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Macrometric study of the digestive system of the African giant rat (*Cricetomys gambianus*, Waterhouse 1840)

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Summary

Forty African giant rats (AGRs*), (Cricetomys gambianus*) were used for the macrometric study. The rats were sacrificed according to the method of Adeyemo and Oke (1990) and the various segments of the gastrointestinal tract (GIT) and the digestive glands of each of the rats were weighed and measured. The large intestine was observed to have the highest mean weight (19.98 ± 0.39 g) followed by the stomach (19.47 ± 0.26 g) and then the small intestine (17.19 ± 0.30S g), respectively. Of all the digestive glands, the liver was found to have the highest mean weight (21.29 ± 0.43 g). The small intestine was observed to be the longest (109.17 ± 28.68 cm) followed by the large intestine (75.57 ± 1.78 cm). Out of all the intestinal segments (small and large), the jejunum was observed to be the longest (72.26 ± 2.39 cm) followed by the colon (57.30 ± 1.58 cm).

Key words: Macrometric – Digestive system – African Giant Rat (*Cricetomys gambianus*-Waterhouse, 1840)

Introduction

There is a great need to enhance food production in the developing countries. According to Paarlberg (2000), the UN's Food and Agriculture Organization (FAO) recently reported that one out of every five citizens from the Developing countries, totaling approximately 828 million people, is still suffering from chronic malnutrition. The situation may even be more disastrous for the whole of the African continent, with an estimated population of about 776 million inhabitants (FAO, 2002a). Most of these people live under deplorable conditions, with little or no hope of significant future development in sight. The shortage of protein-rich food in some areas has reached serious levels.

Protein, an essential constituent of our daily diet, like fat and carbohydrates, can also serve as a source of energy for the body. Protein is also the only source of amino acids especially essential amino acids. A regular daily intake is absolutely necessary to replace nitrogenous materials in the tissues (FAO, 2002a). An alternative source of protein is being provided by the African giant rat

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(*Cricetomys gambianus*- waterhouse). Its meat is habitually consumed in most areas of Africa where the rodents are still living naturally. A study carried out in Nigeria showed that 71.4% of the people find it acceptable to use the animal as food (Ajayi and Olawoye, 1974). Despite taboos and prohibitions that exist in some areas of the Democratic Republic of Congo (DRC), the meat of this rodent is generally well appreciated.

The African giant rat (*Cricetomys gambianus*-Waterhouse) is a member of the order, *Rodentia,* subfamily, *Cricetomyinae*, and genus, *Cricetomys* (Delany and Happold, 1979). This rat weighs up to 1200 g at adult life, and grows up to 38 cm long with a 45 cm tail which has a characteristic white tip (Delany and Happold, 1979). They are omnivorous animals feeding on vegetables, insects, crabs, snails and other items, but apparently preferring palm fruits and palm kernels. They can survive in sewages and rubbish dumps of large towns, where they do little damage, and on farms, where their status as pest is in little doubt (Booth, 1991). The rats live in all parts of Nigeria. In the rain forest zone, they are restricted to farmlands, grasslands and human habitations. They are frequently seen at night crossing roads, running along drains and in house compounds. They are social animals, and as such several individuals live together in a burrow. They walk and run on their four legs, usually with their tails raised and are good climbers and jumpers. In Nigeria, these rodents are often incorrectly called "rabbits" or "Nigerian rabbits" (Delany and Happold, 1979).

In view of their abundance and size, the rodents are often eaten by the people and considered a delicacy. Their smoked carcasses are often seen in village markets. Attempts have been made to breed and rear the animal in captivity for food (Ajayi, 1975). The rodent has a good potential for use as a laboratory animal (Dipeolu et al., 1981), and has been shown to be a good host for the laboratory passage of *Schistosoma mansoni* and *Trypanosoma evansi* (Lariviere and Buttner, 1961). Recently, the rodent has been used to detect tuberculosis patients and to sniff out landmines in Mozambique (Lindow, 2001).The excessive and uncontrolled consumption of this animal poses a threat to the ultimate survival of this species, and Ajayi (1975) had attempted to study its biology and domestication. As a contribution towards this pioneering effort, several attempts at characterization of the reproductive organs have been made by Oke (1988), Oke and Aire (1989, 1990, 1995) and Ali (2009). Other works on the AGR include those on the brain by Nzalak (2002), Nzalak et al. (2005, 2008) and Ibe (2010).

An understanding of the digestive system will aid in maintenance, domestication and preservation of wild and endangered species (Ewer, 1967). The morphology of the gastrointestinal tract (GIT) has been reported in a number of other animals such as the cattle, sheep, pig, horse, dogs (Getty, 1975), man (Haroldy, 1992), laboratory rats (Olds and Olds, 1991) and birds (Devyn et al., 2000). Despite the features of this rat that have been studied, the digestive system is yet to be fully investigated. Research done on the digestive system of this rodent in this part of the country include those by Ali et al. (2008), Byanet et al. (2010), Nzalak (2010), Nzalak et al. (2010a, b) and Nzalak et al. (2011).

The present study was aimed at documenting the macrometric features of the digestive system of the African Giant Rat in order to add to the available information on the anatomy of the rodent. This study will serve as baseline data for feature research on the digestive system.

Materials and Methods

Animal Source

Forty adult African giant rats, (AGR) *Cricetomys gambianus,* of both sexes were captured alive in the wild around Samaru and Bomo villages in Zaria, Kaduna State, Nigeria from January to April 2009 using metal cage traps. They were transferred into standard laboratory rat cages in the Department of Veterinary Anatomy, Ahmadu Bello University, Zaria and fed with commercial feed for a while before sacrifice. Water was given *ad libitum* during the period.

Macrometric study

Forty of these rats were used for the morphometric study and each was weighed alive using a Mettler balance (Model P1421) which a sensitivity of 0.1gm and the weight recorded in grams. Sex difference was not taken into consideration. Each rat was later sacrificed according to Adeyemo and Oke (1990) and placed on a lateral recumbency. The skin and fascia at the base of the ear and the caudal border of the mandibles were excised, and the parotid and mandibular salivary glands dissected out. The weights and lengths were recorded in grams and centimeters, respectively. The mouth of each of the rats was opened and a cut made through the masseter muscles. The articulating surfaces of the mandibles were dislocated using a handsaw to show the complete tongue. Each tongue was dissected out and its weight and length recorded. Another incision was made from the first cervical region up to the level of the pelvic region with the rat lying on a dorsal recumbency to show the esophagus and the content of the GIT. The entire GIT was exteriorized and the contents removed starting from the esophagus and the various segments of the stomach (non-glandular and glandular), the small intestine (duodenum, jejunum and ileum), the large intestine (caecum, colon and rectum), the pancreas, gall bladder and the liver were weighed and their lengths measured and recorded. All these measurement were done using a Fatzun balance (model P141 with a sensitivity of 0.01 gm), a ruler, vernier caliper and thread (in cm), respectively.

Statistical analysis

Recorded weights and lengths studied were express as mean ± standard error of mean (M ± SEM) using statistical package for social sciences (SPSS) version 17.

Results

The mean weight of the AGR was observed to be 1045.0 ± 28.06 g. The mean weight of the gastrointestinal tract was 58.18± 0.89 g which accounted for 5.56% of the total weight of the animal. The mean weight of the esophagus was 1.39± 0.08 g accounting for 0.13% of the total weight of the animal. The mean weight and the percentage of the stomach: Glandular and non-glandular stomachs were 19.47 ±0.26 g, 4.67 ± 0.08 g and 14.79 ± 0.21 g representing, 1.86%, 0.45% and 1.41% of the total weight of the animal, respectively. The mean weight of the small intestine and its segments: duodenum, jejunum and ileum were 17.19 ± 0.30 g,

Table 1. Morphometric features of the digestive system of the African giant rat (AGR) (g).

Parameters	Minimum Value (g)	Maximum Value (g)	Mean ± SEM	% body wt
Body weight 800	1400	1045.0±28.06	100	
Weight of GIT 47.70	69.20	58.18±0.89	5.56	
Weight of esophagus 0.60	2.40	1.39±0.08	0.13	
Weight of stomach 15.40	23.0	19.47±0.26	1.86	
Weight of glandular stomach	3.90	5.80	4.67±0.08	0.45
Weight of non glandular stomach	11.10	18.00	14.79±0.21	1.41
Weight of small intestine	14.00	21.00	17.19±0.30	1.64
Weight of duodenum 4.00	7.00	5.00±0.11	0.48	
Weight of jejunum 6.10	12.00	9.46±0.20	0.90	
Weight of ileum 2.00	3.90	2.65±0.07	0.26	
Weight of large intestine	15.40	25.70	19.98±0.39	1.91
Weight of caecum 5.90	11.40	9.51±0.21	0.85	
Weight of colon 5.00	10.47	8.83±0.21	0.88	
Weight of rectum 1.20	2.70	1.84±0.07	0.18	
Weight of the tongue 2.00	3.70	2.76±0.61	0.27	
Weight of the parotid gland	0.50	1.20	0.81±0.03	0.08
Weight of mandibular gland	0.50	1.00	0.78±0.02	0.07
Weight of liver 18.00	28.00	21.29±0.43	2.03	
Weight of pancreas 0.60	1.40	0.99±0.03	0.01	
Weight of gall bladder0.20	0.60	0.35±0.16	0.03	

n = 40, SEM = Standard error of mean.

Table 2. Morphometric features of the digestive system of the African giant rat (cm).

Parameters	Minimum Value (cm)	Maximum Value (cm)	Mean ± SEM	% body wt
Length of GIT 169.0	264.50	213.32±3.88	100.00	
Length of esophagus 5.40	18.40	11.78±0.53	5.50	
Length of stomach 9.50	23.00	15.80±0.47	7.40	
Length of glandular stomach	3.50	10.40	6.85±0.23	3.20
Length of non glandular stomach	6.00	13.10	9.06±0.32	4.30
Length of small intestine	81.00	141.00	109.17±28.68	51.20
Length of duodenum 12.00	33.00	20.15±0.93	9.50	
Length of jejunum 55.00	95.00	72.26±2.39	33.90	
Length of the ileum 11.00	20.00	16.25±0.37	7.80	
Length of large intestine	54.00	95.00	75.78±1.78	35.50
Length of caecum 9.00	17.00	12.70±0.37	6.00	
Length of colon 39.00	74.00	57.30±1.58	26.90	
Length of rectum 3.00	9.00	5.65±0.26	2.60	
Length of tongue 3.80	8.80	4.62±0.14		
Length of parotid gland1.00	1.90	1.47±0.04		
Length of mandibular gland	1.00	2.40	1.68±0.049	

n = 40, SEM = Standard error of mean.

5.06± 0.11 g, 9.46 ± 0.20 g and 2.65 ± 0.07 g, representing 1.64%, 0.48%, 0.90% and 0.26% of the total weight of the animal, respectively. Those of the large intestine and its segments: caecum, colon and rectum were 19.98 ± 0.39 g, 9.51 ± 0.21 g, 8.83 ± 0.21 g and 1.84 ± 0.07 g, accounting for 1.91%, 0.85%, 0.88% and 0.18% of the total weight of the animal, respectively (Table 1).

The mean weight of the accessory digestive glands: parotid, mandibular, liver, pancreas gall bladder and tongue were 0.81 ± 0.03 g, 0.78 ± 0.02 g, 21.29 ± 0.43 g, 0.99 ± 0.03 g, 0.35 ± 0.16 g and 2.76 ± 0.61 g, respectively. The accessory digestive glands: parotid, mandibular, pancreas, gall bladder and tongue accounted for 0.08%, 0.07%, 0.01%, 0.03% and 0.27% with the liver accounting for 2.03%, respectively (Table 1).

The large intestine was found to have the highest mean weight (19.98 ± 0.39 g) followed by the stomach (19.47 ± 0.26 g) and then the small intestine (17.19 ± 0.30 g), respectively. Of all the digestive glands, the liver was found to have the highest weight (21.29 ± 0.43 g) and accounted for about 2.03% of the total body weight (Table 1).

The mean length of the gastrointestinal tract was found to be 213.32 ± 3.88 cm. The mean length of the esophagus was observed to be 11.78 ± 0.53 cm, accounting for 5.50 % of the total length of the gastrointestinal tract (GIT).The mean length and the percentage of the stomach and its segments: glandular and non-glandular stomachs were 15.80 ± 0.47 cm, 6.85 ± 0.231 cm and 9.06 ± 0.32 cm, accounting for 7.40%, 3.20% and 4.30% of the total length of the GIT, respectively. The mean length of the small intestine and its segments: duodenum, jejunum and ileum were 109.17 ± 28.68 cm, 20.15 ± 0.93 cm, 72.26 ± 2.39 cm and 16.25 ± 0.37 cm, respectively. The mean length of the large intestine and its segments: caecum, colon and rectum were found to be 75.78 ± 1.78 cm, 12.70 ± 0.37 cm, 57.30 ± 1.58 cm and 5.68 ± 0.26 cm, respectively. The length of the small intestine and its segments: duodenum, jejunum and ileum accounted for 51.20%, 9.50%, and 33.90% and 7.80%, while the length of the large intestine and its segments: caecum, colon and rectum accounted for, 35.50%, 6.0%, 26.90% and 2.60% of the total length of the GIT, respectively (Table 2).

The small intestine was observed to be the longest (109.17 ± 28.68 cm) followed by the large intestine (75.57 ± 1.78 cm).Out of all the intestinal segments (small and large), the jejunum was observed to be the longest (72.26 ± 2.39 cm) followed by the colon (57.30 ± 1.58 cm). The mean lengths of the tongue, the parotid and mandibular salivary glands were 4.62 ± 0.14 cm, 1.47 ± 0.04 cm and 1.68 ± 0.049 cm, respectively (Table 2).

Discussion

In the present study, the mean weight of the AGR was found to be lower than that of the male grasscutter and higher than that of the female grasscutter. This agrees with the findings of Byanet et al. (2008). However, the mean weight was the same with what was reported by Ali et al. (2008) for the same animal. The weight of the GIT was observed to be 58.18±0.19 g which accounted for about 5.6% of the weight of the animal. Ali et al. (2008) observed the mean length of the GIT of the AGR to be 232.3±11.9 cm which was higher than 213±0.88 cm that was obtained in the present study. Byanet et al. (2008) reported a higher value for the grasscutter and Rudolf and Stromberg (1976) reported lower value for the laboratory rat.

The esophagus was observed to be longer than those of the laboratory rat (Rudolf and Stromberg, 1976) and shorter than those of the rabbit (Timothy, 1990). The feeding habit of the rodent may probably be responsible for its short esophagus.

In the present study, the weight of the stomach accounted for 1.86% contrary to what was observed by Ali et al. (2008). In their study, they observed that the weight of the stomach accounted for 3% of the total weight of the animal. However, it was noticed that they did not remove the content of the stomach before weighing the stomach and this was responsible for that increase in weight.

The small intestine was made up of the duodenum, jejunum and ileum. The small intestinal segments were observed to be longer than those of the large intestine. The jejunum was the longest segment of the GIT in this rodent. Byanet et al. (2008) observed that in the grasscutter, the colon was the longest segment of the gastrointestinal tract suggesting more of microbial activities in the colon of the grasscutter because it is coprophage on its feces. The AGR, although a rodent as the grasscutter do not coprophage, and the presence of pouch in the mouth for storing food and the action of mucosubstances in the stored food may probably be responsible for the less microbial activities in the colon of the AGR.

The large intestine of the AGR was observed to be made up of caecum, colon and rectum. The caecum was the largest segment in the abdominal cavity and serves as a principal site for microbial fermentation.

In conclusion, this study has described the macrometry of the digestive system of the African Giant Rat (*Cricetomys gambianus*) based on its weight and length. This will serve as a baseline data for further investigation.

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