Original Research Article

Exploring Consumer Preferences and Nutritional Value: A Study on Wild vs. Farmed African Giant Rat Meat *(Cricetomys gambianus)* in Mampong Ashanti of Ghana

ABSTRACT

The African giant rat is one of Ghana's most common animals sought after as a source of meat (game). Local hunters use unhealthy means to hunt these animals, so attempts have been made to domesticate African giant rats in Ghana. The study was carried out to investigate consumer preference, sensory attributes, proximate composition, and acceptability of meats from wild and farmed African giant rats in Mampong Ashanti municipality in the Ashanti Region of Ghana. The study was conducted from November to December 2023. A survey was carried out among the residents of Asante Mampong using a structured questionnaire, with 500 individuals aged 20 years and older randomly selected to participate. Twenty (20) animals comprising ten (10) wild and ten (10) farmed African giant rats were used for the sensory and proximate analyses in a completely randomized design. Statistical Package for Social Sciences software was used for data analysis. Most participants (57 %) preferred meat from wild African giant rats to their farmed counterparts, while only 7 % indicated an equal fondness for both. Respondents with Islamic faith showed a preference for the meat of farmed African giant rats because of halal slaughter. The proximate composition of the raw giant rat meat was not affected by the sex since the values were very similar. However, wild African giant rat meat showed significantly *(P* =0.05) better proximate composition than the farmed ones. Except for meat colour and tenderness, meat from wild giant rats showed significantly (*P* = 0.05) better sensory properties than the meat from the farmed animals. This study concludes that meat sourced from giant African rats raised on farms is safer, has an impressive protein content, and has moderate fat levels.

Keywords: African giant rat, consumer awareness, Cricetomys gambianus, proximate, sensory properties.

1. INTRODUCTION

The world faces the challenge of feeding an ever-increasing population while conserving natural resources and biodiversity [1]. According to [2], an estimated one billion people worldwide suffer from protein deficiency.

Due to rapid population growth, animal producers are unable to meet existing demands for meat, especially in developing countries, due to over-reliance on domestic animal species [3]. Increasing demand for animal protein and high prices associated with such products have increased reliance on local wildlife species for subsistence [1]. It is estimated that more than 71 genera and 89 species of rodents (Hystricomorphs) are hunted as game. In the tropical world,

rodents are accepted as a popular source of protein [4]. African giant rat (AGR) (*Cricetomys gambianus*), which belongs to the family Nesomyidae, is widespread in Sub-Saharan Africa and is an economically significant rodent within Africa. It is one of the most common mammals exploited as bushmeat [5]. The African giant rat, locally known as “Kusie”, and the grasscutter, locally called “Akrantie”, are popular delicacies in Ghana.

In Africa, wildlife is an essential food item, especially for the people in rural areas. It accounts for about 20 % of the mean annual consumption of animal protein [6]. Unfortunately, many of these species currently face the threat of overhunting, particularly in regions such as Nigeria and Ghana [7]. One serious challenge possibly associated with the Overhunting of game animals could lead to a decline in their populations and threaten biodiversity in African ecosystems, leading to ecological imbalances in the region. To alleviate these problems, efforts have been made to farm them at home. This is expected to reduce the adverse effects on the environment and the welfare of hunting animals in the wild.

There is a perception among consumers that meat from farmed African giant rats and grasscutters is less palatable than their wild counterparts. This speculation may reduce the demand and marketability of farmed rodents’ meat, thereby undermining the possibility of realising the potential benefits associated with its production, such as environmental sustainability, employment generation, and improved public health. This study was therefore conducted in the Ashanti Region of Ghana (Mampong Ashanti Municipality) to compare consumer preference, sensory attributes, proximate composition, and acceptability of meats from wild and farmed African giant rats.

2. MATERIALS AND METHODS

2.1 Study area

The study was conducted from November to December 2023 at Ashanti Mampong Municipality. Mampong-Ashanti lies in the transitional zone between the Guinea savanna zone of the north and the tropical rain forest of the south of Ghana along the Kumasi-Ejura road. Mampong lies on latitude 07^0 03’ N and longitude 01^0 24’W at an altitude of 289.7m above sea level with 350mm of rainfall. The average daily temperature is between 25^0 C and 30^0 C, and the average relative humidity of the area is 70% [8]. The dry season occurs from December to March [8]. The vegetation in this area is transitional savanna woodland, which is suitable for livestock rearing due to prevailing conducive rearing temperatures. The rainfall pattern is bimodal, with the significant rainfall season occurring from April to July with 1000mm of rainfall, while the minor season occurs from August to November with 350mm of rainfall. Mampong Ashanti is suitable for rearing and producing African giant rats since most animal feed ingredients are readily available and cheap in this area.

2.2 Data Collection (Survey)

A survey was carried out among the residents of Ashanti Mampong, with 500 individuals aged 20 years and older randomly selected to participate in the survey. A structured questionnaire was utilised to gather relevant information from meat consumers from the region. The data collected encompassed socio-economic factors such as age, gender, occupation, income and religious affiliation.

2.2.1 Acquisition and slaughtering of African giant rat

Ten unskinned carcasses (2.2 ± 0.2 kg) of wild African giant rats, taken down by hunters' firearms and traps, were acquired in the early morning following nocturnal hunting expeditions. Additionally, a comparable quantity of domestically raised African giant rats (2.1 ± 0.3 kg) aged 8 months old were procured from the Teaching and Research Farm of the Department of Animal Science Education, Akenten Appiah-Menka University of Skills Training and Entrepreneurial Development, Asante Mampong campus, Ghana. The carcasses were initially exsanguinated for 5 minutes, followed by scalding in warm water at approximately 75 °C for approximately one

minute and removing coarse and bristly fur using sharp knives. Subsequently, the de-furred carcasses underwent a washing process and were eviscerated. The wild African giant rats did not undergo exsanguination as they had already died upon arrival. Fresh meat samples from the hind limbs were extracted for proximate analysis

2.2.2 Processing of the African giant rat

The meat processing technique employed in this study was based on the methodology developed by Oyeyinka *et al.* (2019). The hind limbs of wild and farmed male and female African giant rats were used because they are the meaty and the most preferred part of the African giant rat. Subsequently, an electric oven (Logik LBFANX23, UK) was preheated to a temperature of 200 °C; the meats were weighed and grilled in an electric oven to a core temperature of about 70^{o}C. The grilled samples were randomly selected for cooling. Afterwards, the processed samples were transported to the laboratory for sensory evaluation.

2.2.3 Proximate analysis of the carcass

Proximate analysis of fresh meat samples from both wild and farmed African giant rat hind limbs was conducted at the Biological Sciences Laboratory at Akenteng Appiah Menka University of Skills Training and Entrepreneurial Development, Mampong-Ashanti Campus (AAMUSTED). The study aimed to determine the meat's ash, crude protein, fat, and moisture content. The methodology involved determining the moisture, fat, and ash contents using the [9] methods. The protein content was determined using the Kjeldahl method (6.25 × N)

2.2.4 pH Determination

The pH measurement of the animal's carcass was taken 45 minutes after slaughtering, according to [10]. A portable Hanna pH meter (Hanna Instruments, Woonsocket, RI) was used to measure the pH level in the quadriceps femoris of the thigh. To ensure accuracy, the pH meter was calibrated using pH 4 and pH 7 buffer solutions, which helped maintain the pH level within the range of pH 4 and 7 ± 0.05.

2.2.5 Sensory evaluation of the meat

The process of assessing the sensory properties of the African giant rat meat was derived from [11] methodology with minor adjustments. The panellists' preliminary screening involved a duo-trio test to gauge their taste sensitivity. Following this stage, a group of fifteen participants, comprising AAMUSTED faculty staff and students, were selected from the preliminary screening and trained according to the [12]. The meat products were sliced into uniform sizes of 2cm × 2 cm × 2cm and wrapped in aluminium foil with random three-digit numbers. To ensure that the panellists' results were not influenced by one another, they were positioned in different areas of the laboratory. Moreover, the panellists were given water and bread as neutralisers while tasting the items. The samples were evaluated for colour, aroma intensity, tenderness, juiciness and overall acceptability.

A five-point category scale, as described by [11,13] with few modifications, was used to describe the products as follows:

Colour: very pale (1), pale (2), intermediate (3), dark (4), very dark (5)

Tenderness: very tough (1), tough (2), intermediate (3), tender (4), very tender (5)

Juiciness: very dry (1), dry (2), intermediate (3), juicy (4), very juicy (5)

Flavour intensity: very weak (1), weak (2), intermediate (3), strong (4), very strong (5)

Overall acceptability: dislike very much (1), dislike (2), intermediate (3), like (4), like very much (5)

2.3 Statistical analysis

The data from the survey were organised and presented in frequency tables and graphs using Microsoft Excel and IBM-SPSS software version 21.0. whilst data from the sensory and carcass parameters were analysed using analysis of variance (ANOVA), and means were compared using the Fisher Least Significant Difference (LSD) test (P = .05). Correlation coefficients among education, income, age, availability, flavour and consumer preference for farmed and wild African giant rat were estimated using the IBM-SPSS software version 16.0.

3. RESULT AND DISCUSSION

3.1 Demographic characteristics of consumers of African giant rat meat

The result of the survey revealed that the majority of the respondents (52.2 %) were males. The majority (65.0 %) of the respondents were between 40 and 60 years old, and this category was mainly employed (Table 1). Most participants had a tertiary education level (62.0 %). Utilising these participants for the study was ideal as they could provide more precise descriptions of their observations and experiences of consuming African giant rat meat. The higher number of respondents with tertiary education could be due to the survey site since Mampong can boast of many tertiary institutions. The study found that 64 % of the participants adhered to Christianity, whereas the rest followed Islam or the Traditional African religion.

Responding to a survey query regarding their preference for farmed or wild African giant rat meat, the participants provided varied feedback, as illustrated in Fig 1. More specifically, most participants (57 %) preferred meat from wild African giant rats to their farmed counterparts, while only 7 % indicated an equal fondness for both. Upon further inquiry into the reasons behind their choice, a notable portion of the participants cited the availability, less expensive and robust flavour and savoury quality of the meat from wild giant rats than farmed giant rats.

The graphical representation in this study depicts the frequency or count of survey participants who favour farmed, wild, or both African Giant Rats within various demographic categories. Fig. 2 illustrates that the majority (80 %) of individuals lacking formal education exhibit a marked preference for wild African giant rat meat compared to meat from farmed African giant rats.

According to Fig. 2, Respondents with an Islamic background abstained from consuming the meat of African giant rats obtained from the wild, owing to the delayed or absent bleeding of such carcasses, which is inconsistent with Islamic dietary laws. Furthermore, their religious beliefs prohibit such meat consumption, i.e. they consider such meat not to be halal [14]. Respondents with African traditional faith showed no preference at all for the farmed African giant rat, which is the direct opposite of the preference of respondents of Islamic orientation.

Table 1. Socio-economic characteristics of the respondents

Parameter	Response	Frequency	Percentage%
Gender	Male	261	52.2
	Female	239	47.8
Age	20-40	151	30.2
	41-60	325	65.0
	61 and above	24	4.8
Religion	Christianity	320	64.0

	Islamic	150	30.0
	African traditional religion	30	6.0
Level of education	No formal education	34	6.8
	Basic level education	36	7.2
	Secondary level education	120	24.0
	Tertiary level education	310	62.0
Occupation	Student	117	23.4
	Farming	74	14.8
	Trading	64	12.8
	Artisan	20	4.0
	Civil servant	201	40.2
	Retired	24	4.8
Monthly Income (GH₵)	1-500	80	16.0
	501-1000	210	42.0
	1001-1500	120	24.0
	1501-2000	55	11.0
	< 2000	35	7.0

Fig. 1 Respondents' preference for wild and farmed African giant rat meats

Male = M, Female = F, Christianity = CHR, Islamic = ISM, Traditionalism = TRD, No formal education = NLE, Basic level education = BLE, Secondary level education = SLE, Tertiary level education = TLE, Student = ST, Farmer = FA, Trader = TR, Artisan = AR, Civil servant = CS, Retired = RT

Fig. 2 Effect of sex, religion, level of education, occupation and income on the preference for wild and farmed African giant rat meat

3.1. 2 Constraints against the preference of farmed and wild African giant rat meat in Mampong Ashanti Municipality

The research conducted in the study area shows a decline in the preference for farmed African giant rat meat. The study provides a detailed analysis of the perceived barriers to the consumption of this meat within the Asante Mampong Municipality. As per the data presented in (Table 2), a significant proportion of respondents (33.33 %) identified the lack of or low availability as the primary impediment to their consumption and preference of farmed African

giant rat meat. This finding was not a surprise since few known farmers in the study area indulged in rearing the African giant rat. The non-availability of farmed giant rats may be due to several factors. Firstly, it could result from the very low commitment of the Ministry of Food and Agriculture to provide support and funding for the improvement and domestication of this highly prolific rodent. In addition, farmers lack the technical expertise to rear and breed the African giant rat. The majority of respondents, citing availability as the main constraint for the preference of the farmed African giant rat, suggested that engaging in rearing and producing these animals will be lucrative since there is a surplus of demand over supply. Moreover, the study highlights additional constraints affecting the consumption, including the high cost of the meat (25.26 %), its inadequate flavour profile (18.95 %), and the complexities involved in its preparation (14.39 %). Interestingly, the study suggests that low palatability is not a considerable deterrent to the consumption of farmed African giant rat meat in the Asante Mampong Municipality.

Table 3 provides information on the perceived constraints to the preference for wild African giant rat meat in Asante Mampong Municipality. Among the respondents who preferred farmed meat over wild meat, 62.67 % believed that safety and hygiene were the most significant constraints that deterred them from consuming wild meat. Respondents argued that unsustainable hunting methods, like the use of poisonous substances as bait to trap animals, posed health hazards to unsuspecting consumers. Other constraints to the consumption of bush meat included religious belief (33.33 %), destruction of biodiversity, and environmental damage (2.67 %).

Most respondents who cited religious belief as a reason for the non-preference of wild African giant rats were of Islamic background. In most situations, wild African giant rats are not bled sufficiently when killed, which goes against Islamic doctrines [14]. Using crude hunting methods, such as setting bushfires to hunt African giant rats, can potentially destroy farmlands and biodiversity [15].

Table 2. Constraints against consumer preference of farmed giant rat meat consumption. source: field survey, 2023

Constraints	Frequency	Percentage (%)
Expensive	72	25.26
Not readily available	95	33.33
Low palatability	23	8.07
Low flavour	54	18.95
Difficulty in processing	41	14.39
	Total 285	100

Table 3. Constraints against consumer preference of wild giant rat meat consumption. source: field survey, 2023

Constraints	Frequency	Percentage (%)

Not safe and hygienic	94	62.67
Religious beliefs	50	33.33
Destruction of biodiversity	4	2.67
Tough meat	2	1.33
	Total 150	100

3.1.3 Relationship between some variables and preference for meat from farmed and wild African giant rat

The study examined the factors influencing the consumption patterns and preferences for farmed African giant rat meat (Table 4). The coefficients for education, age, income, flavour, and availability were significant at a 5 % level, indicating that these variables influenced the preference and consumption of farmed African giant rat meat in the study area. However, the coefficients of the level of education and income factor of respondents who prefer the wild African giant rat were negative and significant, suggesting respondents with higher education and high-income levels are not likely to consume meat from wild African giant rats. This could be attributed to the fact that the higher the level of education and respondent's income, the more likely the respondent would be aware of the unhealthy methods of hunting these animals for food. The affluent have the purchasing power to buy farmed animals that are more expensive than the wild. However, a positive correlation is observed between the level of education and the preference for farmed African giant rat meat. On the other hand, the coefficient of the availability of farmed and wild African giant rats was positive and negative, respectively, indicating that if meat from farmed animals was available, respondents were likely to consume it. Also, age negatively correlated with meat from farmed African giant rats, indicating that as respondents age, they are more likely to consume less meat from farmed African giant rats.

Table 4. Relationship between some variables and preference for farmed and wild giant rat meat consumption

Demographic variable	Coefficient for F AGR	Coefficient for W AGR
Education	0.24**	-0.12**
Age	-0.34**	0.16
Income	0.43**	-0.21**
Availability	0.19**	-0.07**
Flavour	-0.12**	0.34**

****** Significant *P* = 0.05, F= farmed, W = wild, AGR = African giant rat

3.2 Proximate composition of wild and farmed African giant rat thigh meat

The proximate composition analysis of uncooked meat from wild African giant rats showed a significant difference (*P <.01)* in composition when compared to farmed meat (Table 5). Furthermore, sex type did not significantly impact meat composition since the proximate composition values were similar for both male and female rats (Table 5). The moisture, protein,

and ash contents of African giant rat thigh meat from male and female rats were consistent with values previously noted by [7,16]. According to Table 2, the protein content of meat obtained from the wild African giant rat was significantly higher ($P < 0.01$) than that obtained from the farmed giant rat. This finding aligns with previous studies by [11], which reported very high protein levels in the carcasses of wild grass cutters. When African giant rats are obtained from the wild, they are typically not immediately bled out after being killed. [17] have demonstrated that delayed bleeding-out in cattle results in high levels of residual blood in the forequarters. According to [18], blood is a rich protein source. Therefore, blood in the muscles could have contributed to the higher crude protein content in the meat from the wild African giant rats.

This study indicated that the meat of wild African giant rats has a lower fat content ($P < 0.01$) than that of their farmed counterparts. This phenomenon may be attributed to differences in the rats' diet or potentially to the farmed rats' inactive lifestyle due to insufficient space in their cages and the absence of opportunities to engage in typical behavioural patterns as they would in the wild. As a result, the farmed rats utilise less energy and accumulate more fat [19]. Numerous esteemed health organisations, including the World Health Organization, have recommended reducing daily fat intake to improve overall health. Farmers should construct a system to create enough space for the giant rat to exercise and burn fat.

The pH value of the meat of farmed African giant rats was higher ($P = 0.03$) than that of the wild African giant rats, as indicated in Table 5. The lower pH of the meat of wild African giant rats could be attributed to increased lactic acid production caused by stress before death. It is noteworthy that some wild African giant rats were killed using traps that induced neck strangulation, while others were shot with guns, leading to a prolonged struggle before death. This factor could contribute to the significantly lower pH levels in the meat of wild African giant rats. According to [18], when animals sense danger or experience stress before slaughter, they trigger the mechanism of glycolysis to produce energy for escape. However, without oxygen following their death, glycolysis produces lactic acid instead of energy. Conversely, farmed African giant rats exsanguinated with mammal pre-slaughter stress.

Table 5. Proximate composition of raw farmed and wild giant rat thigh.

Parameter	Farmed AGR			Wild AGR		SED	P value
	Male	Female		Male	Female		
Crude protein	23.713[b]	23.757[b]		25.863[a]	25.883[a]	0.022	*<.001*
Fat	6.750[a]	6.627[a]		3.810[b]	3.683[b]	0.068	*<.001*
Moisture	62.407[b]	61.557[b]		63.133[a]	63.157[a]	0.200	*<.001*
Ash	1.143	1.160		1.193	1.193	0.022	0.133
pH	5.690[a]	5.643[a]		5.41[b]	5.420[b]	0.038	0.003

AGR = African giant rat; SED = Standard error of difference; Means in the same row with different superscripts are significantly different (P >0.05)

3.3 The sensory characteristics of the farmed and wild African giant rat meat

The processed meat's sensory scores were significantly different (Table 6). Sex type significantly

(*P* =.05) affected the aroma, juiciness and tenderness of the processed African giant rat thigh meat. The results from Table 3 indicated that the meat of the wild African giant rat exhibited a statistically significant darker colour, with (*P*< 0.01), compared to that of the domesticated African giant rat. This difference could potentially be attributed to a delay in the bleeding-out process of the carcasses of the wild African giant rats. This observation agrees with [11], who reported darker meat colour in wild grasscutter meat. According to [11], the colour of blood is commonly dark, so carcasses that have not been adequately bled can exhibit darker hues. This may harm the marketing of meat products since the colour indicates perceived freshness, a critical factor in the meat industry [20]. Thus, the colour of meat plays a crucial role in determining its overall quality and marketability.

Meat from farmed African giant rats was significantly (*P* = 0.05) better than wild giant rats in terms of tenderness. Females were more tender than those in farmed and wild African giant rats. The tenderness of meat in farmed giant rats was significantly better than that of wild giant rats. This might be because farmed African giant rats have limited space in their cages, which results in less exercise. Additionally, the wild African giant rats might be older than their farmed counterparts, as meat becomes tougher as the animal ages. However, the opposite results were observed for the juiciness of the meat. On the contrary the aroma intensity of the African giant rat meat, males produced a better aroma than females in both farmed and wild giant rats. These results do not match the findings of [7], who reported no significant influence of sex on the sensory properties of African giant rat meat. The difference between the present study and that of [7] could result from animal genetic makeup, feed and feeding regime variations. The aroma of meat derived from wild African giant rats was significantly more pronounced than that of their farmed counterparts. This difference was likely due to the age differences between the wild and farmed rats used in the study, as the age of the wild rats could not be determined. Despite the darker nature of wild African giant rat meat, overall acceptability was significantly (*P* = 0.05) higher than that of farmed giant rat meat.

Table 6. Sensory characteristics of farmed and wild African giant rat meats

Parameter	Farmed AGR		Wild AGR		SED	P value
	Male	female	Male	Female		
Colour	3.620^{b}	3.626^{b}	4.910^{a}	4.913^{a}	0.006	*<.001*
Tenderness	4.816^{b}	4.913^{a}	3.466^{d}	3.623^{c}	0.006	0.003
Juiciness	3.620^{d}	3.713^{c}	4.720^{b}	4.880^{a}	0.007	0.007
Aroma intensity	3.623^{c}	3.533^{d}	4.683^{a}	4.630^{b}	0.009	*<.001*
Acceptability	3.917^{b}	3.920^{b}	4.757^{a}	4.717^{a}	0.073	*<.001*

AGR = African giant rat; SED = Standard error of difference; Means in the same row with different superscripts are significantly different (*P* = 0.05)

4. CONCLUSION

According to the study, most individuals who consume meat prefer meat from wild African giant rats instead of farmed ones. However, individuals adhering to Islamic dietary laws do not prefer wild African giant rat meat. It was further noted that individuals with higher education levels and

higher income levels preferred farmed African giant rat meat. Overall, the study suggested that wild rat meat possesses favourable characteristics in terms of protein content, fat content, and sensory properties. Despite all the advantages of meat from wild African giant rats, the present study has revealed that meat sourced from giant African rats raised on farms is safer, has an impressive protein content, and moderate fat levels. In light of the low capital input required for this venture, the inherent fecundity of the African giant rat, and the abundance of feed available in the Asante Mampong Municipality, residents stand to benefit from a potentially lucrative business opportunity in raising these rodents.

ETHICAL APPROVAL

Experimental protocols used in this study strictly conformed with the internationally accepted standard ethical guidelines for laboratory animal use and care as described in the European Community guidelines; EEC Directive 86/609/EEC, of the 24th November 1986 (EEC,1986).

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