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# Macroscopic Studies of the Gastrointestinal Tract of the African Grasscutter (*Thyronomys swinderianus*)

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**Abstract:** We observed and measured the macroscopic anatomical parameters of the gastrointestinal tract of 8 grasscutter. The stomach was relatively small, about 3% when compared to the body size. It presented 3 portions: Cardiac, fundic and pylorus, which are similar to the monogastric animals documented in the literature. It can therefore, be classified as a simple stomach (with one chamber), in form of a curved sac and similar to an inverted letter 'J'. The Gastrointestinal Tract (GIT) mean weight and length were 142.3±11.94 g and 2.89.5±21.30 cm, respectively. This accounted for 14% of the total body weight in this animal. The cecum was slightly longer than the stomach but was observed to be the largest organ in the abdominal cavity, similar to that of the horse. It had 3 portions: Base, body and apex. Longitudinal bands of smooth muscles called tenias with intervening sacculations or haustra were observed in both cecum and colon. The colon mean length was 121±12.9 cm, while, the jejunum was 109.5±9.03 cm, given a differences of 12 cm in favor of the colon. This accounted for 42 and 38% of the colon and jejunal total length of the GIT, respectively. The colon was the longest segment of the GIT and not the jejunum.

**Key words:** Anatomy, Gastrointestinal Tract (GIT), grasscutter, jejunum, cardiac, fundic

## INTRODUCTION

Grasscutter (*Thyronomys swinderianus*) is a wild herbivorous rodent. It is found only in Africa (Baptist and Mensah, 1986). In West Africa where grass provides it main habitat and food, it is commonly known as the Grass cutter or the Cutting grass, while in other parts of Africa, particularly Southern Africa, where it is closely associated with cane fields, it is called the Cane rat (NCR, 1991). Its distribution is therefore, determined by the availability of adequate or preferred grass species for food (NCR, 1991). The Grasscutter is the second largest African rodent after the Porcupine. The average adult weight is 3 kg for females and 4.5 kg for males (Eben, 2004). The Grasscutter meat is the most expensive and preferred bush meat in West Africa (Asibey and Addo, 2000). Apart from its excellent taste like most bush meat, it is nutritionally superior to most domestic meat because of its higher protein and mineral with low fat content (Ledger, 1963). The animal adapts readily to diets like grasses, leguminous folder, the roots, fruits and food crops (Eben, 2004).

Grasscutter domestication is largely in the hands of peasant farmers in the villages who keep these animals in boxes, empty drums and small pens. Constraint to large scale production was and is still the unavailability of breeding stocking information on housing, feeding, anatomy, physiology for the few breeders (Adu *et al*., 1999). All the activities that grasscutter performs require the use of energy which is the products of oxidation

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of nutrients derived from food. Most food materials need to be broken down either by enzymatic or microbial activities in the intestinal lumen before they can be absorbed. These food materials according to Olusanya and Olowo (1988) are necessary to build, repair tissues and regulate body processes.

The macroscopic studies of the GIT has been documented for conventional animals like sheep, cattle, pig, horse and dog (Sisson and Grossman, 1975) and for rodents like rat, rabbit and mouse (Caster *et al*., 1956; Rudolf and Stromberg, 1976), but non on the grasscutter. It is on this basis, that the study is designed to examine the GIT of the grasscutter with emphasis on the morhphometry and morphology in order to establish their normal structures.

## MATERIALS AND METHODS

Total number of 8 matured grasscutters without sex differences was used for the study. They were purchased from the local breeders who raised them in captivity in Benue State, Nigeria. They were then transported to a laboratory in the Department of Veterinary Anatomy, Ahmadu Bello University, Zaria, Kaduna state Nigeria. The animals were fed with elephant grass, feed supplement and water was given *ad-libitum*. The animals were acclimatized for 3 days prior to the research.

Physical examination revealed that they were clinically healthy and in good nutritional status prior to euthanasia. All animals were weighed using mettler balance and recorded in grams. They were sacrificed according to the method described. An incision was made immediate after the sacrifice on the ventral midline, beginning from the cervical region up to the level of the pelvic region. The abdominal cavity was opened and the regular body fat stores around the kidneys and in the mesenteric were observed in all animals. Photographs of the organs were taken *in situ*. The intestines were dissected from the mesenteric, spread in a straight line and their length measured by thread and meter rule recorded in centimeters (cm). Measurements are expressed as Mean±SEM.

## RESULTS

**Morphometric observations:** Measurements taken from individual animals are recorded in Table 1 and 2. The mean GIT weight and length in this study were 142.3±11.94 g and 289.5±21.30 cm (Table 1), respectively. The mean length of the stomach was 9.79±0.83 cm, while, the cecum was 12.7±1.14 cm. The jejunum accounted for 75% of the total GIT length, with mean length of 21.25±0.77 cm. The longest segment of the GIT in this study was the colon which had a mean length of 121.9±12.03 cm, followed by the jejunum with mean length of 109.5±9.03 cm. These accounted for 42 and 38% of the total length of the GIT of these segments. The shortest portion was the rectum, which had a mean length of 1.48±0.10 cm and accounted only for 1% of the total length of the GIT.

**Morphologic observations:** Grossly, the stomach of the grasscutter was observed to be relatively small in relation to the size of the animal and constituted the following portions: cardiac, fundic/body and pyloric. It presented 2 surfaces, the parietal and visceral, two curvatures; small or lesser and another big or greater surface and 2 orifices cardiac and pyloric (Fig. 2 and 3). The thickening pylorus sphincter surrounded the lumen of the pylorus canal. So, the stomach of this animal can be classified as a simple stomach (with one chamber), in the form of a curved sack and similar to an inverted letter 'J'.

The intestine was observed to be divided into small and large intestines. The small intestine was subdivided into the duodenum, jejunum and ileum, while the large intestine was also subdivided into 3 segments: The cecum, colon and rectum. The duodenum appeared smooth and was measured from the pylorus to the origin of the jejunum (Fig. 2). The jejunum occupied the abdominal floor between the stomach cranially and the urinary bladder caudally. It's was observed to be very long, convoluted or coiled, but gradually stopped forming coils near its end (Fig. 1 and 2). The ileum was also smooth and curved only where it joined the large intestine (Fig. 2 and 4).

Table 1: Body weight, GIT weight and length of the grasscutter (Mean±SEM, n = 8)

| | Animal number | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Parameters | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | Mean±SEM |
| BW (g) | 1500 | 1500 | 1400 | 1600 | 921 | 520 | 438 | 371 | 1031±187.10 |
| GTW (g) | 183 | 187 | 167 | 150 | 119.5 | 120 | 105 | 107 | 142.3±11.94 |
| GTL (cm) | 321 | 339 | 332.5 | 316.5 | 348.5 | 227.3 | 193.1 | 237.8 | 289.5±21.30 |

BW: Body Weight; GTW: Gastrointestinal Tract; GTL: Gastrointestinal Tract Length; ST: Stomach

Table 2: Morphometric indices of the stomach and the intestinal tract of the grasscutter (Mean±SEM, n = 8)

| Morphometric indices | Animal number | | | | | | | | Mean±SEM | GTL (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | | |
| ST (cm) | 9 | 8 | 10 | 9 | 15 | 11 | 8 | 8.3 | 9.79±0.83 | 3 |
| Dd (cm) | 24 | 18 | 20 | 21 | 24 | 20 | 23 | 20 | 21.25±0.77 | 7 |
| Jj (cm) | 126 | 129 | 118 | 112 | 144 | 77 | 71 | 99 | 109.5±9.03 | 38 |
| Il (cm) | 13.5 | 14 | 12 | 13.5 | 12 | 13 | 12.5 | 12 | 12.81±0.28 | 4 |
| Cc (cm) | 14 | 10 | 16 | 15 | 17 | 8 | 10.6 | 11 | 12.7±1.14 | 4 |
| Cl (cm) | 133 | 158 | 155 | 144 | 135 | 97 | 67 | 86 | 121.9±12.03 | 42 |
| Rt (cm) | 1.5 | 2 | 1.5 | 1.5 | 1.5 | 1.3 | 1.0 | 1.5 | 1.48 0.10 | 1 |

Dd: Duodenum; Jj: Jejunum; Il: Ileum; Cc: Cecum; Cl: Colon; Rt: Rectum

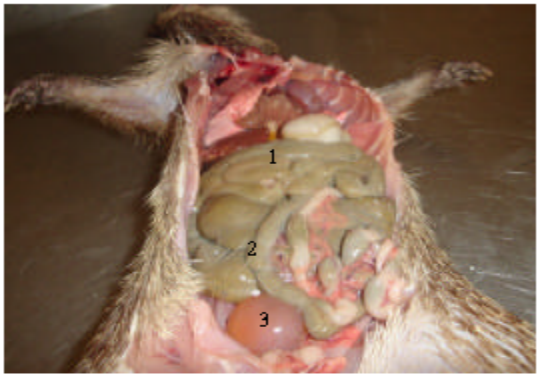


Fig. 1: Grasscutter (*in situ*) showing the visceral organs: intestine: jejunum (1), colon (2) and Urinary bladder and fecal balls in the colon

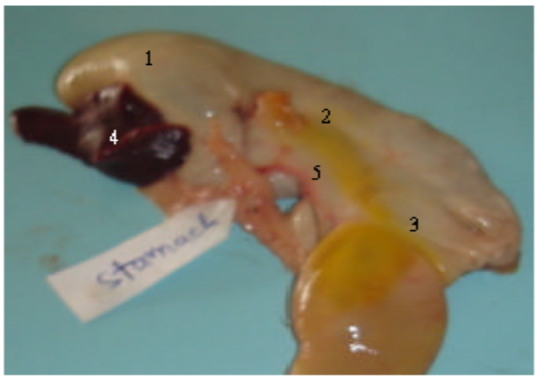


Fig. 3: The gross anatomy of the stomach of the grasscutter showing its parts: cardiac (1), fundus (2) and pylorus (3)


Fig. 2: The gastrointestinal tract of the grasscutter showing the stomach (1), the small intestine: Duodenum (2), jejunum (3) and ileum (4). The large intestine: cecum (5), colon (6) and rectum (7)

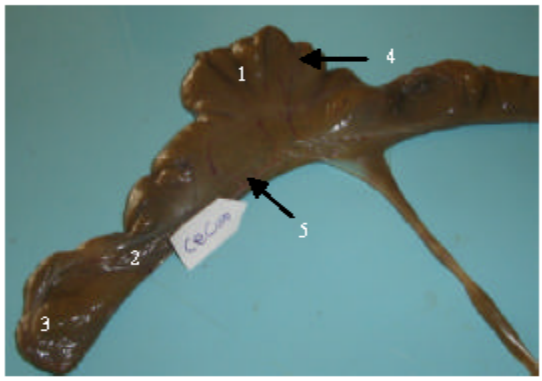


Fig. 4: The gross anatomy of the cecum of the grasscutter showing its three parts: Base (1), body (2) and apex (3). The teniea (4) and the haustra (5)

The cecum was the largest segment in the entire GIT. It was very large, coma-shaped blind ended sac situated at the ileo-ceacal junction. It had 3 portions: Base, body and apex. Teniae (longitudinal bands of smooth muscle) with intervening sacculations or haustra were also the common features observed (Fig. 4). The colon was very long (longest of the GIT segments) with wide lumen and contained the Fecal balls (Fig. 1 and 2). Rectum was relatively short and straight with narrow which terminated at the slightly enlarged region, the anal orifice.

## DISCUSSION

In our study, the mean Gastrointestinal Tract (GIT) weight and length were 142.3±11.94 and 289.5±21.30 cm,

respectively. This accounted for 14% of the total body weight of the grasscutter. The mean length of the stomach was found to be 9.79±1.01 cm; accounting for only 3% of the length of the GIT. The small intestine segments: duodenum and jejunum and the large intestine segments: cecum and colon mean lengths were 12.70±1.14, 121.9±12.03, 12.45±2.88 and 121.13±10.24 cm, respectively. These accounted for duodenum, 7%; jejunum, 38%; cecum, 4% and colon, 42% of the total length of the GIT. The present study showed that the colon in grasscutter is the longest segment of the GIT and not jejunum as documented previously in man and other animals by David (1975), Sisson and Grossman (1975), Ojo *et al.* (1987) and Olusanya and Olowo (1988).

The results of this study showed that the intestinal segments of the grasscutter were longer than those of the rabbit and rat (Rudolf and Stromberg, 1976). However, the lengths of these segments in different species like the dog (Miller, 1964), laboratory rats (Rudolf and Stromberg, 1976) and in man (David, 1975) have been reported to be longer than these results.

The stomach observed grossly in this study was the simply monogastric type. It was relatively small in relation to the animal, with a thin wall, inverted J-shaped and relatively distended sac-like when full. It had 2 surfaces and 3 regions: Cardiac, fundus/body and pylorus. These results corresponded well with those of the previous study documented in man and rabbit (Harold, 1992; Cathy, 2006). Contrariwise, the stomach of dog has been described to be C-shaped, rotated 90° in a clock wise direction, though the division is similar to those of the monogastric animals (Millar, 1964). Also, typical ruminants, ox, sheep and goat have compound stomach (Vallenas *et al*., 1971; Frandson, 1981; Banks, 1993). The first three compartments (rumen, reticulum and omasum) are non-glandular, whereas, the fourth (abomasum) is glandular and contains typical cardiac, fundus and pylorus regions (Banks, 1993). Camels also are considered as pseudo-ruminants having 3 stomach compartments (Banks, 1993).

In this research, the large intestine was observed to consist of the cecum, colon and rectum. The cecum was found to be a blind sac, consisting of 3 portions; the base, body and apex. It was the largest organ in the abdominal cavity and grossly had a longitudinal muscle bands (teniae) intervened by sacculations (haustra). The cecum described in this study resembled that in the horse. Anonymous (2007) reported that the cecum in the horse is a blind sac, microbial inoculation vat, similar to the rumen in a cow. The microbes in the cecum break down feed that was not digested in the small intestine, particularly fibrous feeds like hay or pasture. In addition to the vitamins and fatty acids absorption in the colon, water is also said to be absorbed, resulting in the fecal ball formations. These fecal balls which are the undigested and mostly indigestible portion of what was fed were then passed through the rectum in the horse (Anonymous, 2007).

In this study, the large intestine of the grasscutter was observed to be similar to that of the rat (Rudolf and Stromberg, 1976). The presence of tenias and sacculations in the cecum and colon has been described in man (David, 1975). These can be demonstrated in plain radiograph of the man's abdomen when the large bowel is distended (Harold, 1992). The koala, a marsupial, feeds preferentially on eucalyptus leaves has a cecum that may be up to 6 f long. This is correlated with the fact that the diet has low nutritional values, which mandate a large gut capacity (George, 1973). Monogastric herbivores like the rabbits and rodents have shorter, but prominent cecum (George, 1973). In avian, the rectum and colon are not morphologically distinguishable and therefore, are together called the colo-rectum. The colo-rectum is very short and little or no digestion or absorption occurs in it (Olusanya and Olowo, 1988). The major absorption in the chicken therefore, occurs in the small intestine where the major part of digestion also takes place. Absorption of digested food material is also very rapid in birds, because they have higher body temperature than mammals and their food circulation is rapid (Olusanya and Olowo, 1988). Cecum is said to be shortest in the rat and increasingly longer in the dog, pig, ruminants and horse where it is a long elongated pouch (Ojo *et al*., 1987). Man in addition to these structures, has vermiform appendix (David, 1975). This is a small blind process close to ileo-cecal valve, which varies in length from 1-20 cm and 5 mm in diameter. The large intestine in this study agreed who reported that the cecum in rabbit is the largest internal organ in the abdomen, which have 3 folds and contain semi-fluid ingesta. In the cecum fermentation of the intestinal contents occurs and periodically, the cecum contracts and the fermented ingesta are propelled into the colon and then out of the anus. The fecal pellets are directly ingested by rabbit, in a process called coprophagy or cecotrophy, meaning the ingestion of feces. The cecotropes or night feces are coated with mucus which acts as a barrier to the acidic pH of the stomach, ensuring that the content will be absorbed from the small intestine.

The anatomy of the gastrointestinal tract of the grasscutter showed the cecum was the largest organ in the abdominal cavity and was similar to that of the horse. The colon was the longest segment of the tract and not jejunum.

## CONCLUSION

This study has presented the following:

- A baseline data comprising the mophometric and morphologic observations of the GIT of the grasscutter
- We were able to classify the stomach of grasscutter as simple monogastric type
- The observed large cecum which resembled that of the horse function in the digestion of the cellulose
- And the longest segment of the GIT, that is, the colon performed more absorptive function than the jejunum in the grasscutter

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