academicJournals

Vol. 12(48), pp. 6785-6790, 27 November, 2013
DOI: 10.5897/AJB2013.12131
ISSN 1684-5315 ©2013 Academic Journals
http://www.academicjournals.org/AJB

African Journal of Biotechnology

Full Length Research Paper

Seasonal variation of plasma testosterone levels in Algerian male Arabia goats

Ait Amrane A.[1]* , Hammoudi S. M.[1], Belhamiti B. T.[1], Selles S. M. A.[1], Benia A. R.[1] and Kaidi R.[2]

[1]Department of Animal healthy, Veterinary science Institute, Ibn KhaldounUniversity, Tiaret, Algeria.
[2]Departement of veterinary science, faculty of agro veterinary, Saad Dahlab University, Blida, Algeria.

Accepted 9 October, 2013

The aim of the present work was to evaluate the general monthly averages of the testosterone hormone and the influence of season and photoperiod on plasma testosterone levels in Arabia bucks of Algeria. Testosterone concentrations were determined throughout one year in blood samples collected every fortnight of the month from nine males of Arabia goat breeds, fed a constant diet, maintained without interactions with female goat. Plasma testosterone level was measured by radioimmunoassay. Analyses performed show that the monthly averages of the testosterone hormone vary during the year; higher levels were recorded during August (T=8.57±6.72, P=0.00*) however, bucks displayed the same change tendency during the same period (P=0.79). Plasma testosterone concentrations vary significantly between seasons (P=0.00***) being higher during autumn (6.15±3.81ng/ml) compared with spring (0.90 ± 1.27ng/ml) when hormone synthesis reaches its lowest levels. In conclusion, Arabia bucks of Algeria displayed a clear seasonality of plasma testosterone concentration with very low levels in winter and spring (from January to May) and high levels in summer and autumn (from July to November).**

Key words: Arabia bucks, testosterone, season, photoperiod.

INTRODUCTION

The balance of the mechanisms that controls reproduction is based on the permanent relation between the central nervous system and the gonads, a relation which is ensured by the gonadotrophic and the steroidian hormones. However, this control is modified by several external factors (Chemineau and Delgadillo, 1994). Photoperiodic changes related to season have a direct effect on the reproductive activities due to a change in the levels of the hormones secreted by hypothalamus, pituitary, epiphysis and gonads (Pérez and Mateos, 1995).

At intermediate and higher latitudes, the breeding season begins when the duration of daylight becomes shorter (autumn) and ends in winter, when the photoperiod is increasing. However, considerable variation exists between goat breeds (Restall, 1992; Mascarenhas et al., 1995; Zarazaga et al., 2005). Male goats originating from the temperate regions generally display marked seasonal variation in reproductive activity. The decrease in day length in autumn is accompanied by an increase in gonadotrophic hormone production and testosterone levels, with maximum secretion (Delgadillo and Chemineau, 1992).

Testosterone is the hormone responsible for spermatogenesis and sexual behaviour, thus the seasonal pattern of testosterone secretion could limit the male reproductive efficiency during some periods of the year (Chemineau and Delgadillo, 1994). The study carried by Hammoudi et al. (2010) on two parameters of the sexual activity of Arabia bucks (scrotal circumference and sexual

*Corresponding author. E-mail: dahveto@yahoo.fr. Tel: + 213 554208186. Fax: + 213 46427161.

behaviour) shows that the intensity of sexual activity varies according to the season of the year with a maximal activity during summer and autumn. The aim of this research is to determine the changes in the levels of the testosterone hormone in the blood serum of male Arabia goats. Thus, this will be a possible contribution to this field of research on Arabia goats where limited numbers of researches are available and these results may be useful in the determination of the reproduction season.

MATERIALS AND METHODS

Location and animals

The study was conducted on an experimental farm of the University of Tiaret in western Algeria (latitude of 35°15' N and longitude of 1°26' E). This 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 0.7 and 12.7°C in winter and between 13.5 and 36.2°C in summer. The annual rainfall is 389.3 mm for the year of experiment. The daily photoperiod varies between 9 h 37 min during the solstice of winter and 14 h 23 min during the solstice of summer. Nine sexually mature Arabia bucks aged 4 were used in the study. During the trial, the animals were maintained permanently under natural photoperiod and housed separately from the female goat. All bucks received a daily diet of 500 g barley, and had free access to straw, mineral additive block and freshwater.

Blood sampling and hormonal assay

In this study, for the annual fluctuation of testosterone levels, a single blood samples were collected every fortnight from all male goats throughout the year (January 20011-december2011). A total of 216 samples were analyzed. Blood sample collection began 2 h after the expected dawn time (National Meteorological Institute, Meteorological Calendar 2011). Sampling was done via the jugular vein into heparinized 4 ml tubes, and immediately placed in ice box. The samples were then transported to the laboratory and centrifuged at 3000 round per min during 5 min. The serum was recovered and stored at −20°C in duplicate, until analyzed for plasma testosterone concentration, using a commercial RIA kit (Immunotech A Beckman Coulter Company: RIA Testosterone, direct REF: 1119). The minimum detectable plasma testosterone concentration for the assay was 0.1 ng/ml. The hormone analyses were performed at the pharmaceutical laboratory of the nuclear center research of Draria in Algiers.

Statistical analysis

In order to determine any possible significant effects of the months, seasons and photoperiod on the testosterone variations for the Arabia bucks, one way variance analysis was performed using the procedure GLM using the software SPSS package (Chicago,1986). Multiple comparisons of means were analyzed using the Student-Newmen-Keuls test. The factors used in the statistical model (months, seasons and photoperiod) are not random factors; they depend on the geographical position or the latitude of the study region.

RESULTS

Annual evolution of testosterone

Our results show that the testosterone levels start to increase sensitively from June to reach a maximal value during the month of August (8.57 ± 6.72 ng/ml), then they start to fluctuate between September and November and decrease remarkably in December reaching minimal values in May (0.52 ± 0.54 ng/ml) (Figure 1). Despite displaying the same changes tendency of testosterone hormone levels during the same period (P=0.79), bucks individual reproductive performances seem to be variable.

Testosterone seasonal variations

Testosterone levels follow seasonal variations during the year. Maximal values were recorded in autumn (6.15 ± 3.81 ng/ml) then they begin to decrease progressively during winter (1.06 ± 1.42 ng/ml) reaching the minimal averages in spring (0.90 ± 1.27 ng/ml). From summer, the testosterone seasonal mean value increases again (4.81 ± 5.30 ng/ml) (Figure 2).

For the male Arabia goat, the difference between the testosterone seasonal average in summer and autumn was statistically significant from that in winter and spring (P=0.00). But, the difference was not significant between the testosterone seasonal average in summer - autumn and in winter - spring (P=0.05, P=0.82, respectively). On the other hand, the smelling of bucks varies around the year being more pronounced in summer and autumn.

Comparison between photoperiod and testosterone levels

Results show that the increase in the testosterone levels coincides with the decrease of the day-length (summer solstice) and a remarkable decrease in the testosterone levels coincides with the increase in the day-length (winter solstice) (Figure 3).

DISCUSSION

The present study demonstrated that Arabia bucks maintained under a natural photoperiod show marked seasonal variation of testosterone secretion. These variations were recorded despite feeding animals with a constant diet. The results indicate that season strongly influences testosterone secretion of these animals. Hammoudi et al. (2010) demonstrated that in male Arabia goats, both exual 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).

The testicular activity of bedouine breed bucks of in the south-west of Algeria shows clear seasonal variations with a maximum in summer and autumn (July-August-

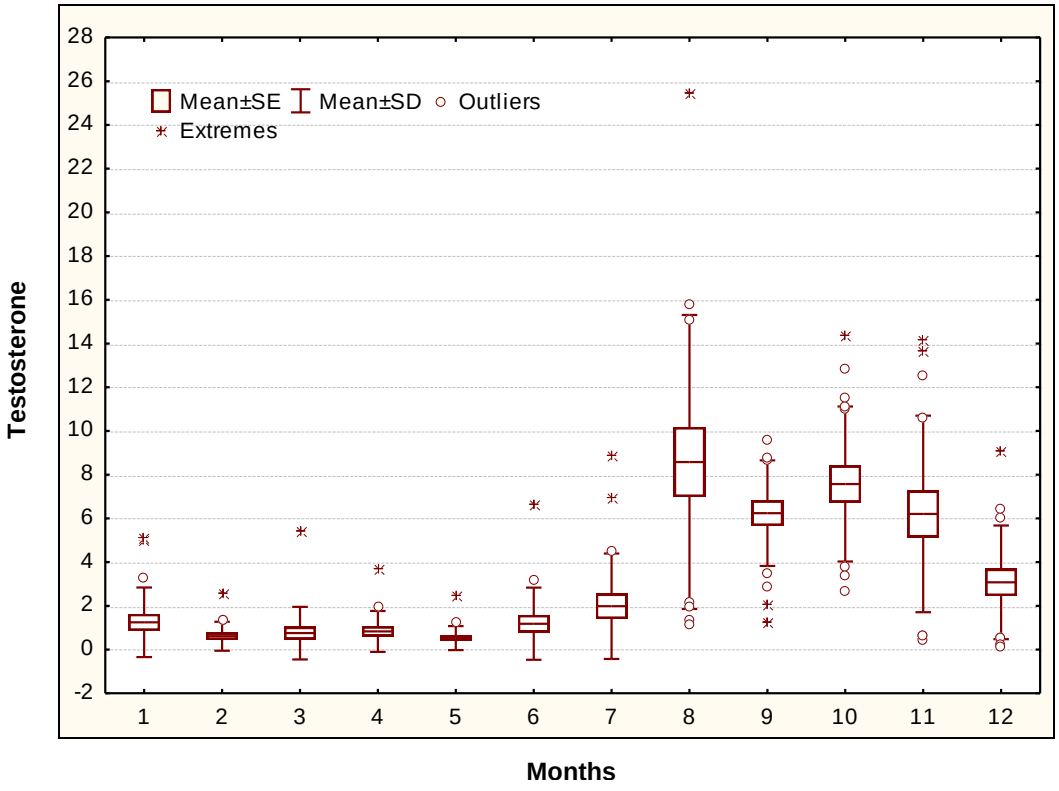

Figure 1. Testosterone monthly mean levels of male Arbia goat. 1, January; 2, February; 3, March; 4, April; 5, May; 6, June; 7, July; 8, August; 9, September; 10, October; 11, November; 12, December.

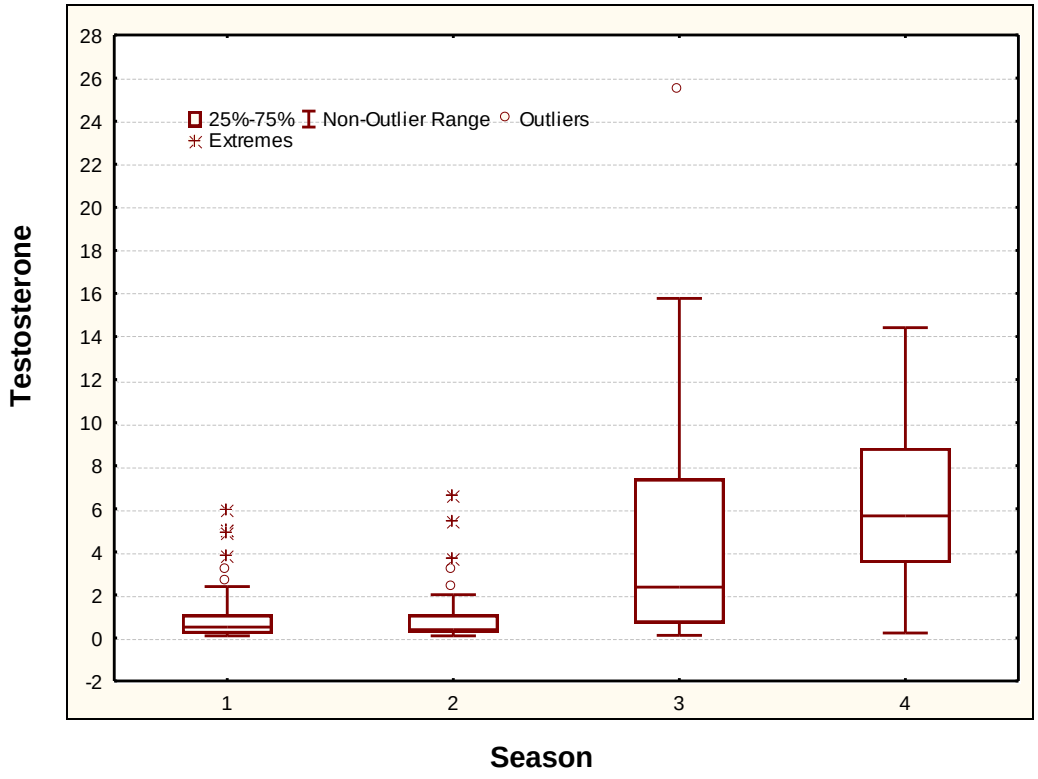

Figure 2. Box plot showing the testosterone seasonal mean levels of male Arbia goat.

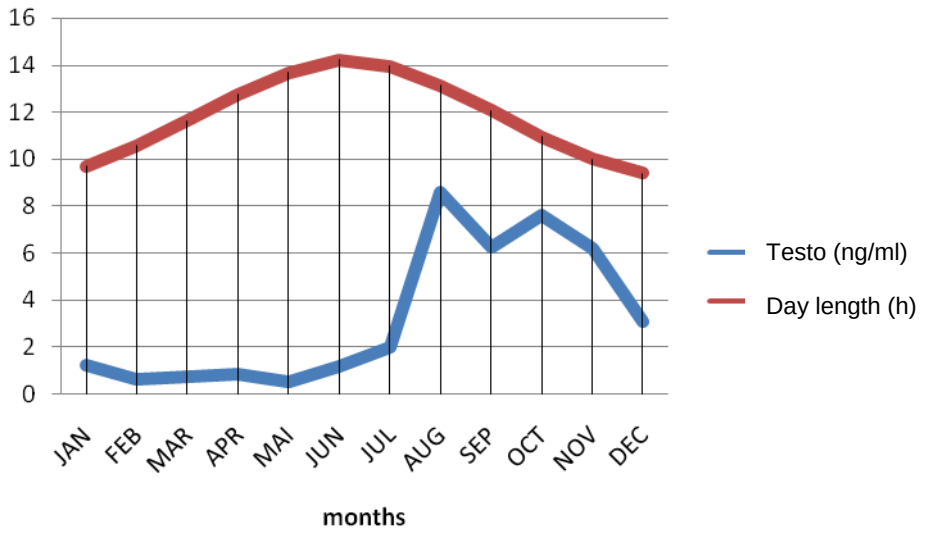

Figure 3. Comparison between plasma testosterone levels and photoperiod.

September) and a minimum in winter and spring (December-April) (Charallah et al., 2000). In seasonal breeds, the gonadotrope activity variations are responsible for the high seasonal variations of the sexual activity with alternate activity and inactive sexual periods. This effect is due to the photoperiodic variations which affect the central nervous system through the modification of the duration of nocturnal secretion melatonine (Chemineau and Delgadillo, 1994). The increase of the negative retroaction of the oestradiol in the hypothalamo-hypophysis axis is responsible for the weak gonadotrope activity during the anoestrus season. The frequency and the amplitude of the LH peaks and the testosterone concentration evolve with season. The testicular weight, the sexual behavior and the semen quality evolve at the same time as the hormonal modifications. The increase of the LH pulsatile activity (amplitude in June – July; frequency in September) lead to the beginning of the testicular increase (July- August) then the release of the testosterone (September) which stimulate the sexual behavior (increase in the number of mating, decrease in ejaculation latency) and the semen quality (October).

In our study, seasonal plasma testosterone patterns are similar to those reported by Todini et al. (2007), they found that the mean plasma testosterone concentration from all bucks of four Mediterranean breeds (Ionica, Garganica, Maltese and Red Syrian) were affected by season of sampling, being higher during summer than during autumn, which were in turn higher than during winter and spring.

Male north Moroccan goats show reproductive seasonality related to photoperiod. Testis measurements, sperm characteristics and plasma testosterone levels were low during winter, increasing through the spring and summer (Chentouf et al., 2011). In Zaraibi goats in Egypt, Barkawi et al. (2006) conclude that this breed has a distinct seasonal sexual activity. In this breed, libido, seminal characteristics and plasma testosterone concentration were highest during summer and lowest during spring. In this same breed, histological structure of the testis demonstrates a clear difference between seasons. The gonads are more active in summer and autumn compared to spring and winter. In the seminiferous tubules, the number of spermatic layers as the best indicator of testicular activity was high during autumn and low during spring (Eitedal et al., 2007). In vérata and Malguena bucks, plasma testosterone concentration was highest during autumn and summer when photoperiod is decreesing and lowest during winter and spring when photoperiod is increasing (Pérez et Mateos, 1995).

Hüseyin et al. (2011) shows that in Turkey, male white goats exhibit seasonal changes in plasma testosterone levels. The highest values were recorded in autumn and the lowest ones in spring. Zarazaga et al. (2009) studying effects of season and feeding levels on reproductive activity and semen quality in Payoya bucks goats conclude that this breed displayed considerable reproductive seasonality with intense sexual activity between August (mid- summer) and November (mid-late autumn). Al-Ghalban et al. (2004) report that in Damascus breed scrotal circumference begins to rise during spring and summer reaching maximal values in august. For local breeds in subtropical Mexico, plasma testosterone reach maximal levels in summer but the rise begins before or around the summer solstice (Delgadillo et al., 1999, 2002, 2004). Male Creole goats in subtropical northern Mexico displayed marked seasonal variations in testosterone secretion. However, low concentrations were observed from November to mid-June, and then the plasma testosterone concentration rose and remained elevated from July to October (Delgadillo et al., 2001).

In Mediterranean bucks the period of high testosterone

concentration started two months earlier than in breeds adapted to high latitude (Todini et al., 2007). These differences are most probably due to changes of photoperiod amplitude between subtropical and temperate zones. In fact in alpine bucks at 46°N plasma testosterone starts to increase in late August-September (Delgadillo and Chemineau, 1992). Compared to the onset of the breeding season in Creole bucks in subtropical Mexico with Alpine bucks at higher latitudes, it was suggested a shorter lag time between the perception of the photoperiodic signal and the expression of the physiological responses (Delgadillo et al., 2004).

In the Alpine bucks, the LH basic level (0.3 ng/ml of plasma), the frequency of pulses (around 1 in 8 h), their amplitude (less than 0.2 ng/ml) and so the LH mean concentrations (0.4 ng/ml of plasma) is low from January to May. The amplitude of pulses increases regularly in June and July to reach 1.0 ng/ml in August. Then in September, their frequency increases abruptly (3.5 pulses in 8 h). However, their amplitude decreases due to the inverse relation between frequency and amplitude and probably due also to the influence of the testosterone secreted in high quantity (4 ng/ml of plasma in August, 13 ng/ml in September). Following the high levels of LH and of the testosterone in August and September, a progressive decrease is noticed until January, then the annual cycle begins again (Saumande and Rouger, 1972; Delgadillo and Chemineau, 1992).

Similar observations were reported for the Australian cashmere bucks with a 6 month delay in the south hemisphere (Walkden-Brown, 1991). Goats in temperate latitude show important seasonal variations of their sexual activity in both male and female, the sexual activity is low between February and September. For Alpine and Saanen, testicular weight which is closely correlated to testicular spermatogenesis activity undergoes seasonal variation with low values from January to April and high values from September to December (Delgadillo et al., 1991). Volume ejaculation from Alpine and Poitevine bucks is high in autumn and winter (breeding season) and low in spring and summer (non breeding season) (Corteel et al., 1977). Walkden-Brown et al. (1994) report that sexual activity of Creole male goats of Guadeloupe did not vary throughout the year because in this area photoperiod is mainly constant.

The smelling of bucks is more pronounced during the breeding season than in the non-breeding season. This fact is due to the action of testosterone on the sebum glands in the skin, the head and the neck (Walkden-Brown 1991).

Conclusion

In conclusion, the results of this work support the hypothesis that native Arabia bucks studied displayed a clear seasonality of plasma testosterone levels, with an intense sexual activity in summer and autumn.

ACKNOWLEDGMENTS

My deepest thanks to Khelil Rachid and his wife of the Nuclear Research Center of Draria (Algeria) for carrying out the radioimmunoassay. My thanks also go to Mr TAibi Khaled and Mr Benaichata Lazrague for the statistical analyses. Finally I would like thank Mr Ait Amrane Ali, who contributed in the writing of my paper.

REFERENCES

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

Barkawi AH, Eitedal HE, Ashour G, Shehata E (2006). seasonal changes in semen characteristics, hormonal profiles and testicular activity in Zaraibi goats. Small Rumin. Res. 66: 209-213.

Charallah S, Khammar F, Amirat Z, Lakhdari Y (2000). Evaluation de l'activité sexuelle male et femelle: caractérisation zootechnique et nutritionnelle chez la chèvre bédouine. In : actes conférence internationales sur caprins, Tours, France, 15-21 Mai 1990, Tome I, p, 460.

Chemineau P, Delgadillo JA (1994). Neuroendocrinologie de la reproduction chez les caprins. INRA Prod. Anim. 7 (5) : 315-326.

Chentouf M, Bister JL, Boulanouar B (2011). Reproduction characteristics of North Moroccan indigenous goats. Small Rumin. Res. 98:185–188.

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

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, Chemineau P (1992). Abolition of the seasonal release of luteinizing hormone and testosterone in Alpine male goats (Capra hircus) by short photoperiodic cycles. J. Reprod. Fertil. 94: 45-55.

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

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

Eitedal HE, Barkawi AH, Shafie MM, Ashour G, Shehata E (2007). Seasonal variation in the activity of the Leydig cells in Egyptian Nubian goat (Zaraibi) bucks. Small Rumin. Res. 70: 280-285.

Hammoudi SM, Aït-Amrane A, Belhamiti TB. Khiati B. Niar A. Guetarni D (2010). Seasonal variations of sexual activity of local bucks in western Algeria. Afr. J. Biotechnol. 9 (3): 362-368.

Mascarenhas R, Simões A, Robalo J (1995). Cyclic reproductive activity and efficiency of reproduction in Serrana goats. Anim. Reprod. Sci. 38: 223–9.

Meteorological Station (2011). Aïn Bouchekif. Dahmouni. Tiaret. Algeria

Pérez B, Mateos E (1995). Seasonal variations in plasma testosterone levels in Verata and Malagueña bucks. Small Rumin. Res. 15: 155-162.

Restall BJ (1992). Seasonal variations in reproductive activity in Australian goats. Anim. Reprod. Sci. 27: 305-318.

Saumande J, Rouger Y (1972). Variations saisonnières des taux d'androgènes dans le plasma de sang périphérique chez le bouc. C. R. Acad. Sci., Paris, 274, Sér. III, 89-92.

SPSS. version .16 Chicago Inc, (1986).

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): 627-631.
Walkden-Brown SW (1991). Environmental and social influences on reproduction in Australian Cashmere goats. PhD Thesis, Univ Queensland, Australie. p. 237.
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.
Zarazaga LA, Guzmán JL, Domínguez C, Pérez MC, Prieto R (2005). Effect of plane of nutrition on seasonality of reproduction in Spanish Payoya goats. Anim. Reprod. Sci. 87: 253-67.
Zarazaga LA, Guzmán JL, Domínguez C, Pérez MC, Prieto R (2009). effects of season and feeding level on reproductive activity and semen quality in Payoya buck goats. Theriogenology 71:1316-1325.