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Consumer awareness, proximate composition, and sensory properties of processed African giant rat (*Cricetomys gambianus*) thigh meat

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ABSTRACT

This study investigated the knowledge of consumption of giant rat meat within the University of Ilorin, Kwara State Nigeria and further determined the effect of processing methods on the most preferred meat part (thigh meat). After the survey, two male and female giant rats each were obtained from a farm and slaughtered according to standard method. A 2 × 2 design was used to obtain four samples. The male rats were boiled and then divided into two portions. One portion was deep-fat fried and the other grilled to produce. The same process was employed for the female samples. Proximate composition and sensory properties of the processed thigh meat was also assessed. Majority of the respondents (27) prefer the hind limb (thigh) of the giant rat compared to the head (3), ribs and stomach area (5) and the fore limbs (8). The proximate composition of the raw giant rat meat were not affected by the sex, since the values were very similar. Protein is the major nutrients in the meat (approx. 24%), while fats, ash, fibre and carbohydrate were very low. Frying and grilling resulted in significant reduction in the proximate composition of the meat. Grilling showed slightly higher protein contents (approx. 22%) than the fried samples (approx. 18%). In general, there was no significant ($p \leq .05$) difference in the sensory properties of the processed meat. The low fat content of the giant rat meat is advantageous for adults and people suffering from fat related diseases. In conclusion, giant rat meat is popular among students and staff of the University of Ilorin, but its low consumption pattern is due to the limited amount raised or within the University environs.

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1. Introduction

Meat is valued as a complete protein food containing all amino acids necessary for the human body (Pimentel and Pimentel, 2003). The groups of meat include; red meat, poultry meat, sea foods and game. Game is any animal hunted for food. In Africa, they are referred to as wild animals usually hunted for their meat and therefore called bush meat. In Nigeria, game animal include antelope, grass cutter, squirrel and giant rat among others. The African giant rat (*Cricetomys gambianus*) is highly overhunted in many parts of Africa including Nigeria (Ajayi and Tewe, 1978; Oyarekua and Ketiku, 2010) and are frequently seen at night crossing roads, running along drains and in house compounds (Nzalak et al., 2012). African giant rat walk and run on their four legs, usually with their tails raised and are good climbers and jumpers (Nzalak et al., 2012). Oyarekua and Ketiku (2010), reported that over 71% of people living in the Southern Nigeria, especially among people of low economic status, accept giant rat as food. However, in recent times, it appears that the consumption of bush meat is rising due to increasing demand from urban dwellers (Oyarekua and Ketiku, 2010).

In Nigeria, the major meats consumed are beef, pork, chicken and mutton. However, there seems to be an increased demand for the consumption of other meat types. The reason may have stemmed from the high cost of beef and other meat types such as chicken due to the dwindling economy and the recent economic recession facing the country. Several factors such as the awareness, availability and cultural acceptability may influence the attitude of consumers to a new food source and may translate into their purchasing behaviour (Feldmann and Hamm, 2015).

The nutritional composition of African giant rat may vary with the sex, age ration and the part of the meat. For example,

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Oyarekua and Ketiku (2010) found that the protein content (approx. 20%) of the African giant rat muscle was higher than the liver (approx. 18%), the brain (approx. 12%) or the skin (approx. 9%). Processing methods may also influence the nutritional value of foods. For example, coagulation of proteins by heat improve their digestibility, and also reduces anti-nutritional compounds in foods. Heat also destroys some types of heat-labile vitamin and reduces the biological value of proteins (owing to destruction of amino acids or Maillard browning reactions) (Fellows, 1997). Meat may be processed by boiling, frying, grilling or a combination of boiling and frying or grilling.

Previous studies on Africa giant rat meat mainly focused on macrometric study of its digestive system (Nzalak et al., 2012), morphometric studies of the kidney (Onyeanusi et al., 2007), haematological studies (Oyewale et al., 1998), behavioural changes under domestication (Ajayi et al., 1978) and the nutritional information of the various parts of the rat in its raw state (Oyarekua and Ketiku, 2010). Previous survey on the marketing of bush meat in South Western Nigeria showed that majority of the respondents are males, got supplies mainly from hunters and are literate (Bifarin et al., 2008). These authors suggested that due to the perishable nature of bush meats, hunters usually dispose the meat readily or process the meat for their own consumption. The processing of African bush meat using traditional frying and grilling methods have not been reported in the literature. Furthermore, there seems to be no report on the consumption pattern on the meat from African giant rat. The knowledge of the consumption pattern as well as possible processing methods that can be adopted for the processing of the giant rat meat is important to facilitate the utilisation of the meat. Hence, in this study, a survey on the consumer awareness of African giant rat was conducted within the University of Ilorin, Ilorin, Kwara state, Nigeria. The most preferred meat part was fried or grilled and the proximate composition and sensory properties of processed samples was determined.

2. Materials and methods

2.1. Materials

Male and female African giant rats (two each) of average weight of 1.4 and 1.2 kg respectively were obtained from a farm in Osogbo, Osun State (Fig. 1). The live animals were transferred gently in a cage to the laboratory of the Department of Home Economics and Food Science, University of Ilorin, Ilorin.

2.2. Consumer awareness of African giant rat

This study was conducted among students and staff within the University of Ilorin, Ilorin, Kwara state Nigeria. A total of 215 staff and students were randomly consulted to participate in the survey. Structured questionnaire was used to elicit data from the respondents. Data collected include socio-economic variables, such as age and occupation, knowledge, consumption pattern and availability, preference for different meat parts, factors influencing the consumption pattern and processing methods usually employed for the processing of African giant rat meat. Descriptive statistics such as frequency distribution, percentage, mean score, and ranking were used to analyse the data obtained.

2.3. Slaughtering of African giant rat

Giant rats were slaughtered using the scalding method as previously described (Omole et al., 2005). Briefly, the rats were slaughtered and allowed to bleed for about 5 min before further processing. The furs of the slaughtered giant rats were removed by scalding method (dipped in hot water and scraped with a knife). The giant rats were eviscerated and samples were taken to the laboratory further processing.

2.4. Processing of African giant rat

Preliminary survey showed that the hind limb was the most preferred part of African giant rat meat. Hence, hind limbs of the male and female giant rats were boiled separately after adding the same amount (10 g) of salt (NaCl). The mid-portion of the hind limb was randomly taken and deep-fat fried at 180 °C for 5 min. Grilling of the boiled meat was done as previously described (Chung et al., 2011). Briefly, approximately 2 kg of charcoal were placed in the bottom of the grill and 100 mL of gasoline were poured onto charcoal to start a fire. The boiled samples were grilled for 30 min and samples were randomly collected for cooling. Processed samples were taken to the laboratory for proximate analysis and sensory evaluation.

2.5. Proximate composition of African giant rat

Moisture, fat and ash contents were determined using AOAC (2000) methods. Protein content was determined by the Kjeldahl method (6.25 × N) and total carbohydrate was calculated by difference. Fibre content were determined by standard laboratory procedure.

2.6. Sensory properties

Sensory evaluation of fried and grilled meat was carried out as described by Karim, et al. (2015). Briefly, a 9-point hedonic preference scale and a multiple comparison test were used to assess the acceptability of the meat. Fifty (50) semi-trained panellists,

Fig. 1. African giant rat. (A) Un-slaughtered female. (B) Un-slaughtered Male.

selected from students of the Department of Home Economics and Food Science, University of Ilorin, Nigeria were used for the evaluation. The selected students were those accustomed to eating African giant rat meat. Prior to the sensory analysis, they were screened with respect to their interest and ability to differentiate food sensory properties. The samples were evaluated for colour, aroma, taste, tenderness, juiciness and overall acceptability.

2.7. Statistical analysis

All analyses were performed in triplicate. Data was analysed using analysis of variance (ANOVA) and means were compared using the Fisher Least Significant Difference (LSD) test ($p < .05$).

3. Results and discussion

3.1. Survey on knowledge of consumption of giant rat

The result of the survey revealed that majority of the respondents (46.5%) were within the ages of 20–30 and these category of people were mostly students (Table 1). The reason for the higher number respondents being student could be due to the site of the survey, which is a University environment. All the respondents (215) are familiar with giant rat and reported that the rat is available in their area (Table 2). However, only about 95% of the respondents consumes giant rat (Table 2). According to the respondents giant rat is considered a delicacy relished by either grilling or frying before consumption. Nzalak et al. (2012) reported that their smoked carcasses are often seen in village markets. Majority of the respondents (135) prefers the hind limb (thigh) of the giant rat compared to those who prefers the head (15), ribs and stomach area (25) and the fore limbs (40) (Table 3). Although most of the respondents reported that they are familiar with giant rat and is available in their area, 67.44% of the respondent reported that the rat is not readily available for consumption (Table 4). The non-availability of giant rat may be due to several factors. Firstly, it could result from the very low demand of the meat and the less popularity due to the wide consumption of beef chicken, mutton and fish as sources of protein. Furthermore, the stress of hunting these games may also be another factor limiting its availability. However, in rural areas, African giant rat is readily available for sale. Attempts have been made to breed and rear the animal in captivity for food (Ajayi, 1975). Hence, there could be a need to further increase the quantity by raising them under controlled conditions in cages for breeding purposes.

Table 1
Socio-economic characteristics of the respondents. *Source:* Field survey, 2017.

Socio economy variables	Frequency Responses	Percentage %
Age		
20–30	100	46.5
31–40	35	16.3
41–50	35	16.3
51–60	30	14
60 and above	15	6.9
Total	215	100
Occupation		
Artisan	10	4.7
Student	100	46.5
Trading	40	18.6
Farming	20	9.2
Civil servant	35	16.3
Retired	10	4.7
Total	215	100

Table 3
Preference for various parts of giant rat meat. *Source:* Field survey, 2017.

Part	Responses	Rank
Head	15	4th
Fore limb	40	2nd
Stomach and rib area	25	3rd
Hind limb	135	1st
Total	215	

Table 4
Constraint militating against frequent consumption. *Source:* Field survey, 2017.

Constraints	Frequency of respondents	Percentage
Not readily available	145	67.44
Expensive	15	6.97
Cultural belief	15	6.97
Difficulty in processing	15	6.97
Low palatability	0	0
It's meant for old people	5	2.32
Not sold in city restaurants	20	9.30
Total	215	100

3.2. Proximate composition of raw and processed African giant rat thigh meat

The proximate composition of the African giant rat raw meat were significantly ($p < .05$) higher than the processed meat (Table 5). Sex type did not affect the composition of the meat, since their proximate composition values were very similar (Table 5). The moisture, protein and ash contents of the male and female African giant rat thigh meat are similar to values reported by Oyarekua and Ketiku (2010). However, the fat contents (approx. 3%) in this study appear very low compared to values (11.4%) reported by these authors (Oyarekua and Ketiku, 2010). Variation in the fat contents may be attributed to genetic differences and possibly the diet fed to the animals as well as the feeding pattern. The low fat content of the giant rat meat is advantageous for adults and people suffering from fat related diseases. Frying or grilling resulted in significant ($p < .05$) reduction in the proximate composition of the giant rat thigh meat (Table 5). This could be attributed to the different temperatures employed. Previous studies similarly found reduction in nutrients of fried foods. For instance, about 17% loss in available lysine was reported in fried fish (Tooley, 1972), while approximately 15% loss in thiamine was reported in shallow-fried liver (Kotschevar et al., 1955). Heat treatment has been found to affect the nutritional value of foods (Fellows, 1997). Grilled samples showed significantly ($p < .05$) higher

Table 2
Knowledge, consumption and availability of giant rat meat in selected area. *Source:* Field survey, 2017.

Parameters	Yes	% Yes	No	% No	Total
Awareness	215	100	0	0	215
Consumption	205	95.3	10	4.65	215
Availability	215	100	0	0	215

Table 5
Proximate composition of raw and processed giant rat thigh.

Parameters	Raw		Boiled and fried		Boiled and grilled	
	Male	Female	Male	Female	Male	Female
Moisture	$63.01^{a} \pm 0.72$	$63.09^{a} \pm 0.13$	$43.50^{b} \pm 0.71$	$42.97^{b} \pm 0.25$	$40.90^{c} \pm 0.42$	$40.30^{c} \pm 0.21$
Ash	$1.44^{a} \pm 0.06$	$1.49^{a} \pm 0.01$	$0.89^{bc} \pm 0.07$	$0.81^{c} \pm 0.01$	$0.91^{b} \pm 0.01$	$0.86^{bc} \pm 0.05$
Fat	2.64 ± 0.06	$2.45^{a} \pm 0.07$	$1.09^{c} \pm 0.35$	$1.23^{b} \pm 0.06$	$0.90^{d} \pm 0.01$	$1.01^{c} \pm 0.14$
Protein	$24.15^{a} \pm 0.49$	$24.51^{a} \pm 0.43$	$19.20^{c} \pm 0.42$	$18.50^{c} \pm 0.42$	$22.25^{b} \pm 0.35$	$21.80^{b} \pm 0.14$
Fibre	$0.84^{a} \pm 0.06$	$0.79^{a} \pm 0.01$	$0.48^{b} \pm 0.35$	$0.40^{b} \pm 0.00$	$0.48^{b} \pm 0.04$	$0.40^{a} \pm 0.00$
CHO	$6.57^{a} \pm 0.52$	$7.10^{a} \pm 0.14$	$4.45^{b} \pm 0.06$	$4.16^{b} \pm 0.06$	$3.46^{c} \pm 0.06$	$3.30^{c} \pm 0.25$

Mean ± SD. Means with same superscripts are not significantly different ($p \leq .05$).

Table 6
Mean sensory scores of raw and processed African giant rat thigh meat.

Parameters	Boiled and fried		Boiled and grilled	
	Male	Female	Male	Female
Aroma	$7.63^{ab} \pm 1.24$	$7.29^{b} \pm 0.97$	$7.93^{a} \pm 0.85$	$7.75^{ab} \pm 0.96$
Colour	7.63 ± 0.83	$7.32^{a} \pm 0.90$	$7.43^{a} \pm 1.10$	$7.43^{a} \pm 1.07$
Taste	$7.67^{a} \pm 1.49$	$7.43^{a} \pm 0.79$	$7.82^{a} \pm 1.05$	$7.46^{a} \pm 1.40$
Tenderness	$7.56^{a} \pm 1.45$	$7.75^{a} \pm 0.96$	$7.82^{a} \pm 0.81$	$7.36^{a} \pm 1.19$
Juiciness	$6.67^{a} \pm 1.66$	$7.00^{a} \pm 1.09$	$7.39^{a} \pm 1.34$	$6.89^{a} \pm 1.37$
Acceptability	$7.56^{a} \pm 1.37$	$7.46^{a} \pm 0.88$	$7.79^{a} \pm 1.13$	$7.50^{a} \pm 1.10$

Mean ± SD. Means with same superscripts are not significantly different ($p \leq .05$).

protein content (approx. 22%) compared to the fried samples (approx. 19%). Frying and grilling are heat treatment that may change the nutritional value and alter the eating quality of a food. These processing methods may enhance the shelf-life of foods due to thermal destruction of micro-organisms and enzymes, and a reduction in water activity at the surface of the food (Fellows, 1997). The shelf life of fried foods is mostly determined by the moisture content after frying. Hence, the relatively high moisture contents (>40%) of the processed meat suggest that they have a low shelf life. However, these foods are usually consumed shortly after frying and there are few losses during storage (Fellows, 1997).

3.3. Sensory evaluation

The mean sensory scores of the processed meat were very similar (Table 6). In general, there was no significant ($p < .05$) differences between the processing methods employed, although the ratings for grilled male giant rat was the highest among the four samples. Sex type and processing methods did not significantly ($p < .05$) affect the sensory properties of the processed African giant rat thigh meat. Previous research found that temperature of frying significantly influenced the sensory properties of fried meat and the development of burnt caramel (Meinert et al., 2007). However, in this study, there seem not to be any influence of the temperature on the sensory properties of the processed meat. Hence, consumers may employ any of the preferred method for processing giant rat thigh meat.

4. Conclusion

African giant rat meat is popular among students and staff of the University of Ilorin. The low consumption of African giant rat meat is due to the limited amount raised or available in the University environs. However, African giant rat meat has the potential to be used as an alternative protein source to meat and chicken. Raw African giant rat thigh meat is rich in protein and very low in fat. Frying and grilling slightly reduced the proximate composition of the processed meat. The low fat content of the rat is advantageous for adults and people suffering from coronary heart diseases. The study therefore recommend the inclusion of African giant rat meat on the list of family menus and restaurants in order to stimulate the interest of young and old ones in the consumption of the meat.

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