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INTESTINAL PARASITIC FAUNA AND PREVALENCE IN AFRICAN GIANT RAT (C*ricetomys gambianus*) IN NSUKKA METROPOLIS SOUTH EASTERN NIGERIA

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ABSTRACT

African giant rat *Cricetomys gambianus* is a source of food and could serve as a complement of animal protein to combat food insecurity and malnutrition among the local populace. However, the giant rat has been reported to harbour many parasites thus, its close association with man in raising them as mini-livestock and the consumption of the meat could be a public health risk to individuals handling them. This study was conducted to investigate the gut parasites and their prevalence on African giant rat in Nsukka metropolis. A total of 21 giant rats comprising 13 males and 8 females were trapped for the study. The giant rats were dissected, and the guts were removed and searched for parasites. A total of 506 parasites where recovered. Four different parasites *Trichostrongylus* sp., *Trichuris muris* (nematodes) and *Hymenolepis diminuta* and *Taenia* sp. (Platyhelminthes) were identified in the gastrointestinal tract of the giant rats. *Hymenolepis diminuta* was the most prevalent (100%) while *Taenia* sp. had the highest mean intensity of 10.15 (7.46 – 12.85, 95% CI) followed by *Trichostrongylus* sp. *Taenia* sp. is significantly higher in the caecum of males than the females ($p< 0.05$). The weight of African giant rat has positive correlation with the prevalence and intensity of the parasites. Given the parasitic load of African giant rats it is recommended that the giant rat should be reared to reduce the intensity of parasitic infection and increase the market value since the farmed ones will be regularly dewormed.

Keywords: Giant rat, nematode, Nsukka, parasite, platyhelminthes

INTRODUCTION

The African giant rat, *Cricetomys gambianus* which is also known as the Gambian pouched rat belong to the largest muroid in the world (Ryan, 1989). *Cricetomys gambianus* is widely distributed in the African sub regions where they are being exploited as a source of food to provide the needed animal protein (NRC, 1991).

In Nigeria, *C.gambianus* is gaining a lot of attention as a mini-livestock to combat food insecurity and supply the scarce and costly animal protein needed by the populace (Ajayi *et al*., 1978; FAO, 1997). *Cricetomys gambianus* is consumed extensively in Nsukka where they can be found as "bushmeat" in bars and restaurants. In Nsukka, giant rat is consumed as a second choice or substitute of bush meat after the wild Grasscutter (*Thryonomys swinderianus*). The meat is of high quality and is nutritionally better than some other domestic meat in terms of protein content (Mogbo *et al*., 2011). They serve as cheap source of protein for the locals (Ekeh and Ekechukwu 2009). *Cricetomys gambianus* in addition controls insects by keeping their population low, and also play major role in seed dispersal (Joo and Myers, 2004; Cooper, 2008). They are useful animal model in biomedical research and provide vital information on mammal physiology and behaviour (Audu *et al*., 2008).

The giant rat has been found living in close association with man, searching for food such as nuts and other household items and leftover food. Some of them burrow in mud houses and near the households though majority of them live in the forest. They are omnivores and feed on a variety of fruits, vegetables, nuts, and even insects when available. Some common foods include cassava, beans, sweet potatoes, and other roots. Termites have been known to be eaten along with snails (Amador, 2003; Cooper, 2008).The feeding habit ensure close association with man which could be a public health risk (Joo and Myers, 2004; Hornok *et al.*, 2015). Thus, the giant rats might serve as a reservoir host of parasites of medical and veterinary importance (Dipeolu and Ajayi, 1976; Al-Bashan and Sabra, 2012). Giant rats have been reported to harbour many ecto and endoparasites, *Trichinella*, *Schistosoma*, *Trypanosoma*, and many other endo-parasitic helminths (Bicalho *et al.*, 2007; Ekeh and Ekechukwu, 2009; Mbaya *et al.*, 2011).

Despite the abundance and close association of giant rat in Nsukka and the habitual attitude of the locals to hunt, keep and consume the meat, studies on the prevalence of gut parasites of the giant rat has been scanty. Ekeh and Ekechukwu (2009) studied the ecto and gut parasites of giant rat in Nsukka however, they sampled only 15 giant rats and their study did not consider the weight in relation to parasite intensity and prevalence. In addition, their study did not look all the regions of the gut and as such did not provide the information on the parasitic localization on all the sections of the gut. There is also lack of data on the relationships between weight of the giant rat with the parasitic load it harbours as it is expected that the older individuals should have more parasites. These lacks of data create a knowledge gap that hampers public health advice on peoples hunting and consuming the giant rat and to people intending to raise the giant rat as mini-livestock. The objectives of the study thus were to determine the intestinal parasitic fauna, assess the prevalence and intensity of the parasites in African giant rat *C. gambianus* in Nsukka.

MATERIALS AND METHODS

The Study Area

Nsukka is located in the northern part of Enugu State and lies on latitude 6º43' - 7º00' and longitude 7º13' - 7º35' covering a land area of 1810km^2 in South-eastern Nigeria (Ezeh and Ugwu, 2010). Nsukka is bounded on the north by Kogi State, on the south by Igbo-Etiti Local Government Area (LGA), on the west by Uzo-Uwani LGA and on the east by Udenu and Igboeze South LGAs (Figure 1). The natural day length for Nsukka is 12–13 hours and the average annual maximum and minimum temperatures are 29.7˚C and 21.0˚C respectively. The relative humidity ranges from 34 to 78% (Inyang, 1978).

Nsukka is a derived savanna zone with vegetations consisting mainly of grasses with sparse distribution of tall trees. Majority of the people in Nsukka are farmers, traders, and civil servants.

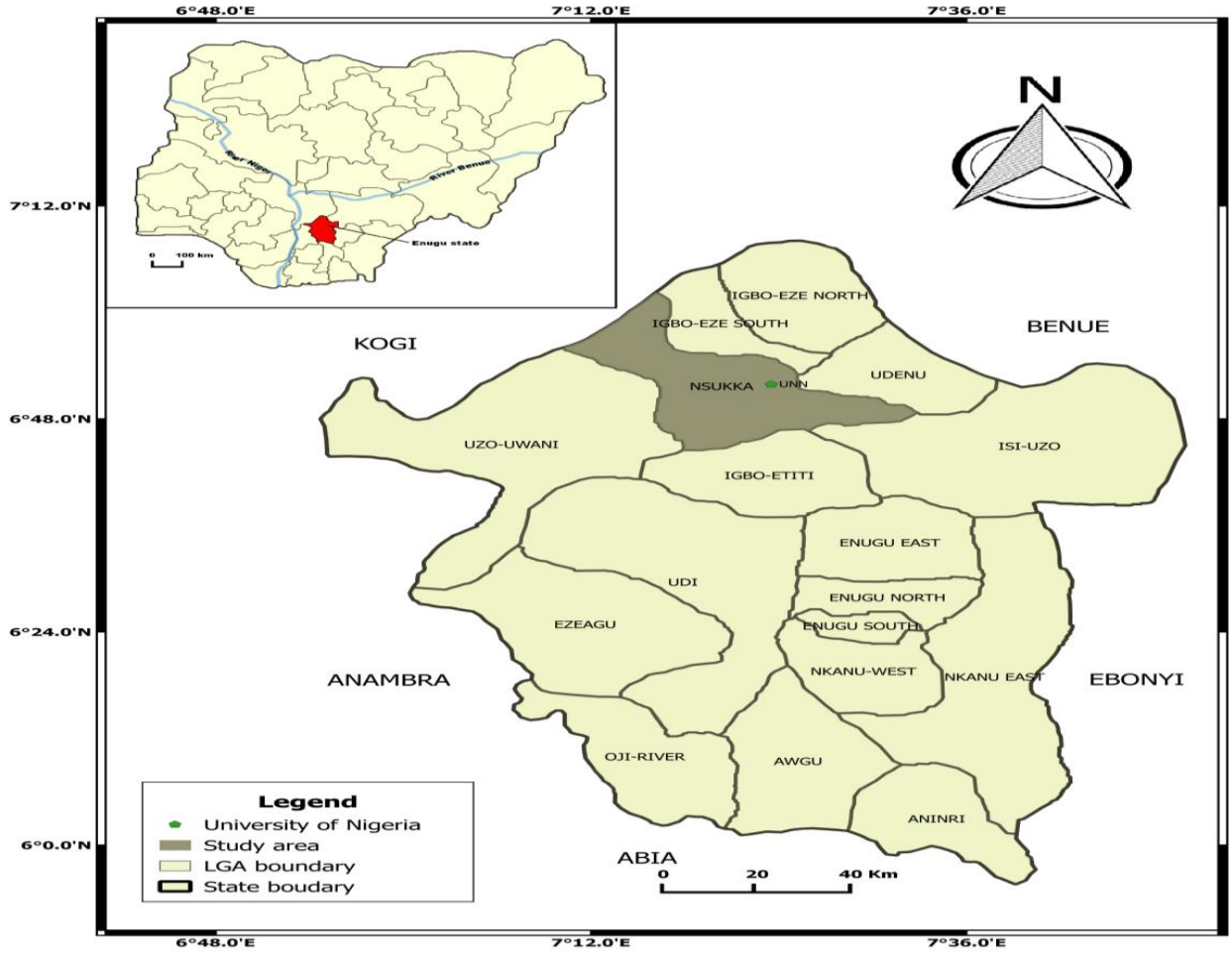

Figure 1. Map of Enugu State showing the study area (Nsukka)

Collection of African Giant Rats

The giant rats, *C. gambianus*, were collected randomly from Nsukka Local Government Area using traps. Traps were set late in the evenings in locations with evidence of giant rant presence such as presence of heaps of droppings and its burrows. The traps were baited with bean cake (akara) , pilled cassava tuber, potato, and pilled yam. The traps were inspected very early in the morning the following day to prevent the trapped animal from harm by other predators. Five traps were set at a time at different locations in the study area. The trapping continued through October – December 2020 when we assumed that the number of giant rats trapped was enough for the study. The weight and prevalence of gut parasites of the giant rats were analysed as soon as they were trapped.

Preliminary Examination of African Giant Rats

The rats trapped were immediately taken to the Parasitology and Public Health Laboratory, Department of Zoology and Environmental Biology, University of Nigeria Nsukka. Thereafter, the rats were anaesthetized with chloroform (Ekeh and Ekechukwu, 2009). When unconscious, the weight of the giant rat was taken using a weighing balance to the nearest 0.1g. The sexes of the rats were determined by checking the genial region; the males have the penis and descending scrotum while the females have the vulva. In addition, the females have numerous teats along the sides of the abdomen which bear openings to the mammary glands.

Examination of African Giant Rats for Gastrointestinal Helminth Parasites

The giant rat was pinned with the ventral region facing up while the dorsal region was on the dissecting board. The rats were dissected along the ventral section. The gastrointestinal tract was excised and appropriately sectioned into stomach, duodenal-jejunal region, ileum, caecum, and colon. Each section was carefully cut open to expose the lumen of the tract. The sections were washed in physiological saline and examined for parasites. Scrapings from the stomach and intestinal lining were also smeared on slide and examined under a binocular microscope. The rinse of the gut content was also mixed with sodium bicarbonate ($NHCO_3$) (one spoonful per litre) to remove mucus and enhance helminth parasite search. Parasite search was according to the guideline by Paperna (1996). The gastrointestinal helminths isolated were stored temporarily in normal saline before identification and counting.

Identification of the Intestinal Parasites

Parasites recovered were identified according to Soulsby (1982). The identities of the parasites were thereafter

confirmed by a parasitologist in the Department of Zoology and Environmental Biology, University of Nigeria, Nsukka.

Data Analysis

Data was analysed using Statistical Package for Social Sciences (SPSS) version 20 (IBM Corp., Armonk, New York). Charts were plotted in Excel (Microsoft Inc., Redmond, Washington). Parasite prevalence was obtained by Chi-square analysis. Level of significance was set at $p < 0.05$. Parasite prevalence and intensity were calculated using the formulae:

$$\text{Prevalence (\%)} = \frac{\text{Number of infected host}}{\text{Number of examined host}} \times \frac{100}{1}$$

$$\text{Mean intensity} = \frac{\text{Total number of parasites}}{\text{Number of positive individuals}}$$

RESULTS

The Giant Rats and the parasites recovered in the study Area

A total of 21 *C. gambianus* were caught and examined for the duration of the study. The weight of the giant rats ranged from 437.00 - 693.00 g with a mean weight of 586.37 ± 17.42 g. The giant rats were all adults and comprised 13 males and 8 females.

Four gut parasites were recovered from the giant rats. They include *Trichuris muris, Hymenolepis diminuta, Trichostrongylu* sp. and *Taenia* sp. The parasites were distributed differently between the sexes and the various sections of the guts.

Prevalence and Intensity of the gut parasites in the Giant Rats

A total of 506 gut parasites were recovered from the 21 giant rats. All the giant rats examined were infected by at least one of the parasites (Table 1). *Hymenolepis diminuta* had the highest prevalence (100%), that is, it was found in the 21 giant rats examined. This was followed by *Trichostrongylus* sp. which infected 16 out of the 21 rats examined (76.2%). The *Trichuris muris* had the highest mean intensity of 10.46 and ranges from 7.29 – 12.00, 95% CI, while *Hymenolepis diminuta* had the least mean intensity of 4.76 with ranges of 3.81 – 5.76, 95% CI (Table 1).

The distribution of the parasites in different sections of the giant rat gastrointestinal tract is shown in Table 2. *Trichostrongylus* sp. is the only parasite that was found in all sections of the gastrointestinal tract of the giant rats however, the infection was greater in ileum and caecum with prevalence of 12 (57.1%) and 15 (71.4%) respectively in the 21 giant rats examined. *Trichuris muris* was found only in the duodenal-jejunal region while *Hymenolepis diminuta* was found in the duodenal-jejunal region, caecum, ileum and colon but it had significantly greater preference for the ileum (100%, χ^2=102.646, p = 0.000) (Table 2).

Table 1. Prevalence and intensity of parasites in the giant rats

Parasite species	Prevalence	Intensity				
	No. infected (%)*	No. of Parasites Recovered	Mean	95% Confidence Interval	Min.	Max.
Trichostrongylus sp.	16 (76.2)	138	8.63	4.88 – 12.76	1	39
Taenia sp.	14 (66.7)	132	9.43	7.46 – 12.85	3	18
Trichuris muris	13 (61.9)	136	10.46	7.29 – 12.00	3	18
Hymenolepis diminuta	21 (100)	100	4.76	3.81 – 5.76	2	10
	χ^2 = 9.975, p = **0.019					

*Number infected by parasite out of 21 giant rats examined. **χ^2 and p-value compared parasite prevalence

Table 2. Prevalence of parasites in gastrointestinal sections of African giant rats

Parasites	Giant rat gastrointestinal sections (n = 21)					
	Stomach	Duodenum + jejunum	Ileum	Caecum	Colon	χ^2, p - value
	No. infected (%)*					
Trichostrongylus sp.	3(14.3)	3 (14.3)	12 (57.1)	15 (71.4)	8 (38.1)	**33.857, 0.000**
Taenia sp.	0 (0.0)	0 (0.0)	1 (4.8)	6 (28.6)	11 (52.4)	**40.444, 0.000**
Trichuris muris	0 (0.0)	14 (66.7)	0 (0.0)	0 (0.0)	0 (0.0)	**78.750, 0.000**
Hymenolepis diminuta	0 (0.0)	1 (4.8)	21 (100)	1 (4.8)	2 (9.5)	**102.646, 0.000**

n = number of each sections examined, *number infected out of 21

Prevalence and Intensity of Gut Parasite by Sex

Thirteen out of the 21 African giant rats examined were male (61.9%) while 8 (38.1%) were females. *Trichostrongylus* sp. significantly infected more male (92.3%) than the female (50.0%) of *C. gambianus* (χ^2 = 4.887, p = 0.027). Similarly, the intensity of *Trichostrongylus* sp. was higher in male (9.92 ± 2.89) than the females (3.80 ± 1.11). All the males and females examined were infected with *Hymenolepis diminuta* (100%) (Table 3).

Table 3: Parasite prevalence and intensity between the sexes of the giant rat

	Giant rat (n = 21)		
	Sex	**No. infected (%)**	**Mean Intensity**
Trichostrongylus sp.	Male (n = 13)	12 (92.3)	9.92 ± 2.89
	Female (n = 8)	4 (50.0)	3.80 ± 1.11
		χ^2 = 4.887, p = 0.027	
Taenia sp.	Male (n = 13)	10 (76.9)	11.30 ± 1.53
	Female (n = 8)	3 (37.5)	6.33 ± 2.85
		χ^2 = 3.264, p = 0.071	

Trichuris muris	Male (n = 13) Female (n = 8)	10 (76.9) 4 (50) $\chi^2 = 1.615$, p = 0.204	9.56 ± 1.13 8.00 ± 2.89
Hymenolepis diminuta	Male (n = 13) Female (n = 8)	13 (100) 8 (100)	4.92 ± 0.65 4.50 ± 0.78

Relationship of Parasites Prevalence and Intensity to the weight of the African Giant Rat

Hymenolepis diminuta infection was recorded in all weight intervals for the studied giant rat. *Trichostrongylus* sp. had 80%, 85.7% and 77.8% prevalence in weight intervals of 400 – 499.9 g, 500 – 599.9 g and 600 – 699.9 g respectively (Figure 2).

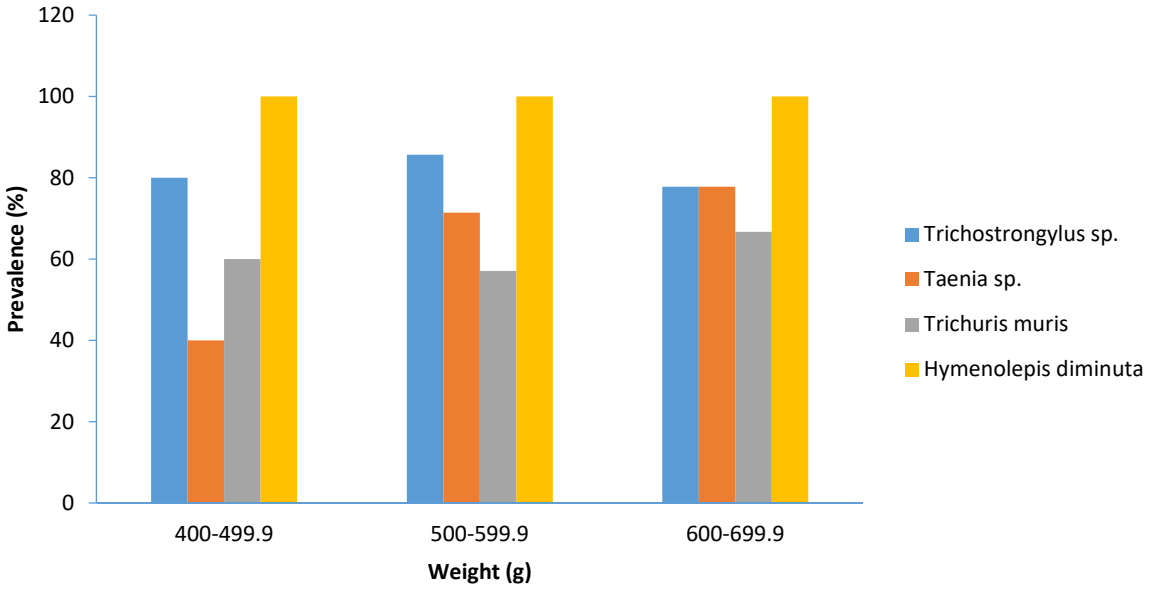

Figure 2: Variations of parasite prevalence with weight of African giant rat

The number of parasites infecting a particular African giant rat was found to have a positive significant correlation with the rat's weight (r = 0.457, p = 0.037). From a regression plot of the linear relationship between the rat weight and the number of parasites it harboured, 20.84% of the variation in the number of parasites harboured was accounted for by the giant rat's weight. The regression equation linking both is shown in Figure 3.

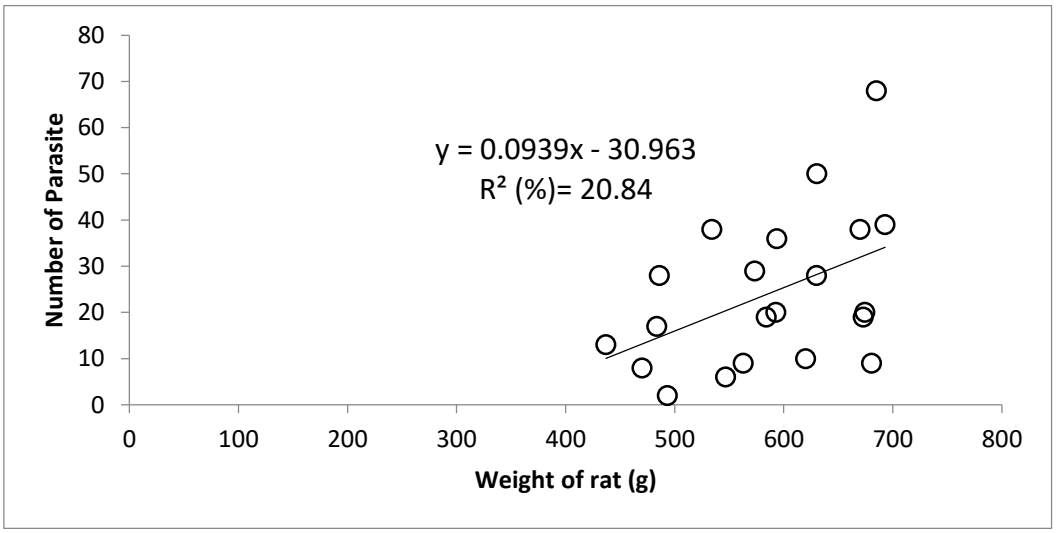

Figure 3: Linear relationship between number of parasites and weight of giant rat

DISCUSSIONS

Parasites constitute a burden to wildlife and domestic animals. They cause physiological distress and mechanical injuries to their host. The prevalence of helminth infection among the giant rats was 100% which is considered very high. The high prevalence of gastrointestinal helminth parasites in the giant rat is similar to the findings of Ekeh and Ekechukwu

(2009) who reported 87.4% prevalence of nematodes in the guts of *C. gambianus* in Nsukka Local Government Area.

The present study recorded *Hymenolepis diminuta*, *Trichostrongylus* sp., *Taenia* sp. and *Trichuris muris* in the giant rats. These findings corroborated the reports of earlier investigators on the gut parasites of *C. gambianus* across Nigeria. Abdullahi and Mamman (2021) reported *Hymenolepis* spp. on giant rats in North Eastern Nigeria. In line with the findings of this study, Okoye and Obiezue (2008), Ekeh and Ekechukwu (2009) and Mbay*a et al*., (2011) recorded *Hymenolepis* spp. in guts of giant rats in South Eastern and North Eastern Nigeria respectively. *Hymenolepis diminuta* has the highest prevalence in this study and its widespread infection across Nigeria is an indication that it is a major gut parasite of giant rats. The high incidence of *Hymenolepis diminuta* might imply that the parasite is evolving an efficient and effective transmission cycle within the giant rat population (Antonovics *et al*., 2012). The implication of this result is that, the giant rats may serve as a reservoir of intestinal parasites of medical and veterinary importance. *Hymenolepis diminuta* recorded in this study is of medical and veterinary importance and has been reported to causes diarrhoea, anorexia and stunted growth in canines (Soulsby, 1982) while the larvae are associated with cutaneous larval migrations in humans (William, 2001). Other parasites recorded in this study such as *T. muris* was also recorded by Okoye and Obiezue (2008) in rodents including giant rat in Nsukka while Mbaya *et al*., (2011) similarly recorded *Taenia* sp. in giant rats in North Eastern Nigeria.

Parasites are known to show specificity for hosts and locations or niche in the host. This preferential host choice and site localization is the product of evolutionary interactions (Antonovics *et al.*, 2012). *Trichostrongylus* sp. was found in all sections of the gut and shows that this parasite is adapted to the gut of giant rats more than the other parasites recorded in this study. *Taenia* sp. has the highest intensity and was recorded in the ileum, caecum, and colon. This knowledge of the localized adaptations of the different parasites in the different regions of the gut will give insight into the drug of choice to combat these parasites in populations of farm animals.

The prevalence and intensity of parasites are known to differ by sex in a population of animals (Webber *et al.*, 2015). These differences in the infection of the different sexes are linked to disparity in demands by males and females in terms of energy expended in mate acquisition, sexual activities, spermatogenesis, ovulation, pregnancy and other sex-related physiological stress inducing activities (Rohlenova *et al.*, 2011; Ejere *et al.*, 2014). Thus, where males expend more energy than females in meeting some of these demands than for immuno-competence related activities, predisposition to infection is increased. This is probably the reason why males were infected by the gut parasites more than the females in this study area,

Age, here estimated as related to the African giant rat weight, is known to affect disease prevalence and intensity (Cosmas *et al.*, 2014; Ejere *et al.*, 2014). The longer an organism lives, the higher the probability of its coming in contact with one or more parasites. Therefore, the positive linear relationship between the numbers of parasites and the weight of host, a rough estimate of host's age, is accounted for by this conception.

Given the wide distribution of African giant rat in the study area, there is need for more detailed studies to determine accurately the dynamics of parasite infection of the gastrointestinal tracts of the African giant rat (*Cricetomys gambianus*) and thus access the risk which they pose to animal health as well as human health. This is pertinent because as a large proportion of the local population over the years and in recent times consume the meat of the giant rat as a special delicacy due to their taste, protein and low cholesterol content. Our survey therefore points to the need for more intensive study on the entire body of the species to fully comprehend the general parasites composition of the animal. In addition, given that a large number of parasites were recorded in the gut of the giant rats, people intending to raise giant rats as mini-livestock should deworm the rats regularly.

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