido y capacidad de servicio de carneros machos adultos de pelo bajo condiciones ambientales tropicales

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RESUMEN

Los objetivos del presente estudio fueron evaluar la libido y la capacidad de servicio de carneros de pelo adultos Pelibuey (PB), Blackbelly (BB), Dorper (DR) y Katahdin (KA) durante las tres épocas del año en el trópico. Dos veces por época 28 carneros maduros fueron individualmente expuestos durante 10 minutos a una oveja inmovilizada e inducida al estro. Se registró el número total de las actividades de la conducta sexual, el tiempo de reacción al primer servicio, y período de latencia entre servicios. El efecto de raza influyó en el tiempo de reacción al primer servicio y los tiempos de latencia ($P < 0,05$), excepto el tiempo de latencia en el segundo servicio, también la época resultó significativa ($P < 0,05$), pero no la interacción entre raza*época ($P > 0,05$). Todos los carneros realizaron al menos un servicio. La media (± EE) del tiempo de reacción y las latencias entre el segundo y tercer servicio fueron 37,62 ± 4,97; 136,43 ± 9,75 y 180,95 ± 11,87 segundos, respectivamente. Los carneros PB, BB y KA fueron más rápidos que los DR en el tiempo de reacción y latencia al segundo servicio ($P < 0,05$). Para la latencia al tercer servicio los carneros PB y KA fueron más rápidos que BB y DR ($P < 0,05$). Las actividades de la libido más frecuentes fueron el olfateo anogenital y el pateo de extremidades. Se concluye que bajo condiciones de clima tropical los carneros adultos PB, KA y BB mostraron mayor capacidad de servicio que los DR, con menor tiempo de reacción y latencia al segundo servicio. Los carneros de pelo exhibieron con mayor frecuencia actividades de olfateo anogenital y pateo de extremidades.

Palabras clave: libido, capacidad de servicio, carneros de pelo, trópico.

SUMMARY

The objectives of the present study were to evaluate the libido and serving capacity of Pelibuey (PB), Blackbelly (BB), Dorper (DR) and Katahdin (KA) hair sheep rams in three seasons under tropical environmental conditions. Twenty-eight mature rams were individually exposed for 10 minutes to an immobilized, oestrous-induced ewe twice per season. The total number of sexual behaviours, reaction time to first mating and latencies between mating were recorded. Reaction time and latencies were affected by breed effect ($P < 0.05$) and except for the latency time for the second ejaculation, the season was also significant ($P < 0.05$) while no interaction effects were observed ($P > 0.05$). All rams attained at least one ejaculation during testing. The overall mean (± S.E.M.) of reaction time and latencies to second and third mating were 37.62 ± 4.97s, 136.43 ± 9.75 and 180.95 ± 11.87 seconds, respectively. PB, BB and KA rams were faster than DR in reaction time and latency to second mating ($P < 0.05$). For latency to third mating, PB and KA rams were faster than BB and DR ($P < 0.05$). The libido activities that rams performed most frequently were anogenital sniffing and foreleg kicks. It was concluded that under tropical environmental conditions PB, KA and BB rams showed better serving capacity than DR, with shorter reaction time and latency to second mating. Hair rams exhibited more frequencies of anogenital sniffing and foreleg kicks.

Key words: libido, serving capacity, hair sheep rams, tropics.

INTRODUCTION

Breeding rams represent a significant investment for the sheep enterprise and it is expected that their working lifetime might be as productive and long as possible. In breeds originated in tropical regions, the photoperiod differences between seasons do not affect the ram reproductive performance as it does with breeds with temperate origin, affecting their sexual activity and sperm production (Aguirre *et al* 2007, Riders *et al* 2012). Under commercial conditions, rams need to be ready to perform and farmers have to be sure that their reproductive performance is continuous during the year, avoiding changes in their sexual behaviour and performance which could affect the flock performance (Alexander *et al* 2012).

Sexual performance of rams can be highly variable and it is considered as a determinant factor for stimulating ovarian response in ewes (Carrillo *et al* 2007, Hawken *et al* 2008). The use of rams with high sexual performance improves flock fertility by increasing ovulation and pregnancy rates of ewes and lambing percentage compared to rams with low sexual performance (Alexander *et al* 2012). This capacity depends upon combination of libido and serving capacity in the ram (Perkins *et al* 1992, Perkins and Fitzgerald 1994, Veliz *et al* 2004, Stellflug *et al* 2006).

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It is very important to evaluate the sexual behaviour; therefore, several procedures to measure sexual performance in rams have been developed (Álvarez-Córdoba *et al* 1999, Ibarra *et al* 1999, Snowder *et al* 2002, Stellflug and Berardinelli 2002, Kridli *et al* 2007, Stellflug *et al* 2008). However, these procedures are difficult to conduct due to required labour, time and significant number of synchronized females (Katz 2008, Alexander *et al* 2010).

Sheep production in the tropical regions of Mexico is based on hair sheep breeds, mainly Pelibuey and Blackbelly with the recent introduction of Dorper and Katahdin, although they are hair sheep breeds they do not have tropical origin. All of these breeds apparently are well adapted to the tropical environmental conditions of high ambient temperature, humidity and rainfall, where it has been demonstrated that hair rams express adequate levels of good quality semen and sexual behavior throughout the year (Godfrey *et al* 1998, Aguirre *et al* 2007, Cardenas-Gallegos *et al* 2012). Unfortunately, information about sexual performance of hair rams is scarce due to non-existent or rarely conducted sexual performance tests as a consequence of unknown or inadequate ram management by breeders. Therefore, the aim of the present study was to evaluate libido and serving capacity of mature Pelibuey, Blackbelly, Dorper and Katahdin rams during the three seasons of the year under tropical conditions.

MATERIAL AND METHODS

This study was carried out in the central region of Yucatan, Mexico (89º 37' W longitude and 20º 58' N latitude; 9 m altitude). The predominant climate is tropical warm sub-humid (AW0) with summer rains. The annual temperature ranges from 26 to 27.8 ºC; humidity ranges from 63 to 83 % and rainfall from 940 to 1132 mm (Orellana *et al* 2009).

ANIMALS AND SEASONS

Twenty eight healthy, mature and purebred Pelibuey (PB; n = 7), Blackbelly (BB; n = 6), Dorper (DR; n = 8) and Katahdin (KA; n = 7) rams were used from March 2010 to February 2011. At the beginning of the study, all animals had previous experience both with breeding ewes and for semen collection, also their breeding soundness were evaluated, with a mean (± S.E.M.) age of 3.4 ± 0.3 years old and body condition of 3.6 ± 0.4 points (scale 0-5 described by Russell (1984). All males were housed individually and fed with chopped grass (*Cynodon nlemfuensis*), concentrate with 14 % crude protein and free access to water and mineral supplement.

According to annual rainfall and temperature in the region (Flores and Espejel 1994), as well as reproductive activity of hair ewes in tropic (Porras *et al* 2003, De la Isla *et al* 2010), three seasons were considered. The hot-dry season (spring to early summer corresponding from March to June) considered as lower reproductive period, the hot-humid (late summer to early autumn from July to October) considered as transitional reproductive period and the fresh-humid (winter from November to February) considered as higher reproductive period were used.

RAM EVALUATIONS

All rams used had experience on artificial vagina ejaculation. In the middle of each season, the sexual performance test was conducted by exposing the rams individually to a restrained (held by an operator), oestrous-induced ewe for 10 minutes, in a 4 m x 4 m pen, twice at 10-day interval. As the rams used had previous experience in the management of artificial vagina, the presence of the human operator did not influence negatively on the sexual behavior of the ram and its interaction with the restrained ewe. During each test, the number of anogenital sniffing, flehmen, foreleg kicks, mounts and mating (mounts with ejaculations) was recorded. Time from the introduction of the ram and his first mating (reaction time) and latency (refractory period) between the first and second and between the second and third mating were recorded. At no time rams were allowed to copulate the exposed ewes, first due to health reasons and secondly because studies such as Aguirre *et al* (2007) and Cárdenas-Gallegos *et al* (2012), show that this method of assessment does not affect sexual behaviour of rams. It was considered as mating when rams mounted, penetrated and ejaculated into an artificial vagina. The artificial vagina was placed on the right side of the ewe at the height of the vulva and just as the ram was to penetrate, with the help of the operator's hand, the penis was diverted into the artificial vagina and the ejaculation was performed. Semen characteristics of these rams were reported by Cárdenas-Gallegos *et al* (2012).

Ewe oestrus induction/synchronization was performed by inserting an intravaginal sponge (Chronogest®; Intervet Lab) and at its removal (12 days later) 250 IU of equine chrorionic gonadotropin (Folligon®; Intervet Lab) was applied. Oestrus behaviour was detected with the aid of vasectomised teaser rams, which were introduced 12h later and only ewes that allow mounting were used; the mean of oestrous duration was 35.1 h.

STATISTICAL ANALYSES

Data were analysed as repeated measures ANOVA, using PROC MIXED (SAS Institute, Cary, NC, Version 9.1). The model included the effects of breed, season, breed x season interaction and the residual, the effect of ram within breed was considered as repeated. Least squares means and their least square differences were used for the comparison of breed and season effects on reaction time and latencies (after subtracting the restraint time) between the first and second mating and between the second and third mating. The average of libido activities was considered as the sum

of anogenital sniffing, flehmen, foreleg kicks, mounts and mating (mount with ejaculation).

RESULTS

All rams attained at least one ejaculation during testing throughout seasons. Breed and season were significant ($P < 0.05$) for the traits evaluated with exception of latency to second ejaculation. There was no interaction breed x season effect ($P > 0.05$) for any trait measured. The overall mean and standard error of reaction time and latencies between mating in the four hair sheep breeds and in the three seasons are shown in table 1. Black Belly, Pelibuey and Katahdin rams performed the first mating faster and had shorter latency to second mating than Dorper ($P < 0.05$), with a difference of 31 and 109 seconds, respectively. For third mating, PB and KA rams had shorter latency than BB and DR ($P < 0.05$), with a difference of 61 seconds.

The libido activities summed by breed and season is shown in table 2. It is noticed that anogenital sniffing and foreleg kicks had more frequency in the four hair breeds during testing, except foreleg kicks during first mating. Also, as shown in table 2, the Dorper breed had lower Flehmen, foreleg kicks and mating ($P < 0.05$) and higher mount activities than PB, DD and KA breeds and this behavior was similar during all seasons.

DISCUSSION

In this study, even though all rams in all seasons had at least one service during the 10 minutes assessment, PB, BB and KA rams performed three mating more frequently during the 10 minutes assessment than DR, which might suggest a better sexual performance of these breeds. Schoeman *et al* (1987) demonstrated that DR rams range from 1.6 to 2.9 mates during 1 h tests. This could explain the low percentage of rams that completed three mating during 10 minute tests and the differences found in this study.

Although differences were found in reaction time in the four breeds, the overall mean of 37.62 ± 4.89 seconds is within the reported range of 20 to 59 seconds in several sheep breeds (Zenchak *et al* 1988, Kheradmand and Babaei 2006, Aguirre *et al* 2007) and is shorter than the average mentioned for mature hair rams (Chi *et al* 2009), young hair rams (Godfrey *et al* 1998, Lezama *et al* 2003), yearling Targhee rams (Price *et al* 1991) and for local wool breeds (Pimentel *et al* 2005). In relation to second and third mating, the overall mean of 136.43 ± 9.13 and 180.95 ± 11.46 seconds, respectively, is similar with the results of Chi *et al* (2009), but is lower than results reported in yearling Katahdin rams (Lezama *et al* 2003) and for local wool breeds (Pimentel *et al* 2005). These variable results in reaction time and latencies might be due, in part, to differences between individuals and to serving capacity of younger rams used in the cited studies. The difference in serving capacity of mature rams could be a consequence a greater degree of sexual experience (Price *et al* 1991).

On the other hand, PB, BB and KA rams had shorter latency to second mating compared to DR rams, with a difference of 90 seconds ($P < 0.05$). To third mating, PB and KA rams had shorter latency compared to BB and DR rams ($P < 0.05$) with a difference of 84 seconds. These results suggest that PB and KA rams, after completing two ejaculations in a shorter period of time, are more active

Table 1. Mean values (± SEM) of reaction time and latencies between mating in rams of four hair sheep breeds and in the three seasons studied.

Medias (± EE) para el tiempo de reacción y latencias entre servicios en los carneros de cuatro razas y tres épocas estudiadas.

	Reaction time (s)* Tiempo de reacción (s)		Latency to second mating (s) Latencia al segundo servicio (s)		Latency to third mating (s) Latencia al tercer servicio (s)	
Breed						
PB	(42)	33.28 ± 9.68[a]	(41)	109.10 ± 17.35[a]	(31)	133.47 ± 20.16[a]
BB	(34)	23.03 ± 10.77[a]	(32)	105.30 ± 19.66[a]	(26)	217.36 ± 22.01[b]
DR	(48)	59.95 ± 9.06[b]	(38)	218.59 ± 18.28[b]	(13)	218.14 ± 31.29[b]
KA	(42)	28.80 ± 9.68[a]	(39)	112.95 ± 17.79[a]	(27)	179.96 ± 21.59[ab]
Season						
Hot-dry	(54)	48.30 ± 8.58[a]	(46)	136.96 ± 16.44[a]	(31)	158.81 ± 20.57[b]
Hot-humid	(56)	32.43 ± 8.40[ab]	(52)	131.69 ± 15.43[a]	(32)	195.46 ± 20.54[ab]
Fresh-humid	(52)	28.07 ± 8.74[b]	(52)	140.81 ± 15.56[a]	(34)	207.42 ± 19.40[a]

(s)* seconds
Values included into the parenthesis correspond to the number of mating performed.
Values with different superscripts (a,b) in the same column, indicate a statistical difference between breeds or season ($P < 0.05$).
Valores con diferente literal (a,b) en la misma columna indican diferencia estadística entre razas o épocas ($P < 0,05$).

Table 2. Average (± SEM) of sexual behaviours of hair sheep breeds during 10 minute tests during the seasons of study.
Promedios (± SEM) de la conducta sexual en ovinos de pelo durante los 10 minutos de la prueba en las tres épocas de estudio.

Trait	Season			Average
	Hot-dry	Hot-humid	Fresh-humid	
Anogenital sniffing				
PB	6.78 ± 4.38	4.57 ± 3.56	4.35 ± 2.40	5.23 ± 3.63ab
BB	6.66 ± 2.14	5.83 ± 3.04	5.50 ± 3.34	6.0 ± 2.84a
DR	4.62 ± 2.84	3.56 ± 2.82	4.06 ± 3.15	4.08 ± 2.91b
KA	5.35 ± 3.95	4.78 ± 2.57	7.71 ± 3.56	5.95 ± 3.56a
Flehmen				
PB	1.35 ± 1.49	0.07 ± 0.26	0.71 ± 1.38	0.71 ± 1.27a
BB	0.50 ± 0.79	0.91 ± 1.16	0.83 ± 0.71	0.75 ± 0.90a
DR	0.18 ± 0.54	0.06 ± 0.25	0.56 ± 1.15	0.27 ± 0.76b
KA	0.28 ± 0.61	0.0 ± 0.0	1.0 ± 1.70	0.71 ± 1.27a
Foreleg kicks				
PB	2.0 ± 1.61	4.07 ± 5.21	5.57 ± 7.55	3.88 ± 5.45a
BB	1.58 ± 2.23	3.58 ± 5.83	3.58 ± 4.60	2.91 ± 4.45ab
DR	1.43 ± 2.87	1.50 ± 2.75	1.0 ± 1.21	1.31 ± 2.36b
KA	3.50 ± 2.34	3.35 ± 2.53	6.0 ± 4.05	4.28 ± 3.24a
Mounts				
PB	2.50 ± 2.76	3.85 ± 4.75	1.64 ± 3.22	2.66 ± 3.70a
BB	1.08 ± 2.21	1.08 ± 1.44	0.66 ± 1.43	0.91 ± 1.69b
DR	3.25 ± 7.13	3.87 ± 4.44	2.75 ± 3.67	5.20 ± 2.06a
KA	0.78 ± 1.36	0.50 ± 0.85	0.85 ± 1.56	1.27 ± 2.57b
Mating				
PB	2.71 ± 0.46	2.78 ± 0.42	2.64 ± 0.63	2.71 ± 0.50a
BB	2.25 ± 1.21	2.66 ± 0.65	2.75 ± 0.45	2.55 ± 0.84a
DR	1.93 ± 0.77	2.06 ± 0.57	2.18 ± 0.75	2.06 ± 0.69b
KA	2.50 ± 0.75	2.57 ± 0.64	2.64 ± 0.49	2.57 ± 0.63a

PB = Pelibuey; BB = Black Belly; DR = Dorper; KA = Katahdin

Values with different superscripts (a,b) in the same column, indicate a statistical difference ($P < 0.05$).

Valores con diferente literal (a,b) en la misma columna indican diferencia estadística ($P < 0,5$).

and able to perform more matings. Consequently, more oestrous ewes could be mated in shorter time, improving the flock fertility when breeding intensity would be required. This was demonstrated with the use of higher performing rams that increased the pregnancy rate, supporting studies by Barwick *et al* (1989), Perkins and Fitzgerald (1994) and Snowder *et al* (2002). However, further experiments should be conducted to clarify this breed effect on serving capacity of hair rams.

In relation to the sexual activities, in this study, more frequency of anogenital sniffing and foreleg kicks was observed and was similar among the seasons studied. These behaviours are considered as libido activities that males use in order to determine the sexual receptivity of females (Price *et al* 1992, Ungerfeld and Gonzalez 2008). These sexual behaviours are indicative of hair sheep (Godfrey *et al* 1998) and other breeds (Kridli *et al* 2007). All hair rams exhibited a full repertory of sexual behaviour throughout the three seasons. However, Dorper rams showed lower number of sexual activities, except the number of mounts compared to the other breeds evaluated. There are several factors that could affect the libido and serving capacity of males. These factors result in a great variation of sexual performance of rams: season of year, breed differences, individual rams, previous breeding experience, method of restraint of ewes and age (Katz *et al* 1988, Zenchak *et al* 1988, Mandiki *et al* 1998, Advi *et al* 2004, Dickson and Sanford 2005, Aguirre *et al* 2007, Marai *et al* 2008).

In conclusion, under tropical environmental conditions PB, BB and KA rams had a better serving capacity than DR, demonstrating a higher sexual performance of these breeds. The rams, evaluated in this study, exhibited a full repertory of libido behaviour throughout the seasons and

anogenital sniffing and foreleg kicks were more frequent. This, along with a good reproductive capacity, would mean a greater number of ewes served and impregnated in shorter time. However, it is necessary to conduct more studies in order to evaluate the reproductive performance of hair rams in presence of groups of oestrous ewes under tropical conditions.

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