Original article

# Gross anatomy of the intestine and their peritoneal folds in the tucu - tucu (*Ctenomys pearsoni*)

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## Abstract

The anatomy of the intestines and its mesenteries of *Ctenomys pearsoni* have not been described. In the present study, ten adult *Ctenomys pearsoni* were studied using gross dissection. The small intestine was divided into duodenum, jejunum and ileum as usual. The duodenum started at the pylorus with a cranial portion, which dilated forming a duodenal ampulla. The ileum was very short and attached to the coiled cecum by means of the iliocecal fold. The ascending colon had one ansa with two parts, one proximal and one distal. Both parts of the ascending colon's ansa were parallel to each other and joined by an apical flexure and the ascending mesocolon. The descending duodenum was fixed to the proximal part of the ascending colon by a peritoneal fold named accessory duodenocolic fold. The ascending duodenum was fixed by the duodenocolic fold to the descending colon. This study indicates that there are minor differences in the divisions of the intestine and their peritoneal folds, as it usually happens when comparing other rodents.

**Keywords:** rodentia, digestive system, abdominal organs, mesentery.

## 1 Introduction

The digestive anatomy has been studied in only a few species of the order Rodentia. Previous studies show that species belonging to the order Rodentia have differences in their intestinal anatomy (BONFERT, 1928; SNIPES, 1979a, b; PERRIN and CURTIS, 1980; SNIPES, 1981, 1982a, b; SNIPES, HÖRNICKE, BJÖRNHAG et al., 1988; SNIPES, NEVO and SUST, 1990; NIETERS, SCHNORR and KRESSIN, 2003; KOTZE, van der MERWE and O'RIAIN, 2006; PÉREZ, LIMA and BIELLI, 2008). Especially the cecum shows large differences among rodent species (PERRIN and CURTIS, 1980). There is no consensus on the anatomical nomenclature for this species.

In this paper we studied the anatomy of the abdominal digestive organs of the herbivorous tucu - tucu, *Ctenomys pearsoni* (Rodentia, Octodontidae) from Uruguay.

According to Altuna, Bacigalupe and Corte (1998) a unique feature of *C. pearsoni* is the size and mass of its cecum, where microbial fermentation of cellulose and pectin take place. The cecum in *C. pearsoni* weighs around 30% of the animal's total body weight and occupies the entire breadth of the abdomen, making it the most developed among hystricognath rodents (ALTUNA, BACIGALUPE and CORTE, 1998).

The description of the mesentery of the tucu - tucu requires concise definitions, particularly with respect to the divisions of the intestine. Pérez, Möller and Martin (2005, 2007) have described the divisions of the intestine and the peritoneal folds of the *Oryctolagus cuniculus*, and recently the intestine and peritoneal folds of the nutria (PÉREZ, LIMA and BIELLI, 2008).

The objective of this work is to give a complete and detailed description of the anatomy of the intestine of the tucu - tucu, including its length and its mesentery, with a defined nomenclature, in order to improve the existing knowledge on this species.

## 2 Material and methods

The study was performed using 10 healthy adult tucu - tucu (9 females and 1 male). They were euthanized with an overdose of ketamine administered intramuscularly. All animals were promptly dissected fresh, without fixation. The ventral abdominal wall of each animal was removed and after the observation of the topography of the organs and the peritoneal folds, the intestinal tract was separated after sectioning the pylorus just before the duodenum, and separating it from its attachments to the dorsal abdominal wall. The rectum was tied off at its union with the canal anal and transected. After removal of all mesenteric attachments, the lengths of the different sections of the intestinal tract on the anti-mesenteric side were taken with a standard measuring tape. The results were recorded and tabulated. Pictures were taken with a Nikon D 80 digital camera. Terms were used in agreement with the NAV (2005).

## 3 Results

### 3.1 Divisions of the intestine

The body weight and measurements from the individual intestinal sections are presented in Table 1. Figures 1 and 2 showing the aspect of the ventral abdominals organs of this animal.

The small intestine was divided into duodenum, jejunum and ileum. The duodenum (Figures 3, 4) started at the

**Table 1.** Corporal length, body weight and lengths of the intestine and its parts in the *Ctenomys pearsoni*.

| Animal number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Mean | SD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sex** | **Female** | **Female** | **Female** | **Female** | **Male** | **Female** | **Female** | **Female** | **Female** | **Female** | | |
| Body weight (g) | 130 | 134 | 126 | 154 | 164 | 168 | 214 | 169 | 212 | 134 | 160.5 | 32,011283 |
| Corporal length in cm (nucae to radix caudae) | 24.0 | 22.8 | 24.8 | 25.4 | 24.9 | 26 | 27.8 | 27.8 | 27.3 | 26.5 | 25.73 | 1,66469888 |
| Length Duodenum (cm) | 21.5 | 18.5 | 17 | 28 | 18.5 | 34.0 | 39 | 26 | 35 | 32 | 26.95 | 7,8791215 |
| Length Jeyunum- Ileum (cm) | 48 | 47.5 | 70 | 46 | 36.5 | 39 | 53 | 33 | 27 | 36.5 | 43.65 | 12,181612 |
| Length Cecum (cm) | 15.5 | 15 | 13 | 14 | 14 | 11 | 16 | 17 | 14 | 11 | 14.05 | 1,9783551 |
| Length Initial part ascending colon (cm) | 15 | 16.5 | 18 | 19 | 16 | 16 | 18 | 21 | 23 | 16 | 17.85 | 2,5391381 |
| Length Distal part ascending colon (cm) | 12 | 14.5 | 12.5 | 16 | 11 | 13 | 14 | 18 | 14 | 13 | 13.8 | 2,0303256 |
| Length Colon transversum, descending and rectum (cm) | 12.5 | 15 | 8.5 | 13.5 | 15 | 16 | 16 | 12 | 15 | 13 | 13.65 | 2,2979459 |

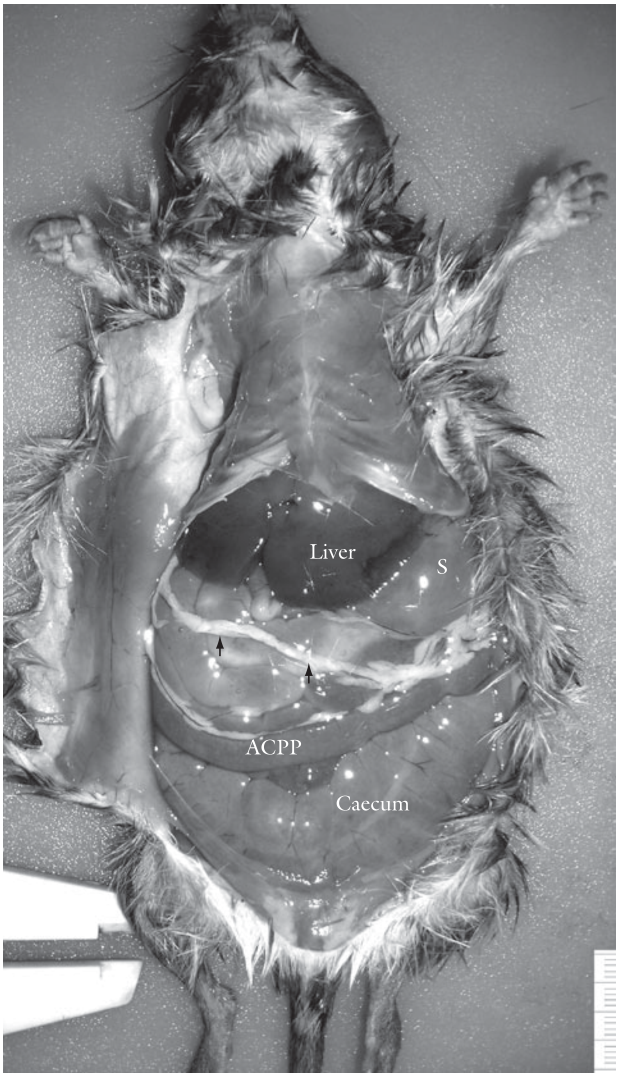


**Figure 1.** Ventral view of the abdominal organs of the *Ctenomys pearsoni*. S: stomach; ACPP: ansa coli proximal part; Arrows: greater omentum. In scale bar minor divisions are in mm.

pylorus with a cranial, dilated portion, directed to the right and forming a duodenal ampulla. The following portions of the duodenum were the cranial flexure and the descending duodenum that ended at the caudal flexure. From the caudal flexure the duodenum ran cranially as the ascending portion.

The jejunum followed up to the beginning of the ileocecal fold. The ileum was very short.

The abdominal part of the large intestine was divided in ascending colon, transverse colon and descending colon. The cecum and the ascending colon were the most voluminous sections of the intestine of the tucu - tucu (Figures 1-4). The cecum had a coiled proximal part composed of the base and the body, and an elongated distal part that ended at the apex.

The ascending colon had one ansa, with a proximal and a distal part (Figures 1-3). The ansa coli was composed of two parallel parts merged in an apical flexure and folded back over each other. The topographic localization of the apical flexure varied.

The distal ansa was followed at the level of the right colic flexure by the short transverse colon which turned left around the cranial mesenteric artery. The transverse colon was continued at the left flexure of the colon by the descending colon. The descending colon ran straight at the level of the roof of the abdomen, from the left flexure of the colon, until it fused with the rectum, at the left side of the ascending duodenum.

In accordance to what we observed and to the criteria of the NAV, we made the following list of anatomic terms for the intestine of the *Ctenomys pearsoni*:

INTESTINUM TENUE
Duodenum
- Pars cranialis
  - Ampulla cranialis
- Flexura duodeni cranialis
- Pars descendens
- Flexura duodeni caudalis
- Pars ascendens

Jejunum
Ileum
INTESTINUM CRASSUM
Cecum [Caecum]
- Basis ceci [caeci]
- Corpus ceci [caeci]
- Apex ceci [caeci]
- Curvatura ceci [caeci] major
- Curvatura ceci [caeci] minor

Colon
Colon ascendens
Ansa coli
Pars proximalis
Flexura
Pars distalis
Flexura coli dextra
Colon transversum
Flexura coli sinistra
Colon descendens
Rectum

Mesentery and peritoneal folds of the intestine.

The duodenum was sustained by the mesoduodenum, with the pancreas being included in the mesoduodenum and in the deep wall of the greater omentum.

The jejunum was sustained by the mesojejunum, which contained the jejunal vessels between its sheets. The ileum was attached to the cecum by the ileocecal fold.

The descending duodenum was fixed to the proximal part of the ascending colon by a peritoneal fold named accessory duodenocolic fold (Figure 3, arrows). The ascending duodenum was fixed by the duodenocolic fold to the descending colon (Figure 4, arrows).

In all examined animals, the ascending mesocolon was short. The ascending mesocolon, which linked both parts of the ansa of the ascending colon was very narrow, especially at the opposite end of the flexure that joined both parts.

The greater omentum (Figure 1, arrows) was attached to the transverse colon, which in turn, was attached to the mesoduodenum. The transverse mesocolon was short. The descending colon was held by a wide mesentery and by the duodenocolic fold.

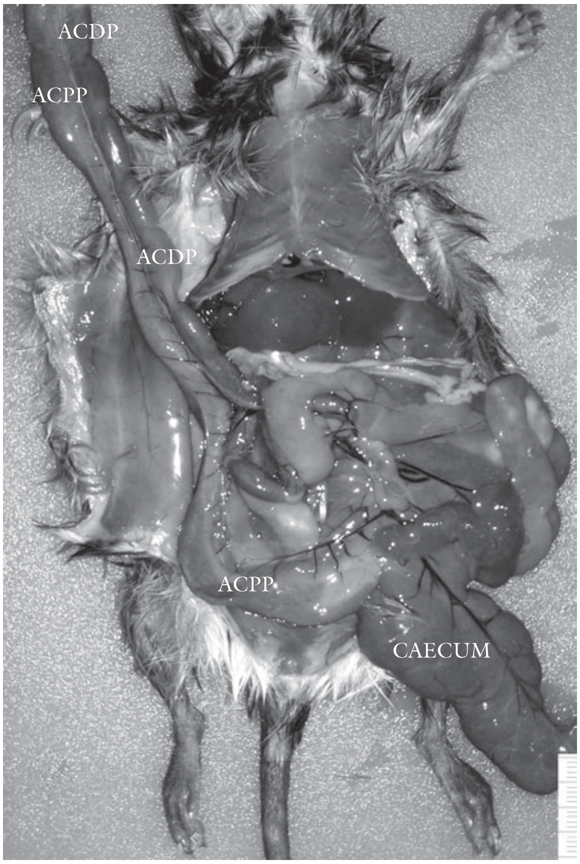


**Figure 2.** Ventral view of the abdominal organs of the *Ctenomys pearsoni*. ACPP: ansa coli proximal part; ACDP: ansa coli distal part. In scale bar minor divisions are in mm.

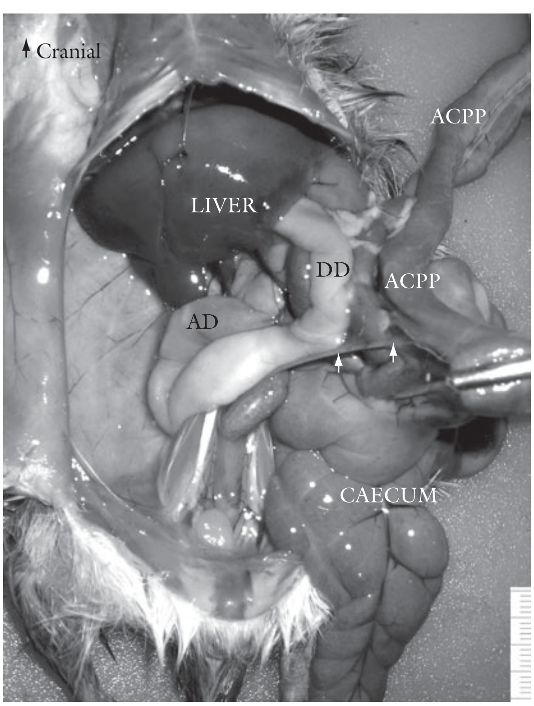


**Figure 3.** Ventral view of the abdominal organs of the *Ctenomys pearsoni*. AD: ascending duodenum; DD: descending duodenum; ACPP: ansa coli proximal part; Two arrows: accessory duodenocolic fold. In scale bar minor divisions are in mm.

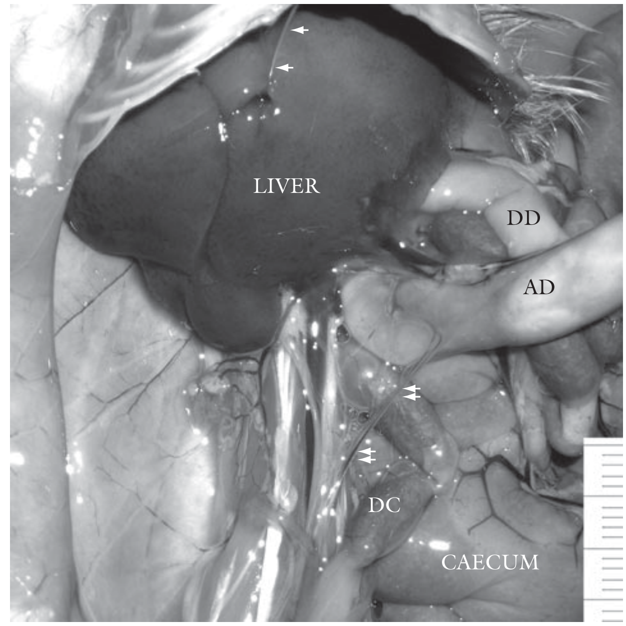


**Figure 4.** Ventral view of the abdominal organs of the *Ctenomys pearsoni*. AD: ascending duodenum; DD: descending duodenum; DC: descending colon; Arrows: duodenocolic fold. In scale bar minor divisions are in mm.

## 4 Conclusion

According to our knowledge, this is the first anatomical description of the intestinal tract and the mesenteric folds of the *Ctenomys pearsoni*.

Comparing the rabbit (BARONE, 1997) and the tucu - tucu, we found that the duodenal ampulla is much more evident in the tucu - tucu. In contrast, the ileal ampulla or sacculus rotundus, the last portion of the ileum that is markedly extended in the rabbit (BARONE, 1997), is not present in the tucu - tucu.

In the rabbit, the ileum, cecum and a part of the ascending colon are coiled together forming a spiral with one and a half loops (BARONE, 1997). However, in the tucu - tucu, the cecum, ileum and the ascending colon were separated. There is no cecocolic fold.

The cecum of rodents has been divided into ampulla ceci (Basis ceci), corpus ceci and apex ceci (SNIPES, 1979a, b; PERRIN and CURTIS, 1980; SNIPES, 1981, 1982a, b; SNIPES, HÖRNICKE, BJÖRNHAG et al., 1988; SNIPES, NEVO and SUST, 1990). In the tucu - tucu, we recognized the same parts. The fact that the cecum was voluminous, with taenia and haustra, is in agreement with the general trend in rodents (PERRIN and CURTIS, 1980; KOTZE, van der MERWE and O'RIAIN, 2006).

The colon, in particular the ascending colon, has received less attention in studies about rodents. We found the parts of the colon were well differentiated topographically. This is in accordance with the terms established by the NAV (2005). The ascending colon had one ansa, with a proximal and a distal part but in the nutria we described two ansae, proximal and distal with two parts (PÉREZ, LIMA and BIELLI, 2008). The distal ansa of the nutria is analogous to the ansa coli of the tucu - tucu. The other portion, the ansa proximalis coli, of the nutria was inexistent in the tucu - tucu.

We recognize the transverse colon in the tucu - tucu, but Snipes, Hörnicke, Björnhag et al. (1988) did not mention the transverse colon in their study about the nutria and Alogninouwa, Agba, Agossou et al. (1996) did not mention the transverse colon in the grasscutter.

The accessory duodenocolic fold is characteristic of the tucu - tucu.

This study indicates that there are minor differences in the divisions of the intestine and their peritoneal folds, in similar form as happens when comparing other rodents.

This work is a further contribution to the anatomy of the tucu - tucu. We described the anatomy of the intestines of the tucu - tucu and its mesentery.

## References

ALOGNINOUWA, T., AGBA, KC., AGOSSOU, E. et al. Anatomical, histological and functional specificities of the digestive tract in the male grasscutter (*Thryonomys swinderianus*, Temminck 1827). *Anatomia Histologia Embryologia*. 1996, vol. 25, no. 1, p. 15-21.

ALTUNA, CL., BACIGALUPE, LD. and CORTE, S. Food-handling and Feces Reingestion in *Ctenomys pearsoni* (Rodentia, Ctenomyidae) from Uruguay. *Acta Theriologica*. 1998, vol. 43, no. 4, p. 433-437.

BARONE, R. *Anatomie comparée des mammifères domestiques*. 3 ed. Paris: Vigot Fréres, 1997. (vol. 3)

BONFERT, A. Vergleichende Untersuchungen über die Homologie der Darmteile bei Nagetieren unter teilweiser Berücksichtigung der arteriellen Blutversorgung. *Anatomischer Anzeiger*. 1928, vol. 65, no. 1, p. 369-398.

INTERNATIONAL COMMITTEE ON VETERINARY GROSS ANATOMICAL NOMENCLATURE - ICVGAN. *Nomina Anatomica Veterinaria*: NAV. 5 ed. Hannover, Columbia, Gent, Saporo. 2005. Available from: <http://www.wava-amav.org/Downloads/nav_2005.pdf>. Access in: 9/2/2010.

KOTZE, SH., Van der MERWE, EL. and O'RIAIN, MJ. The Topography and Gross Anatomy of the Gastrointestinal Tract of the Cape Dune Mole-rat (*Bathyergus suillus*). *Anatomia Histologia Embryologia*. 2006, vol. 35, no. 4, p. 259-264.

NIETERS, M., SCHNORR, B. and KRESSIN, M. Der Rumpfdarm des Burunduk (*Eutamias sibiricus*, Laxm. 1769): Makroskopische und lichtmikroskopische Untersuchungen. *Anatomia Histologia Embryologia*. 2003, vol. 32, no. 3, p. 161-168.

PÉREZ, W., LIMA, M. and BIELLI, A. Gross anatomy of the intestine and its mesentery in the nutria (*Myocastor coypus*). *Folia Morphologica*. 2008, vol. 67, no. 4, p. 286-291

PÉREZ, W., MÖLLER, R. and MARTIN, E. Peritoneal Folds of the Rabbit (*Oryctolagus cuniculus*). *Anatomia Histologia Embryologia*. 2005, vol. 34, no. 3, p. 167-170.

PÉREZ, W., MÖLLER, R. and MARTIN, E. Suggested nomenclature for the cecum and ascending colon of the Rabbit. *Anatomia Histologia Embryologia*. 2007, vol. 36, no. 5, p. 389-395.

PERRIN, MR. and CURTIS, BA. Comparative morphology of the digestive system of 19 species of Southern African myomorph rodents in relation to diet and evolution. *South African Journal of Zoology*. 1980, vol. 15, no. 1, p. 22-33.

SNIPES, RL. Anatomy of the cecum of the dwarf hamster (*Phodopus sungorus*). *Anatomy and Embryology*. 1979b, vol. 157, no. 3, p. 329-346.

SNIPES, RL. Anatomy of the cecum of the gerbil *Meriones unguiculatus* (Mammalia, Rodentia, Cricetidae). *Zoomorphology*. 1982b, vol. 100, no. 3, p. 189-202.

SNIPES, RL. Anatomy of the cecum of the laboratory mouse and rat. *Anatomy and Embryology*. 1981, vol. 162, no. 4, p. 455-474.

SNIPES, RL. Anatomy of the cecum of the vole, *Microtus agrestis*. *Anatomy and Embryology*. 1979a, vol. 157, no. 2, p. 181-203.

SNIPES, RL. Anatomy of the guinea-pig cecum. *Anatomy and Embryology*. 1982a, vol. 165, no. 1, p. 97-111.

SNIPES, RL., HÖRNICKE, H., BJÖRNHAG, G. et al. Regional differences in hindgut structure and function in the nutria, *Myocastor coypus*. *Cell and Tissue Research*. 1988, vol. 252, no. 2, p. 435-447.

SNIPES, RL., NEVO, E. and SUST, H. Anatomy of the caecum of the Israeli mole rat, *Spalax ehrenbergi* (Mammalia). *Zoologischer Anzeiger*. 1990, vol. 224, no. 5-6, p. 307-320.

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