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Full Length Research Paper

Seasonal variations of sexual activity of local bucks in western Algeria

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The aim of the present study was to evaluate the seasonal variation of sexual activity among bucks of local breed (Arbia) in western Algeria. The experiment was carried out using eight bucks aged between 4 and 6 years, a group of males in their pre-puberty age (4 to 6 months) and two females. Animals were kept in a building during one year and fed with a constant ration of wheat and hay with free access to water. Sexual activity was evaluated by scrotal circumference and sexual behaviour analysis. Results showed that the monthly average of scrotal circumference was high during August and September (27.58 ± 0.16 and 27.67 ± 0.17 cm, respectively) and low during April and May (25.18 ± 0.11 and 25.25 ± 0.17 cm, respectively). Monthly averages of sexual behaviour followed similar evolution. When the season of the year is considered, sexual behaviour and scrotal circumference presented significant variations. The two parameters are maximal during autumn (7.96 ± 1.28 and 26.89 ± 0.55 cm, respectively) and go down during winter (6.09 ± 1.25 and 25.65 ± 0.27 cm, respectively) to reach minimal values during spring (4.89 ± 1.66 and 25.41 ± 0.37 cm, respectively) then they go up during summer. In conclusion, bucks of local breed in western Algeria have seasonal variations of sexual activity in relation to annual photoperiod variation; short days stimulate the sexual activity whereas long days inhibit it.

Key words: Buck, sexual activity, Arbia breed, photoperiod, seasonality.

INTRODUCTION

Seasonal variations of fertility in goats are due to the change of day duration throughout the year. This determines the annual rhythm of hormonal secretion by the hypothalamo – hypophyso – gonadic axe, particularly the frequency of LH pulses. Many goat and sheep breeds living in subtropical zones express seasonal variations of their sexual activity. These variations are similar to those observed in temperate zones, except in terms of duration of sexual activity expression which could be due to the amplitude of photoperiod variation between these different zones (Delgadillo et al. 1999). In males, decreasing duration of days starting from summer involves the augmentation of the testicular size and consequently the scrotal circumference (Pelletier et al., 1988), the level of secretion of LH, FSH and testosterone (Lincoln and Peet, 1977; D'ochio, 1984) and sperm production qualitatively and quantitatively (Colas and Guérin, 1981). Increasing duration of days from winter to spring involves the inverse effects.

Reproduction season of Algerian local goat concerning as well as the female and the male, had never been reported before. The present work is the first to describe this season based on the variations of scrotal circumference and male sexual activity. The study was carried out during thirteen months, representing the different seasons of the year. It is well documented that as well as scrotal circumference and sexual activity are highly correlated to the reproduction hormones and subsequently to semen parameters in term of gametes concentration, motility and fertility (Walkden-Brown et al., 1994; Delgadillo

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Abbreviations: LH, FSH etc

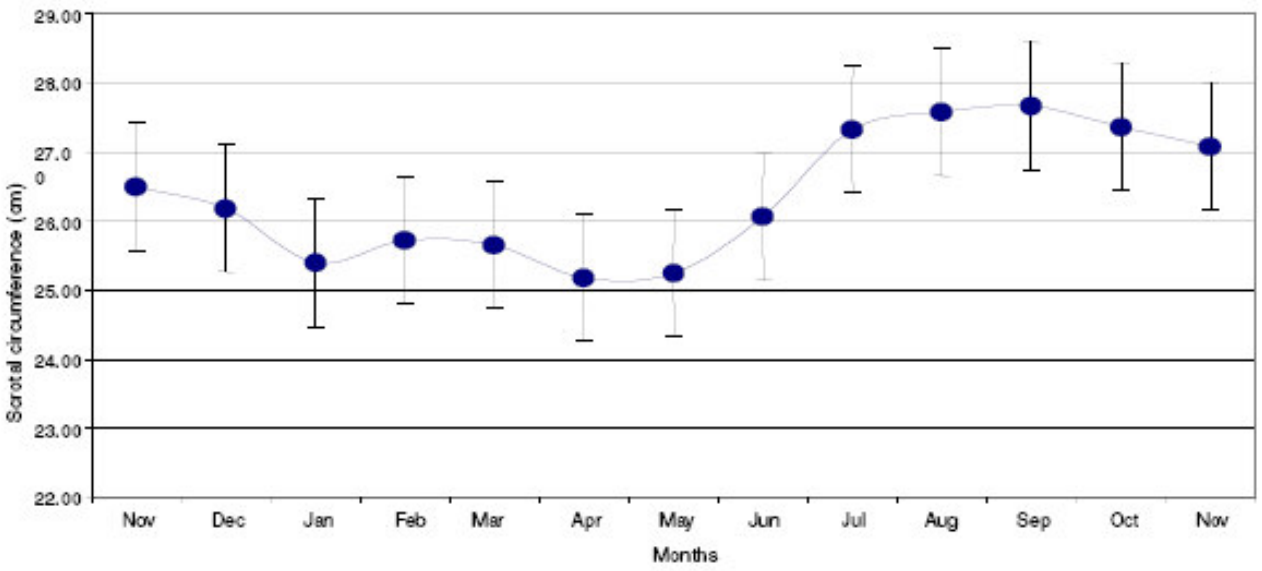

Figure 1. Monthly variation of scrotal circumference in bucks.

et al., 2002). Thus, the variations in these two parameters can be considered as real indicators of the reproduction activity.

The purpose of the present study was precisely to evaluate the seasonal variations of the scrotal circumference and sexual activity of the Algerian arbia goat breed in relation to photoperiod during the four seasons of the year.

MATERIALS AND METHODS

The present study was carried out in the district of Tiaret in western Algeria during a one year period (from November 2003 to November 2004). The region is situated in the high plateau of Algeria, a semi-arid area characterized by cold and humid winter and hot and dry summer. Temperatures vary between 2.1 and 16.4°C in winter and between 21.9 and 35.5°C in summer. The daily photoperiod varies between 9.34 (in the solstice of winter) and 14.23 h (in the solstice of summer) (Meteorological Station, 2004).

Milieu and animals

The experimental batch contained 8 bucks aged between 4 and 6 years and two goats of local breed. After identification, animals were kept in the experimentation building during 6 months prior to the experiment for adaptation. They received constantly grinded barley at the rate of 500 g per day per animal with free access to hay and water. Vitamins were added as supplement powder to ration whereas minerals were given as sucking stones.

Assessment of scrotal circumference

This was carried out weekly during the thirteen months of the experimental period. The scrotal circumference was measured with a flexible metric tape. Testes were maintained in the bottom of the scrotal bourses with the aid of an assistant and the metric tape was applied gently on the largest portion of the scrotal perimeter and the values were expressed in cm.

Assessment of sexual behaviour

On weekly basis males were tested during 10 min in the presence of oestrogenized females and the frequency of appearance of the different expressed behaviours was registered: smelling, approach, overlapping and ejaculations as well as their latency (Chenweth, 1981; Ahmad and Noakes, 1995). Scores were given on a scale varying form 0 to 10. A male which did not express any interest for females received a score of 0. That which overlapped two times without mating received 5 and that which mated two times and was all time expressing interest for females received 10. Simultaneously, the behaviour of the other male spectators was observed.

RESULTS

Monthly evolution of scrotal circumference

Our results showed that the scrotal circumference (Figure 1) starts to increase sensitively from June to reach a maximal value during the month of September (27.67 ± 0.17 cm), then it starts a decrease from this month to reach minimal values on April and May (25.24 ± 0.19 cm and 25.25 ± 0.17 cm respectively).

Monthly sexual behaviour evolution

Sexual behaviour also varied significantly in the studied bucks during the year (Figure 2). The registered score during May was 4.84 ± 1.28 and reached 7.03 ± 0.78 in June. It then stabilized at the score of 7.71 ± 0.08 till September and reached its peak during October and

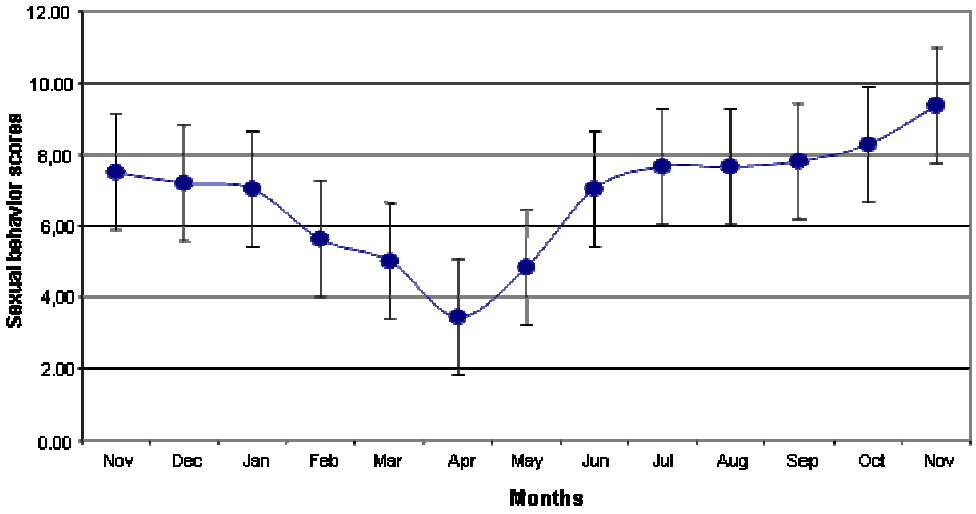

Figure 2. Monthly variations of sexual behavior.

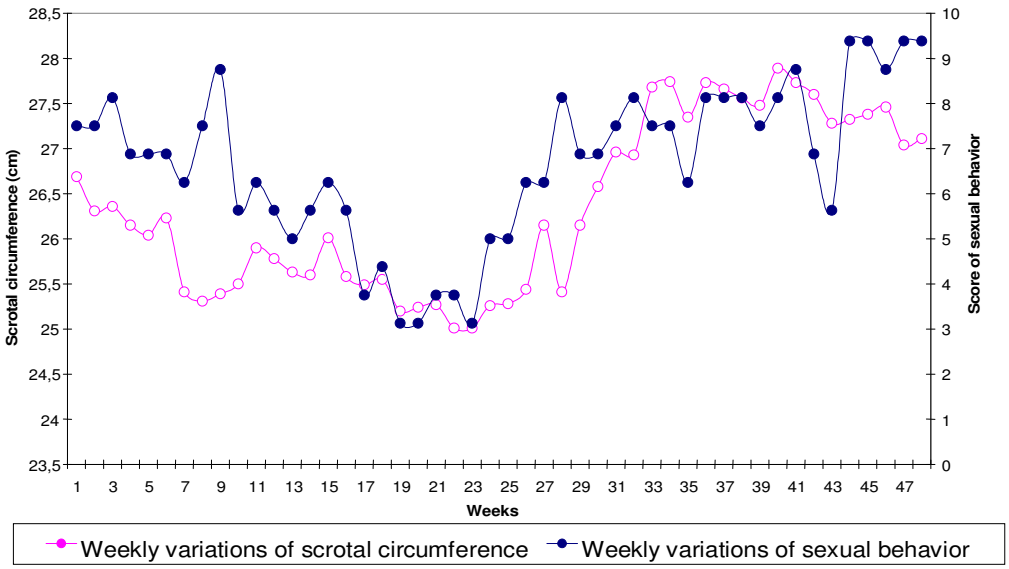

Figure 3. Comparisons of weekly variations of scrotal circumference and sexual behavior.

November (8.83 ± 0.55). A slight decrease is noticed during December and January (7.19 ± 0.62 and 7.03 ± 1.38 respectively). Minimal values were registered during the period of February to May (5.63 ± 0.51 and 4.84 ± 1.28 respectively).

Sexual behavior and scrotal circumference relationship

Comparison between sexual behavior and scrotal circumference on the basis of weekly and monthly variations (Figures 3 and 4 respectively) has revealed similar evolution throughout the year except the fact that there is a shifting of 4 weeks between the peaks of these two parameters. The peak of scrotal circumference was attained during the second week of September whereas that of sexual behavior was attained during the second week of October.

The study showed a significant correlation between sexual behavior and scrotal circumference (r = 0.799).

Comparison between photoperiod, scrotal circumference and sexual behavior

Results show that the maximal monthly values of scrotal circumference and sexual behavior are observed during

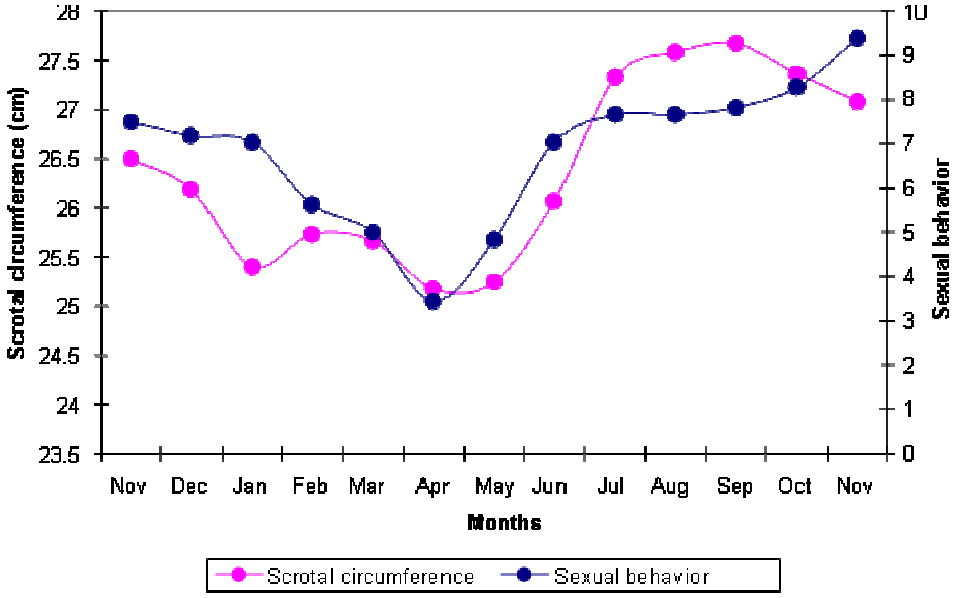

Figure 4. Comparisons of monthly variations of scrotal circumference and sexual behavior.

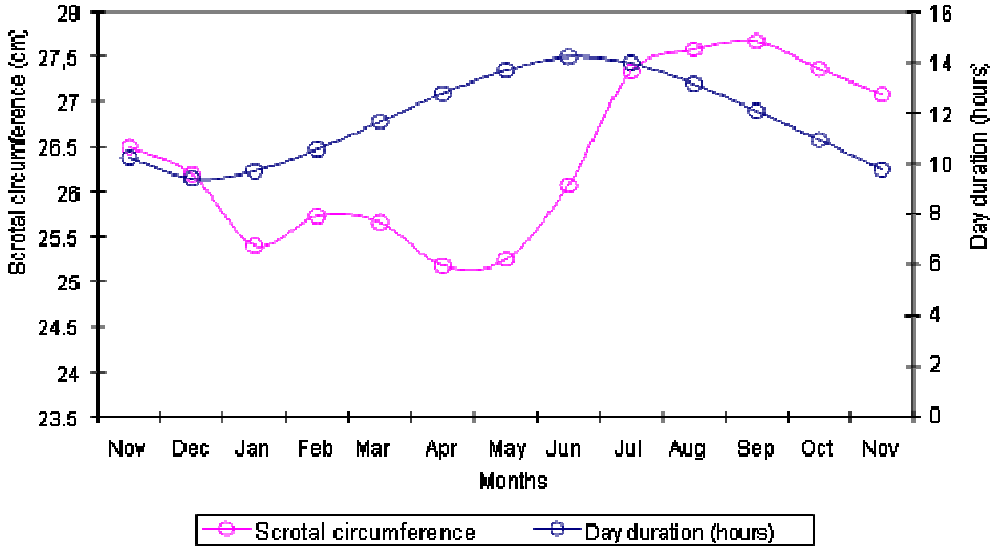

Figure 5. Comparisons between scrotal circumference and day duration.

the short days. On the contrary, low values are observed during long days (Figures 5 and 6).

Seasonal variations of scrotal circumference and sexual behavior

Sexual behavior and scrotal circumference follow seasonal variations during the year. They attain maximal values in autumn (7.96 ± 1.28 and 26.89 ± 0.55 cm respectively) then they decrease progressively during winter (6.09 ± 1.25 and 25.65 ± 0.27 cm respectively) to reach the minimal averages in spring (4.89 ± 1.66 and 25.41 ± 0.37 cm). In summer the values start again to increase (7.70 ± 0.67 and 27.43 ± 0.40 cm) (Table 1).

According to our results the following elements could also be highlighted:

1. The intensity of sexual behavior increases significantly during the month of June. This was observed among the goats of the region and affirmed by breeders.
2. Latency of the second ejaculation increases signifycantly starting from June to January. This coincides with the diminution of the scrotal circumference and the

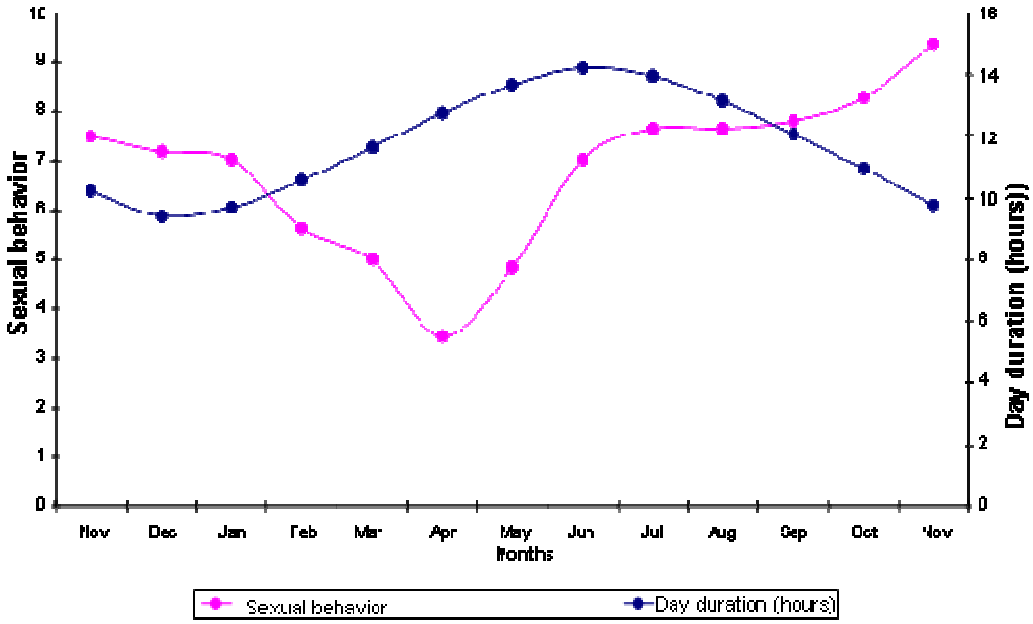

Figure 6. Comparisons between sexual behavior and day duration.

Table 1. Seasonal variation of sexual behavior and scrotal circumference.

Saison	Sexual behavior	Scrotal Circumference
Winter	6.09 ± 1.25	25.65 ± 0.27
Spring	4.90 ± 1.66	25.41 ± 0.37
Summer	7.708 ± 0.67	27.44 ± 0.40
Autumn	7.969 ± 1.28	26.89 ± 0.55

decrease of sexual behavior for the most studied bucks.
3. The sperm, which is milky from February to May, becomes creamy from the month of June.
4. The specific odor of bucks becomes hard during June; it is adjusted to the sexual behavior and the scrotal circumference. This odor is more pronounced during summer.

DISCUSSION

A rise of scrotal circumference was observed in the present study during summer and autumn followed by their decrease in winter and particularly in spring. It has been noticed that the studied bucks expressed a continuous sexual activity throughout the year. Despite a constant type of feeding and female factor during the experiment, there were variations for the tested parameters which means the great influence of season on the reproduction physiology of bucks. The same observations have been noticed within bucks living in subtropical regions. For the breed Damascus (Jordan), Ahmed et al. (2004) reported that the scrotal circum-ference start increasing during spring and summer to reach the peak during August. In Mexican bucks as in other subtropical breeds including Damascus bucks, the breeding season takes place in summer and autumn (Delgadillo et al., 1999). In these breeds, breeding season starts during the natural increasing days, but in controlled photoperiod conditions, longdays were found to inhibit testosterone secretion in Creole goats (Delgadillo et al., 2004) and in Merino and Suffolk rams (Martin et al., 2002). Ahmed and Noakes (1995) have found that the maximal values for British bucks were registered during summer and autumn under temperate climate. According to Walkden-Brown et al. (1994), the recovery of sexual activity in Australian bucks of Cash-mere breed is observed at the end of summer and during autumn accompanied with augmentation of weight and scrotal circumference, intensity of sexual odor, increase of testosterone blood concentration and decrease of the ingested quantity of food. Seasonal variations of testicular weight and sperm production have been noticed among males of the same breed kept in building and receiving constant ration (Canedo et al. 1996).

This is totally in accordance with our results regarding the monthly variations of scrotal circumference, as this latter is strongly related to the testicular weight. According to Delgadillo et al. (1999) minimal values of testicular weight (90 g) and testosterone blood concentration (0.1ng/ml) were registered during January and February, whereas the peaks were observed during July and August (145 g and 10ng/ml respectively). Latency of ejaculation was of 96 s in average (between May and November) to attain a peak of 183 s during April. Minimal number of spermatozoids per ejaculation was registered between February and April (1.4×10^9 spz / ejaculation), the maximal one was observed between May and September (2.8×10^9 spz / ejaculation). Sperm motility is linear and slow between January and April (approx 3.02) and goes up between May and November (approx 3.55). The percentage of live spermatozoids decreases between January and April (68% in April) to attain nearly 80% between May and November. In addition, Roca et al. (1992) found that semen quality of Murciano Grandina goats was highest during summer and fall seasons in Southern Spain (Mediterranean basin). Recently, the best semen quality in Damascus bucks was obtained during increasing photoperiod in spring and summer (Al-Galban et al., 2004). In Damascus male goat, during breeding season, longday exposure followed by melatonin treatments resulted in significant increases ($P < 0.01$) in means of sperm motility, ejaculate volume, sperm concentration, total sperm output, total functional sperm fraction and blood testosterone concentration, while means of reaction time, dead sperm, abnormal sperm and blood triiodothyronine (T3) concentration were significantly decreased ($P < 0.01$). During non-breeding season, long day exposure followed by melatonin treatment exhibited improvements in some reproductive parameters by reducing ($P < 0.05$) reaction time and percentage of dead sperm ($P < 0.01$) and increasing ($P < 0.05$) total functional sperm fraction (Ramadan et al., 2009). Bucks of Creole breed in north Mexico, constantly fed, expressed seasonality in their reproductive activity and the intense sexual activity appears between May and December. The reports made by Walkden-Brown et al. (1994) were at per with the findings in this study. In their report the testis diameter of Creole males of Guadeloupe did not vary throughout the year. The goats of temperate zones express an important variation in their sexual activity. In both sexes, there is a period of minimal sexual activity which lasts from February to September. For bucks of Alpine and Saanan breeds, testicular weight, which is tightly related to the spermatogenetic activity, undergoes seasonal variations with minimal values between January and April and maximal ones between September and December (Delgadillo et al., 1991). Strong decrease in individual motility and fecundity of spermatozoids was also observed between April and August (Delgadillo et al., 1991). Corteel (1977) reported that the volume of ejaculated sperm of Alpine and Poitvine buck breeds is more important during winter (sexual season). This volume becomes less important during spring and summer (sexual rest). The quantity of spermatozoid is also affected by the season; the number of motile spermatozoids is highest during the sexual season and lowest during the rest season (Delgadillo et al., 1992). These variations depend on daily changes of photoperiod and consequently on melatonine secretion profile. Short days stimulate sexual activity and long days inhibit it.

Monthly variations of sexual behavior were less obvious than scrotal circumference in this study. The former starts increasing at the beginning of summer and attains its peak during the same season. The level of sexual activity of the buck fluctuates throughout the year in relation to the testosterone level. According to Delgadillo et al. (1999) the bucks of Creole breed living in Mexico (subtropical zone) express a decrease of their sexual activity from January to April and the sexual season starts in May and finishes at the end of the year with a peak during July and August; this is in full agreement with variations registered under our latitudes. Ejaculation latency, one of the indexes of sexual behavior, increases during the first months of the year and decreases after May. The same authors conclude that, independently of variations of food resources, the seasons have a big influence on the physiology of animal reproduction. Significant changes of testosterone secretion have been also seen with low values between January and April and high values between May and December among the Creole bucks of Mexico (Delgadillo et al., 1999). In fact spermatozoid number is minimal between February and April and it goes up from the month of May. Thus, for the studied bucks, the increase of sexual behavior, preceded by that of scrotal circumference, is explained by the rise of the level of testosterone which happens some weeks before. We also noticed in the present study the change of the color of ejaculation, becoming creamier from the month of June. These changes are different from those observed in breeds of temperate climate in terms of time change (Colas and Guérin, 1981). These differences are most probably due to changes of photoperiod amplitude between subtropical and temperate zones. Under subtropical conditions, the intense sexual activity is observed between October and April. Similarly, for Alpine bucks, the high level of testosterone is registered during autumn and winter (Delgadillo, 1992). From this fact, the sexual season in subtropical zones starts 4 months earlier than that of temperate ones and the activity period is longer (8 versus 5 months). This is in accordance with obtained results of the present study on bucks in western Algeria. Rouger (1974) stated that the sequence elements of sexual behavior (smelling, mating) among Alpine bucks follow very important seasonal variations. Mating frequency is high between October and January and low (almost nil) the rest of the year. According to Fabre (2000) fluctuations of sexual behavior are related to the

rate of testosterone. In temperate zones, the bucks express a sexual behavior in a seasonal manner during autumn and winter. The increase in the testosterone rate (from 3 to 20 ng/ml) is followed, 6 weeks later, by the expression of the sexual behavior (Ahmad and Noakes, 1995; Rouger, 1974), witch support our results as we have noticed that the peak of sexual behavior appears 4 weeks following that of scrotal circumference. The two parameters remain high during autumn and then the decrease of testosterone rate is followed, many weeks later, by that of sexual behavior. In a recent report (Todini et al., 2007) it was clearly demonstrated that Mediterranean bucks are concerned by season variations of plasma testosterone with highest values during summer and autumn. Otravant (1977), Laubser et al. (1982) and Branca and Cappai (1989) reported also that, for bucks of seasonal breeds, sexual behavior, testicular volume and spermatozoid production are influenced by changes in photoperiod.

The present study is the first to be conducted concerning Algerian goat breed. Based on scrotal circumference and sexual behavior variations during thirteen months it can be concluded that the Arbia breed expresses under local photoperiod a seasonal reproduction with a maximal activity during summer and autumn. However, further studies are needed to evaluate as well as hormonal profile and semen parameters of Algerian local bucks during the four seasons of the year.

REFERENCES

Ahmad N, Noakes DE (1995). Seasonal variations in testis size, libido and plasma testosterone concentrations in British goats. Anim. Sci. 6: 553-559

Ahmed M, Al-Ghalban MJ, Tabbaa R, Kridli T (2004). Factors affecting semen characteristics and scrotal circumference in Damascus bucks. Small Rumin. Res. 53: 141-149.

Al-Galban AM, Tabbaa MJ, Kridli RT (2004). Factors affecting semen characteristics and scrotal circumference in Damascus bucks. Small Rumin. Res. 53: 141-149.

Branca A, Cappai P (1989). Osservazioni sul controllo della riproduzione nelle specie effectuate in Sardegna. Symp. Intl Riproduzione nei piccoli ruminate: basi fisiologiche e aspetti applicativi, Varese, pp. 115-129.

Canedo G, Malpaux B, Delgadillo JA (1996). Seasonal variations in testicular weight in Creole male goats in subtropical conditions Northern Mexico. VII nt. Conf. on Goats, 5-11 may, Beijing, International Academia Publisher (Beijing), p. 811.

Chenweth PJ (1981). Libido and mating behaviour in bulls, boars and rams: A review. Theriogenology, 16: 155-177.

Colas G, Guérin Y (1981). Variations saisonnières de la qualité de sperme chez le bélier Ile de France. Fécondance : relation avec les critères quantitatifs observés *in vitro*. Reprod. Nutr. Dev. 21(3): 399-407.

Corteel JM (1977). Production, storage and artificial insemination of goat semen. In: Management of reproduction in sheep and goats Symposium, Madison, July 24-25, pp. 41-57.

Delgadillo JA, Leboeuf B, Chemineau P (1991). Decrease in the seasonality of sexual behaviour and sperm production in bucks by exposure to short photoperiodic cycle's growth cycle. Theriogenology. 36: 755-70.

Delgadillo JA, Leboeuf B, Chemineau P (1992). Abolition of seasonal variations in semen quality and maintenance of sperm fertilising ability by short photoperiodic cycles in he-goats. Small Ruminant Research. 9: 47-59.

Delgadillo JA, Canedo GA, Chemineau P, Guillaume D, Malpaux B (1999). Evidence for an animal reproductive rhythm independent of food availability in male Creole goat in subtropical northern Mexico. Theriogenology, 52: 727-737.

Delgadillo JA, Flores JA, Véliz FG, Hernández HF, Duarte G, Vielma J, Poindron P, Chemineau P, Malpaux B (2002). Induction of sexual activity in lactating anovulatory female goats using male goats treated only with artificially long days. J. Anim. Sci. 80 (11): 2780-2786.

Delgadillo JA, Cortez ME, Duarte G, Chemineau P, Malpaux B (2004). Evidence that the photoperiod controls the annual changes in²testosterone secretion, testicular and body weight in subtropical male goats. Reprod. Nutr. Dev. 44: 183-193.

D'ochio MJ, Schanbacher BD, Kinder JE (1984). Profiles of LH, FSH, Testosterone and PRL in rams of divers breeds: effects of contrasting short (8L: 16D) and (16l: 8d) photoperiods. Biol. Reeprod. 30: 1039-1054.

Fabre N (2000). le comportement sexuel des caprins contrôl hormonal-facteurs sociaux.INRA Prod. Anim. 13: 11-23.

Laubser PP, Van Niekerk CH, Botha LJJ (1982). Seasonal changes in sexual activity and sperm quality in the Angora ram. I. Libido and male hormone concentrations. S. Afr. J. Anim. Sci. 13: 131-133.

Lincoln GA, Peet MJ (1977). Photoperiodic control of gonadotrophin secretion in the ram: a detailed study of the temporal changes in plasma levels of FSH, LH and Testosterone following an abrupt switch from long to short days. Endocrinology, 74: 355-367.

Martin GB, Ho¨tzel MJ, Blache D, Walkden-Brown SW, Blackberry MA, Boukhliq R (2002). Determinants of the annual pattern of reproduction in mature male Merino and Suffolk sheep: modification of responses to photoperiod by an annual cycle in food supply. Reprod. Fertil. Dev. 14: 165-175.

Meteorological Station (2004). Aïn Bouchekif. Dahmouni. Tiaret. Algeria

Otravant R (1977). Photoperiodic regulation of reproduction in the sheep. In: Management of reproduction in sheep and goats symposium. Madison; 25-25, July, pp. 58-71.

Ramadan TA, Taha TA, Samak MA, Hassan A (2009). Effectiveness of exposure to longday followed by melatonin treatment on semen characteristics of Damascus male goats during breeding and non-breeding seasons. Theriogenology, 71: 458-468.

Roca T, Martinez E, Vazquez JM, Coy P (1992). Characteristics and seasonal variations in the semen of Murciano-Granadina goats in the Mediterranean area. Anim. Reprod. Sci. 29: 255-262.

Rouger Y (1974). Etude des interactions de l'environnement et des hormones sexuelles dans la régulation du comportement sexuel des bovidés. PhD thesis, University of Rennes, France.

Pelletier J, Chemineau P, Delgadillo JA (1988). Seasonality of sexual activity and photoperiodic control in the adult ram and he-goat. Proceeed.11th int. Anim. Reprod. Artif. Insem. 26-30June, Dublin, Ireland, pp. 212-219.

Todini L, Malfatti A, Terzano GM, Borghese A, Pizzillo M, Debenedetti A (2007). Seasonality of plasma testosterone in males of four Mediterranean goat breeds and in three different climatic conditions. Theriogenology, 67(3): pp. 627-631.

Walkden-Brown SW, Restall BJ, Taylor WA (1994). Testicular and epididymal sperm content in grasing cashmere bucks: seasonal variations and prediction from measurements in vivo. Reprod. Fertil. Dev. 6: 727-736.

Walkden-Brown SW, Restall BJ, Adams N (1994). Effect of nutrition on seasonal patterns of LH, FSH and testosterone concentration, testicular mass in small ruminant. J. Reprod. Fertil. 42: 181-190.