Ann. Zootech. 48 (1999) 225–230



**Original article**

# Effects of castration on growth and endocrine pattern in the grasscutter (*Thryonomys swinderianus*, Temminck 1827)

Théodore Alogninouwa[a]*, Marc Kpodékon[b], Lassissi Togbé Yewadan[c]

[a] École nationale vétérinaire de Lyon, unité pathologie médicale du bétail, 1, avenue Bourgelat, BP 83, 69280 Marcy l'Étoile, France
[b] Université nationale du Bénin, Laboratoire de recherche en chimie et biologie appliquées, Unité de recherche cunicole et cavicole, BP 2009 Cotonou, Benin
[c] Projet de développement de l'élevage d'aulacodes, BP 504 Cotonou, Benin

(Received 27 May 1998; accepted October 1998)

**Abstract** — In order to analyze the effects of castration on growth performance, cortisol, thyroxine and testosterone assays were performed on three randomized groups of grasscutters (*Thryonomys swinderianus*, Temminck 1827): ten complete females, ten complete males and ten surgically castrated males over 4 months of age. The growth rate of the castrated animals was lower than that of the intact males, but higher than that of the females. The weight gain was positively correlated with blood thyroxine concentration and negatively correlated with blood cortisol concentration. (© Elsevier / Inra)

***Thryonomys* / castration / growth / endocrinology / rodent**

**Résumé — Effets de la castration sur la croissance et le profil endocrinien de l'aulacode (*Thryonomys swinderianus*, Temminck 1827).** Pour apprécier les effets de la castration sur les performances de croissance pondérale d'aulacodes élevés en station, des études ont été menées sur trois lots randomisés (dix femelles, dix mâles entiers et dix mâles castrés chirurgicalement dans le cinquième mois d'âge). Les résultats montrent que les performances des sujets castrés sont moins bonnes que celles des mâles entiers tout en restant meilleures que celles des femelles. La croissance pondérale est corrélée positivement avec la thyroxinémie et négativement avec le taux de cortisol. (© Elsevier / Inra)

***Thryonomys* / castration / croissance / endocrinologie / rongeur**

* Correspondence and reprints.
Tel.: (33) 04 78 87 26 02; fax: (33) 04 78 87 26 06; e-mail: t.alogninouwa@vet-lyon.fr

## 1. INTRODUCTION

The grasscutter (*Thryonomys swinderianus*) (*figure 1*) is a large hystricomorph rodent whose meat is greatly appreciated, especially in Africa [2–4] where grasscutter breeding has spread in many countries (including Benin, Burkina Faso, Côte-d'Ivoire, Gabon, Guinea, Togo, etc.). The growth of the grasscutter is very slow: whereas the breeding rabbit reaches 3 kg at the age of 12 weeks, the same weight is not obtained in the grasscutter before 40 weeks.

Castration of male grasscutters has therefore been considered to improve the males' growth; the female is kept for breeding and to spread the species in the country. According to the preliminary experiment, non-castrated male grasscutters seemed to have a higher growth rate than castrated animals. Nevertheless, it is difficult to interpret the first results because the castrated grasscutters were chosen among animals not kept for reproduction and therefore with low breeding performance. In addition, bias was introduced by the fact that the castrated animals were bred in separate groups and in different feeding and maintenance conditions to those used for non-castrated animals.

This study was undertaken in order to correct the bias and to determine the pattern of endocrinological secretions in castrated males, in intact males and in females.

**Figure 1.** *Thryonomys swinderianus* (Temminck 1827).

## 2. MATERIALS AND METHODS

### 2.1. Animals

The animals used in this experiment were kept in close captivity at the Benin Grasscutter Breeding Development Center, Cotonou.

From a starting sample of 60 males from a standard herd of 247 males, 30 randomized animals were surgically castrated by removing the testicles at 4 months of age. The remaining 30 males were retained as a control group. The experimental groups were randomly constituted with ten castrated and ten non-castrated males selected from the initial sample. A group of ten females of the same age and bred in the same conditions was used as a female group.

The animals were weighed at birth and each month with a Sartorius® MC1 balance (sensitivity: 1 g; reproducibility: < 0.5 g) until slaughter (at about 12 months).

### 2.2. Sampling

Blood samples were collected just before slaughtering at 12 months by venipuncture on the anesthetized animals (Imalgene 1000®, 0.5 $mg \cdot kg^{-1}$ + Rompun®, 0.5 $mL \cdot kg^{-1}$, by intramuscular injection) either on ethylene diamine tetraacetic acid (EDTA) for plasma collection after centrifugation at 400 *g* or without anticoagulant for serum. All samples were then stored below –20 °C until assay.

### 2.3. Endocrine assays

#### 2.3.1. Thyroxine

Thyroxine (T4) assays were carried out using the Amerlex® M T4 RIA (radioimmunoassay) Kit supplied by Kodak Diagnostic (Les Ulis, France) without any changes to the usual kit protocol. The sensitivity of the method is below

4.0 nmol·L$^{-1}$, the intra-assay standard error is 2.6 to 3.3 % and the inter-assay standard error is 3.6 to 4.7 %.

### *2.3.2. Cortisol*

Cortisol assays were carried out using the Amerlex® Cortisol RIA Kit supplied by Kodak Diagnostic (Les Ulis, France), with no modification of the usual kit protocol. The sensitivity of the method is below 3.0 nmol·L$^{-1}$, the intra-assay standard error is 3.4 to 5.7 % and the inter-assay standard error is 5.2 to 8.9 %.

### *2.3.3. Testosterone*

Testosterone assays were carried out using the SB-Testo® supplied by Oris Industrie S A (Gif-sur-Yvette, France) without any changes to the usual kit protocol. The sensitivity of the method is 0.30 nmol·L$^{-1}$, the intra-assay standard error is 6.5 to 9.4 % and the inter-assay standard error is 6.8 to 10 %.

### *2.3.4. Analyses*

The assays were proven by measuring the radioactivity using a Packard RIA Star® solid scintillation counter. Standard curve fitting using a spline transformation was performed using a program included in the counter software. A graphical check of the fitting of the standard point was used to verify each assay.

Statistical analysis was performed using a one-factor analysis of variance (sex) and comparison of means (Microsoft Excel 5.0a on Macintosh®).

## 3. RESULTS

### 3.1. Growth performance (*table I*)

There was no significant difference in growth between the three groups until 4 months of age ($P > 0.01$). At the age of 5 months (1 month after castration), the growth in the intact males group was significantly higher than in the other two groups ($P < 0.01$). From the age of 6 months, weight was significantly higher in the group of castrated males than in the females ($P < 0.01$), but significantly lower than in the intact males ($P < 0.01$).

**Table I.** Comparison of evolution of weights (g) in males, castrated males and females.

| Age | Males[1] | Castrated males[1, 2] | Females[1] |
|---|---|---|---|
| (months) | Weight ± SEM | Weight ± SEM | Weight ± SEM |
| At birth | 126 ± 6$^{a}$ | 125 ± 11$^{a}$ | 119 ± 8$^{a}$ |
| 1 | 367 ± 31$^{a}$ | 352 ± 19$^{a}$ | 347 ± 17$^{a}$ |
| 2 | 564 ± 31$^{a}$ | 590 ± 32$^{a}$ | 574 ± 22$^{a}$ |
| 3 | 954 ± 66$^{a}$ | 876 ± 45$^{a}$ | 803 ± 33$^{a}$ |
| 4 | 1 292 ± 82$^{a}$ | 1 178 ± 61$^{a}$ | 1 134 ± 45$^{a}$ |
| 5 | 1 689 ± 105$^{a}$ | 1 487 ± 73$^{b}$ | 1 472 ± 74$^{b}$ |
| 6 | 2 071 ± 125$^{a}$ | 1 724 ± 73$^{b}$ | 1 626 ± 58$^{c}$ |
| 7 | 2 382 ± 133$^{a}$ | 1 937 ± 81$^{b}$ | 1 771 ± 49$^{c}$ |
| 8 | 2 684 ± 151$^{a}$ | 2 208 ± 87$^{b}$ | 1 917 ± 49$^{c}$ |
| 9 | 2 950 ± 140$^{a}$ | 2 489 ± 93$^{b}$ | 2 062 ± 58$^{c}$ |
| 10 | 3 126 ± 139$^{a}$ | 2 657 ± 81$^{b}$ | 2 207 ± 73$^{c}$ |
| 11 | 3 304 ± 152$^{a}$ | 2 812 ± 103$^{b}$ | 2 352 ± 91$^{c}$ |

[1] Number of animals per group = 10; [2] castration of males at end of the 4th month; SEM: standard error of the mean. For each age the means of weights with different letters were significantly different ($P < 0.01$).

### 3.2. Endocrine assays

The results obtained in the grasscutter were in good agreement with those obtained in the rabbit by Jaffe and Behrmann [17].

#### *3.2.1. Thyroxine* (figure 2)

The level of thyroxine was significantly lower in the females (17.1 nmol·L$^{-1}$) and castrated males (18.1 nmol·L$^{-1}$) than in the intact males (23.5 nmol·L$^{-1}$) ($P < 0.05$).

#### *3.2.2. Cortisol* (figure 3)

The results indicated no significant difference between the intact male (182.5 nmol·L$^{-1}$), female (208.0 nmol·L$^{-1}$) and castrated male (204.7 nmol·L$^{-1}$) groups ($P > 0.05$).

#### *3.2.3. Testosterone (figure 4)*

The concentration was between 2.2 and 66.8 nmol·L$^{-1}$ in the intact male group, due to the pulsatile pattern of the testosterone secretion. The concentration in the castrated and female groups was below the sensitivity level of the assay (0.3 nmol·L$^{-1}$). However, two castrated males exhibited an abnormally high concentration of testosterone: 3.4 and 2.4 nmol·L$^{-1}$.

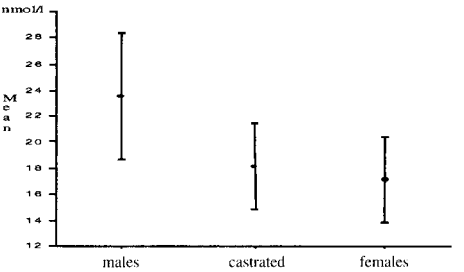


**Figure 2.** T4 interactions (significant at 95 %).

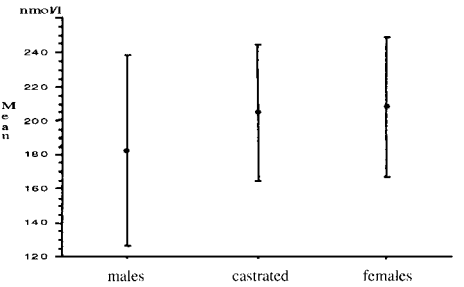


**Figure 3.** Cortisol interactions (not significant).

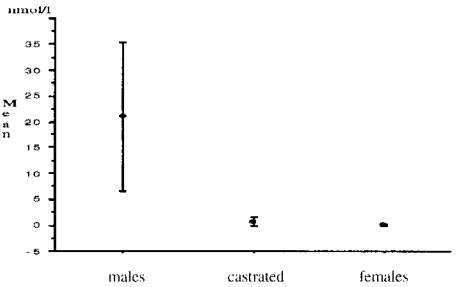


**Figure 4.** Testosterone interactions (significant at 95 %). Non-castrated males vs. castrated males or females.

## 4. DISCUSSION

### 4.1. Growth performance

The effects of castration on growth performance have been studied in numerous species, occasionally with inconsistent results. There are very few reports in the literature regarding rodents and lagomorphs. In 1988, Fekete [14] reported that castration enhances wool production in male Angora rabbits. However, no reports were found on castration in the grasscutter.

In others species, a review of the literature concerning cattle [16] led to the conclusion that castrated males have a lower growth rate than bulls, whatever the age or weight. Investigations performed by Bagley et al. [6], Cohen et al. [10] and Gregory and Ford [15] led to similar results.

The results are not so clear in the goat and the sheep. Chopra [9] found that the intact goat kids' growth was greater than that observed in castrated animals, leading to

the conclusion that castration is not useful. Likewise, Azamel et al. [5] reported that the slaughter weight was lower for castrated (20.75 kg) than for non-castrated animals (22.06 kg). El-Bayomi and El-Sheikh [13] found there was no difference between the average daily gains (ADG) observed in castrated and non-castrated goat kids. In the sheep, Thys et al. [19, 20] compared average body weight and daily gain between non-castrated and castrated rams and found that castration decreased body weight and increased feed consumption per kg gain. They reported that the results were poorer when castration was performed later.

In the pig, a species in which castration is common practice, most authors, such as Desmoulin et al. [11], Marks et al. [18] and Yadav et al. [21], noted that castrated animals have a lower growth performance than non-castrated males. In view of the fact that loin fat is thicker in castrated males, castration is principally used to eliminate the *sui generis* smell in this species.

Yet unexplained differences occur between species in poultry. Castrated turkeys have a lower growth performance than intact controls, no matter when castration is performed [7], but caponization significantly enhances broiler growth with much abdominal fat [8].

In our studies, comparison of the growth rate in the different grasscutter groups led to the conclusion that the best performance is obtained in male animals, whether or not they are castrated. The results also displayed a greater increase in growth performance in the non-castrated versus castrated males and in castrated males versus females. The dissociation between the growth curves of castrated males and females occurred more than 1 month after castration. It is therefore clear that castration around the 5th month of age in the grasscutter does not improve the weight increase in males and should be considered a non-economic method. More research is needed to verify the effect of earlier castration.

### 4.2. Endocrinology

The decrease in testosterone concentrations observed in castrated males in comparison to those obtained in non-castrated animals simply provides evidence of castration, which cuts off testicular endocrine secretion [1, 12]. The high concentrations observed in two animals were probably due to false castration resulting from partial removal of the testicle, as commonly observed in grasscutters. However, the discontinuance of testosterone secretion must be related to growth performance. Indeed, growth hormone (GH) secretion is regulated by many hypothalamic factors that are modulated by the gonadic steroids. Thus, GH concentration is lower in castrated than in non-castrated pigs [12]. Furthermore, castration reduces circulating GH and GH response to GH releasing hormone stimulation. Lack of testosterone secretion can therefore downregulate growth performance.

GH was not assayed in this experiment, but thyroxine is a good parameter not only for direct appraisal of the thyroid activity, but also for the evaluation of growth. In this experiment, the levels of thyroxine concentration were in good correlation with the growth performance (non-castrated males > castrated males > females).

Finally, no differences were found between cortisol concentrations, suggesting that there were no stress differences between the housing management of the three groups of animals [22].

## 5. CONCLUSION

The grasscutter is a slow growing rodent in which the daily weight gain is higher for males than females. Castration of males at 4 months of age is ineffective in improving growth performance. Although the growth performance was greater than in females, castrated males had less daily weight gain than non-castrated males.

## REFERENCES


[1] Adams T.E., Daley C.A., Adams B.M., Sakurai H., Testis function and feedlot performance of bulls actively immunized against gonadotropin-releasing hormone: Effect of implants containing progesterone and estradiol benzoate, J. Anim. Sci. 71 (1993) 811–817.

[2] Alogninouwa Th., Contribution à l'étude anatomique et histologique de l'appareil digestif de l'aulacode (*Thryonomys swinderianus* Temminck 1827), thèse doctorat, Université Paris 6, France, 1994, 131 p.

[3] Alogninouwa Th., Yewadan L.T., Schrage R., L'aulacode, une espèce africaine intéressante à plus d'un titre, Bull. Mens. O.N.C. 117 (1993) 16–19.

[4] Alogninouwa Th., Yewadan L.T., Schrage R., Biologie de l'aulacode (*Thryonomys swinderianus*) en Afrique tropicale, Gibier Faune Sauvage 10 (1993) 81–84.

[5] Azamel A.A., El-Sherbinay A.A., Bata S.S., Mokhtar M.M., Shehata M.F., Effect of early castration on performance, carcass characteristics and meat acceptability in Baladi goat kids, Indian J. Anim. Sci. 62 (1992) 723–727.

[6] Bagley C.P., Morrison D.G., Feazel J.I., Saxton A.M., Growth and characteristics of suckling beef calves as influenced by age at castration and growth implants, J. Anim. Sci. 67 (1989) 1258–1264.

[7] Burke W.H., Edwards J.R.H.M., Effect of early castration on body weight, muscle growth and bone characteristics of male Nicholas strain turkeys, Poultry Sci. 73 (1994) 457–463.

[8] Cason J.A., Fletcher D.L., Burke W.H., Effects of caponization on broiler growth, Poultry Sci. 67 (1988) 970–981.

[9] Chopra S.C., Effect of castration of Beetal kids on their body weight and daily weight gains up to marketable age, Indian J. Anim. Prod. Manage. 4 (1988) 100–101.

[10] Cohen R.D.H., King B.D., Janzen E.D., Nicholson H.H., The effect of castration age, method and implant regime on growth and carcass traits of male beef cattle, Can. J. Anim. Sci. 71 (1991) 301–309.

[11] Desmoulin B., Aumaitre A., Peiniau J., Influence du poids à 10 jours et l'âge à la castration du porcelet mâle sur le taux de croissance et la qualité de la carcasse, Ann. Zootech. 39 (1990) 219–227.

[12] Dubreuil P., Pelletier G., Couture Y., Lapierre H., Petitclerc D., Morisset J., Gaudreau P., Brazeau P., Castration and testosterone effects on endogenous and somatocrinin-induced growth hormone release in intact and castrated male pigs, Domestic Anim. Endocrinol. 6 (1989) 15–24.

[13] El-Bayomi K.M., El-Sheikh A.I., Effects of breed and castration on body growth of goats during fattening, Indian J. Anim. Sci. 59 (1989) 717–721.

[14] Fekete S., Angora rabbit production and research in Europe (especially in Hungary), J. Appl. Rabbit Res. 11 (1988) 178–179.

[15] Gregory K.E., Ford J.J., Effects of late castration, zeranol and breed group on growth, feed efficiency and carcass characteristics of late maturing bovine males, J. Anim. Sci. 56 (1983) 771–780.

[16] Huerta-Leidenz N., Rios G., Castration of bulls at different stages of growth. 1. Effects on production. A review, Rev. Fac. Agron. Univ. Zulia 10 (1993) 87–115.

[17] Jaffe B.M., Behrmann H.R., Methods of Hormone Radioimmunoassay, 2nd edn., Academic Press, New York, 1979.

[18] Marks M.A., Mabry J.W., Seerley R., Rampacek G.W., Comparison of early castration at day 1, 7 or 14 on growth and carcass traits in swine, Livest. Prod. Sci. 20 (1988) 269–273.

[19] Thys E., Hardouin J., Verhulst A., Influence de la castration partielle et totale sur les performances de croissance et de conversion alimentaire de béliers Poulfouli de l'Extrême-Nord Cameroun, Rev. Elev. Med. Vet. Pays Trop. 42 (1989) 267–274.

[20] Thys E., De Wilde R., Hardouin J., Verhulst A., Influence de la castration tardive à 12 mois d'âge sur les performances d'embouche des béliers Poulfouli de l'extrême nord du Cameroun, Rev. Elev. Med. Vet. Pays Trop. 43 (1990) 233–238.

[21] Yadav B.P.S., Varma A., Gupta J.J., Effect of sex and castration on nutrient utilization and growth in crossbred pigs, Indian J. Anim. Sci. 63 (1993) 1094–1096.

[22] Yewadan T.L., Sur les aspects pratiques de la conduite de l'élevage et de l'alimentation de l'aulacode en captivité, Nature et Faune 4 (1988) 22–24.