Development of spermatogenesis in captive-bred Spix's yellow-toothed cavy (Galea spixii)
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Abstract. The aim of this study was to evaluate the phases of sexual development and spermatogenesis of Spix’s yellow-toothed cavy (Galea spixii) based on analyses of the structural components of the testes. The testes of animals from 0 to 150 days of age were collected by orchiectomy, weighed, and processed for analysis by light microscopy. At 45 days of age, spermatozoa were seen in the tubular lumen. Spermatogenesis was not established in animals from 45 to 150 days of age. The stages of sexual development may be classified into the following phases: from birth to the age of 15 days (immature); 30 days of age (prepubertal); 45–105 days of age (pubertal); and 120 and 150 days of age (postpubertal). This is the first study to address the male reproductive biology of Spix’s yellow-toothed cavy.

Additional keywords: puberty, rodentia, sexual development, testis, wild animal.

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Introduction

Over the past few years, increased wild animal breeding has occurred with the establishment of specific farms. Knowledge of reproductive biology and physiology is important for conservation and species management; such knowledge also aids efforts to ensure the propagation of endangered species and provides tools for more sustainable use of animals by industry (Busso et al. 2005; Wildt 2005).

For male animals, the study of the stages of testicular development is particularly relevant. The stages associated with puberty and sexual maturity, which are crucial parameters in determining the magnitude of sperm production, are especially important (França et al. 1988a). These aspects of development are also important for male reproductive physiology and management (Leal and França 2009). The spermatogenic process occurs through the development of germ cells, the stem spermatagonia, which give rise to highly specialised haploid cells, the spermatozoa. The Sertoli cells and Leydig cells are extremely important in this process. Additionally, Sertoli cells are responsible for supporting and nourishing the germ cells, releasing spermatozoa into the lumen, while Leydig cells boost libido and maintain spermatogenesis (Bilaspuri and Guraya 1986; Benton et al. 1995; Chaminudran Mendis-Handagama and Siril Ariyaratne 2001; França et al. 2005; Gendt et al. 2005).

Various investigators have studied the testicular development of males of different species or breeds of domestic animals by histological analysis with the purpose of determining the period in which the onset of puberty takes place. These studies have included investigations of cattle (Cardoso and Godinho 1979; Curtis and Amann 1981), pigs (Orsi et al. 1985; França 1987), buffalo (Melo and Vale Filho 1992) and goats (Silva et al. 2000). However, similar studies on Brazilian wildlife are scarce and have primarily been performed on the collared peccary, white-lipped peccary, agouti paca and capybara (Assis-Neto et al. 2003a; Costa et al. 2004, 2006). Methods for histological quantification of the efficiency of spermatogenesis can accurately determine spermatozoa production in individuals of the same species or among species (Vale Filho 2001).

Spix’s yellow-toothed cavy (Galea spixii) is found in regions of the semidry to arid caatinga vegetation of northeast Brazil. It is an herbivorous species with grey hair and a ring of white hairs around the eyes. When mature it has a length of 22.5–23.5 cm, weighs between 375 and 405 g, and breeds throughout the year with a gestation period of ~48 days, producing litters of 2–4 pups (Eisenberg and Redford 1999; Oliveira et al. 2008). The aim of this study was to evaluate the histological and morphological characteristics of the testes to determine the development of the spermatogenic process and the phases of sexual development in this species.
Materials and methods

Twenty-five male Spix’s yellow-toothed caviies were studied, which were obtained from the Center of Reproduction of Wild Animals at the Universidade Federal Rural do Semi-Arido (UFERSA), Mossoró, Rio Grande do Norte, Brazil. The animals were divided into the following age groups for sampling: newborns (n = 4), 15 days (n = 5), 30 days (n = 3), 45 days (n = 2), 60 days (n = 2), 75 days (n = 2), 90 days (n = 2), 120 days (n = 2) and 150 days (n = 2) to facilitate the characterisation of the sexual phases of this species.

Collection was scheduled and performed in the period between 7 February 2009 and 30 November 2009. The project was conducted in accordance with the ethical principles of animal experimentation of the Animal Experimentation Ethics Committee of the School of Animal Science of Unesp Dracena (Protocol No. 009/2008).

Testis collection

The testes of animals from 0 to 150 days old were collected by orchiectomy and weighed. During the procedure, the older animals were anesthetised with 0.025 mg mL\(^{-1}\) of atropine sulfate administered subcutaneously and 0.2 mL kg\(^{-1}\) of Zoletil administered intramuscularly. Animals that were 0, 30 and 45 days old were anaesthetised similarly to the other groups and then sacrificed due to the difficulty of finding the small testes within the abdominal cavity. After the orchiectomy, each testis was separated from its respective epididymis and then weighed and measured. The weight (g) was determined using an analytical balance (Kern 430–21 max. 50 g d = 0.001 g; Baden, Württemberg, Germany), and the length was measured with a stainless steel pachymeter with divisions in millimetric units (Vernier caliper 4-way measurement, 150 × 0.02 mm; Mitutoyo, Kawasaki, Japan).

Histological processing

Subsequently, the testes of each animal were placed in Bouin’s solution for a period of 24 h. After dehydration in increasing concentrations of alcohol, followed by changes of xylenes, they were embedded in paraffin (Luna 1968). A microtome (Leica RM 2145, Berlin, Germany) was used to obtain sections of 5-μm thickness, which were stained with hematoxylin-eosin (HE). The slides were analysed under a light microscope (Leica DM 2500) and used to obtain microscopic descriptions of the organs.

Cord and tubular diameters

The diameter was determined from 30 cross-sections of seminiferous cords and/or tubules of each testis using an image analysis system (Leica Qwin 3.0). The cross-sections were randomly chosen by horizontal scanning, and those with contours that were as circular as possible were used. The mean diameters of cords and tubules were compared by applying Tukey’s test (5%).

Seminiferous epithelial height

The seminiferous epithelial height was measured in 30 cross-sections of seminiferous tubules from animals of each age in stage I of the seminiferous epithelial cycle (SEC) chosen according to the tubular morphology method (Courot et al. 1970). The samples with the most circular contours were randomly chosen with the aid of an image analyser (Leica Qwin 3.0). The seminiferous epithelial heights were compared by applying Tukey’s test (5%).

Seminiferous tubule cell type counts

These counts were performed in 10 cross-sections of the seminiferous tubules with contours that were as circular as possible and that exhibited the same stage of the SEC each testis. For counts of different cell types, stage I of the SEC was chosen according to the tubular morphology method (Courot et al. 1970). All cell counts were corrected for the thickness of the cut and nuclear diameter (DM) in accordance with the Abercrombie (1946) correction factor, as modified by Amann and Almquist (1962).

\[
\text{Corrected number} = \frac{\text{count obtained}}{\text{cut thickness}} \times \sqrt{\frac{(DM)^2/2 - (DM)^2/4}}
\]

The mean DM was obtained by measuring 10 nuclei of the studied cell type in each testis. The DMs were measured with the aid of Leica Qwin 3.0 software.

Yield and Sertoli index

From puberty onwards, the following parameters were determined: spermatogenetic yield, which was calculated from the ratio between round spermatids and spermatogonia at stage I; and the Sertoli cell index, which was calculated from the ratio between the total number of round spermatids at stage I and the total number of Sertoli cells.

Statistical analysis

Mean and standard deviation descriptive analyses were performed for testicular biometric parameters with the GraphPad Prism4 program (GraphPad Software Inc, USA). The model used in the analysis of variance for age and testicular development was a completely randomised design, and Tukey’s tests (5% significance level) and t-tests (5%) were used for comparisons among the means. Age, bodyweight and testicular biometric parameters were submitted to correlation tests conducted using Statistic-R software (R Development Core Team 2009).

Results

Macroscopic aspects

The mean and standard deviation of the biometric parameters of each age group are shown in Table 1. An abrupt increase in bodyweight and body length was observed from birth to the age of 15 days (Fig. 1). After this peak, the bodyweight has shown in growth, and significant differences were observed relating to the establishment of puberty (Table 1). Fig. 2 shows that from the age of 15 days the body length exhibited constant growth until 150 days of age.
The mean testicular weight showed linear growth from birth to the age of 15 days and was observed to slow during the prepubertal phase (Fig. 3). Growth during the prepubertal and pubertal stages was not statistically different, although it differed from the growth at the immature and postpubertal stages (Table 1). As depicted in Fig. 4, the mean testicular length showed rapid growth up to 15 days, and after this period it presented linear growth, with no statistical differences being observed among groups (Table 1). These periods of increased growth in the first fifteen days of age coincide with the immature stage of sexual development.

**Table 1.** Mean body and testicular biometric and histometric parameters due to the stage of sexual development of Spix’s yellow-toothed cavy (*Galea spixii*) from 0 to 150 days of age

Means with different superscript letters are significantly different ($P < 0.05$) as estimated by analysis of variance and Tukey’s test (5%)

<table>
<thead>
<tr>
<th>Sexual stage</th>
<th>Bodyweight (g)</th>
<th>Body length (cm)</th>
<th>Testicular weight* (g)</th>
<th>Testicular length* (cm)</th>
<th>Tubular diameter (µm)</th>
<th>Seminiferous epithelial height (µm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immature$^a$</td>
<td>88.28 ± 56.45$^a$</td>
<td>13.67 ± 4.01$^a$</td>
<td>0.10 ± 0.07$^a$</td>
<td>0.87 ± 0.58$^ab$</td>
<td>26.03 ± 8.12$^a$</td>
<td>–</td>
</tr>
<tr>
<td>Prepubertal$^c$</td>
<td>143.33 ± 5.69$^{ab}$</td>
<td>18.50 ± 0.71$^b$</td>
<td>0.59 ± 0.49$^b$</td>
<td>1.07 ± 0.36$^b$</td>
<td>31.22 ± 9.78$^c$</td>
<td>–</td>
</tr>
<tr>
<td>Pubertal$^d$</td>
<td>195.45 ± 21.89$^{b}$</td>
<td>18.20 ± 1.36$^b$</td>
<td>0.45 ± 0.21$^b$</td>
<td>1.17 ± 0.32$^b$</td>
<td>75.53 ± 19.40$^b$</td>
<td>24.20 ± 4.25$^a$</td>
</tr>
<tr>
<td>Postpubertal$^e$</td>
<td>272.20 ± 54.57$^e$</td>
<td>21.00 ± 1.63$^b$</td>
<td>1.17 ± 0.40$^c$</td>
<td>1.53 ± 0.21$^b$</td>
<td>98.71 ± 11.74$^c$</td>
<td>27.46 ± 4.87$^c$</td>
</tr>
</tbody>
</table>

$^a$Mean of both testes.
$^b$Newborn and 15 days ($n = 9$).
$^c$30 days ($n = 3$).
$^d$45, 60, 75 and 90 days ($n = 8$).
$^e$120 and 150 days ($n = 4$).
Bodyweight showed a significant correlation with age, body length, testicular weight, testicular length, and seminiferous tubule diameter. A significant correlation was observed between body length and testicular length. There was a positive correlation between testicular weight and length and seminiferous tubule diameters (Table 2).

Table 2. Correlation coefficient between age, bodyweight and testicular parameters of Spix’s yellow-toothed cavy (*G. spixii*) from 0 to 150 days of age

<table>
<thead>
<tr>
<th></th>
<th>Age</th>
<th>BW</th>
<th>BL</th>
<th>TW</th>
<th>TL</th>
<th>TD</th>
<th>SEH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>–</td>
<td>0.89**</td>
<td>0.67</td>
<td>0.85**</td>
<td>0.63</td>
<td>0.90**</td>
<td>0.74</td>
</tr>
<tr>
<td>BW</td>
<td>–</td>
<td>–</td>
<td>0.87**</td>
<td>0.80**</td>
<td>0.79**</td>
<td>0.89**</td>
<td>0.81</td>
</tr>
<tr>
<td>BL</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>0.61</td>
<td>0.76**</td>
<td>0.62</td>
<td>0.99</td>
</tr>
<tr>
<td>TW</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>0.76**</td>
<td>0.78**</td>
<td>0.31</td>
</tr>
<tr>
<td>TL</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>0.68</td>
<td>0.44</td>
</tr>
<tr>
<td>TD</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>0.92</td>
</tr>
<tr>
<td>SEH</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

**, P < 0.05

Microscopic observations

**Testis histology**

Histologically, the testicular parenchyma of animals from birth to the age 30 days is formed by testicular cords and internal cord compartments associated with the presence of Leydig cells, vessels and nerves. Within the testicular cords, gonocytes and undifferentiated supporting cells were observed. Gonocytes were located in the region close to the basal membrane, and their nuclei presented shapes ranging from circular to oval. The undifferentiated supporting cells were characterised by an elongated nucleus interspersed with gonocytes, and they were found side by side in the basal membrane. The testicular cords at this stage had no lumen; one of the five 15-day-old animals had a lumen in seminiferous tubules and mitotic structures were present (Figs 5a, b, 6). In this section, primary spermatogonia and spermatocytes were visualised. A 30-day-old animal showed seminiferous tubules undergoing a luminal process. In the same animal, Sertoli cells, metaphasic plates and cells at different stages of the seminiferous epithelial cycle, such as spermatogonia and spermatocytes in the pachytene and zygotene stages, were seen.

At 45 and 60 days of age, the testicular parenchyma was observed to be constituted of seminiferous tubules and...
interstitial tissue that contained Leydig cells and blood vessels. Seminiferous tubules of these animals had lumen, with a germinative epithelium being formed at different stages of the seminiferous epithelial cycle (Fig. 7a, b). Spermatozoa were first observed in the tubular lumen at 45 days of age (Fig. 7a). Only one 45-day-old animal did not present some development of the germinative epithelium, with cells being observed at different stages of division (not shown).

Testicular cords and seminiferous tubules were observed in the testicular parenchyma of different 75- and 90-day-old animals. It was observed that one animal of each age showed luminal development of the testicular cords with gonocytes and undifferentiated supporting cells. The other animals at these ages presented seminiferous tubules containing lumina and seminiferous epithelial cells at different stages (Fig. 7d, e).

In the 120- and 150-day-old Spix’s yellow-toothed cayies, all of the seminiferous tubules had luminal areas with cells at different stages of division (Fig. 8a, b), and it was possible to classify them into eight stages of cellular associations in accordance with the tubular morphology method (Curtis 1981).

Fig. 7. Development of Spix’s yellow-toothed cavy (Galea spixii) testes during the pubertal sexual phase. Testicular parenchyma composed of seminiferous tubules and interstitium. Observe the germinal epithelium (ep) (a, spermatogonia; arrow, primary spermatocytes in preleptotene/leptotene; p, primary spermatocytes at pachytene; ar, round spermatids; s, Sertoli cells; e, spermatozoa). For the first time, the presence of spermatozoa was observed in the tubular lumen at 45 days of age. The internal cord (i) consists of the interstitial Leydig cells. (a) 45 days, 40×; (b) 60 days, 40×; (c) 60 days, 100×; (d) 75 days, 40×; (e) 90 days, 40×; and (f) 90 days, 100×. Photomicrograph, hematoxylin–eosin method, 400×.

Fig. 8. Testis of Spix’s yellow-toothed cavy (Galea spixii) in postpubertal sexual phase. The seminiferous tubules are bright, with germ cells at different stages of division. At this stage we can see various stages of sexual cycle of the seminiferous epithelium. Note the seminiferous tubule germinal epithelium with developed (p) comprising: spermatogonia (a), primary spermatocytes in PL/L (p), primary spermatocytes at pachytene (pq), round spermatids (ar) and Sertoli cells (arrow). Note spermatozoa (e) in the tubular lumen. (a) 120 days, 40×; and (b) 150 days, 100×. Photomicrograph, hematoxylin–eosin method.
Cord and tubular diameters

The growth of the tubular diameter from birth to the first month (immature phase) of age was found to be slow, and differences were found during the pubertal and postpubertal phases (Table 1). At 45 days of age, the tubular diameter presented significantly more rapid growth that remained linear up to the age of 150 days (Fig. 9). The mean tubular diameter showed a strong significant correlation with age, bodyweight and testicular weight (Table 2).

Seminiferous epithelial height

The seminiferous epithelial height showed no differences in growth among the pubertal and postpubertal groups observed (Table 1), and no significant correlation was found between the body and testicular biometric parameters (Table 2).

Seminiferous tubule cell type counts

The mean corrected numbers of spermatogenic and Sertoli cell types per seminiferous tubule cross-section at stage I of the seminiferous epithelial cycle are shown in Table 3.

The spermatogonia presented a stable cellular population with no significant differences found between the pubertal and postpubertal phases; the primary spermatocytes in the preleptotene/leptotene stage showed an increase associated with changes of the sexual phase. The populations of primary spermatocytes at the pachytene stage and round spermatids were statistically significant differences found between the pubertal and postpubertal phases; the primary spermatocytes in the preleptotene/leptotene stage; P, old primary spermatocyte in the pachytene stage; SPD Ar, round spermatid at stage I; 1correction according to Abercrombie (1946) modified by Amann and Almquist (1962); 245, 60, 75 and 90 days (n = 6); 3120 and 150 days (n = 4)

Table 3. Corrected number1 of cells per cross-section of the seminiferous tubule of Spix’s yellow-toothed cavy (Galea spixii) from 60 to 150 days of age

<table>
<thead>
<tr>
<th>Age (days)</th>
<th>Sertoli index SPD ar : CS</th>
<th>Spermatogenetic yield SPD ar : PA</th>
</tr>
</thead>
<tbody>
<tr>
<td>60 (n = 2)</td>
<td>20.49a</td>
<td>31.02a</td>
</tr>
<tr>
<td>90 (n = 2)</td>
<td>15.57a</td>
<td>24.10a</td>
</tr>
<tr>
<td>120 (n = 2)</td>
<td>20.34a</td>
<td>34.81a</td>
</tr>
<tr>
<td>150 (n = 2)</td>
<td>15.93a</td>
<td>35.82a</td>
</tr>
</tbody>
</table>

Table 4. Ratio between the number of spermatogenic cells per cross-section of the seminiferous tubule of Spix’s yellow-toothed cavy (Galea spixii) from 60 to 150 days of age

Means with different superscript letters are significantly different (P < 0.05) as estimated by analysis of variance and Tukey’s test; SPD ar, round spermatid; SPA, spermatogonia; CS, Sertoli cells

<table>
<thead>
<tr>
<th>Sexual stage</th>
<th>SPG</th>
<th>Primary spermatocyte</th>
<th>SPD Ar</th>
<th>Sertoli cells</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pl/L</td>
<td>P</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pubertal</td>
<td>15.15 ± 3.66a</td>
<td>43.03 ± 8.42a</td>
<td>45.48 ± 8.97a</td>
<td>93.95 ± 31.57a</td>
</tr>
<tr>
<td>Postpubertal</td>
<td>15.05 ± 3.84a</td>
<td>48.88 ± 9.54b</td>
<td>50.74 ± 10.93b</td>
<td>122.60 ± 39.08b</td>
</tr>
</tbody>
</table>

Fig. 9. Mean testicular cord and seminiferous tubule diameter of Spix’s yellow-toothed cavy (Galea spixii) from 0 to 150 days of age.

Yield and Sertoli index

The general spermatogenetic yield was observed to increase, although no significant difference was observed. Additionally, the Sertoli cell index showed similar ratios among the groups of 60 and 120 days and 90 and 150 days; this index was stable and did not differ statistically between the ages observed (Table 4).

Discussion

This was the first study to address the male reproductive biology of Spix’s yellow-toothed cavy, with an emphasis on investigating the structure of the testes and the spermatogenic process and on establishing the sexual stages of the animal based on morphological parameters. Previous studies related to the species Galea spixii evaluated the female reproductive biology (Oliveira et al. 2008).

Macroscopic observations

The bodyweight and length of Spix’s yellow-toothed cavy at birth were less than the values found in the same age group of Cavia aperea (Corradello 1987). Body growth of Spix’s yellow-toothed cavy was rapid from birth to the age of 150 days, as in the chinchilla (Leal and Franca 2009), two peaks of faster growth were observed. The periods of faster growth coincided with the immature and pubertal stages of sexual development. Additionally, similar to what is observed in the chinchilla...
(Leal and França 2009), the testicular weight of Spix’s yellow-toothed cavy exhibited progressive growth, showing a significant correlation ($P < 0.05$) with age, bodyweight and testicular length; this effect has also been observed in rodents (Kenagy and Trombulak 1986), pigs (França et al. 2000), wild boars (Almeida et al. 2006) and Landrace boars (Okwun et al. 1996).

From birth to the age of 150 days, the testicular length of Spix’s yellow-toothed cavy showed a significant correlation with bodyweight, body length and testicular weight, whose growth after 90 days coincides with the growth in the population of the spermatogenic cell type. This observation is similar to what has been found for other species of mammals (Attal and Courot 1963; França et al. 1988b; Melo and Vale Filho 1992).

Microscopic observations

Testis histology

The testicular parenchyma of Spix’s yellow-toothed cavy from birth to the age of 15 days is formed by testicular cords with immature Sertoli cells and gonocytes, which are more centrally located, and an internal cord compartment containing Leydig cells, vessels and nerves, which were also found in guinea-pigs (Cooper and Schiller 1975), chinchillas (Leal and França 2009) and rams (Lunstra and Schanbacher 1988). Additionally, metaphasic plates were found in the seminiferous tubules of Spix’s yellow-toothed cavy during the first month of life. According to Clermont and Perey (1957), several mitotic structures were also seen in rats at this stage.

In the age groups from 30 days onwards, testicular development was not completely established, as has also been noted at seven months of age in agoutis (Assis-Neto et al. 2003b) and pigs (França et al. 1988b). At these ages, spermatozoa have not been observed in the tubular lumen. From 45 days of age, all animals showed spermatozoa in the tubular lumen; however, the stages of the seminiferous epithelial cycle were not completely defined throughout the entire testicular parenchyma. Considering the observation of spermatozoa in the tubular lumen, it can be concluded that the animals were in the pubertal phase from 45 days of age, which is in agreement with the description of Courot et al. (1970) for the definition of puberty from a histological point of view.

Cord and tubular diameters

The mean tubular diameter of Spix’s yellow-toothed cavy was below the values considered typical for most mammals (180–300 μm; Roosen-Runge and Giesel 1950). There was a significant correlation between age, bodyweight and testicular weight. Comparing these data with those obtained from the Piau pig, after slow development in the first 3 months of life, the mean seminiferous tubule diameter of the pig increased suddenly between 4 and 5 months, also showing a positive correlation with age (França 1987). According to Assis-Neto et al. (2003d), the increased tubular diameter in agoutis was accompanied by an increase in the population of spermatogenic cells related to age, this effect was also observed in Spix’s yellow-toothed cavy. In rats, the tubular diameter was observed to increase during the later stages of the seminiferous epithelial cycle (Roosen-Runge and Giesel 1950).

Accelerated growth of the tubular diameter of Spix’s yellow-toothed cavy coincides with the onset of spermatogenesis, indicating that the cellular morphology can be used to mark the pubertal stage of the animal.

Seminiferous epithelial height

According to Wing and Christensen (1982), the seminiferous epithelium height is more effective than the tubular diameter for evaluating sperm production, and it reveals the degree of tubular functionality (Courot et al. 1970). In Spix’s yellow-toothed cavy, the mean seminiferous epithelium height was $27.48 \pm 2.71 \, \mu m$, which was lower than the values observed in domestic animals (60–100 μm) (França and Russell 1998) and wild rodents (63–78 μm) (Leal and França 2009).

Seminiferous tubule cell population

Spix’s yellow-toothed cavy ages 60, 90, 120 and 150 days were confirmed to be in the pubertal stage, which is in agreement with the method of tubular morphology of Courot et al. (1970). When comparing the mean numbers of spermatogonia in Spix’s yellow-toothed cavy at different ages with the number of spermatogonial obtained for Piau pigs by França (1991) and male peccaries by Costa et al. (2006), similar mean values were found. The mean numbers of spermatocytes I in the preleptotene/leptotene and pachytene stages in Spix’s yellow-toothed cavy in this study were lower than those in the Piau pigs studied by França (1991). Similarly, the number of round spermatids was lower than in swine (Godinho and Cardoso 1979; França 1987), collared peccaries (Costa et al. 2006) and capybara (Paula et al. 1999) in previous studies. The Sertoli cell population was found to be stable, with an increase at postpubertal sexual phase. The stabilisation of the population of Sertoli cells and its relationship with the round spermatids suggests that there is variation in daily sperm production (Okwun et al. 1996).

Spermatogenetic yield and Sertoli index

Spermatogenic output is an important indicator of sperm production capacity, and it may serve as a parameter for determining the ideal age for entering reproductive activity (Assis-Neto et al. 2003c). From the time of puberty, this yield increases gradually and stabilises upon reaching sexual maturity (França and Cardoso 1988; Melo and Vale Filho 1992). In Spix’s yellow-toothed cavy, the yield was shown to be stable from puberty to the postpubertal stage, similar to what has been observed in chinchillas, which did not change from 5 to 30 months of age (Leal and França 2009). At the age of 150 days, it was observed that each type A spermatagonia produced only 35.82 round spermatids. This rate was similar to what was found in adult boars (Costa and Silva 2006), but below the rate described for domestic pigs (França and Russell 1998), Piau pigs (França 1991) and sheared sheep (Martins et al. 2008), and higher than the rates found for adult peccaries (Costa et al. 2004) and agoutis (Assis-Neto et al. 2003e).

The Sertoli cells play vital role in the development of spermatogenesis, phagocytosis of degenerating germ cells and residual bodies, providing structural support and nutrition for germ cells, spermatogenesis of mature spermatids, phagocytosis of degenerating germ cells and residual bodies,
secretion of proteins and cell-to-cell communication (Johnson and Nguyen 1986). In the Spix’s yellow-toothed cavies studied here, the Sertoli cell index was not stable, which indicates that up to 150 days of age Spix’s yellow-toothed cavy is not in a stage of sexual maturity. This is similar to what has been reported in agoutis (Assis-Neto et al. 2003c), while in chinchillas, the index of Sertoli cells was found to increase 2-fold from 5 to 17 months of age (Leal and França 2009).

Based on our investigation of the spermatogenesis of Spix’s yellow-toothed cavy from birth to the age of 150 days, it was concluded that the onset of reproductive activity in this species occurs at 45 days of age, as spermatozoa released into the tubular lumen could be seen at this time. In this species, spermatogenesis was not established in the testicular parenchyma, and the spermatogenetic yield was constant during puberty. The stages of sexual development may be classified into the following phases: from birth to the age of 15 days corresponds to the immature stage; 30 days of age to the prepubertal stage; 45, 60, 75, 90 and 105 days of age to the pubertal stage; and 120 and 150 days of age to the postpubertal stage. It was not possible to determine the stabilisation degree of the testicular cells and it was therefore not possible to determine the stage of sexual maturity.

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References


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