

CHARACTERISTICS OF ONSET PUBERTY IN ALGERIAN ARABIA GOAT MALE KIDS

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Abstract: The aim of this study is to determine reproductive characteristics such as age, body weight, scrotal circumference, plasma testosterone and some semen parameters, (ejaculate volume, motility rate and concentration) in Arabia goat male kids at puberty and hence to study the correlation between body weight, scrotal circumference and plasma testosterone levels. The puberty characteristics were as follows: the age of puberty was 228 ± 10.76 days (32.57 weeks) with an average bodyweight of 23.1 ± 3.61 kg, an average scrotal circumference of 25.42 ± 0.99 cm and plasma testosterone at 1.90 ± 0.89 ng/ml. The ejaculate volume, mass motility, sperm cell concentration were 0.95 ± 0.44 ml, 53 ± 8.54 %, $1.006 \pm 0.74 \times 10^9$ spz/m, respectively. The results revealed that Arabia goat male kids, born during winter attain puberty earlier when animals reach 46.2% of its weight at adulthood. In addition, it was found that scrotal circumference is directly correlated to body weight and testosterone concentration.

Keywords: puberty onset, scrotal circumference, body weight, seminal parameters, Arabia goat's kids.

INTRODUCTION

Puberty is generally defined as the point of sexual development at which the animal becomes capable of reproduction (first ovulation in the female and first spermatozoa in the ejaculate of the male) (Bielli et al., 2001). In bucks, live weight, breeds, season of birth and exposure to congeners of the opposite sex influence the attainment of puberty (Ahmad and Noakes, 1996).

Which begins when at least some of the following morphological traits are present: testes size over 6g, appearance of seminiferous tubule and commencement of spermatogenesis (Bielli et al., 2001).

Puberty age variable and is dependent on the genetic type of the animals and the management system (Chakraborty et al., 1989; Delgadillo and Malpau, 1996).

The time of onset of sexual maturity can exert an important influence on the reproductive efficiency of an individual. The characterizations of puberty and of early sexual development are important criteria to use in the selection of males within a breed. The early onset of sexual maturity allows early progeny testing and reduces the generation interval, thus providing an aid to selection (Madani and Rahal, 1988).

Thus, the objectives of the present study is to determine and record the following reproductive characteristics at puberty in this case, age, scrotal circumference, body

weight, plasma testosterone, volume of ejaculate, motility rate and the concentration of spermatozoa in male kid of Algerian Arabia breed goat.

MATERIALS AND METHODS

The study was conducted in the experimental farm of Tiaret University, from June to October 2012. Important characteristics of the male reproductive function have been studied to determine the age of puberty in the male kid Arabia, bodyweight, scrotal circumference, sexual behavior, testosterone and semen parameters.

Environment and animals

Five Arabia male kids born in winter (between January and February 2012), aged between 125 and 152 days at the beginning of the experiment and one adult female goat were used in our study. Once identified, a general examination of the animals, followed by a special physical examination of the genital tract is under taken. The animals received antiparasitics by injection ivermectin 1% and orally albendazole 2.5% and vaccinated against enterotoxaemia. Throughout the experimental period, goats were kept in a stable and received fodder and water ad-libitum and a constant supply from barley milled at 300 g/day/animal. The vitamin intake is provided by a supplement in the form of powder incorporated in the diet while the minerals are provided by licks.

Measurements

Body weight. The weighing of the kids was performed weekly using analogue scales in the following manner: first, the operator measures his weight, and then he carries the kid and climbs again on the scale to take a new measurement. Thus, the weight of the kid is determined by subtracting the first weighing from the second.

Scrotal circumference. This was carried out weekly during 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.

Sexual behavior. Goat male kids were tested during 30 min on a weekly basis in the presence of oestrogenized females and the appearance of the different expressed behaviors was recorded. Puberty was reached when the animal showed a full sequence of sexual behavior, penis exposure, mating and ejaculation shown by a strong forward thrust of the pelvis accompanied by throwing the head and neck backwards before dismounting (Simplicio et al., 2000).

Testosterone dosage. In this study, to determine the serum testosterone levels, single blood samples were collected weekly from all male kids' goats. A total of 105 samples were analyzed. Blood sample collection began 2 h after the expected dawn time (National Meteorological Institute, Meteorological Calendar). Sampling was done via the jugular vein into heparinized 4 ml tubes, and immediately placed in an 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 (Immuno-tech 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.

Semen analysis. Once the goat kids ejaculation observed, they were presented to a goat in estrus to collect their semen with an artificial vagina. The ejaculates thus obtained are placed in a water bath at 37°C. Then, they were sent, immediately to the laboratory, to examine the following spermatic parameters: ejaculate volume, motility rate and spermatozoa concentration.

Statistic alanalysis. Statistical analysis was performed by MATLAB software (version 3.). Scrotal circumference, body weight and plasma testosterone were analyzed by one-way analysis of variance (ANOVA) followed by Tukey’s honestly significant difference (HSD) post hoc test. In addition, $P < 0.05$ was considered statistically significant.

RESULTS AND DISCUSSION

Scrotal circumference, Body weight and Plasma testosterone evolution

From the beginning of the study, the scrotal circumference of goat kids increases in a gradual manner with a monthly average in June and July of 20.16 ± 2.80 cm, 21.07 ± 1.97 cm, respectively. It shows a marked increase from August (23.57 ± 1.58 cm). Body weight of goat kids evolved in a progressive manner from the beginning of the study in June and July, with a monthly average of 18.4 ± 1.94 kg and 20.5 ± 1.73 kg, respectively, and increased significantly from August (23.1 ± 2.38 kg). The monthly average of goat kids plasma testosterone increased progressively from the start of the study in May, June and July (0.27 ± 0.41 ng/ml, 0.79 ± 1.13 ng/ml and 0.80 ± 1.45 ng/ml, respectively) and increased significantly from August (1.48 ± 1.64 ng/ml)(Figure 1).

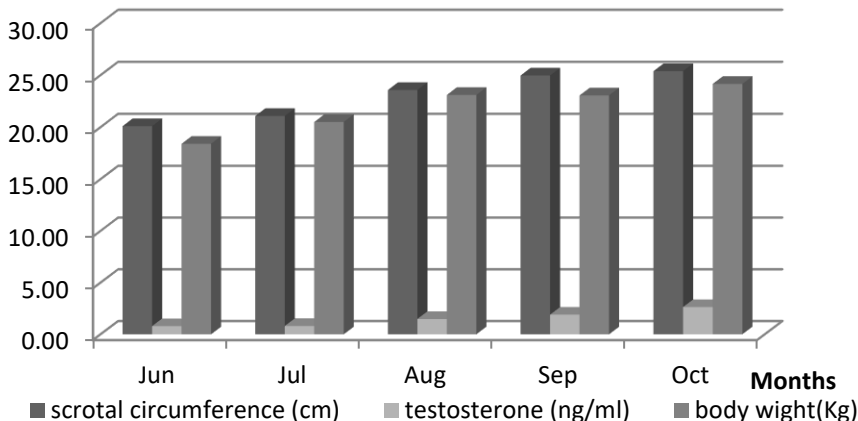


Figure 1. Scrotal circumference, Body weight and Plasma testosterone evolution

In goat kids of Arabia breed born between January-February, puberty appears at an average age of 228 ± 10.76 days (7 to 8 months). At that time, scrotal circumference, body weight and serum testosterone levels are 25.42 cm, 23.1kg, and 1.90ng/ml, respectively. In Arabia breed goats, puberty appears to be influenced by the season of birth. That is to say, as the season of birth is close to the breeding season of the species is more precocious puberty.

Madani and Rahal (1988) described the influence of the season of birth on the age of puberty in native Libyan goats, so that the animals born in winter were more precocious than those born in summer. Therefore, it is evident that the onset of sexual activity in small ruminants may vary depending on breed, management system and birth date (Madani and Rahal, 1988; Ahmad and Noakes, 1996; Abi Saab et al., 1997; Almeida et al., 2007).

Numerous mammals have a well-defined sexual activity season. Their kids reach puberty only during the breeding season. Goats born in April-May express their puberty as soon as physiologically possible, at the age of 5-6 months, from October to November, which is the normal breeding season; those born in June-July may not express it until autumn of the following year (Foster, 1986). All these results comfort our work.

Comparison between evolution of scrotal circumference, body weight and plasma testosterone. In goat kids, the three studied parameters evolved similarly during the study period (figure 4). The statistical analysis shows a significant strong positive correlation firstly between scrotal circumference and body weight ($r = 0.96$; $p = 0.0095$) and on the other hand between scrotal circumference and plasma testosterone ($r = 0.94$; $p = 0.01$). Likewise, correlation is significant and strongly positive between body weight and plasma testosterone levels ($r = 0.88$; $p = 0.04$).

Puberty comes as the growth is not fully completed: copulation and ejaculation of viable spermatozoa occur at the age of 4 to 6 months, during which the weight of the male goat represents 40-60% of the weight in adults (Donald, 1980). This finding comforts our results because goat kids of Arabia breed reach puberty at a body weight representing a rate of 46.2% of the weight in adult buck of the same breed. Puberty is associated with increased secretion of testosterone in spermatogenesis and sexual behavior. This coincides with puberty body development phase during which the gonads secrete hormones in sufficient quantity to cause faster growth of the genitals and the appearance of secondary sexual characteristics. Hormonal changes associated with puberty generate behavioral changes that will be more and more noticeable with the time (Hanzen, 2005).

Ait Amrane et al. (2013) reported, the native Arabia bucks displayed a clear seasonality of plasma testosterone levels, with an intense sexual activity in summer and autumn. It is important to evaluate testosterone levels to determine the development of the reproductive system. Testosterone levels are useful in the selection of young sires and to characterize sexual maturity in different breeds (Eloy and Santa Rosa, 1998). Plasma testosterone concentrations are related to age (Silva, 2000), season of the year (Delgadillo and Chemineau, 1992), protein intake (Azevedo Neto, 2005) and luteinising hormone (LH) pulse frequency (Muduuli et al., 1979; Delgadillo and Chemineau, 1992). Testosterone is directly involved in the onset of puberty, and consequently in the onset of spermatogenesis (Eloy and Santa Rosa, 1998).

When nutritional factors are not involved, the photoperiod duration remains the most important environmental factor for seasonal modulations conditions of the onset of puberty and the role of temperature occurs when the photoperiod length is unfavorable. The sexual activity peak coincides with the increase in plasma testosterone occurring during the autumn (Jainudeen et al., 2000).

On one hand, if the sexual season is short, births will all occur at the same time. The puberty of these young animals will take place, in most cases and if their growth has been normal, during the sexual season following their birth. On the other hand, if the

sexual season is long, births are spread over several months. In this case, according to their month of birth, the young animals will express puberty at different ages although their growth is normal because, they reach a critical stage of development during the breeding season or during the non-breeding season (Levasseur et al., 1980).

Age at puberty and Semen characteristics

In our study, the first ejaculation in goat kids were observed at an age ranging from 215 to 242 day, with an average age of 228 day at puberty (table1).

The first ejaculates of goat kids of Arabia breed are characterized by:

- An ejaculate of watery consistency and light color,
- An average volume of 0.95ml,
- An average sperm concentration of 1.006×10^9 spz/ml,
- A motility rate of 53%.

From the above results, it can be noted that puberty of goat kids in Arabia breed is expressed at (table1):

- A mean body weight of 23.1kg representing 46.2% of the weight of the goat adult of the same breed.
- An average age of 228day,
- An average scrotal circumference of 25.42cm,
- An average of plasma testosterone level of 1.90ng/ml.

Table 1.

Summary table of puberty characteristics acquisition in goat kids in Arabia breed

Kids	D	BW (kg)	SC (cm)	T (ng/ml)	V (ml)	C ($\times 10^9$ spz/ml)	M (%)
K1	242	25.5	25.6	2.83	1.33	0.2	52
K2	228	24	24	2,5	–	–	–
K3	235	26	25.3	1.62	0.45	1.14	45
K4	221	17	25.4	0.55	–	–	–
K5	215	23	26.8	1.94	1.1	1.68	62
average	228	23.1	25.42	1.90	0.95	1.006	53
	± 10.76	± 3.61	± 0.99	± 0.89	± 0.44	± 0.74	± 8.54

K kids **D**: days at puberty; **BW**: body weight; **SC**: scrotal circumference; **T**: plasma testosterone; **V**: ejaculate volume; **C**: sperm cell concentration; **M**: mass motility.

In imported European breeds into tropical regions, puberty begins later than in local animals. While it occurs between 8 and 12 months in temperate zones, puberty is observed between 12 and 20 months in animals of temperate breeds raised in tropical regions. This delay is essentially the result of low growth in animals of these breeds in the latter areas (Gonzalez-Stagnaro,1984). In Saanen and Alpine breeds goats, the average age in days for the first semen collection is 288 ± 41 days and 284 ± 34 days, respectively (Furstoss et al.,2009).

In northern Mexico, the first ovulation in females born in January is detected 8.5 months to a live weight of 25-30 kg and the first mounting of the males born in the same period is seen at 4.3 months for live weight of 20 kg (Chemineau,1986). In some cases,

puberty occurs later, but this is the result of bad rearing. Although, in adult female of Guadeloupe Creole breed, breeding is not seasonal, the age of puberty is influenced by their season of birth even under satisfactory dietary conditions. The average age at first estrus is 172days; it varies from 128days for females born in August to 204days for those born in December (Furstoss, 2009). In our study, the semen volume at first collections varied between 0.45 and 1.3ml with the mean sperm concentration and sperm motility rate of 1.006×10^9 spz / ml and 53%, respectively. The ejaculates were of a clear aqueous appearance.

The sperm volume varies in the different species, and even within the same species according to physiological condition of the male, the individual, breed, body development, the number of projections or collections and collection method (Walkden-Brown, 1994). The ejaculate volume can vary between 0.2 and 0.5ml in goats aged 7 to 10 months and between 0.6 to 2ml in the adult goats (Setchell, 1977; Corteel,1988). In adult Arabia breed bucks, the seasonal average sperm volume is highest in autumn(1.1 ± 0.39 ml) and lowest in spring (0.11 ± 0.14 ml).The seasons of winter and summer are marked by intermediate volume (0.64 ± 0.44 ml and 0.67 ± 0.49 ml, respectively) (Belhamiti et al., 2018).

The buck has a very concentrated but not abundant sperm with a volume of 1ml and the concentration of 3.5×10^9 spz / ejaculate (Dérivaux, 1971; Hafez,1974). The semen volume is between 0.1 to 1.5 ml with a concentration of 2 to 6×10^9 sperm / ml. This volume varies over the life of the animal according to different factors including season, age and collection rate(Zarrouk,2001). In Creole male goats kept in buildings and receiving a constant supply, there is also, a seasonal variation in testicular weight and sperm production (Canedoet al., 1996),this seasonality is similar to that described for males originating intemperate zones(Delgadillo et al.,1992).

CONCLUSION

In young male of Arabia breed goats, puberty appears at a mean age of 228days, when they reach a level of46.2% of the adult weight and an average of 25.42cm and 1.90ng/ml of scrotal circumference and plasma testosterone, respectively. At this physiological stage of the male, they ejaculate semen with the following characteristics:

- An average volume of0.95ml,
- An average sperm concentration of 1.006×10^9 spz/ml,

However, puberty seems to be influenced by the season of birth; the goat kids born in the approach of the breeding season of the species have earlier puberty age.

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