ASSESSING THE BODY WEIGHT AND BEHAVIOURAL TRAITS (DOCILITY) OF AFRICAN GIANT RAT *(CRICETOMYS GAMBIANUS)* FOR IMPROVED PERFORMANCE

Cudjoe. F.N.* **and Duodu, A.**
Department of Animal Science Education, Faculty of Agriculture Education,
Akenten Appiah-Menka University of Skills Training and Entrepreneurial Development,
P. O. Box 40, Asante Mampong, Ghana
**Corresponding author's email: franciscudjoe24@gmail.com*
https://dx.doi.org/10.4314/gjansci.v16i1.9

ABSTRACT
The study assessed the variation in body weight and docility across different sex and age groups of African Giant Rats (Cricetomys gambianus). The initial group of rats used consisted of 15 does and 15 bucks that were regrouped into neonates, juveniles, and adults at 10 rats each of 5 does and 5 bucks in a Randomized Complete Block Design (RCBD). Behavioural docility was assessed on a 4-point scale: docile (1), flighty (2), restless (3), and aggressive (4). The data obtained was analysed with the General Linear Model (GLM) procedure of the Statistical Analysis System (SAS for Windows, version 10) at a significant level of (p < 0.05). The average docility score was 2.52 for the males and 2.75 for the females. Across the age groups, the average docility scores were 2.34 for the neonates, 2.65 for the juveniles, and 2.81 for the adults, with predominantly flighty and restless behaviours. The study revealed that both sex and age had a significant effect (p < 0.05) on docility. While the results showed low variability in docility scores for both sexes, higher variability was observed in the neonatal class compared to the adult and juvenile age groups. Age significantly influenced body weight and weight gain, with neonates recording the highest body weight gain among the three age classes (p < 0.05). The study also found higher variability in body weight of the neonates compared to the other two age groups. Meanwhile, body weight and weight gain were not significantly influenced by sex (p > 0.05), but higher variability in body weight was observed in both sexes. The study highlighted higher variations in the studied traits; hence, their selection in a population of the rat for improvement is possible at neonatal age for both sex.

Keywords: *African giant rat, Coefficient of variation, Cricetomys gambianus, Body weight, Docility, Trait*

INTRODUCTION

"Game" refers to animals hunted in the wild for meat. In Africa, meat from such animals species including: antelope, squirrels, grasscutters, and the African giant rat (*Cricetomys gambianus*) (Oyeyinka *et al.,* 2019) are commonly referred to as "bush meat". Unfortunately, many of these species currently face the threat of overhunting, particularly in regions such as Nigeria and Ghana (Oyarekua & Ketiku, 2010; Oyeyinka *et al.,* 2019). One serious challenge possibly associated with overhunting of game animals is a decline in their populations which is a threat to biodiversity in many African ecosystems; leading to ecological imbalances in the region (Cudjoe *et al.,* 2024).

According to Hoffman and Cawthorn (2012), one way of increasing protein production on a short-time basis is by domesticating fast-breeding wild mammals such as the African giant rat (AGR) which are acceptable to people as meat.

The African giant rat (*Cricetomys gambianus*) is gaining interest in various fields of work, including wildlife conservation, biomedical research, and agricultural pest control. This may be due to its intelligence and usefulness in landmine detection and medical diagnoses. Studies have shown that body weight and docility in both conventional and non-traditional farmed animals vary significantly with sex, with males typically being heavier and more docile than the females (Tsambou *et al.,* 2020).

Behavioural traits, particularly docility, have been noted to improve significantly in individuals raised in captivity and subjected to early handling and socialisation, making them more suitable for roles such as landmine detection and medical diagnosis (Olude *et al.,* 2016). However, systematic studies that show how sex and age affect body weight and behavioural traits of the African giant rat are lacking, making it a challenge to develop optimized breeding and management strategies for the species.

Therefore, this study aims to assess how body weight and docility vary in the two sexes and different age groups of *Cricetomys gambianus* in order to identify optimal conditions for improved performance in the species.

MATERIALS AND METHODS

Study area and duration

The study was conducted from November to December 2023 at the Akenten Appiah Menka University of Skills Training and Entrepreneurial Development, Mampong-Ashanti Campus in the Ashanti Mampong Municipality of Ghana. 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° 03' N and longitude 01° 24' W at an altitude of 289.7 m above sea level with 350 mm of annual rainfall. The area has an average daily temperature between 25 °C and 30 °C, with an average relative humidity of 70%. The dry season of the area occurs from December to March (Meteorological Service Department, 2019). The vegetation in this area is transitional savanna woodland. The rainfall pattern in the area is bimodal, with the significant rainfall season occurring from April to July with 1000 mm of rain. The minor rainfall season occurs from August to November with 350 mm of rain Mampong Ashanti is suitable for rearing African Giant Rats because most of the animal's feed resources are readily available and cheap in the area (Cudjoe *et al.,* 2024).

Animal trapping and source of parent stock

Metallic live-box traps of various sizes were manufactured and baited with peanuts, maize and baked cake made from grinded beans. The AGRs used were trapped from bushes and around residential areas. The traps were set before dusk and checked at dawn; captured animals were immediately removed from the traps to avoid death. The trapping, capturing and handling methods used in the study are in accordance with the American Society of Mammalogists' guidelines (Sikes *et al.,* 2011).

Management and feeding of the experimental animals

The rats were housed in three-tier wooden cages that were enclosed in concrete buildings which were roofed with corrugated iron sheets, to avoid escape. The individual cages measured 60 cm X 50 cm X 40 cm. The cages were partitioned with 2 mm diameter wire mesh; their sides and floor were also covered with the wire mesh. The animals were fed varying quantities of palm fruit (100 - 200 g), cassava (100 - 200 g), and maize (250 - 500 g) based on their body weight. In addition, leafy vegetables such as cabbage and carrot leaves were offered to the animals at 2 % of body weight daily. Water was given *ad libitum*. The animals were supplemented with a concentrate containing 14% crude protein (Annor *et al*., 2011). Routine deworming was carried out monthly using albendazole, 2.5%. The cages, feed and water troughs were cleaned daily.

Identification of the animals

Plastic ear tags were used to identify the animals. Individual rats that belonged to the same sex in all the cages had the same tag shape but the tags varied in colour per each age group. The animals were gouped into three age groups (neonates: rats that were 0–70 g; juveniles: rats that were >70 g but less than 500 g and Adults: those that were > 500 g) as classified by Ajayi (1975) and Oludu *et al.* (2016).

Experimental design and treatment

The initial group of rats used consisted of 15 does and 15 bucks that were regrouped into neonates, juveniles, and adults at 10 rats each of 5 does and 5 bucks in a Randomized Complete Block Design (RCBD).

Measurement of the studied traits

Body weight and weight gain

The initial live body weight of each of the thirty rats was measured immediately they were brought into the experimental house using a weighing balance (50 kg x 200 ModeI 250, Salter, England) while constrained in an empty metal cage. The initial live weight of each rat, defined as LW in this work, was calculated as the difference between the weight of the empty metal cage with the animal and the weight of the animal alone. The same tool and approach was used to measure the bi-weekly live body weight of each rat during the six-month experimental period. The difference between the bi-weekly weight of each rat and its previous weight was defined as the bi-weekly weight gain for that animal.

Docility

Docility was measured with the use of a cage score on a scale of 1 to 4 (Annor *et al*., 2011; Dramani *et al.,* 2024; Duodu *et al*., 2020) and measured as follows:

1. Nonaggressive or docile (walks slowly, can be approached closely by humans, not excited by human presence).
2. Flighty (runs along boundaries, will stand in a corner if humans stay away).
3. Restless (runs along boundaries, look for exits and will run eagerly if humans move closer).
4. Aggressive (excited by human presence, running into boundaries, hitting gates and walls of the cage, avoiding humans, try biting, etc.)

Data organisation and statistical analysis

The growth parameters and docility data were summarised and organised using Microsoft Excel (2019). The effect of sex and age on docility scores, body weight , and body weight gain were analysed with the Generalized Linear Mixed Model, (GLMM) using the GLIMMIX procedure of SAS (2008). The Differences in means were compared using the Fisher Least Significant Difference (lsd) test (p < .05). The model used for the analysis was:

$$Y_{ijklm} = \beta_0 + \beta 1S_i + \beta 2A_j + b_k + r_{klm} + \Sigma_{eijklm}$$

Where:

Yij is the response variable (e.g., body weight, body weight gain and docility) of the ith rat at the jth time point; $\beta 0$ is the overall intercept, $\beta 1S$ is the fixed effect of sex, I = 1,2; $\beta 2A$ is the fixed effect of age, j = 1,2,3; bk is the random effect of the k-th individual rat (accounting for repeated measures within individuals), rklm is the random effect of the l-th replicate nested within the k-th individual and the m-th block and $\epsilon ijklm$ is the random error term.

Estimation of coefficient of variation of traits

The coefficient of variation of the traits was estimated using the formula:

$$CV = \frac{\sigma}{\mu} \times 100$$

where

$$\sigma = \sqrt{\frac{\sum_{i=1}^{n}\left(x_1 - \bar{x}\right)^2}{n-1}}$$ is the standard deviation of the observation.

Xi = Value of the *ith* point in the data set; the mean value of the data set,

$\bar{x}$ = the mean value of the data set,

n = the number of data points in the data set and μ is the mean of the observation.

RESULTS

Effect of Sex and Age on Body Weight and Body Weight Gain of African Giant Rat

Table 1 shows the effect of sex on body weight and coefficient of variation (CV) of African Giant Rats kept under captivity for 1, 60, and 165 days.

Results in Table 1 show that body weight of the adult African Giant Rats was significantly ($p < 0.001$) higher on 1, 60, and 165 days under captivity, followed by the juveniles and then the neonates. No significant differences ($p \leq 0.05$) were observed among the sexes regarding body weight; however, the males were heavier than the females throughout the experimental periods. Similarly, there were no significant differences ($p \geq 0.05$) in body weight gain among the sexes but the results presented in Table 1 show significant differences ($p < 0.001$) in body weight gain among the age class. The neonates recorded the highest body weight gain throughout the experimental periods, followed by the juvenile-age class, which was also significantly different (p <

Table 1: Least square means and coefficient of variation of body weight and body weight gain of AGR

Age class	No.	Body weight (g)	CV%	Body weight gain (g)	CV%
Neonate					
1-day UC	10	22.78[c]	5.35	4.92[a]	0.50
60-days UC	10	318.39[c]	41.97	5.67[a]	9.38
165-days UC	10	913.56[c]	26.51	5.10[a]	4.40
Juvenile					
1-day UU	10	358.31[b]	2.18	4.09[b]	3.19
60-days UC	10	603.72[b]	14.20	4.57[b]	4.31
165- days UC	10	1083.83[b]	15.94	3.80[b]	2.67
Adult					
165-days UC neonate	10	667.51[a]	1.73	3.62[c]	1.54
165-days UC juvenile	10	879.76[a]	7.75	3.60[c]	7.60
165- days UC	10	1258.58[a]	9.82	2.34[c]	1.32
p – value		*<.001*		*<.001*	
Sex class					
1-day UC male	15	384.90	73.59	4.12	14.02
60-days UC male	15	632.50	39.13	4.52	15.83
165-days UC male	15	1106.00	13.76	4.13	27.72
1-day UC female	15	346.80	75.39	4.17	13.33
60-days UC female	15	597.20	38.03	4.60	13.84
165-days UC female	15	1081.00	12.09	4.03	24.23
p – value		0.758		0.831	

UC = under captivity. No. =Number of animals, cm= Centimetre, CV= Coefficient of variation, P Value = Probability value of test of main effects. [abc] Subclass means that have superscripts in common are not significantly different (p<0.05), g= grams, SED= Standard Error of Difference, % = Percentage

0.001) from the adult class.

Generally, body weight of the rats increased while body weight gain decreased as they grew; meanwhile both parameters increased with increasing age in each of the sex groups (Table 1). The coefficient of variation (CV) of the neonates starts low at 1 day (5.35 %), peaks at 60 days (41.97 %), and decreases at 165 days (26.51 %). The CV for the juveniles starts very low at 1 day (2.18 %), increases significantly at 60 days (14.20 %), and slightly rises further at 165 days (15.94 %). In the adult class the CV value for day 1 was (1.73 %), (7.76 %) for 60 days and (9.82 %) for 165 days which were generally low. This indicates that variability in weight increases during early growth but gradually stabilizes over time as individuals approach maturity. The CV of the males at 1 day (73.59 %**),** decrease at 60 days (39.13 %) and further decreases significantly by 165 days (13.76 %) which was similar to what was observed in the females at 1 day (75.39 %), (38.03 %) at 60 days and (12.09 %) at 165 days.

Docility results

The frequency and proportions of observations of the fixed factors

Table 2 presents the distribution of sex and age categories within the experimental groups of African Giant Rats . Most of the African Giant Rats exhibited flighty behaviour with the minority showing, docile behaviour.

The polled data showed that, majority of AGRs are flighty (45%) and restless (42.5%), with fewer being docile (5.83%) or aggressive (6.67%) as presented in Table 2. In terms of gender comparison Females have higher percentages of restlessness (43.33%) and aggression (13.33%) compared to males that are more docile (11.67%) and less aggressive (3.33%), but show a similar trend in being flighty (45%). According to age group neonates show the highest docility (20%) and lowest restlessness (25%), but a significant proportion is still flighty (42.5%) where as Juveniles exhibit increasing aggression (17.5%) and restlessness (32.5%), with slightly less docility (15%). Adults show the highest aggression (20%) and restlessness (42.5%), alongside the lowest docility (10%) and flightiness (27.5%).

Effect of sex on docility and variability of docility (CV) in the rats

The results in Table 3 indicate that docility was not significantly influenced (p $\geq$0.05) by sex in

Table 2: Docility status among sex and age classes for the African Giant Rat

Group	Docility status	Number of observations	Percent (%)
Pooled Data	Docile	7	5.83
	Flighty	54	45.00
	Restless	51	42.50
	Aggressive	8	6.67
	Total	120	100
Female	Docile	5	8.33
	Flighty	21	35.00
	Restless	26	43.33
	Aggressive	8	13.33
	Total	60	100
Male	Docile	7	11.67
	Flighty	27	45.00
	Restless	24	40.00
	Aggressive	2	3.33
	Total	60	100
Neonate	Docile	8	20.00
	Flighty	17	42.50
	Restless	10	25.00
	Aggressive	5	12.50
	Total	40	100
Juvenile	Docile	6	15.00
	Flighty	14	35.00
	Restless	13	32.50
	Aggressive	7	17.50
	Total	40	100
Adult	Docile	4	10.00
	Flighty	11	27.50
	Restless	17	42.50
	Aggressive	8	20.00
	Total	40	100

the first week as both male and female rats recorded docility scores of 2.83 and 2.93 respectively. However, sex significantly ($p < 0.05$) influenced docility of the African Giant Rats from the second week to the end of the experimental period; on the average docility score with lower docility was recorded in the male than the female rats across the weeks (Table 3). The findings in Table 3 further show that on average, the males recorded significantly ($p < 0.05$) a lower docility score of 2.52 than the females that recorded a docility score of 2.73 (Table 3). The findings in Table 3 show that the docility scores for both sexes kept on decreasing throughout the experimental period.

The CV values were intermittent for both the male and female rats across the ages with the males recording a lower range of 6.86 % to 16.76 % compared to the range of 8.08 % to 20.41 % recorded in females (Table 3).

Effect of age on docility and variability of docility (CV) in the rats

Age significantly ($p < 0.05$) influenced docility in the African Giant Rats from the second week to the end of the experimental period and, the average docility score (Table 3). Table 3 indicates d that age did not significantly impact docility during the initial week of the study. The docility score for the neonatal age class was significantly ($p < 0.05$) lower than the juvenile and adult age class; however, there was no significant difference ($p \geq 0.05$) between the docility score of the juvenile and the adult age class in the second to the fifth weeks. On the average, the neonatal, juvenile, and adult age classes recorded docility scores of 2.34, 2.64, and 2.81, respectively (Table 3). The findings in Table 3 show that the docility scores for the neonates, juvenile and adult age groups kept on decreasing throughout the experimental period.

African Giant Rats in the neonatal age class recorded a CV values ranging from low to moderate (6.67 % - 27.73 %), which are lower than the CV values recorded for the juvenile age class (6.53 % -11.16 %) and the (2.65 % - 11.11 %)

Table 3: Means and coefficient of variation for the effects of age class and sex on docility on a weekly basis

		Weekly docility scores											
Variable	**NO**	**WK 1**	**CV %**	**WK 2**	**CV %**	**WK 3**	**CV%**	**WK 4**	**CV %**	**WK 5**	**CV %**	**AVG**	**CV%**
							Sex class						
Male	15	2.83	11.19	2.64^{a}	16.76	2.55^{a}	12.57	2.37^{a}	6.86	2.21^{a}	11.46	2.52^{a}	8.07
Female	15	2.98	8.08	2.81^{b}	10.99	2.73^{b}	8.83	2.61^{b}	10.06	2.51^{b}	20.41	2.73^{b}	6.85
SED		0.147		0.172		0.132		0.089		0.145		0.095	
P - value		*0.062*		*<.001*		*<.001*		*0.003*		*<.001*		*<.001*	
							Age class						
Neonate	10	2.94	12.82	2.56^{a}	19.31	2.22^{a}	6.67	2.05^{a}	17.22	1.94^{a}	27.73	2.34^{a}	16.72
Juvenile	10	2.99	9.21	2.74^{b}	7.83	2.59^{b}	11.16	2.50^{b}	6.53	2.41^{b}	7.24	2.65^{b}	8.36
Adult	10	3.10	8.46	2.91^{b}	9.81	2.81^{b}	10.71	2.68^{b}	2.65	2.56^{b}	11.14	2.81^{b}	8.52
SED		0.197		0.210		0.159		0.164		0.155		0.139	
P - value		*0.683*		*0.002*		*<.001*		*0.005*		*<.001*		*<.001*	

***N0** = Number of animals, **cm** = centimetre,* **CV**= Coefficient of variation, ***p Value** = Probability value of test of main effects. [ab] Subclass means having superscripts in common are not different.at P<0.05. **WK** = Week, **SED** = Standard error of difference, **AVG** = Average* recorded for the adult age class. On average, the coefficients of variation for the neonatal class were 16.77 %, 8.36 % for the juvenile class, and 8.52 for the adult class (Table 3).

DISCUSSION

Effect of sex on body weight, body weight gain, and variability in body weight

The insignificant difference in weight and weight gain observed between the male and female African Giant Rats disagreed with the findings of Dzenda *et al*. (2011), who reported significantly ($p < 0.05$) higher mean body weight of male AGRs (1.28 kg) than their females that recorded body weight of 1.14 kg. The insignificant difference in weight and weight gain observed between the sexes of the present study as compared to that of Dzenda *et al*. (2011), could be a result of differences in the experimental units as in the present study, the AGRs were domesticated for a while and hence were provided quality feed irrespective of sex, but in the study conducted by Dzenda *et al*. (2011), there was no domestication.

Although body weight and weight gain were not influenced significantly by sex, the lower body weight and the corresponding weight gain recorded in the females agree with Maric *et al.* (2022), who reported that female rats tend to be more active than male rats – as activeness is generally linked to light weight. In the current work, the size of the cages could have restricted the movement and activeness of females, as reported by Maric *et al.* (2022); thereby conserving their energy for growth, hence matched the males in terms of body weight; hence the insignificant difference observed.

The coefficient of variation (CV) results from the present data concord with Elamin *et al.* (2012), who reported similar findings in rabbits in a study conducted in Sudan in which they recorded a higher coefficient of variation (20.92 %) for body weight than those of Orheruata *et al.* (2006) recorded in rabbits. In addition, Shahin and Hassan (2000) recorded similar high body weight variability ranging from 21.1 % to 27.6 %. The variability in body weight recorded in the present study was higher than the reports of Udeh and Okonta (2013), who recorded 11 % variability in body weight of grasscutters. Except for day 1, the coefficient of variation in body weight was almost slightly higher in the males than the females throughout the experimental period, although they were both high to moderate (Vaz *et al.,* 2017). This shows that body weight is more variable in males than females. The high variability in body weight recorded suggests that the body weight of AGRs can be improved easily through genetic selection during breeding programs.

Effect of age on body weight, body weight gain, and variability in body weight

Body weight relates to age, thus it was higher in the adult rats than in the juvenile and neonate groups. The significant and higher body weight gain observed for the neonates in the present study is similar to the findings of Ajayi (1977) and suggest that younger rats grow at a faster rate than adult rats. Similar findings were reported by McCutcheon and Marinelli (2009) and Ghasemi *et al.* (2021) stating that the body weight of rats changes considerably during the first two months of postnatal life. Several cross-sectional and longitudinal studies have shown that rodents' body weight gain (BWG) and body weight (BW) increase during their early to middle-age periods (Pappas and Nagy 2019). The slower growth (lower body weight) gained with increasing age in the present study concurs with Ghasemi *et al.* (2021), who reported that post-maturity growth in Wistar rats occurs slowly. The high body weight gain in the younger AGRs may result from higher cell division that occurs during the early stages of life (Cameron and Demerath 2002), or because, as the AGR aged, the rate of apoptosis exceeded the rate of cell division, thereby accounting for the low body weight gained by the adult AGRs.

Results of the present study show that variability in body weight of rats at the neonatal age group is relatively higher than in the other age classes of AGRs. This implies that ranking and selection of African giant rat based on body weight for breeding programs will be easier to achieve during their early and middle ages; because of the high variability of body weight recorded at the stages. Relatively low variability in body weight in the adult class means that as the African Giant Rats age, they turn to be similar in body weights; therefore, the differences between individual body weights decrease; which will pose a challenge to breeders in selecting adult rats for breeding if body weight is the targeted trait for improvement.

Docility of the African Giant Rat

The African Giant Rats appear to possess flight to restless docility rather than the aggression ascribed to the creature (Ajao *et al.,* 2010). Their domestication and interaction with humans may have influenced this shift. However, findings of the study indicate that only a small percentage (5.83 %) of the rats exhibit truly docile behaviour, suggesting that many of them even if domesticated will retain their innate wild nature. In Table 3, the average docility score obtained from the experiment (2.7) is similar to the 2.6 docility score reported in grasscutters by Annor *et al*. (2013); who also observed that grasscutters tend to be restless. Notably, the docility score for African Giant Rats is higher than that of the guinea fowl (2.13), reported by Dramani *et al.* (2018). The difference in docility score between the rats and the guinea fowls could result primarily from differences in their genetic makeup or the environment within which the animals were kept during the respective experiments. Also, guinea fowls were domesticated in Ghana way back compared to the African Giant Rats and grasscutters and therefore they will be more docile than the AGR. There is therefore, a particular need for breeders to include docility in the breeding objectives of non-traditional animals, such as AGR improvement programs to make the handling of these creatures easy and safe and also to increase their productivity as there is a positive correlation between docility and production of farm animals (NRC, 1991; Mensah & Okeyo, 2005; Annor *et al*., 2013).

Effect of sex on docility and variability in docility

It must be noted that the effect of sex on temperament is debatable. The findings of the present work support Voisinet *et al.* (1997) who examined various cattle breeds and found that the females had higher temperament scores than the males; indicating that male cattle are typically tamer than the females. This also aligns with the findings of a study conducted by Burrow (1997) on *Bos indicus* crossbreds. The results of the present study however, contrast those of Annor *et al.* (2013), who found no correlation between sex and docility in grasscutters and Burdick *et al.* (2009, 2011) who similarly found no correlation between sex and docility in some cattle. The current data does not also support Pajor *et al.* (2008) and Pajor (2011) for their insignificant differences ($p < 0.05$) in temperament scores recorded between male and female sheep. In addition, Dramani *et al.* (2018) reported that sex does not significantly influence docility in guinea fowls. The difference in docility between the sexes could be attributed to the fact that females are more active than males, which is in support of Maric *et al*. (2022) who reported that female rats tend to be more active than male rats.

On average, although the male rats recorded somewhat higher coefficient of variation values than the females, the level of variability in terms of docility was not significantly different. This implies that both sexes of the African Giant Rats exhibit similar docility scores (1-4 docility scale). This is very important as it suggests a strong potential for consistent behavioural traits in offspring, improving predictability in temperament across generations and commercial breeding programs.

Effect of age on docility and variability in docility

The results presented in Table 3 indicate that age did not significantly impact docility during the initial week of the study which means that in the wild, both the male and female rats had similar temperament. The high docility scores recorded across all the age classes in the first week of the study may mean that the animals showed fearful responses to handling coupled with exposure to a greater variety of potential stressors such as change of diet and re-grouping with unfamiliar animals which may exacerbate their response as described by Enríquez *et al.* (2011). The gradual decline in docility score as the age of the rats increased is expected because there exists an inverse relationship between the frequency of handling or animal-human interaction and the average temperament score of the animals, provided that the handler adopts a calm approach in handling the animals (Alvarenga *et al.,* 2023). This suggests that excessive animal-human interaction may decrease the animal's temperament score (Parhan *et al.,* 2019; Alvarenga *et al.,* 2022; Alvarenga *et al.,* 2023).

It was observed that, on the average, the rats in their neonatal, juvenile, and adult age groups had significantly different docility scores of 2.32, 2.89 and 2.99, respectively on a 1-4-point scale. The average docility score implies that the neonatal class was flighty while the juvenile and adult classes were restless which conforms to a study conducted by Alvarenga *et al.* (2023) on cattle; they reported from their research that 'The average temperament score of cows at weaning (animals older than 2 years) increased slightly with age'. Their result however, does not conform to the fact that animals become more docile as their age increases (Enríquez *et al.* (2011). However, the results in Table 3 suggest that as the rats grew older, their temperament scores tend to rise, indicating a sensitisation rather than a habituation effect. Another possible hypothesis to explain the high docility scores observed in the adult and juvenile classes as compared to the neonatal class may be attributed to some unpleasant experiences the rats within the adult and juvenile classes might have encountered in the wild, as previous negative experiences can trigger subsequent fearful responses to handling due to memory acquisition (Ede *et al.,* 2019; Lecorps *et al.,* 2019).

The present data highlights significant differences in variability across the different age groups and underscores the importance of considering age when analysing such data. The average African Giant Rat in the neonatal age class had higher variability in docility than those in the juvenile and adult classes. This suggests that selecting African Giant Rats to improve their docility through breeding will be easier during their early stages. The adult African Giant Rats have relatively low variability in docility, which means that as they get older, their docility becomes more similar. As a result, the differences in docility scores between individuals get smaller, making it difficult for breeders to choose the best docile performers at that age for breeding activities.

CONCLUSION

The findings of this research have revealed that the African Giant Rat at the neonatal age group exhibited the highest rate of body weight gain compare to the juvenile and adult age groups. This observation is accompanied by a significant variability in body weight, particularly within at the neonatal age. Additionally, the study emphasises the notable impact of sex and age on docility of the African giant rat which is primarily characterised by restlessness. There was a greater variability in docility scores within the neonatal age group compared to the other age groups; however, this variability does not significantly differ between the sexes. This comprehensive analysis underscores the intricate interplay of age and sex on behavioural traits in the African giant rat, shedding light on this species's nuanced physiological and behavioural dynamics. Based on the present study's results, it is recommended that farmers and breeders Prioritize neonates and juveniles for growth-focused production due to their higher weight gain efficiency. Special attention should be given to their nutritional needs to maximize growth rates. Adults should be maintained primarily for breeding. Breeders aiming for more docile offspring should consider selecting males and younger individuals from docile lines for reproduction during the early stages of life.

AUTHORS' CONTRIBUTIONS
This work was carried out by all the authors. Francis Nkrumah Cudjoe and Addison Duodu designed the study, wrote the protocol and the first draft of the manuscript. Addison Duodu analysed the data. Francis Nkrumah Cudjoe conducted the literature searches. All the authors read and approved the final manuscript.

Competing Interests
There is no competing interest.

Ethical Approval
The 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).

REFERENCES

Ajao, M. S., Olaleye, O., & Ihunwo, A. O. (2010). Melatonin potentiates cells proliferation in the dentate gyrus following ischemic brain injury in adult rats. *Journal of Animal and Veterinary Advances*, *9*(11), 1633-1638.

Ajayi, S. S. (1975). Observations on the biology, domestication and reproductive performance of the African giant rat Cricetomys gambianus Waterhouse in Nigeria. 3*9*(3), 343–364. Https://doi.Org/10.1515/mamm.1975.39.3.343

Ajayi, S. S. (1977). Field observations on the African giant rat Cricetomys gambianus Waterhouse in Southern Nigeria. *African Journal of Ecology*, *15*(3), 191–198.

Alvarenga, A. B., Oliveira, H. R., Miller, S. P., Silva, F. F., & Brito, L. F. (2022). Genetic modelling and genomic analyses of yearling temperament in American Angus cattle and its relationship with productive efficiency and resilience traits. *Frontiers in Genetics*, *13*, 794625.

Alvarenga, A. B., Oliveira, H. R., Turner, S. P., Garcia, A., Retallick, K. J., Miller, S. P., & Brito, L. F. (2023). Unravelling the phenotypic and genomic background of behavioural plasticity and temperament in North American Angus cattle. *Genetics Selection Evolution*, *55*(1), 3.

Annor, S. Y., Ahunu, B. K., Aboagye, G. S., Boa-Amponsem, K., Djang-Fordjour, K. T., & Cassady, J. P. (2011). The genetics of morphological traits in the grasscutter. *Livestock Research for Rural Development. Volume 23, Article #167.* Retrieved June 6, 2023, from http://www.lrrd.org/lrrd23/8/Anno23167.htm

Annor, S. Y., Iddisah, I., & Djang-Fordjour, K. T. (2013). Growth, carcass and behaviour characteristics of castrated and intact male grasscutters (Thryonomys swinderianus). *Livestock Research for Rural Development*, *25*(3), 2013.

Burdick, N. C., Banta, J. P., Neuendorff, D. A., White, J. C., Vann, R. C., Laurenz, J. C., ... & Randel, R. D. (2009). Interrelationships among growth, endocrine, immune, and temperament variables in neonatal Brahman calves. *Journal of animal science*, *87*(10), 3202-3210.

Burdick, N. C., Randel, R. D., Carroll, J. A., & Welsh Jr, T. H. (2011). Interactions between temperament, stress, and immune function in cattle. *International Journal of Zoology*, *2011*(1), 373197.

Burrow, H. (1997). Measurements of temperament and their relationships with performance traits of beef cattle. In *Animal Breeding Abstract* (Vol. 65, pp. 477-495).

Cameron, N., & Demerath, E. W. (2002). Critical periods in human growth and their relationship to diseases of aging. *American Journal of Physical Anthropology: The Official Publication of the American Association of Physical Anthropologists*, *119*(S35), 159-184.

Cudjoe, F. N., Duodu, A., Dotser, J. K., & Kwenin, W. K. J. (2024). Comparative Analysis of Consumer Preferences and Nutritional Composition of Wild and Farmed African Giant Rat. (Cricetomys gambianus) in Mampong Ashanti of Ghana. *Asian Journal of Advances in Agricultural Research,* 24(6), 102–111. https://doi.org/10.9734/ajaar/2024/v24i6518

Dramani, W., Husein, S. M. A., & Birteeb, P. T. D. (2024). Determination of the most suitable methodology for measuring docility in guinea fowls (*Numida meleagris*) in Ghana. *Ghanaian Journal of Animal Science*, 14 (1), 2023.

Duodu, A., Annor, S. Y., Kagya-Agyemang, J. K., Zagbede, G. A., & Kyere, C. G. (2020). Phenotypic and Genetic Parameter Estimates for Local Guinea Fowl Production and Some Other Traits. *Asian Journal of Biochemistry, Genetics and Molecular Biology*, *4*(1), 1-12.

Dzenda, T., Ayo, J. O., Lakpini, C. A. M., & Adelaiye, A. B. (2011). Seasonal and sex variations in live weights of captive African Giant Rats (Cricetomys gambianus, Waterhouse) in the Northern Guinea Savannah zone of Nigeria. *International Journal of Zoological Research*, *7*(1), 49.

Ede, T., Lecorps, B., von Keyserlingk, M. A., & Weary, D. M. (2019). Calf aversion to hot-iron disbudding. *Scientific Reports*, *9*(1), 5344.

Elamin, K. M., Hassan, H. E., Musa, A. M., & Elkhairey, M. A. (2012). Evaluation of body weight and some morphometric traits at various ages in local rabbits of Sudan. *Journal of Animal Science Advances, 2* (4), 407-415.

Enríquez, D., Hötzel, M. J., & Ungerfeld, R. (2011). Minimising the stress of weaning of beef calves: a review. *Acta Veterinaria Scandinavica*, *53*(1), 1-8.

European Economic Community. (1986). Council directive 86/609/EEC of 24 November 1986 on the approximation of laws, regulations and administrative provisions of the Member States regarding the protection of animals used for experimental and other scientific purposes. *Official Journal of the European Communities*. https://faolex.fao.org/docs/pdf/eur36598.pdf

Ghana Meteorological Service. (2019). Mampong Climate Summary, Ghana. https://www.meteo.gov.gh/gmet/regional-weather-ashanti-region.

Ghasemi, A., Jeddi, S., & Kashfi, K. (2021). The laboratory rat: Age and body weight matter. *EXCLI Journal*, *20*, 1431-1445. https://doi.org/10.17179/excli2021-4072

Hoffman, L. C., & Cawthorn, D. M. (2012). What is the role and contribution of meat from wildlife in providing high quality protein for consumption?. *Animal frontiers*, *2* (4), 40-53.

Lecorps, B., Ludwig, B. R., Von Keyserlingk, M. A., & Weary, D. M. (2019). Pain-induced pessimism and anhedonia: Evidence from a novel probability-based judgment bias test. *Frontiers in Behavioral Neuroscience*, *13*, 54.

Maric, I., Krieger, J., Börchers, S., Asker, M., Vujicic, M., Wernstedt Asterholm, I., & Skibicka, K. P. (2022). Sex and Species Differences in the Development of Diet-Induced Obesity and Metabolic Disturbances in Rodents. *Frontiers in Nutrition*, *9*, 828522. https://doi.org/10.3389/fnut.2022.828522

McCutcheon, J. E., & Marinelli, M. (2009). Age matters. *European Journal of Neuroscience*, *29*(5), 997–1014. https://doi.org/10.1111/j.1460-9568.2009.06648.x

Mensah, G. A., & Okeyo, A. M. (2005). Continued harvest of the diverse African Animal Genetic Resources from the wild through domestication as a strategy for sustainable use: A case of the larger grass cutter

(*Thryonomys swinderianus*). International Livestock Research Institute, Nairobi, Kenya.

Microsoft Corporation. (2018). *Microsoft Excel* (Version 2019) [Computer software]. Retrieved from https://office.microsoft.com/excel

National Research Council. 1991. *Microlivestock: Little-Known Small Animals with a Promising Economic Future*. Washington, DC: The National Academies Press. https://doi.org/10.17226/1831.

Olude, M. A., Mustapha, O. A., & Olopade, J. O. (2016). Morphological characterization of the African Giant Rat (Cricetomys gambianus, Waterhouse) brain across age groups: Gross features of cortices. *Nigerian Journal of Physiological Sciences*, *31*(2), 133-138.

Orheruata, A. M., Vaikosen, S. E., Alufohia, G., & Okagbare, G. O. (2006). Modeling growth response of broiler chicken to feed consumption using linear data based model structure. *International Journal of Poultry Science, 5*, 453-456.

Oyarekua, M. A., & Ketiku, A. O., (2010). The nutrient composition of the African rat. *Advance Journal of Food Science and Technology*, *2*(6), 318-324.

Oyeyinka, S. A., Alabi-Ogundepo, T., Babayeju, A. A., & Joseph, J. K. (2019). Consumer awareness, proximate composition, and sensory properties of processed African giant rat (Cricetomys gambianus) thigh meat. *Journal of the Saudi Society of Agricultural Sciences*, *18*(4), 385-388.

Pajor, F. (2011). Adaptability of temperament as a production trait in sheep breeding. Ph.D.Thesis.SzentIstvan University, Hungary.

Pajor, F., Szentléleki, A., Láczó, E., Tőzsér, J., & Póti, P. (2008). The effect of temperament on weight gain of Hungarian Merino, German Merino, and German Blackhead lambs. *Archives Animal Breeding, 51*(3), 247–254. https://doi.org/10.5194/aab-51-247-2008

Pappas, L. E., & Nagy, T. R. (2019). The translation of age-related body composition findings from rodents to humans. *European journal of clinical nutrition*, *73*(2), 172-178.

Parham, J. T., Tanner, A. E., Barkley, K., Pullen, L., Wahlberg, M. L., Swecker Jr, W. S., & Lewis, R. M. (2019). Temperamental cattle acclimate more substantially to repeated handling. *Applied Animal Behaviour Science*, *212*, 36-43.

Shahin, K. A., & Hassan, N. S. (2000, September). Sources of shared variability among body shape characters at marketing age in New Zealand White and Egyptian rabbit breeds. In *Annales de zootechnie* (Vol. 49, No. 5, pp. 435-445). EDP Sciences.

Sikes, R. S., Gannon, W. L., & Animal Care and Use Committee of the American Society of Mammalogists. (2011). Guidelines of the American Society of Mammalogists for the use of wild mammals in research. *Journal of Mammalogy, 92*(1), 235–253. https://doi.org/10.1644/10-MAMM-F-355.1

Tsambou, A. M. M., Kenfack, A., Vemo, B. N., Fonkem, S., Fonou, L. T., Foda, C. F., & Teguia, A. (2020). Effects of dietary energy level on reproductive characteristics in male African giant rat Cricetomys gambianus. *International Journal of Reproduction, Contraception, Obstetrics and Gynecology*, *9*(2), 468-474.

Udeh, I., & Okonta, B. C. O. (2013). Prediction of body weight from body measurements in grass cutters. *Tropical Animal Health and Production*, *45*, 1331-1334.

Vaz, M. A. B., Pacheco, P. S., Seidel, E. J., & Ansuj, A. P. (2017). Classification of the coefficient of variation to variables in beef cattle experiments. *Ciência Rural*, *47*, e20160946.

Voisinet, B. D., Grandin, T., Tatum, J. D., O'connor, S. F., & Struthers, J. J. (1997). Feedlot cattle with calm temperaments have higher average daily gains than cattle with excitable temperaments. *Journal of Animal Science*, *75*(4), 892–896.