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QUALITY EVALUATION OF RAT SPECIES SOLD IN MAKURDI METROPOLIS

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ABSTRACT

In this study rat species sold in Makurdi metropolis including *Yongov* (A), *Kpev* (B) and *Ihev* (C) were purchased randomly and subjected to proximate composition, microbiological, mineral and sensory quality analyses to determine their nutrients, microbiological contamination and acceptability for consumption. Results proximate composition analysis showed that all the species contained high protein 23.81 (A), 26.71 (B) and 21.85 (C) %, ash were 9.38, 9.40 and 9.43 % respectively. Fat ranged from 22.10 – 35.54%. Results microbiological quality were on yeast count which ranged from 1.5×10^5 – 2.6×10^7, while bacteria were 4.1×10^6 – 4.5×10^6. Acceptability based on 9-point hedonic scale were A(6.67), B(7.20) and C(7.20) without significant difference ($P>0.05$). Other sensory quality parameters were appearance 6.67 – 7.53. Results of mineral analysis showed that rat species contained calcium, magnesium and zinc. Their proportions were Calcium (ppm) for *Yongov* (1.14), *Kpev* (0.96) and *Ihev* (0.90), Magnesium contents were 0.38, 0.29 and 0.41 respectively. Zinc contents were *Yongov* (3.96), *Kpev* (3.64) and *Ihev* (4.10). Conclusion: The rat samples studied contained enough nutrients and acceptable for consumption. However, all the rat species were recommended for proper preservation before consumption.

Keywords: Quality Analyses, Rat Species and Makurdi Metropolis

INTRODUCTION

Most Nigerians have deficiency of animal protein in their diets. Bush rats one of the popular mammalian rodents can also provide the needed proteins. Other than the bush some species of rats are found in homes. There are many species of rats such as; wood, kangaroo, black, norway, wistar albino, fisher, sprague, dawley, dumbo, rex, hairless, berkshire, platinum and tailless rats among many different species. Almost all domestic pet rats and laboratory rats belong to a single *species*, the norway rat (*Rattus norvegicus*). A tiny number of black rats (*Rattus rattus*) also found in the homes are implicated as causative agents for Lassa fever, while bush rats most which destroy food crops are also vital source of high quality protein. Bush rats especially are highly accepted for consumption among the Tiv people of Benue state Nigeria. The common bush rats also known as the wild species are *Ihyev* and *Yongov*. Both are consumable and their demand is very high with considerable increase in cost. The gap between the demand and supply of bush rats is widening due to increase in population. In view of this, some hunters have resulted to supplying both home and bush rat species for consumption. The nutrient, microbiological, mineral and sensory quality attributes of both home and bush rats species sold in Makurdi metropolis have not been studied before. The main objective of this study was to evaluate the quality of rat species sold in Makurdi metropolis and provide this information as an aspect of quality assurance.

MATERIALS AND METHOD

Sample Collection

Three different species of rat were bought from Ujam village, Makurdi local government and used for analysis.

Sample Preparation

The three rat species were killed, roasted, oven dried and blended into powdered form for analysis.

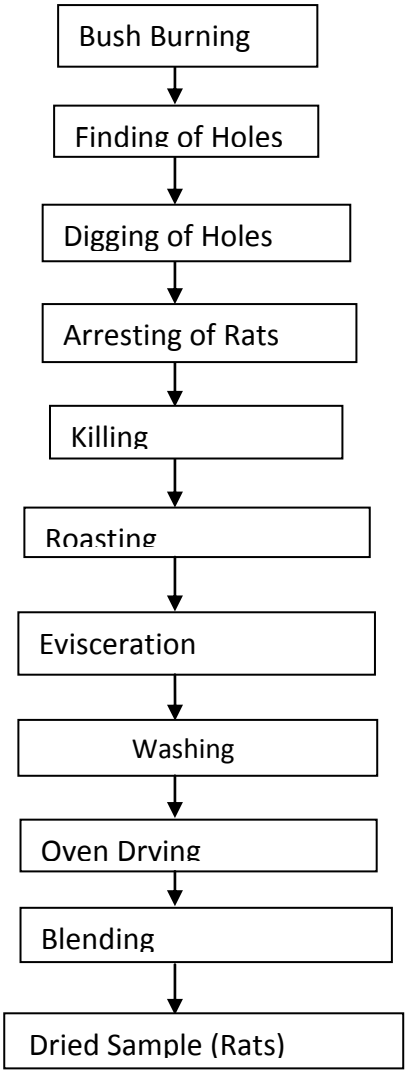

Fig 1: flow chart for the preparation of rat for analysis

The following were conducted, and below are the procedures:

Proximate Analysis (Dry Weight Bases)

Ash Content Determination

The procedure outlined in AOAC (2005) was used to determine the ash content of the test samples. The weight of the crucible dish were taken, 5g of sample were added to each of the crucibles. The dish and content was placed on the muffle furnace rack and the furnace was set at 500^0c for 16 hours until the samples were completely ashed. The ash in crucible dishes were reweighed and percentage ash content was calculated as

$$\%Ash\ content = \frac{W3 - W1}{W2 - W1} \times 100$$

Were *W1*= weight of empty crucible
W2= weight of sample plus crucible before ashing
W3= weight of sample after ashing.

Also calculating as:

$$\%Ash = \frac{total\ weight\ of\ extract\ cash}{weight\ of\ sample} \times 100$$

Crude Protein Determination

The micro Kjeldah method describe by *AOAC* (2005) which was used to determine crude protein. 0.8g of mixed catalyst was placed in a conical flask with few boiling chips (anti-burns). 0.2g of the sample was weighed using an electric weighing scale and transferred into the flask. 10ml of concentrated sulphuric acid was added and the mixture heated on the heated mantle. Initially gently until foaming has ceased and the content become completely liquid. It was then heated vigorously until the liquid was clear and free from black colour to a clear greenish colour. The flask was then cooled and the content was diluted with 25ml distilled water. The distillation apparatus was connected, 5ml of boric acid solution was measured into a 100ml conical flask and 2drops of mixed indicator was added. The flask was placed on the receiver so that the end of the delivery tube tips just below the level of boric acid . 5ml of digested samples was pipette into distillation unit and 10ml of 40% Na0H solution was added. The unit was closed and the liberated ammonia was steam distilled into boric acid. 50ml of distillate was collected and the tip of the delivery tube was rinsed with distilled water. The distillate was titrated with 0.1 M HCl acid until the green colour changed to purple. The percentage of nitrogen in the sample was calculated using the formula.

$$\%\ Nitrogen = \frac{Titre\ volume\ of\ sample - blank \times 0.0014 \times dilution}{Weight\ of\ sample \times 5ml} \times 100$$

Where S – B means samples titre value minus the blank
D= means dilution factor 25ml
$\%Crude\ protein = \%Nitrogen \times 6.25$

Fat Content Determination

This was determined using the Soxhlet extraction method, as described by AOAC (2005). 10g of sample from rat species (dry weight bases) were weighed and poured into a clean known weight thimble and placed in the extractor or extraction flask 150ml of solvent (hexane) was introduced into the flask. Heating was introduced at 150^0c for 3hours. The solvent was recovered and the flask was transferred which includes the oil and solvent mixture into a hot air oven. It was heated until the solvent evaporates. It was later transferred into desiccator to cool for 15 minutes before weighing the oil percentage fat content was calculated as

$$\%Fat = \frac{Weight\ loss}{Weight\ of\ sample} \times 100$$

Crude Fibre Determination

This was determined using the method described by AOAC (2005). 2g of each sample was weighed into 250ml conical flask and the fat was extracted with petroleum spirit by stirring, settling and decanting 3 times. The extractor sample were then oven dried and transferred into a 60ml beaker was placed on the digestion apparatus with pre-adjusted hot plate and boiled for exactly 30 minutes, rotating the beaker periodically to keep solid from adhering to the side of the beaker. At the end of 30 minutes, the mixture was allowed to stand for 1 minute and filtered immediately in already prepared buncher funnel without breaking solution, the insoluble matter was wash with boiling water until it was free from acid and back washed into the flask for alkaline digestion using 200ml of 1.2% boiling sodium hydroxide (NaOH). It was boiled briskly for 30 minutes with similar precautions as mention above. After 30 minutes it was allowed to stand for 1 minute and filtered as mentioned above. The residue was washed successfully with boiling water until was

free from acid. It was then washed twice with alcohol and 3 times with diethyl ether. The residue was transferred to the crucible and dried at 100^0c to constant weight. The difference between oven dried and weight after ashing was considered. The crude fibre content of samples was calculated as:

$$\%Crude\ fiber = \frac{Oven\ dried\ weight - weight\ after\ ashing}{weight\ of\ sample} \times \frac{100\%}{1}$$

Determination of Carbohydrate

The procedure described by *AOAC* (2005) was used in determining the carbohydrate content. This was calculated by difference: the sum total of fat, protein and ash content were subtracted from 100. $Carbohidrate = 100 - (\%protein + \%moisture + \%fat + \%ash)$.

Minerals

Procedure: 1gram of sample (on dry matter basis) was weighed into each crucible and transferred into muffle furnace preset at 530^0C for 120minutes. The crucibles were cooled and weighed; and this was done in triplicates. The percentage ash was calculated. Three of 50% nitric acid was added to crucibles with ash samples and heated slowly on a heating plate until the ash was still black, the crucible was replaced in the burners for another 60minutes. After the slow heating, 2ml of 50% HCl was added to each crucible and left for 15minutes. Where there was suspension, the mixture was filtered with filter paper (Filres Durieux No 111-70 m/m filtration rapide). The filtrate was poured into 25ml volumetric flasks. Each crucible was rinsed with water three times into the volumetric flasks and made up to volume with water. Some aliquots from each volumetric flasks was stored in propylene tubes for colorimetric estimation of phosphorus while the remaining was used for the determination of macro elements Ca, Fe, K, Na, and oligo elements Mg, Cu, Zn and Mn by atomic assumption, phosphorus was determined using spectrophotometer at 430nm.

Microbiological Analysis

Preparation of Samples by Serial Dilution

MacConkey bottle were sterilized, arranged and labeled appropriately 9.0ml of peptone water was dispensed into the bottle. 1ml of the text samples was taken from the first bottle and transferred to containing peptone water and labeled 10^{-1} using another pipette, the content of the first dilution was taken and transferred to the second bottle and labeled 1/100 or $10^{-2,}$ and this was repeated four times.

Preparation of Media for Total Plate Count

78 nutrient agar powders was weighed and added to deionized water in a volumetric flask bringing the volume to 250g litre and mixed thoroughly. It was gently heated and heated to boiling and then sterilized in the autoclave at 15psi at $121^{0}C$ for 15minutes.

Preparation of Media for Mould and Yeast

Sabourand dextrose agar was prepared for the determination of mould and yeast. 14g of sabourand dextrose agar was suspended in 250 liter of deionised water and soaked for 10 mins in a volumetric flask, swirled to mix and sterilized by autoclave for 15mins at $12^{0}C$ cooled at $47^{0}C$ and 2 vital of x0001 was added to increase selectivity.

Determination of Total Plate Count

1ml from the prepared sample was dropped into a dessicator 15ml solid agar medium was poured into petri dish and allowed to form a gel, this was done in duplicate. The plate were incubated at $37^{0}C$ for 24 – 48 hours, the colonies were calculated per plate using hand level as described by Adeyeye and Faleye (2004).

Determination of Mould and Yeast

1ml of the prepared serial dilution was dropped in a petri dish and 15mls of sabourand dextrose agar was poured and allowed to gel, and then incubated at $37^{O}C$ for 48 - 72hrs. The colonies were counted

per plate using hand lens as described by Adeyeye and Faleye (2004).

Sensory Evaluation of Rat Species

The three rat species(samples) were served to a 15 semi-trained panelist made up of a population of staff and students of the department of food science and technology, University of Agriculture, Makurdi who were familiar with the sensory attributes; taste, aroma, texture, colour and appearance of the samples. A 9-point hedonic scale was designed to measure the degree of preferences of the samples. The categories were converted to numerical score ranging from 1 to 9, with 9, as the highest and 1 at the lowest level of preference (Adeyeye and Faleye, 2004). Necessary precautions were taken to prevent carry-over flavour during the analysis by ensuring that panelist rinsed their hands with water after each stage of sensory evaluation.

Statistical Analysis

All data were analyzed using one way analysis of variance and difference (ANOVA), difference between means was determined using LSD.

RESULTS AND DISCUSSION

Protein: Apart from water, protein forms major part of lean body tissue. 17% of body weight is protein. Protein is required for regulation and maintenance of body functions like blood clotting, cell repair, enzymes, hormone transportation of many substances. Low protein in diet slows down anabolism leading to decrease in size of heart and liver. Only brain resists protein breakdown allow 35% of total calone intake to be supplied by protein. In table 1, domestic rat (*Rattus rattus*) had the lowest crude protein value (Food and Nutrition Board, 2005). Generally, the value of crude protein these three rat species compare favorably with that of other wild and domestic animals (Paul *et al.*) RDA for protein 0.8g/kg of healthy body weight. In this study, the values of protein were comparable.

Carbohydrate

Carbohydrate is the main source of cells. The muscle depends on it for physical activity. Liver and muscles are major storage organs of glycogen. Table 1 in this study, however showed highest value of carbohydrate in *Golunda ellioti,* followed by *Rattus rattus* and *Rattus norvegicus* respectively. The high value in *Golunda ellioti* might be due to the fact that glucose is much more stored under its skin as glycogen (Kramilich *et al.,* 1973). However, the value of carbohydrate was higher than that of calf.

Fat

There is no RDA for fat, though the 2005 dietary Guidelines for Americans recommend total fat intake should not exceed 20 to 35% of total calories which equals 44-78g/day for a person that consumes 2000kCal/day. *Rattus norvegicus* has higher fat content which might be due to large amount of Nyelin which is 70% fat, this insulates the axons and neurons (Dorfman, 2005).

Yeast and Mold Count

In terms of microbiological quality, *Rattus rattus* has higher value for yeast and molds count, while *Rattus norvegicus* has the lowest yeast count.

Bacteria Count

Golunda Ellioti has higher bacteria count, followed by *Rattus rattus* and *Rattus norvegicus* has the highest bacteria count.

Appearance

Appearance of any product is what actually motivates individual on whether to accept or reject a product. It is the first impression created over a product. In this study, *Rattus rattus* has desirable appearance, followed by *Golunda ellioti* and *Rattus norvegicus* has poor appearance as a result of high fat content.

Aroma

Golunda ellioti had nice aroma despite its poor appearance compared to *Rattus rattus* and *Rattus norvegicus*.

Mineral Safety Index

Mineral safety index (minimum toxic dose of minerals) is a numerical statement of the safety of high doses of minerals in relation to the United state RDA (Martin, 2009). All the rat species used for analysis: *Rattus norvegicus*, *Rattus rattus* and *Golunda ellioti* have lower value in magnesium, calcium and zinc. Though *Rattus norvegicus* has higher value of calcium compared to *Rattus rattus* and *Golunda ellioti*. *Golunda ellioti* has higher value of magnesium compared to *Rattus rattus* and *Rattus norvegicus*. But *Golunda ellioti* has higher zinc content compared to the two.

Magnesium

Magnesium is important for nerve and hear function and in many enzymes reactions. Although magnesium values in *Rattus norvegicus*, *Rattus rattus* and *Golunda ellioti* were significantly higher (p0.05) the value did not meet the RDA values for adult male of 400mg and adult female of 310mg/day.

Zinc

zinc bioavailability can be decreased by lack of animal protein. About 40% of dietary zinc is absorbed especially when animal protein sources are used. About 200 enzymes require zinc as a co-factor. Zinc is needed for DNA, cell membrane, insulin release and storage and protein metabolism. The RDA value for female adult is8mg/day and for male adult 11mg/day. In this study, zinc values in *Rattus norvegicus*, *Rattus rattus* and *Golunda ellioti* did not meet the adult value for male and female.

CONCLUSION

This study revealed that the nutrient contents of rats species sold in Makurdi Metropolis were favourable and comparable to other

sources of meat for human consumption. *Rattus rattus* had higher value of protein content compared to *Rattus norvegicus* and *Golunda ellioti* while *Rattus norvegicus* had higher fat content compared to *Rattus rattus* and *Golunda ellioti*. *Golunda ellioti* on the other hand had higher carbohydrate and ash contents. As for microbiological quality, *Rattus rattus* contained more yeast and molds count than *Rattus norvegicus* with the lowest yeast count. The bacteria count of *Golunda Ellioti* I was low but that of *Rattus rattus* and *Rattus norvegicus* were fairly high but within safe limits but need proper preservation. Based on the results obtained from the mineral analysis, *Golunda ellioti* contained higher value of zinc and magnesium but low in calcium. Considering also the results from sensory quality analysis, *Golunda ellioti* had higher value in aroma, texture and general acceptability. From all the results obtained from the various analyse *Golunda ellioti* rat species sold in Makurdi Metropolis was highly recommended for human consumption and export to earn national income.

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Table 1: Result for Proximate Composition of Rat Species

Parameters	A	B	C	LSD
Fat	35.5 ± 0.01^{a}	22.10 ± 0.21^{c}	26.67 ± 0.08^{b}	0.1762
Protein	23.81 ± 0.01^{b}	26.71 ± 0.02^{a}	21.85 ± 0.04^{c}	0.0545
Ash	9.38 ± 0.03^{a}	9.40 ± 0.10^{a}	9.43 ± 0.05^{a}	0.1307
Fiber	5.283 ± 0.03^{c}	7.82 ± 0.01^{a}	7.16 ± 0.55^{b}	0.0726
Carbohydrates	25.83 ± 0.01^{c}	33.77 ± 0.02^{b}	34.79 ± 0.02^{a}	0.0312

Table 2: Result for Microbiological Quality

Parameters	A	B	C	LSD
Yeast	$1.5\times10^{6}\pm0.98^{c}$	$4.0\times10^{6}\pm69.20^{b}$	$2.6\times10^{7}\pm1.60^{a}$	0.6010
Bacteria	$4.1\times10^{6}\pm17.08^{c}$	$4.3\times10^{6}\pm0.20^{b}$	$4.5\times10^{6}\pm1.79^{a}$	21.1760

Values are means std ± triplicate determination
Means in the same role not followed by the same not followed by same superscript are significantly (p>0.05)

Key:
A = Yongov, Scientific name: *Rattus norvegicus*
B = Kpev, scientific name: *Rattus rattus*
C = Ihyev, scientific name: *Golunda ellioti*

Table 3: Result for Sensory Quality Characteristics

Parameters	A	B	C	LSD
Appearance	6.67^{b}	7.67^{a}	7.53^{a}	0.6270
Aroma	6.33^{a}	6.67^{a}	7.07^{a}	0.9210
Texture	6.47^{b}	7.13^{a}	7.40^{a}	0.7460
General Acceptability	6.67^{a}	7.20^{a}	7.20^{a}	0.8370

Values are means std ± triplicate determination
Means in the same role not followed by the same not followed by same superscript are significantly (p>0.05)

Key:
A = Yongov, Scientific name: *Rattus norvegicus*
B = Kpev, scientific name: *Rattus rattus*
C = Ihyev, scientific name: *Golunda ellioti*

Table 4: Result for Mineral Analysis

Rat Species Parameters (ppm)	A	B	C	LSD
Calcium	1.14 ± 0.06^{a}	0.96 ± 0.06^{b}	0.90 ± 0.01^{c}	0.0970
Magnesium	0.38 ± 0.01^{b}	0.29 ± 0.01^{c}	0.41 ± 0.05^{a}	0.0134
Zinc	3.96 ± 0.03^{a}	3.64 ± 0.01^{c}	4.10 ± 0.55^{a}	0.0275

Values are means std ± triplicate determination
Means in the same role not followed by the same not followed by same superscript are significantly (p>0.05)

Key:
A = Yongov, Scientific name: *Rattus norvegicus*
B = Kpev, scientific name: *Rattus rattus*
C = Ihyev, scientific name: *Golunda ellioti*

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