

Reproductive evaluation of bucks (*Capra hircus* L.) with usual management in herds from Benito Juarez, Guerrero, Mexico

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ABSTRACT

Objective: To evaluate the reproductive characteristics of male goats (*Capra hircus* L.) with habitual management on their herds at Benito Juarez municipality, Guerrero, Mexico.

Design/methodology/approach: Ten male Creole goats from seven herds were evaluated, aged between 2 to 7 years and 2 to 3 body condition (BC). The males were evaluated regarding their sexual behavior, sperm quality, physical examination and reproductive clinical evaluation.

Results: All the assessed male Creole goats displayed sexual behavior ($P < 0.05$). However, for the males of three of the evaluated herds the sexual behavior was lower ($P < 0.05$). Of the ten electro-ejaculated males, 20% ejaculated and 80% did not ($P < 0.05$). From the males that ejaculated, a sperm concentration of 224×10^6 and 16×10^6 sperm mL^{-1} was recorded for the first and second male. Finally, the physical and clinical reproductive evaluation concurred with the established parameters for the species.

Limitations of the study/implications: Under the conditions in which the study was carried out, it was not possible to evaluate males in the same age conditions and reproductive characteristics. However, this allowed collecting information from field conditions so that producers can apply it for herd improvement.

Findings/conclusions: The male Creole goats of the evaluated herds showed intense sexual behavior with low sperm characteristics.

Keywords: sexual behavior, sperm quality, clinical examination, herd management.

INTRODUCTION

Currently, in Mexico, there are around 9 million heads of goat cattle (*Capra hircus* L.), which produces 44 thousand tons of goat meat in carcasses (SIAP, 2018). In this context, the state of Guerrero, Mexico, is the fifth producer of goat cattle for meat with 655,055 heads (SIAP, 2018; Mellado *et al.*, 2012). Goats in their different gestation stages may suffer alterations in the uterine environment that could be due to

undernourishment (Laporte-Broux *et al.*, 2011). Consequently, malnourished females modify their metabolism to survive and distribute nutrients to the placenta, causing the uterine environment in which the embryo and fetus develop to be nutrient deficient (Laporte-Broux *et al.*, 2011). Animals that developing in restricted growth conditions during gestation are at increased risk of health complications, metabolic and reproductive problems (Caton *et al.*, 2019). This phenomenon is known as maternal malnutrition or "fetal programming" (Barker and Osmond, 1986). In sheep and goats, it is known that gene expression related to the growth of the offspring occurs during gestation thanks to the "fetal programming" (Macías-Cruz *et al.*, 2017). Showing damage to the metabolism and the offspring reproduction, in females (primordial follicles/oocytes) and males (Sertoli cells, sperm and testicular size in adulthood) affecting cell proliferation, the reproductive axis and hormonal control (Pedrana *et al.*, 2020).

Consequently, the sexual behavior displayed by males during their adult life directly influences the reproduction of goat herds (Fernández *et al.*, 2011). Indeed, the sexual behavior displayed by males during adult life is important for the reproductive future of the herd (Lacuesta *et al.*, 2018), even more so, if their production system is extensive, where both nutritional and seasonal factors influence (Espinoza-Flores *et al.*, 2020). In the Costa Grande region of Guerrero, there are problems regarding the reproductive, genetic and sanitary management in goat herds. The advice of veterinarians is necessary before bucks' acquisition, to ensure the adequate genetics of the offspring and in this way select bucks which exhibit minimum physical (phenotypic characteristics, jaws, poise and vision) and reproductive (reproductive system, testicles, libido and sperm quality) characteristics.

Also, the knowledge of the place of origin of the bucks, allows one to know the nutritional effects it might have and that may affect their sexual performance. Due to the aforementioned the reproductive characteristics of male Creole goats with habitual management in herds at the municipality of Benito Juarez, in the Costa Grande region of Guerrero, Mexico, were evaluated.

MATERIALS AND METHODS

All procedures, methods, and animal handling in this research were done following the accepted guidelines for ethical use, care and welfare of research animals at the national (NAM, 2002) and international (FASS, 2010) levels. The study took place during October 2019 at San Jeronimo de Juarez community, Benito Juarez, Guerrero, Mexico (17° 08' 09" N and 100° 28' 08" W). The mean temperature is 26 °C (range 20-32 °C) and 89.93% ambient humidity, registering their highest during the summer months, and lowest during winter months (24 to 30 °C). Precipitation occurs from June to September (1,236 mm) (Uribe and Vázquez-Zavaleta *et al.*, 2017).

Description of a characteristic herd

In this region, particularly in the Benito Juarez municipality, subsistence goat farming is practiced. Local goat herds have between 25 to 100 animals: including multiparous females (pregnant and empty), bucks, replacement primal females, pubescent males for sale, and kids of both sexes at different

ages. The animal breed is Creole for meat, their main market is local consumers. These herds graze and remain in the field from 12:00 to 19:30 h, during the evening they are kept in open pens until taken to graze again, this practice is carried out throughout the year including the dry season. Goats receive no food supplementation, although some producers provide corn stubble to females that with low weight and low body condition, but never done in pregnant females that are key for good offspring. The pens are built with wood and cyclonic mesh, they have feeders and drinkers out of plastic tubs. Regarding preventive and curative medicine, they are generally dewormed every six months with ivermectin (gastroenteric parasitosis: 1 mL per 24 kg, Ivermectin, Sanfer Laboratory, Mexico City). Additionally, when animals become ill, they receive treatment with broad-spectrum and anti-inflammatory antibiotics. The goat farmers usually have no medical advice. The most common diseases are diarrhea, respiratory problems, pododermatitis, among others.

Animals and measurements

Ten male Creole goats were assessed in this study, with an age between 2 to 7 years and body condition of 2 to 3 (scale 1 to 4, with increments between units of 0.5; Walkden-Brown *et al.*, 1997). Seven herds of goat cattle were evaluated (R-1, R-2, R-3, R-4, R-5, R-6 and R-7), herds 2, 6 and 7 had two bucks, the rest only one. In male goats, the genital organs (testes, foreskin and penis) were anatomically evaluated. Also, the general appearance of the scrotum for lacerations, wounds, or discoloration was evaluated. Likewise, testicular symmetry was

determined according to the parameters indicated for bovines (Boligon *et al.*, 2010); scrotal circumference was measured from the widest part of the testicles, using a graduated tape measure in centimeters. Subsequently, the sexual behavior was evaluated in a pen constructed of cyclonic mesh at more than 300 m from the herd corral. For this, an estrogenized goat was used, the female was introduced to the pen where the male was, the development of sexual behavior was assessed; Nudging, ano-genital sniffing, flehmen, vocalizations, mounting attempts and mounts with intromission (Ponce *et al.*, 2014).

The evaluations of sexual behavior were made between 8:00 and 9:00 h by two persons previously trained in the evaluation criteria. The goats used to stimulate the male goats were synchronized with CIDR for seven days, 24 h before removing the device, 200 IU of eCG were injected intramuscularly (García y González *et al.*, 2018). Sperm quality was also evaluated: sperm concentration, latency to ejaculate and semen pH; technique described by Jeyendran *et al.* (1984). Additionally, other physiological constants (rectal temperature, heart rate, respiratory rate, capillary return time, ruminal movements and mucous coloration) were measured in the males. Likewise, weight and body condition, state of the locomotor system (displacement-lameness or pain), vision (eyeball injury) and teeth (prognathism and agnathism) were evaluated. Finally, the FAMACHA[®] method was used to compare the mucous membrane color and obtain an estimate of the parasite load.

Electroejaculation and sperm count

In the evaluated male goats, the semen was collected via electroejaculation following Abril-Sánchez *et al.* (2017). Semen sampling was considered not possible when the male did not ejaculate after ten 3 V pulses followed by ten 4 V pulses, each pulse of a three-second period and rest periods of the same duration. The above, so that the buck was not stressed, since it was the first time, they received this type of management. To calculate the sperm count, a Neubauer chamber was used after the sperm mass was added to 1.0 mL of diluent. The percentage of motile spermatozoa and the quality of the motility were qualitatively evaluated using a 400-x phase-contrast microscope. Additionally, the sperm pH was measured with test strips (range: 6.5 to 10.0) after depositing a drop on the strip, after a ten-second period their color was compared with the scale.

Feeding and accommodation

The plants that the animals consume in the field are plum (*Spondias purpurea*), hawthorn (*Crataegus*), vines (*Cissus verticillata*) and seasonal fruits such as coconut (*Cocos nucifera*) and mango (*Mangifera indica*).

Statistical analysis and definitions

The data of the sexual behavior of the males: Nudging, flehmen, vocalizations, mounting attempts and mounts with intromission were analyzed with the Friedman test for non-parametric statistics. Subsequently, a Wilcoxon test was used to compare two by two. Likewise, descriptive statistics (percentages, means and \pm standard error from the mean) were used to analyze the data on the sperm quality, physical and clinical reproductive diagnosis of the bucks. All data were analyzed with the SAS (2004) statistical software. The abbreviations of concepts and variables used in the study are also described: international units (IU), hydrogen potential (pH), standard error from the mean (sem), centimeters (cm), body condition (BC), testicular circumference (TC), right testicular depth (RTD), left testicular depth (LTD), foreskin length (FL), respiratory rate (RR), heart rate (HR), rectal temperature (RT), capillary return (CR), breaths per minute (BPM) and beats per minute (bpm).

RESULTS AND DISCUSSION

All the evaluated male goats presented sexual behavior: Nudging, flehmen, vocalizations, ano-genital sniffing, mounting attempts and mounts with intromission ($P < 0.05$). However, 40% of the evaluated male goats (4 males from 3 herds: R-1, R-3 and R-4) presented low sexual behavior ($P < 0.05$; Figure 1).

There are available studies in the literature regard male goats from tropical regions. These mentions that they present sexual activity throughout the year (De-Combellas, 1993; Ahmed *et al.*, 1997). Other studies affirm that male goats from tropical regions such as those evaluated here have a period in which their sexual behavior decreases, this phenomenon observed when the environmental temperatures increase, there is the presence of rains and a decrease in forage availability (Chemineau *et al.*, 1986; Ponce *et al.*, 2019). Similar events to that observed in males originated or adapted to temperate and subtropical regions, where these animals have a sexual rest period due to the photoperiod (Zamiri and Haidari, 2006).

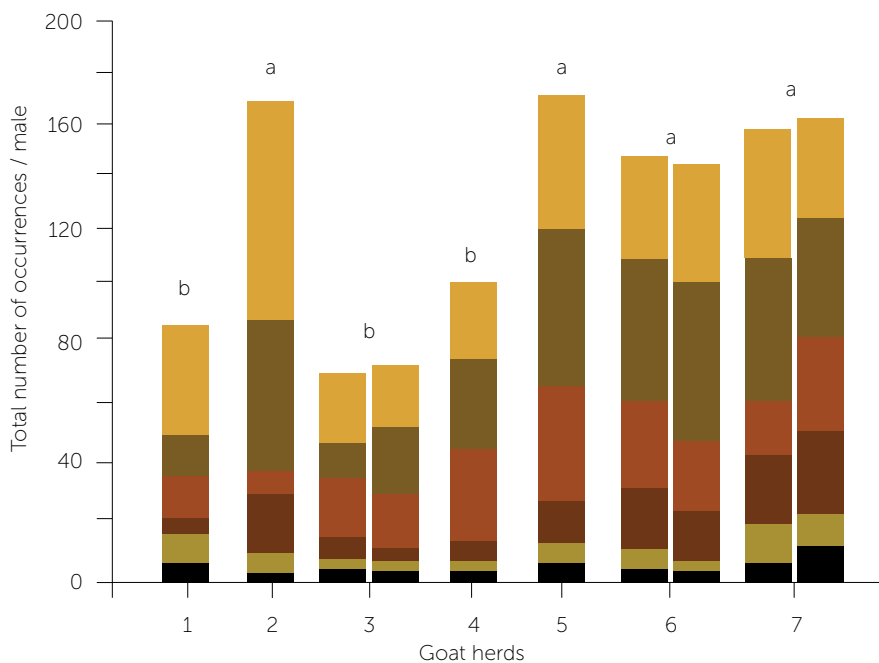


Figure 1. Sexual behavior of male goats: Nudging (■), ano-genital sniffing (■), flehmen (■), vocalizations (■), mounting attempts (■) and mounts with intromission (■) (different colour within bar implies each behaviour). The "Y" axis represents the scale of the total number of occurrences per male and the "X" axis the number of herds where the males came from.

In the present study, all males exhibited sexual behavior; however, males from three herds showed low sexual behavior. This was due to the fact that the males presented claudication problems due to interdigital pododermatitis and the pain possibly prevented them to display sexual behavior like the rest of the males.

From the total number of electro-ejaculated male goats, 20% ejaculated, and 80% did not. Of the males that ejaculated (volume of 1 mL per male), a sperm concentration of $224 \times 10^6 \text{ mL}^{-1}$ was found in the first male and 16×10^6 in the second, the latency to ejaculate was 5 min. Sperm motility was 80% in the first male and 40% in the second. Finally, the semen pH was seven in one male and eight in the other. The ejaculation of the evaluated males was carried out in October when at the end of the rainy season and the beginning of the forage availability; however, the sperm quality of the males was lower (224×10^6 sperm mL^{-1} and 16×10^6 sperm mL^{-1}) than that established for this species ($2,500$ to $3,000 \times 10^6$ sperm mL^{-1}) (Hernández-Corredor *et al.*, 2018). This can be explained in the following way (first) the males were recovering from the dry season where there was little available food, followed by the moment when the males were ejaculated, who had finished the riding period, and finally, for a male to ejaculate, previous

training is needed to reduce their stress level.

It is to be noted that the present study took place under normal management conditions in local goat herds, so it is not possible to control when they mate, and if there are some diseases such as interdigital pododermatitis, which are common during the rainy season, they affect their health and impact their reproductive performance; However, some recommendations may be offered to goat farmers to improve the habitual management of their herds, to improve the reproductive and productive performance of females and male goats. The reproductive evaluation of the ten male goats: TC (26.5 ± 8.7 cm), LTD (19.7 ± 0.9 cm), RTD (20 ± 0.7 cm) and FL (16.6 ± 0.7 cm) were similar between the evaluated males according to the species parameters (Table 1).

In this regard, a RR (22.2 ± 3.7 rpm), HR (60.7 ± 9.3 bpm) and RT (38.3 ± 0.4 °C) were within normal physiological parameters. The mucous membranes: bulbar and palpebral, buccal, nasal; were found to be normal among the evaluated males and there were no alterations in capillary return (Table 2).

According to the literature for small ruminants and cattle, the physical examination and reproductive evaluation include the external genitalia: testicles, foreskin, glans; in the present study, normal values were found to what was established for the species (Espitia-Pacheco *et al.*, 2018). However, some bodily characteristics such as the general condition of the animals: dull and bristly hair, watery eyes, presence of mucus in the nasal cavity, dirt in

Table 1. Body condition and reproductive variables of male goats under grazing conditions (mean \pm standard error from the mean).

Males	BC	TC	RTD	LTD	FL
10	3.3 ± 0.8	26.5 ± 8.7	20 ± 0.7	19.7 ± 0.9	16.6 ± 0.7

Body condition (BC): scale 1 to 4. Testicular circumference: TC (centimeters). Right testicular depth: RTD (centimeters). Left testicular depth: LTD (centimeters). Foreskin length: FL (centimeters).

the hairs of the foreskin can alter the physical and reproductive health of the animals (De Celis et al., 1996). Therefore, even when the physiological constants and reproductive variables evaluated were normal, this situation could have adverse effects and consequently on the reproductive performance of the bucks and affect their herds. This situation provides the guideline for technical advice to the goat farmers. Also, it was recorded that some pregnant females had low weight and body condition, also, some offspring, especially primal females, presented general deterioration, watery eyes and shaggy hair. This is most likely because pregnant females are not supplemented to obtain the nutritional requirements according to their gestation stage, leading to health and reproductive problems in the offspring.

CONCLUSIONS

The male Creole goats from herds at Benito Juarez municipality extensively grazed showed intense sexual behavior, although this was lower in the males of three of the assessed herds. Of all the males, only two were able to ejaculate and their sperm concentration was low. All males had normal physiological constants and in the reproductive clinical evaluation were found within the established normal parameters for this species.

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Table 2. The FAMACHA® technique and the physiological variables in male goats (mean \pm s.d.m).

Males	Value	FAMACHA®	RT	HR	TR	CR
10	Normal ¹	1 a 5	12 a 20	70 a 80	38.6	2 a 3
	Registered	4.0 \pm 0.18	22.2 \pm 3.7	60.7 \pm 9.3	38.3 \pm 0.4	2.3 \pm 0.48

Respiratory rate: RT/min. Heart rate: HR/min. Rectal temperature: RT/min. Capillary return: CR/sec. FAMACHA®: 1 to 5 points. ¹DERBYSHIRE JB. 1967. The goat "*Capra hircus* L." In: The UFAU Handbook on the care and management of laboratory animals. 3rd Ed. E.S. Livingstone Ltd. Edinburg and London.

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