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Research Article

Evaluation of Species Composition and Food Preferences of Rodent Pest Species in Some Selected Vegetations in Ibadan, Southwest Nigeria

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ABSTRACT

The species among rodents that are pests have been identified as those that are highly destructive pest species which inflict serious damage to food produce while some are carriers of zoonotic diseases. However, they also play vital ecological roles in the ecosystem as they aide in soil mixing and aeration, serve as dispersal agents and prey-base for predatory species. Studying the food preferences of the rodent species could help in their effective management. Sampling of small mammal species (rodents and insectivores) was carried out in six selected vegetations between 2019 and 2021, within the University of Ibadan premises. Ten (10) snap traps were set for three (3) consecutive nights per month for 24 months in each sampling site. Seven species of rodents were encountered which include *Cricetomys gambianus*, *Arvicanthis niloticus*, *Rattus rattus*, *R. norvegicus*, *Lemniscomys striatus*, *Funisciurus anerythrus*, and *Crocidura olivieri*. The stomach contents of the snap-trapped species were removed and analysed to know their food preferences. The diets of all the snap trapped rodent species contained vegetable matters but in varying percentage. *Cricetomys gambianus* had the highest mean wet (6.76 ± 1.58) and dry (4.97 ± 1.20) content weights. Diet diversity was highest in *C. gambianus* (7.63) in *F. anerythrus* (2.82) but the difference in the diet diversity of the species showed no statistical significance (p>0.05). The vegetable matters which form one of the major diets of the captured species indicates their preferences for plant matters and these could be used as a bait or delivery medium for natural products of rodenticidal and/or abortifacient potential.

Keywords: *rodent, damage, food produce, zoonotic disease, food preference, effective management.*
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INTRODUCTION

Rodents are vertebrate pest species (Makundi and Massawe, 2011). Most rodent species have been implicated as the most persistent and ubiquitous vertebrate pest species. This is because they inflict damage to agricultural crops and pose serious health problems being the carriers of zoonoses (Buckle and Smith, 2015). Severe damage to agricultural production from rodent outbreaks is well-documented from Australia, Asia and Africa (Singleton *et al*., 2010b). Globally, an average of agricultural crops estimated to be $30billion are consumed by pest rodents (Fieldhamer *et al*., 2007). They consume diverse food items ranging from vegetable matters, animal matters, and inorganic substances (Smith *et al*., 2002). Their incisors form the clue to the great success of rodents in the animal kingdom (Ofuya and Lale, 2001). The incisors have three important characteristics which in combination, distinguish them from the teeth of other animals in that they are strongly curved, grow continuously throughout the life of the animal and are furnished with a thick layer of enamel on one side only (Ofuya and Lale, 2001). Most species constantly gnaw to keep the incisors at an appropriate length and position (Witmer, 2007). Most rodent species are small, secretive, nocturnal and adaptable, and have keen senses of touch, taste, and smell (Witmer, 2007). The losses caused by rodents are often perceived by farmers as that which cannot be controlled perhaps because of the frequent failure usually recorded in the management activities (Brown *et al*., 2008). Rodent success is attributed to the fact that they are highly adaptable and have high omnivorous tendency (Witmer, 2007). Several studies have been conducted on the species composition, distribution, and abundance of rodent species in Africa (Akpan *et al*., 2015; Chane and Yirga, 2014; Kasso and Bekele, 2011). Some other studies have also been conducted on food preferences of rodent species (Mulungu *et al*., 2014; Smith *et al*., 2002; Iwuala *et al*., 1980). However, over the years, there has been perception among the farmers that rodent pests are very difficult to manage (Makundi and Massawe, 2011). Some farmers factor in the depredation as a result of rodent pests by planting eight rows of crops and two rows for the rodent pests. Unfortunately, farmers can no longer afford to make provision for the rodent pests while cultivating because of human population increase and continuous shortage of food produce. To this end, there is need for effective management of rodent pest population in order to reduce their economic losses. One of the strategies for rodent management is by removing their alternative food resources and nesting sites. This study seeks to evaluate species composition and food preferences of rodent pest species in some selected vegetations in Ibadan, South Western Nigeria.

MATERIALS AND METHODS

Description of the Study Area/Sites: Based on the vegetation and habitat types, six sampling sites were selected within the study area (University of Ibadan premises). These sampling sites include Conserved Forest (CF), Mixed farmland (MFL), Plantain plantation (PP), Cassava Farmland (CFL), Oil Palm Plantation (OPP), and Shrubland (SHL).

Ethics approval certificate collection: Approval certificate, with assigned number UI-ACUREC/19/0136, was collected for this study from Animal Care and Use Research Ethics Committee (ACUREC), University of Ibadan, Ibadan, Nigeria.

Snap trapping procedure: Ten (10) snap traps were used along with the live-traps at the same time in order to carry out stomach content analysis. Snap-traps were set at 5 m apart from each other (Datiko and Bekele, 2013). They were also set during the dry and wet seasons and baited with roasted yam. They were then examined two times a day i.e. early in the morning (7:00a.m- 8:00a.m) and late in the evening (5:00p.m - 6:00 p.m). Permanent marker was used to label the traps with consecutive numbers. The captured individuals were identified to species level using identification key characteristics (Happold, 2013; Aplin *et al*., 2003). The stomach of each of the captured individuals was removed, weighed, and preserved in 70% alcohol (Smith *et al*., 2002).

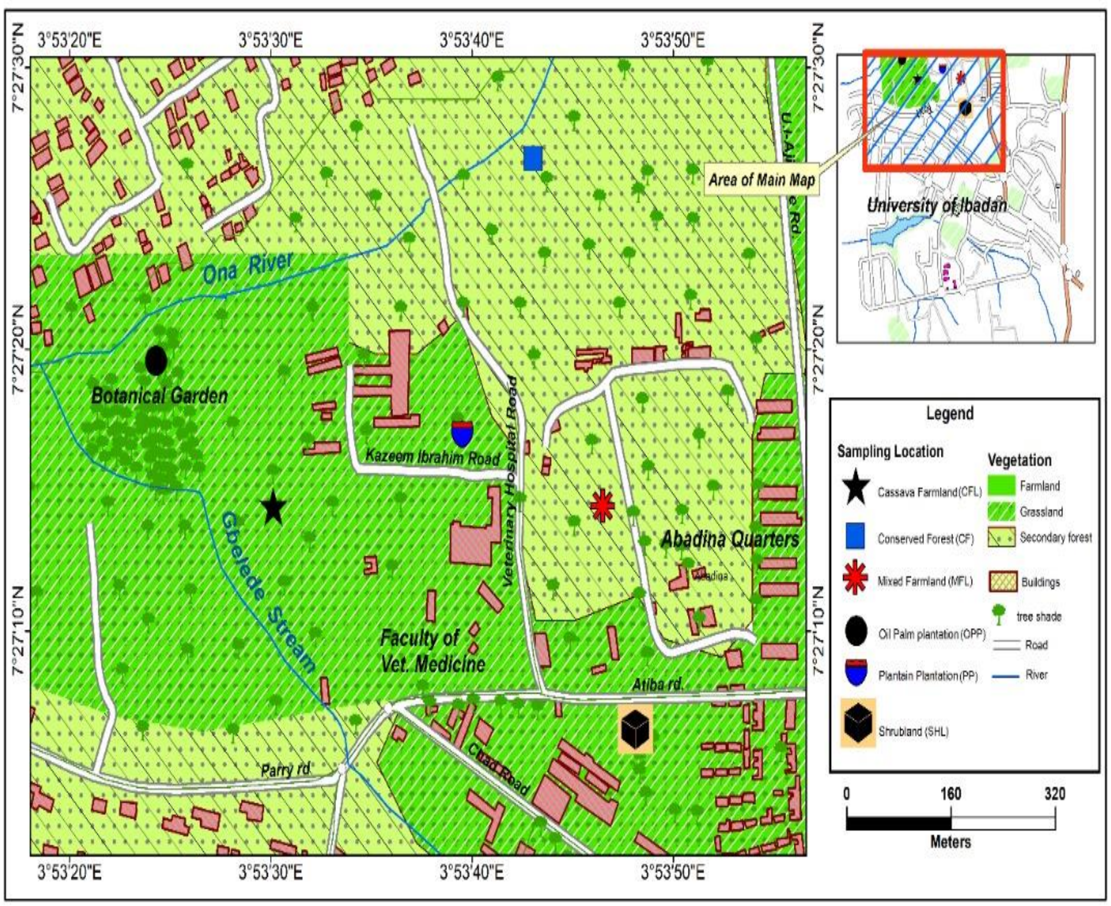

Plate 1:
A map of University of Ibadan showing the six sampling sites.
Conserved forest (CF), Plantain plantation (PP), Shrubland (SHL), Cassava farmland (CFL), Oil Palm Plantation (OPP), Mixed farmland (MFL)

Analysis of the Stomach contents: The contents of the stomachs removed from each of the snap trapped individuals were brought to the Ecology laboratory of the Department of Crop Protection and Environmental Biology, University of Ibadan. They were rinsed with warm water to remove gastric juice and fully digested items, dried to a constant weight, mixed thoroughly, and spread the contents of each stomach in a Petri-dish. A small portion from each of the dried contents was put on a microscope slide and viewed under a binocular dissecting microscope (under ×25 and ×50 magnifications) (Smith *et al*., 2002). The proportion and the type of contents were identified and sorted according to the following categories: Vegetable matters (Palm nut and Kernel, Maize seeds, Other grains, leaves and grasses, Tubers, root and stem fibres, Fruits), Animal matters (Annelid worms, Insects, Hair), Inorganic matters (Sand grains, Plastic) (Iwuala *et al*., 1980; Chekol *et al*., 2012). The quantities of the each of the dietary items in the contents were estimated as described by Smith *et al*. (2002).

Estimation of Percentage Volume (PV) was done as the contribution of each item to the volume of the particular stomach content. The estimated value was taken to the nearest 10%, with an additional category of 5% where an item was present but contributed <10% to the stomach content volume. Diet diversity was calculated following Ebersole and Wilson (1980) as Levins' index (Levins, 1968) as

$$\frac{1}{\sum pi2}$$

where p (= PV/100) is the mean proportion of each of the diet items. Levins' index ranges from 1 to n (n = total number of food item categories).

The PC of a particular food item in a sampling period was estimated as follows:

$$PC = \frac{\text{Number of stomach it was found in}}{\text{Number of stomach examined}} * 100$$

The relative importance value (RIV) of a particular item was computed

$$RIV = 100 \times IV/\sum IV.$$

Data were analysed using SPSS (version 20) software. MS Excel spreadsheet was used to manage the data collected. Relative abundance data were analysed using descriptive statistics. Mean weights of the stomach contents and means dietary components of the snap trapped individual species were separated using Duncan Multiple Range Test (DMRT)

RESULTS

Species of snap trapped small mammals captured: In all the six habitat types selected in the study area, seven (7) different species of small mammal species were snap-captured which include *Cricetomys gambianus* Waterhouse, 1840, *Arvicanthis niloticus* Ḗ. Geoffrey, 1803, *Rattus rattus* Fischer de Wldeheim, 1803, *Rattus norvegicus* Fischer de Wldeheim, 1803, *Lemniscomys striatus* Linnaeus, 1758, *Funisciurus anerythrus* Thomas, 1890, and *Crocidura olivieri* Lesson, 1827.

Gut Content weight of the snap trapped small mammal species: The mean weight of the gut contents of snap trapped small species encountered in the study area were measured and recorded (Table 1). The highest mean wet (6.76 ± 1.58) and dry (4.97 ± 1.20) weights were recorded in *C. gambianus* while the lowest mean wet (2.13 ± 0.41) and dry (1.08 ± 0.19) weights were recorded in *R. rattus* (Table 1). It was observed that the difference in the mean wet weight of the snap trapped species was statistically significant (F = 29.53, df = 6, p<0.05). Similarly, the difference in the mean dry weight of the snap trapped species was significant statistically (F = 46.46, df = 6, p<0.05).

Table 1:
Weight of the stomach contents of snap trapped small mammal species (Mean ± SD)

Species	Wet weight **(g)**	Dry weight **(g)**
Cricetomys gambianus	6.76 ± 1.58b	4.97 ± 1.20c
Arvicanthis niloticus	3.13 ± 1.52a	1.96 ± 0.75b
Rattus rattus	2.13 ± 0.41a	1.08 ± 0.19a
Rattus norvegicus	2.35 ± 0.51a	1.69 ± 0.36ab
Lemniscmys striatus	2.80 ± 0.53a	1.61 ± 0.32ab
Funisciurus anerythrus	2.76 ± 0.45a	1.39 ± 0.28ab
Crocidura olivieri	2.76 ± 0.82a	1.70 ± 0.41ab

Means with the same letter are not significantly different from each other (p>0.05)

Dietary Components in the guts of the snap trapped small mammal species: There were observed variations in the mean dietary components among the snap trapped small mammal species recorded. The mean PNK in *C. gambianus* (52.63 ± 9.82) was significantly the highest of the PNK in other species (Table 2). The mean PNK in *R. norvegicus*, *F. anerythrus*, and *C. olivieri* were recorded to be 0.00 ± 0.00. the in the mean PNK among the snap trapped species was statistically significant (F = 91.22, df = 6, p<0.05).

The mean MG measured in *C. gambianus* (46.32 ± 13.91) was the highest of MG in other species. The second highest mean MG was recorded in *R. norvegicus* (31.38 ± 6.95) followed by that recorded in *A. niloticus* (27.08 ± 18.92) (Table 4.10). No MG was recorded in *R. rattus*, *L. striatus*, *F. anerythrus*, and *C. olivieri* as the mean MG recorded in each was 0.00 ± 0.00 (Table 2). The overall difference in the mean MG among the snap trapped species was significant statistically (F = 33.46, df = 6, p<0.05).

Cricetomys gambianus recorded the highest mean OS (62.63 ± 17.88). The second highest mean OS (33.54 ± 9.09) was recorded in *A. niloticus*. The mean OS in *A. niloticus* was, however, not significantly higher than that recorded in *R. rattus* (26.13 ± 6.64) (Table 2). The mean OS in *L. striatus* (12.30 ± 3.21) was significantly lower than that in *R. rattus* (Table 2). The lowest mean OS was recorded to be 0.00 ± 0.00 in *R. norvegicus*, *F. anerythrus*, and *C. olivieri*. There was overall significant difference in the mean OS among the guts of the snap trapped small mammal species examined (F = 60.32, df = 6, p<0.05).

Table 2:
Mean Dietary component in each of the snap trapped small mammal species

	Dietary components (Mean ± SD)											
	Vegetable matters							Animal matters			Inorganic matters	
Species	PNK	MG	OS	LGR	TB	RSF	FR	AW	INS	HAI	SG	PLA
Cg	52.63± 9.82a	46.32± 13.91a	62.63± 17.88a	59.53± 14.32bc	56.20± 45.88a	73.53± 14.51a	6.68± 6.45c	3.53± 3.12a	2.05± 5.05c	68.68± 24.49a	125.20± 48.22a	2.53± 2.63a
An	14.23± 7.42b	27.08± 18.92b	33.54± 9.09b	56.15± 9.80bc	0.00± 0.00c	55.92± 21.86a	5.00± 7.43cd	4.77± 3.19a	9.38± 7.74bc	23.54± 13.36c	67.23± 39.78b	0.00± 0.00b
Rr	15.75± 4.23b	0.00± 0.00c	26.13± 6.64b	70.38± 11.35b	0.00± 0.00c	74.25± 10.99a	0.00± 0.00d	0.00± 0.00b	0.00± 0.00c	49.50± 8.45b	29.88± 4.02c	0.00± 0.00b
Rn	0.00± 0.00c	31.38± 6.95ab	0.00± 0.00d	19.50± 7.07e	28.25± 6.02b	0.00± 0.00d	31.13± 5.06a	0.00± 0.00b	0.00± 0.00c	33.63± 24.34bc	10.88± 9.40c	0.00± 0.00b
Ls	20.50± 10.52b	0.00± 0.00c	12.50± 3.21c	90.25± 21.29a	0.00± 0.00c	18.00± 4.72b	0.00± 0.00d	0.00± 0.00b	14.13± 5.92b	24.88± 4.67c	0.00± 0.00c	0.00± 0.00b
Fa	0.00± 0.00c	0.00± 0.00c	0.00± 0.00d	52.38± 19.09cd	0.00± 0.00c	28.38± 10.46c	0.00± 0.00d	0.00± 0.00b	0.00± 0.00c	43.63± 7.48b	0.00± 0.00c	0.00± 0.00b
Co	0.00± 0.00c	0.00± 0.00c	0.00± 0.00d	38.60± 13.22d	0.00± 0.00c	18.4± 3.51b	25.60± 4.28b	0.00± 0.00b	115.8± 38.44a	24.40± 3.72c	0.00± 0.00c	0.00± 0.00b

The mean LGR recorded in *L. striatus* was significantly the highest among the guts of the snap trapped species (90.25 ± 21.29). The mean LGR in *R. rattus* (70.38 ± 11.35) was the second highest but was not significantly higher than that in *C. gambianus* (59.53 ± 14.32) and *A. niloticus* (56.15 ± 9.80). The lowest mean LGR was recorded in *R. norvegicus* (19.50 ± 7.07) (Table 2). The overall difference observed in the mean LGR in the guts of the snap trapped species was significant statistically (F = 19.41, df = 6, p<0.05).

Out of all the guts of the snap trapped species encountered, Tubers (TB) was only recorded in *C. gambianus* and *R. norvegicus*. The mean TB recorded in *C. gambianus* (56.20 ± 45.88) was significantly higher than that in *R. norvegicus* (28.25 ± 6.02) (Table 2). There was overall significant difference in the mean TB in the gut of the snap trapped species (F = 11.47, df = 6, p<0.05). Out of the seven snap trapped species examined, the highest mean RSF was recorded in *R. norvegicus* (74.25 ± 10.99) though it was not significantly higher than that in *C. gambianus* (73.53 ± 14.51) and *A. niloticus* (55.92 ± 21.86). The mean RSF recorded in *L. striatus* (18.00 ± 4.72) was significantly different from that in *C. olivieri* (18.40 ± 3.51) (Table 2). No mean RSF was recorded in *R. norvegicus* (0.00 ± 0.00). the overall mean RSF in the guts of the snap trapped species was statistically significant (F = 46.98, df = 6, p<0.05).

The snap trapped species with the highest mean FR (31.13 ± 5.06) was *Rattus norvegicus* and was significantly higher than that in *C. olivieri* (25.60 ± 4.28). However, the mean FR recorded in *C. gambianus* (6.68 ± 6.45) and *A. niloticus* (5.00 ± 7.43) were not significantly different. there was no mean FR recorded in *R. rattus*, *L. striatus*, and *F. anerythrus* (Table 2). The mean FR in the guts of the snap trapped species showed statistical significance (F = 46.68, df = 6, p<0.05).

The animal matters examined in the guts of the snap trapped species include Annelid worm (AW), Insect (INS), and Hair (HAI). The mean AW was recorded only in *A. niloticus* (4.77 ± 3.19) and *C. gambianus* (3.53 ± 3.12) but the difference was not statistically significant (Table 2). However, there was statistically significant difference in the mean AW among the snap trapped species (F = 10.12, df = 6, p<0.05). The highest mean INS was recorded in *C. olivieri* (115.80 ± 38.44) which was significantly higher than the mean INS recorded in all other species. Meanwhile, there was significant difference in the mean INS recorded in *L. striatus* (14.13 ± 5.92) and *A. niloticus* (9.38 ± 7.74) (Table 2). There was overall difference in the mean INS which was statistically significant (F = 83.59, df = 6, p<0.05).

All the snap trapped species had the mean HAI recorded in their gut. The mean HAI recorded in the gut of *C. gambianus* (68.68 ± 24.49) was significantly higher than that recorded in other species. However, there was no significant difference in the mean HAI recorded in *R. rattus* (49.50 ± 8.45), *F. anerythrus* (43.63 ± 7.48) and *R. norvegicus* (33.63 ± 24.34). The lowest mean HAI was recorded in *A. niloticus* but was not significantly different from the mean HAI recorded in *R. norvegicus* (33.63 ± 24.34), *L. striatus* (24.88 ± 4.67) and *C. olivieri* (24.40 ± 3.72) (Table 2). The overall difference in the mean HAI was statistically significant (F = 12.99, df = 6, p<0.05).

Two inorganic matters recorded in the gut of species include Sand grains (SG) and Plastics (PLA). SG was recorded in four out of the seven snap trapped species encountered. The highest mean SG was recorded in the gut of *C. gambianus* (125.20 ± 48.22) which was significantly higher than that recorded in the gut of other species (Table 2). The second highest mean SG was recorded in *A. niloticus* (67.23 ± 39.78) followed by *R. rattus* (29.88 ± 4.02) and *R. norvegicus* (10.88 ± 9.40) (Table 2). The overall difference in the mean SG was statistically significant (F = 30.05, df = 6, p<0.05). The only snap trapped species where mean PLA was recorded was in *C. gambianus* (2.53 ± 2.63). The overall mean PLA was significantly different (F = 7.28, df = 6, p<0.05).

Relative Importance Value (RIV) of the dietary components of snap trapped small mammals in 2019-2020: Table (3) shows the Relative Importance Value (RIV) of the dietary components in the guts of the dissected small mammal species between 2019 and 2020 (dry and wet seasons). In *C. gambianus*, MG and TB had the same and highest RIV (11.32) recorded among the vegetable matters during the dry season while 11.40 was recorded as the highest RIV for RSF during the wet season among the vegetable matters. Among the animal matters which include AW, INS, and HAI, HAI had the highest RIV both in the dry (9.25) and wet (10.68) seasons. SG had the higher RIV both in the dry (15.56) and wet (15.33) seasons than PLA which were the two inorganic substances identified in the gut of *C. gambianus* (Table 3). Diet category with the highest RIV among the vegetable matters in the gut of *A. niloticus* during the dry and wet seasons was LGR (17.51 and 14.98 respectively). Among the animal matters, AW and HAI had the same and highest RIV in the dry season (9.70) while INS and HAI had the same and highest RIV during the wet season (10.59). Inorganic substance with the highest RIV was SG both in the dry (10.99) and wet (14.02) seasons (Table 3).

Table 3:
RIV of each of the dietary components in the guts of the dissected rodent species in the dry and wet seasons (2019-2020)

Diet category	Cg		An		Rr		Rn		Ls		Fa		Co	
	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
PNK	7.78	8.65	8.89	10.59	9.70	10.59	0.00	0.00	11.32	10.59	0.00	0.00	0.00	0.00
MG	11.32	9.22	9.73	8.88	0.00	0.00	24.52	22.53	0.00	0.00	0.00	0.00	0.00	0.00
OS	10.32	11.29	9.63	10.05	8.13	8.88	0.00	0.00	9.70	9.71	0.00	0.00	0.00	0.00
LGR	8.70	9.94	17.51	14.98	20.60	22.49	14.64	14.33	44.74	53.07	40.75	41.43	0.00	12.87
TB	11.32	8.48	0.00	0.00	0.00	0.00	18.66	16.38	0.00	0.00	0.00	0.00	0.00	0.00
RSF	10.23	11.40	16.04	14.11	22.16	24.19	0.00	0.00	9.81	10.59	15.05	16.22	8.47	12.36
FR	5.66	6.18	4.31	9.71	0.00	0.00	0.00	21.16	0.00	0.00	0.00	0.00	10.40	11.84
AW	4.85	5.30	9.70	7.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INS	1.13	0.00	6.47	10.59	0.00	0.00	0.00	0.00	9.70	8.83	0.00	0.00	43.90	42.98
HAI	9.25	10.68	9.70	10.59	14.20	15.50	0.00	13.88	8.61	13.21	25.07	30.62	0.00	12.61
SG	15.56	15.33	10.99	14.02	10.04	10.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PLA	3.88	3.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

PNK: Palm nut and Kernel, MG: Maize grain, OS: Other seeds, LGR: Leaves and Grasses, TB: Tuber, RSF: Root and stem fibres, FR: Fruits, AW: Annelid worm, INS: Insect, HAI: Hair, SG: Sand grain, PLA: Plastics
Cg: *Cricetomys gambianus*; An: *Arvicanthis niloticus*, Rr: *Rattus rattus*; Rn: *R. norvegicus*; Ls: *Lemniscomys striatus*; Fa: *Funisciurus anerythrus*, Co: *Crocidura Olivieri*

Table 4:
RIV of each of the dietary components in the guts of the dissected rodent species in the dry and wet seasons (2020-2021)
PNK: Palm nut and Kernel, MG: Maize grain, OS: Other seeds, LGR: Leaves and Grasses, TB:

Diet category	Cg		An		Rr		Rn		Ls		Fa		Co	
	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
PNK	11.53	8.29	2.56	7.63	9.61	8.48	0.00	0.00	12.46	13.09	0.00	0.00	0.00	0.00
MG	11.53	10.17	4.48	11.02	0.00	0.00	13.06	14.96	0.00	0.00	0.00	0.00	0.00	0.00
OS	11.53	9.29	13.45	8.06	8.32	11.87	0.00	0.00	13.45	10.17	0.00	0.00	0.00	0.00
LGR	7.45	9.42	14.45	13.89	26.19	23.11	11.53	9.98	35.27	40.59	15.25	27.53	14.59	18.05
TB	10.75	11.87	0.00	0.00	0.00	0.00	17.23	17.46	0.00	0.00	0.00	0.00	0.00	0.00
RSF	10.78	11.25	17.85	12.65	27.92	25.09	0.00	0.00	12.47	11.87	31.14	25.65	10.57	11.02
FR	0.06	5.09	0.00	0.00	0.00	0.00	14.09	16.45	0.00	0.00	0.00	0.00	9.50	9.19
AW	0.00	5.09	1.92	5.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INS	1.44	0.97	2.88	5.93	0.00	0.00	0.00	0.00	10.34	11.87	0.00	0.00	59.41	41.88
HAI	11.41	9.79	12.49	8.90	19.08	16.84	34.98	18.46	17.33	10.43	49.69	31.60	11.53	8.51
SG	23.52	18.49	25.57	25.26	10.06	0.00	9.92	11.87	0.00	0.00	0.00	0.00	0.00	0.00
PLA	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Tuber, RSF: Root and stem fibres, FR: Fruits, AW: Annelid worm, INS: Insect, HAI: Hair, SG: Sand grain, PLA: Plastics
Cg: *Cricetomys gambianus*; An: *Arvicanthis niloticus*, Rr: *Rattus rattus*; Rn: *R. norvegicus*; Ls: *Lemniscomys striatus*; Fa: *Funisciurus anerythrus*, Co: *Crocidura olivieri*

In *R. rattus*, vegetable matter with highest RIV was RSF during both the dry (22.16) and wet (24.19) seasons. HAI had the highest RIV among the animal matters both during the dry (14.20) and wet (15.55) seasons while the inorganic substance with the highest RIV was SG having 10.04 in the dry season and 10.96 during the wet season (Table 3). Highest RIV recorded among the vegetable matters was MG both during the dry (24.52) and wet (22.53) seasons in the gut of *R. norvegicus*. Among the animal matters, HAI had highest RIV recorded during the wet (13.88) seasons only. In the gut of *R. norvegicus*, neither SG nor PLA was of importance (Table 3).

In the gut of *L. striatus*, the vegetable matter with the highest RIV was LGR both during the dry (44.74) and wet (53.07) seasons. while among the animal matters, INS was the diet category with the highest RIV in the dry (9.70) season and HAI in the wet (13.21) season. Similarly, LGR was the diet category with the highest RIV both during the dry (40.75) and wet (41.43) seasons in the gut of *F. anerythrus*. HAI was the diet category with the highest RIV both during the dry (25.07) and wet (30.62) seasons (Table 3).

Among the vegetable matters found in the gut of *C. olivieri*, FR had the highest RIV in the dry (10.40) season and LGR in the wet (12.87) season. The highest RIV was recorded for INS among the animal matters in the gut of *C. olivieri* with 43.90 and 42.98 in the two seasons i.e. dry and wet respectively (Table 3).

Relative Importance Value (RIV) of the dietary components of snap trapped small mammals in 2020-2021: Table 4 shows the Relative Importance Value (RIV) of the dietary components in the guts of the dissected small mammal species between 2020 and 2021 (dry and wet seasons). In *C. gambianus*, PNK, MG, and OS had the same and highest RIV (11.53) recorded among the vegetable matters during the dry season while 11.87 was recorded as the highest RIV for TB during the wet season among the vegetable matters. Among the animal matters, HAI had the highest RIV both in the dry (11.41) and wet (9.79) seasons. SG had the higher RIV both in the dry (23.52) and wet (18.49) seasons than PLA which were the two inorganic substances identified in the gut of *C. gambianus* (Table 4).

Diet category with the highest RIV among the vegetable matters in the gut of *A. niloticus* during the dry and wet seasons was RSF (17.85) and LGR (13.89). Among the animal matters, HAI had the highest RIV both in the dry (12.49) and wet (8.90) seasons. Inorganic substance with the highest RIV was SG both during the dry (25.57) and wet (25.26) seasons (Table 4).

In *R. rattus*, vegetable matter with highest RIV was RSF both in the dry (27.92) and wet (25.09) seasons. HAI had the highest RIV among the animal matters both in the dry (19.08) and wet (16.84) seasons while the inorganic substance with the highest RIV was SG during the dry (10.06) season only (Table 4).

Highest RIV recorded among the vegetable matters was TB both during the dry (17.23) and wet (17.46) seasons in the gut of *R. norvegicus*. Among the animal matters, HAI had highest RIV recorded both in the dry (34.98) and wet (18.46) seasons. In the gut of *R. norvegicus*, SG had the higher RIV both in the dry (9.92) and wet (11.87) seasons (Table 4).

In the gut of *L. striatus*, the vegetable matter with the highest RIV was LGR both during the dry (35.27) and wet (40.59) seasons while among the animal matters, HAI was the diet category with the highest RIV in the dry (17.33) season and INS in the wet (11.87) season.

RSF was the diet category with the highest RIV during the dry (31.14) while LGR had the highest RIV during the wet (27.53) season in the gut of *F. anerythrus*. Meanwhile, none of the animal matters was of importance during both the dry and wet seasons as all had RIV of Zero.

Among the vegetable matters found in the gut of *C. olivieri*, LGR had the highest RIV both in the dry (14.59) and wet (18.05) seasons (Table 4). The highest RIV was recorded for INS among the animal matters in the gut of *C. olivieri* with 59.41 and 41.88 during the dry and wet seasons respectively. Neither SG nor PLA was of importance as Zero RIV was recorded for both during the dry and wet seasons (Table 4).

Diet diversity of the gut of the dissected small mammal species between 2019 and 2021

There were variations in the diet diversity among the dissected small mammal species. Highest diet diversity was recorded for *C. gambianus* (7.63) while the second highest diet diversity was recorded for *A. niloticus* (6.51) (Table 5). Meanwhile, *F. anerythrus* recorded the lowest diet diversity (2.82) (Table 5).

Table 5:
Diet diversity of the gut of the dissected small mammal species between 2019 and 2021

Species	Diet Diversity
C. gambianus	7.63
A. niloticus	6.51
R. rattus	4.80
R. norvegicus	5.48
L. striatus	3.32
F. anerythrus	2.82
C. olivieri	3.02

DISCUSSION

The gut contents of the snap trapped small mammal revealed that the variations observed among the mean gut content weight of the species were significant. *Cricetomys gambianus* was recorded to be the species with the highest mean gut content weight. This could be attributed to its omnivorous habit in the study area. This was evident in the result of the present study as the wet and dry content weights of *C. gambianus* were significantly higher than those of other species. Meanwhile, the wet weights of the gut contents of other species were not significantly different.

Dietary components among the small mammal species were observed to be varied. All the dietary components were represented in the gut of *C. gambianus* only, though, at varying quantities. This was probably because of their tendency to adapt and survive in any habitat at any season provided there is/are favourable environmental conditions. It has earlier been reported by Litvaitis (2000) that the knowledge about the food habits of a particular rodent species is a very crucial in understanding its ecology, modes of life and indeed their control.

It was observed that vegetable matters formed the bulk of the food of *C. gambianus* and *A. niloticus* except that tuber were not represented in *A. niloticus* presumably because tubers were not among the preferred food of this species. Other snap trapped species had varying number of the food items in their stomach contents. This could be due to the variations in the food preference of the species in relation to the identified food items.

The presence of animal and inorganic matters in the guts of some of the snap trapped species, particularly *C. gambianus* and *A. niloticus*, indicated their multi-phagous and omnivorous tendency. It could be said that species with wide range of dietary components in their guts have the ability to survive in various habitat types than those having few dietary components. The insects contained in the gut of *C. olivieri* was significantly the highest of all other insects found in the guts of other species presumably due to the fact that *C. olivieri* is mainly insectivorous in habit. Happold (2013) has earlier described the species that belong to the genus Crocidura as being insectivores. The result of the present study on the food habit and preference showed that relationship exists between the niche (feeding) of a species in an ecosystem. Information about the diet is important in understanding foraging behaviour, habitat use as well as migration activities (Smith *et al*., 2002). The seasonal dietary information/percentage of food items obtained from the present study during the dry season were similar to those of the wet season throughout the study period. This particular trend was observed in all the snap trapped species whose guts were examined. This was an indication that the snap trapped species' dietary components were independent of the seasonal variability in the area where the study was carried out at that period. This could mean the snap trapped species were able to adapt based on the availability of the limited food resources for their continuous survival in the study area irrespective of the seasonal changes. It was, however, reported by Workneh *et al*. (2004) that most rodents are known to change their habit of feeding based on the seasonal food availability i.e. they are opportunistic feeders.

Out of the inorganic substances found in the gut contents of the small mammal species, sand grains were the most common. They were found in the guts of virtually all the snap trapped species. This report is in agreement with that of Iwuala *et al*. (1980) in their study on the observations on the food habits of some African rodents. Frequency in the recovery of specific food items from guts of the rodents as examined by Iwuala *et al*. (1980) provides indices of their food choices.

The frequent occurrence of sand and other inert materials in the guts of small mammal species was reported to be equally significant which could be considered as roughage or grit of some type in the diet of the animal species (Iwuala *et al*., 1980).

The relative importance values clearly indicated that vegetable matters (PNK, MG, OS, LGR, TB, RSF, and FR) overwhelmingly dominate the diet of all the snap trapped species except *C. olivieri* both in the dry and wet seasons in the first and second year of sampling period. In fact, the RIV of the vegetable matters added up to about half of the whole percentages of the diet category in each of the species. Meanwhile, in both dry and wet seasons of the sampling period, Insects had the highest RIV in the gut of *C. olivieri*. This indicated that *C. olivieri* actually specialized as insectivores. This present report is in consonance with the earlier report given by Iwuala *et al*. (1980) that vegetable items formed the bulk of the gut contents of the four rodent species examined. Mulungu *et al*. (2011a) also gave similar report in their study on differences in diet between two rodent species, Mastomys natalensis and Gerbilliscus vicinus in fallow land habitats in Central Tanzania. This present study also corroborates the findings by Mulungu *et al*. (2011b) in their study carried out on dietary differences of Mastomys natalensis in Tanzania and Swaziland where it was reported that vegetable matters were of more importance in the diet of *M. natalensis* in both fallow land and woodland.

Cricetomys gambianus was the species with the highest diet diversity as shown from the present study. This could be due to its relatively diverse food preferences both in the dry and wet seasons in the study area. It was confirmed from the present study that *C. gambianus* was largely but not entirely granivorous. A similar report was given by Mulungu *et al*. (2011) That multimammate rat utilises a large number of resources based on the habitat and season. In other words, it is a generalist species.

In conclusion, vegetable matters as the food preference of the species could be used as a bait or delivery medium for natural products having rodenticidal or abortifacient potential which could serve as alternative to chemical rodenticides in the management of these rodent species population. Habitat manipulation by removing the source of food, water, and shelter for the rodent population, may help to reduce rodent population.

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