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Chemical Composition of Giant Rat (*Cricetomys gambianus*) Found in Southwestern Nigeria

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Abstract. The study assessed the proximate composition, mineral contents and *in vitro* digestibility of lean meat of male and female giant rat *(Cricetomys gambianus)* found in the vicinity of Federal College of Agriculture, Akure, Nigeria. After sacrificing and dissecting, the lean meat was dried, ground and chemically analyzed using standard methods. The mean wet weights of the males were 1161.2 g and females, 949.1 g. The protein content varied, males having 46.78% and females, 48.64%. The mean (% dry matter) fat, fibre, ash, and moisture content were 6.38±0.79, 1.10±0.08, 15.29±2.08 and 3.69±0.60, respectively. The energy content was 2.36±0.11 kcal/g. The highly concentrated minerals in both sexes were K, Na, Ca, Mg and Fe. The digestibility value was 70% (female) and 68.25% (male). Biological value, net protein utilization and net protein value were higher in female than in male samples. Both sexes were found to have nutritive values (protein and minerals), which compared favourably with other sources of conventional proteins and minerals.

Keywords: giant rat *(Cricetomys gambianus),* meat, mineral content, digestibility

Introduction

Rats are a member of family of the order Rodentia and are of great economic importance to humans. In addition to harbouring many diseases transmissible to humans, such as bubonic plague, endemic typhus, rat-bite fever, and jaundice, ingested rats can transmit trichinosis to swine (Curtin, 1987).

African giant rat (*Cricetomys gambianus*) is a member of Rodentia. It has large cheek pouches and is at times referred to as the Gambian pouched rat. It is a vegetarian and occurs in forest regions, where it rests near the base of trees. It harbours a large, wingless, ectoparasitic cockroach, *Hemimerus talpoides*, which is similar to a louse and is apparently host specific (Curtin, 1987).

In Nigeria, hunting of bush rats (groups of rats that are found in the forest reserve) has been on the increase due to the rising costs of the conventional sources of meat; the nutritional needs of the populace is thus being satisfied. There is hardly any available information on the nutritional quality of giant rat. The present study is an attempt to assess the chemical composition of male and female *Cricetomys gambianus*.

Materials and Methods

Giant rat (*Cricetomys gambianus*) specimens were collected from the vicinity of Federal College of Agriculture, Akure, Ondo State, Nigeria in February 2005. The rats were cleaned and weighed upon arrival at the Chemistry Laboratory. The animals were carefully dissected to separated the parts and weighed, then the lean meat was separated from the carcass, dried in the oven at 105 °C for 16 h, ground in a Kenwood blender, sieved (45 mm mesh) and stored. 0.5 g dried meat was dry ashed in a muffle furnace at 550 °C for 2 h. 2 M HCL was used to prepare the ashed sample, filtered and made up to 50 cm^3. All minerals were determined in each sample by using atomic absorption spectrophotometer (Pye Unicam, UK, Model SP9).

Moisture, ash, fat and fibre content of meat were determined by the method of Association of Official Analytical Chemists (1990). Nitrogen was determined by the micro-kjehdal method as described by Pearson (1976) and the percentage nitrogen was converted to protein through multiplying by a factor of 6.25. The digestibility was determined using a detailed procedure as described by Adeola (1995). Sample (1g) was placed in a large test tube; 40 cm^3 standard phosphate buffer (pH 6) solution and 0.02 g papain enzyme powder was added to the suspension. The suspension was covered with cotton wool, the test tube was closed with aluminum foil and was incubated at 37 °C for 3 days. The digested nutrient was filtered off while the residue assumed to be indigestible material, was dried in the oven at 70 °C for 2 h. It was then cooled in the desiccator for 30 min and weighed. Calculations were made according to the formulae as follows:

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$$\text{Digestibility coefficient (\%)} = \frac{\text{Wt. of sample} - \text{Wt of indigestible residue} \times 100}{\text{Wt. of sample}}$$

$$\text{Biological value (BV)} = \text{Digestibility coefficient} \times 0.8$$

$$\text{Net protein utilization (NPU)} = \frac{\text{BV} \times \text{digestibility coefficient}}{100}$$

$$\text{Net protein value (NPV)} = \frac{\text{NPU} \times \text{\% crude protein}}{100}$$

Energy was determined using Manzi *et al.* (2001) method. Sensory evaluation was obtained by means of a taste panel for the cooked meat samples (male cooked in 500 cm^3 of water for 30 min) while (female was cooked in 500 cm^3 of water for 40 min because of meat tenderness). It was conducted at the Federal College of Agriculture, Chemistry Laboratory, using adult judges, who evaluated the samples in terms of attractiveness, texture, tenderness, juiciness and flavour on a 9 point hedonic scale of 1 to 7, with 1 = like very much and 7 = dislike very much. Scores were analysed using Frieman test for ranked data.

Statistical analysis. Statistical analysis (ANOVA) of the data was carried out using Microsoft window (10.0). All analyses were performed in triplicate.

Results and Discussion

The anatomical weight composition of the male and female giant rat (wet weight in g) is shown in Table 1. The live weight of male was 1161.2 g while that of female was 949.1g. The size was 37.5 cm of male and 32.5 cm of female. The tail length was longer in male. All the other parts separated were found to be larger in the male than in the female. These weight differences could be due to differences in the physiological activities of the rats, the location of catch, age and diet.

The data on proximate composition is shown in Table 2. Protein content was high in the samples with values ranging from 46.78% for male to 48.6% for female. The fat content was low with a mean value of 6.38±0.79 with coefficient of variation of 12.41%. The ash content was high ranging from 13.82 to 16.76%. Fibre was generally low among the samples. The overall mean proximate composition of dry matter, moisture and energy were 36.32%, 63.69% and 2.36 kcal/kg, respectively. The main reason for numerically higher dry matter content in female meat might be attributed to the greater content of grains and vegetables, eaten by the female rats.

In this study, the values obtained for protein, fat, ash and fibre were relatively higher than 17.60, 1.77, 1.29 and not detected (ND), respectively, reported by Adeyeye (1996) for land snails, but moisture content was lower. Consistent with this study were the values for protein and fat found in fresh water crab by Adeyeye (2002) and Amoo, (1998) (for beef, crayfish and stockfish). Abulude (2004 a) reported findings with regard to protein, fibre and gross energy in termites similar to the present results, but fat and moisture were lower as compared to this study. Similar values for protein (50.6-51.4%) and ash (11.6-15.5%) were obtained by Abdullahi (2000) for Nigerian freshwater fishes. Guner *et al.* (1998) reported higher fat contents (9.72-18.44%) and moisture (58.98-65.53%) in fishes from black sea when compared to the present study. The calculated gross energy of these samples was moderately similar to 4.67 kcal/g dry matter, reported for cricket by Abulude (2004 b).

Table 1. The anatomical weight composition of meat sample (wet weight in g)

Parts	Male	Female
Wet weight	1161.2	949.1
Head	108.3	90.7
Tail	40.3	34.9
Right leg	120.0	95.9
Left leg	133.7	8.7
Right hand	63.5	52.2
Left hand	53.4	47.3
Right lung	3.8	2.4
Left lung	3.4	2.3
Bile duct	1.1	1.0
Liver	39.1	25.4
Intestine (small & large)	135.1	60.4
Pancreas	3.2	1.8
Testes (Left/Right)	18.5	-
Penis	3.5	-
Tail (cm)	35.5	36.5
Size (cm)	37.5	32.5

Table 2. Proximate composition of meat sample (%DM)

Parameter	Male	Female	Mean	SD	CV (%)
Protein	48.78	48.64	47.71	1.31	2.76
Fat	5.82	6.94	6.38	0.79	12.41
Fibre	1.15	1.04	1.10	0.08	7.10
Ash	13.82	16.76	15.29	2.08	13.60
Dry matter	35.89	36.74	36.32	0.60	0.66
Moisture	64.11	63.26	63.69	0.60	0.94
Energy (kcal/g)	2.28	2.44	2.36	0.11	4.79

SD = standard deviation; CV = coeffecient of variation

Protein content of the bush rats has been found to be of quality higher than that of beef meat, edible insects and fish. This means that giant rat can be used as substitute for fish, beef and edible insects. The low fibre content obtained in this study can facilitate easy digestion of the proteins present in the samples. High ash content of any sample is a measure of its likely mineral content. This analogy explains high mineral content of each of the samples. The low fat content will not contribute significantly as source of non-visible oil to any diet.

The results of the elemental concentrations determined as described above are presented in Table 3. Calcium magnesium, sodium and potassium were found to occur at high level in the analyzed samples. Zinc, iron and copper values were found to be relatively higher, but cobalt was not detected in any of the samples. The values of Ca, Mg and K were higher than those earlier found by the authors for mushrooms (Abulude *et al*., 2004) and vegetables (Abulude, 2001). The results in Table 3 show significant differences ($P<0.05$) between the samples. Mg, Zn, Cu and Mn are important components of foods because they act as enzymatic systems, maintain the electrical potential in nerves and are involved in energy metabolism. Na and K play an important role in cation-anion and osmotic balance mechanisms (Adeyeye, 1996), while Ca supports bone formation in conjunction with other contributors.

Table 3. Mineral composition of meat samples (mg/kg DM)

Parameter	Male	Female	Mean	SD	CV (%)
Fe	98.0	90.0	94.0	5.66	6.02
Zn	14.0	16.0	15.0	1.41	9.43
K	610.0	540.0	575.0	49.50	8.61
Na	490.0	557.0	523.8	47.73	9.11
Ca	532.0	524.0	528.0	5.66	1.07
Mg	620.0	550.0	585.0	49.50	8.46
Cu	11.2	16.2	13.7	3.54	25.81
Co	ND	ND	--	--	--

ND = not detected; DM = dry matter

Table 4. Mineral ratios of meat samples

Ratio	Male	Female	Mean	SD	CV (%)
K/Mg	0.98	0.98	0.98	--	--
K/Ca	1.15	1.03	1.09	0.09	7.79
Mg/Ca	1.17	1.05	1.11	0.09	7.64
Na/K	0.80	1.03	0.92	0.16	17.77
K/Ca+Mg)	0.53	0.50	0.52	0.02	4.12

The concentration ratios of K/Mg, K/Ca, Mg/Ca, Na/K and K/(Ca + Mg) are presented in Table 4. All the ratios showed a low variability. Thus it can be interpreted that anyone consuming this meat will take in more potassium, magnesium and sodium than other minerals from this source. These results compared well with results of K/Mg (>0.34), K/Ca (>1.0) and Na/K (>0.12) reported for green leaves, apricot puree and millipede by Abulude and Folorunso (2003), Guil-Guerrero (1998) and Belitz and Grosh (1988), respectively.

Table 5 shows the protein digestibility of the samples. The mean digestibility was 69.13%; variation in the values may be due to the location of catch. The values obtained for each sex of rat is consistent with values for African Yam bean seeds (Adeyeye, 1997; Oshodi *et al.*, 1995) and some tropical plant seeds (Abulude, 2005). Differences in protein digestibility may be due to the nature of food protein, presence of anti-physiological factors and presence of non-protein constituents which may modify the digestion (FAO/WHO, 1990; Adeyeye, 1997). The mean Biological Value (BV), Net Protein Utilization (NPU), Net Protein Value (NPV), 55.31%, 38.24% and 17.25%, respectively, tally with the values for standard protein (Table 5). BV measures the proportion of absorbed protein from a diet that is retained while NPU measures the proportion of the consumed protein that is retained.

The lean meat of the samples was subjected to sensory evaluation for attractiveness, texture, tenderness, juiciness and flavour. The data pertaining to these parameters was subjected to statistical analysis. The results are given in Table 6. The mean value for attractiveness was 6.88±0.53. Components of

Table 5. *In vitro* digestibility of meat samples

Parameter	Male	Female	Mean	SD	CV (%)
Digestibility (%)	68.25	70.01	69.13	1.25	1.80
Biological value	45.60	56.01	55.31	1.00	1.80
Net protein utilization	37.27	39.21	38.24	1.37	3.59
Net protein value	17.43	19.07	17.25	0.26	1.48

Table 6. Sensory evaluation of meat samples

Parameter	Male	Female	Mean	SD	CV (%)
Attractiveness	6.50	7.25	6.88	0.53	7.71
Texture	6.50	7.00	6.75	0.35	5.24
Tenderness	7.65	7.05	7.35	0.42	5.77
Juiciness	6.95	7.85	7.40	0.64	8.60
Flavor	6.56	6.85	6.71	0.21	3.06

N. B. values are on 9 point hedonic scale of 1 to 7: 1 = like very much; 7= dislike very muych attractiveness are colour of lean meat, firmness, texture and blood drip. Colour of lean meat ranges from bright cherry red (pH 5.6) to dark (pH 6.5) (McG. Copper and Willis, 1984). In general, colour tends to become darker with age which may be of some importance for the male meat, which was darker than that of female. The mean values for texture and tenderness were 6.75 and 7.35, respectively. It may be an evidence that male meat has more coarse texture and is also less tender. The female meat was more resistant to compression and required a greater effort to bite through it. This was reflected in the longer cooking time than that for male. As juiciness, the panelists enjoyed the juice produce by the female lean meat. This could be due to its high fat content. Differences in meat quality do not imply that male meat was not accepted. There was no significant difference (P>0.05) in flavour.

Conclusion

It can be concluded from the study that the giant rat *Cricetomys gambianus* contains good amount of protein and the digestibility values were high. Meat of both sexes of the rat had nutritive values, which compared favourably with other sources of conventional proteins and minerals.

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