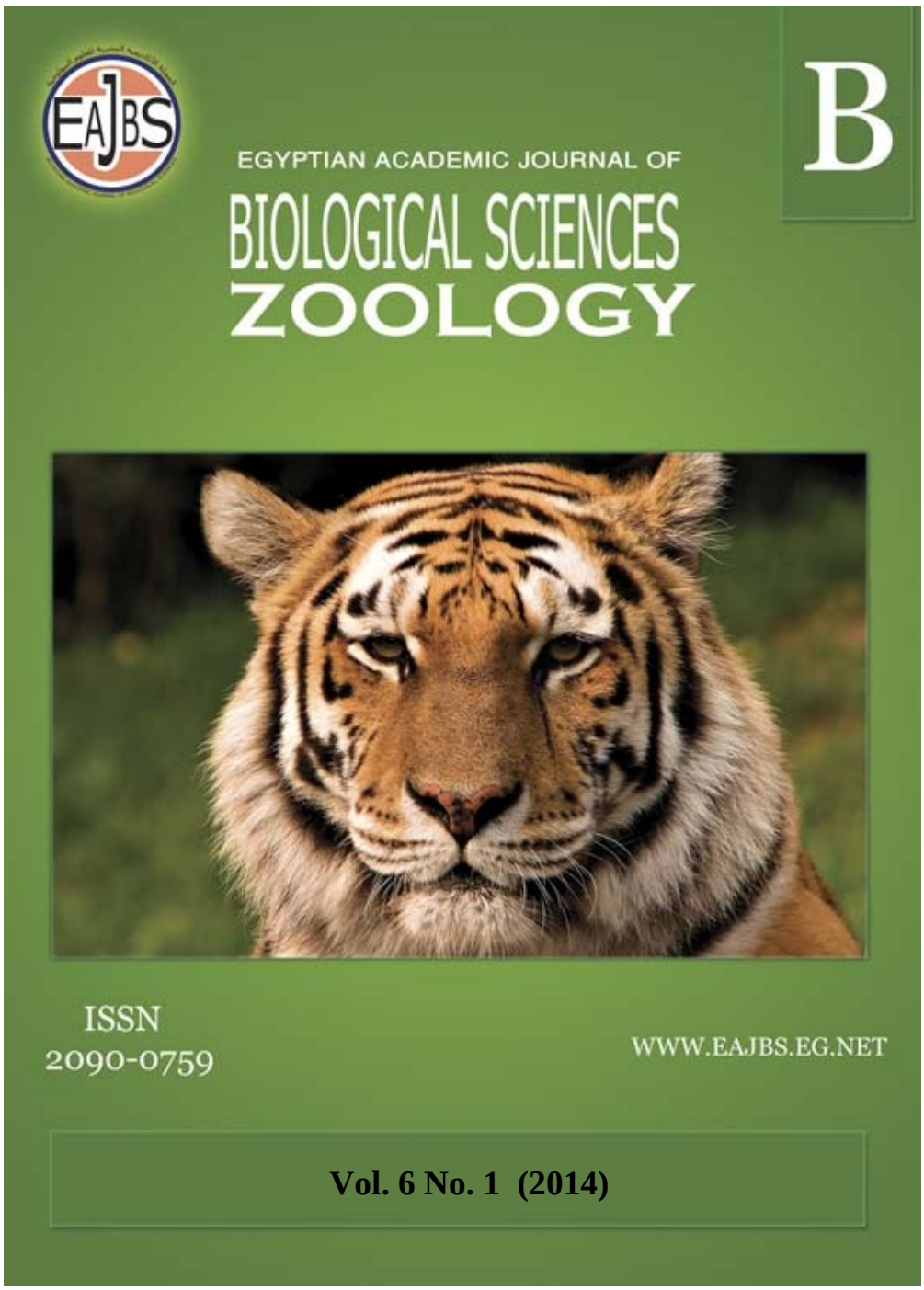

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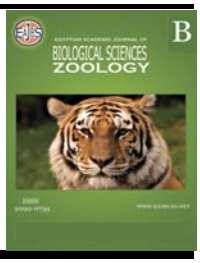

Incidence of gastrointestinal helminthes in emin's pouch rat (*Cricetomys emini* Wroughton) in the semi-arid zones of katsina state

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ABSTRACT

A survey was carried out to determine the multiple incidence and compositions of gastrointestinal/helminth parasites of Emin's Pouched Rat, *Cricetomys emini* that inhabit the Semi-Arid Areas of Katsina State, and to analyze the parasitic load of these parasites. Out of the eighty six (86) trapped and caught pouched rats, 57% were females and 48% males, of immature sub-adult individuals per sex and were examined base on the parasites incidence and multiplication rate. The following parasites were detected in accordance with the gastrointestinal gut parts: In the alimentary canal found are the Cestodes: *Hymenolepis diminuta* (39.53%) and *Rodentolopis fraterna* (25.58%); found in the ileum and lumens of large intestine are Nematodes, *Heterakis spumosa* (36.05%) and *Ascaridia collumbae* (30.23%). Similarly, *Capillaria collumbae* (18.60%) was detected in the ileum/small intestine. Found in the caecum and rectums were also nematodes: *Aspiculuris* sp (11.63%), *Trichuiris trichuira* (3.49%) and *Strongyloides* sp (5.81%). The nematodes were the most prevalent followed by cestodes and *Trichuiris trichuira* as the least incident species. The helminthes showed significant difference (P>0.05). Acanthocephalans and flukes (Trematodes) and a few of minute intestinal worms were not recognized during the practical analysis. Proper sanitation need to be adapted in the Saharan and the Semi-Arid Zones so as to minimize the population of these zoonotic helminthes in order to yield healthy living wild life/muroid rodents.

Keywords: Emin's Pouch rat, *Cricetomys emini*, intestinal helminthes and Semi-Arid Zones

INTRODUCTION

Emin's pouched rat *(Cricetomys emini),* also known as the African pouched rat, is a large rat of the family muridae; placed in the family Nesomyidae by the recent molecular studies, as part of an ancient radiation of African and Malagasy muroids (Nowak, 1999). It is related to *Cricetomys gambianus*, the Gambian pouched rat which is among the largest muroids in the world; growing up to about 0.9 meters (3 ft) long including their tail which makes up half their length.

Most Emin's pouched rats are native to Africa and widely widespread in Sub-Saharan Africa ranging geographically from Senegal to Kenya and from Angola to

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Mozambique and are found along the edges and along the plains of forests and in the mountain up to 3,500m above the sea level. They are found living in colonies of up to twenty, usually in forests and thickets, but also commonly in termite mounds. The pouched rats are also omnivorous, feeding on vegetables, insects, crabs, snails, and other items, but apparently preferring palm fruits and palm kernels. (Wood, 2007).

Emin's rats are actually better climbers that inhabit tropical rainforest and rely upon fruits, and seeds for consumption. They are nocturnal and known to larder hoard food, especially seeds and nuts, in their burrow, but their role as seed disperser as observed in geotropically scatter hoarding rodents is unknown (Cooper, 2000).

In advance countries, these rats are also becoming useful for detecting land mines, as their acute sense of smell is very effective in detecting explosives, and they are light enough to not detonate any of the mines. They are easily tamed as pets (Nowak, 1997). But, in many African countries giant pouched rats are valued and as an important food item that is eaten as bush meat and a cheap source of protein for the common man, (Ajayi, 1977).

However, rat of any kind is a well specialized pest that destroyed and damages materials both in the form lands and residential places. The rats feed on form products such as grains, legumes and vegetables that leads to loses and reduction of both quantity and quality of those products. Meanwhile, in the residential places, it destroys and damages domestic products such as money, papers, clothes, shoes and food produce in stores (Xylander, 1988).

They are considered rather tasty and are hunted and even raised on farms for their meat. This had led to a significant drop in the population. A smaller industry is the pet industry, although these rats are rather large and sensitive to temperature changes, resulting in a need for high maintenance. In the scientific community, these rats are often used for experiments, and these rats provide a wealth of information on rodent physiology and behavior (Kingdon, 1989; Nowak, 1997).

Gambian rats are sometimes considered pests in urban areas where they may infest the sewers. In rural areas, they may destroy farm crops and build burrows in the soil which lead to soil desiccation and loss of plant crops. Gambian rats often inhabit barns and other farm buildings which can lead to property damage (Ajayi, 1977).

Intestinal worms are common problems of both domestic and wild vertebrates' worldwide (Yorke and Maplestone, 1963). The biggest economic impact of Gambian rats is as a source of food in Africa.

Giant pouched rats contained in their gastrointestinal parts specialized reservoir for helminth parasites that are found in almost all part of its alimentary canals such as stomach, duodenum, small intestine, large intestine and other parts. This was due to the nature of pouch rat which can feed on different types or forms of nutrients and decayed matters such as gavages, insects, nuts and other kinds of food.

Observations made on distantly related parasites have revealed a variety of adaptations to parasitism including changes in physiology, morphology and life history traits. Parasites such as intestinal and blood parasites have been reported to be associated with this giant rat. These animals because of its close association with man can transmit pathogens to man and may also be an intermediate of some important human diseases and those of domestic and farm animals.

Giant pouched rat aroused sympathetically in Jamaica as a definitive host for *Acanthocephala cantonensis* in the Inland in which human infection have been reported in residents and visitors (Lindo *et al*., 2004; Stom *et al*., 2002). Wild rats in Jamaica transmit *Leptospirosis* to the human population (Segree *et al*., 1982) often with grave

outcomes. Work has been done on parasitic or zoonotic fauna of wild rat, giant rat and common rats.

Mettrick and Podesta (1974) recovered intestinal parasites such as tapeworm *Hymenolepis* sp. Ajayi *et al*. (2007) investigated four groups of helminthes; trematode, cestode, nematode and acanthocephala. Others worked on intestinal helminth of *Cricetomys gambianus, C. ansorgei* and *C. emini* included Winfield, (1933) and Ezeifeka *et al*. (1987), who discovered *Nematosproides dubrius* in the duodenum and scantly on lower small intestine amongst others.

Several parasitic worms inhabit the gastrointenstinal tracts of these rats, but the most prevelant of these are the *Strongyloides*. A study performed also showed minor prescences of tape worms among other parasites. Other parasites include *Xenopsylla cheopis, Aspiculuris tetraptera*, Ixodes rasus, and *Ornithonyssus bacoti*. Hymenolepis is usually found in the small intestine while Aspicularis is found in the rectum and colon (Ajayi, 1977; Bobe and Mabela, 1997; Dipeolu and Ajayi, 1976; Kingdon, 1989).

This research was carried out to determine the mechanisms/incidence of gastrointestinal helminth parasites development in Emin's pouch rat.

MATERIALS AND METHODS

Study Area

Katsina State, covering an area 23,938 sq. km., is located between latitudes 11Â°08'N and 13Â°22'N and longitudes 6Â°52'E and 9Â°20'E. The State is bounded by Niger Republic to the North, by Jigawa and 84 miles northwest of Kano State, by Kaduna State to the South and by Zarnfara State and 160 miles east of the city of Sokoto. As of 2007, Katsina's estimated population was 459,022. The city is the centre of an agricultural region producing groundnuts, cotton, hides, millet and guinea corn, and also has mills for producing peanut oil and steel. Hence, total the annual rainfall figures ranging from 1000mm around Funtua to over 800m around Dutsim-Ma. Retrieved 10th July 2011 from www.albarkablog.com.

The Northern of Katsina State (from around Kankia to the extreme northeast) as the Semi-Arid, has total rainfall figures ranging from 600 - 700mm annually. Generally, climate varies considerably according to months and seasons. They are: a cool dry (harmattan) season from December to February; a hot dry season from March to May; a warm wet season from June to September; a less marked season after rains during the months of October to November, characterized by decreasing rainfall and a gradual lowering of temperature.

The southern half of the state belongs to the Northern Guinea Savannah Zone, while the north belongs to the Sudan Savannah Zone. The vegetation in the South thus consists of broadleaved species with tall tussock grasses of guinea affinities, mixed up with fine leaved species of thorny trees with continuous short and feathery grass cover.

The State and other Semi-Arid Zones, suffer from the perennial ecological problems of drought, desertification and the menace of pest invasion. These are experienced mostly in the Northern part of the State, like Jibia and Daura Areas. The marked fall in the level of underground water has also compounded the problem of sustaining the ecological balance in some parts of the State. The increasing menace of pest invasion is probably due to this climatic change, and desertification, which have brought about conditions favorable to the breeding of pests. Retrieved 10th December, 2012 from www.gamji.com/article3000/NEWS3662.htm

Collection of Pouched Rat Samples

Pouched rats used for the study were collected during the Month of September, 2012 from different locations/Arid Areas of Katsina State, which include two (2) Zones: Katsina Central Zone (Natsinta, Riko and Jibia) and Daura Zone (Daura town, Mai'adua and Baure) with their neighboring villages. Positions considered in catching the rats encompass garden, markets underneath of houses, roofing and mostly in abandoned farmland**s** dominated date palm**,** Mahogany, *Balanites aegyptiaca*, *Adansonia digitata* tree plants, grasses and shrubs. The habitats occupied by the Emini's pouched rat *C. emini* were different in terms of location and burrowing patterns, which is related to tree plant species and position of the land.

During the collection, break-black traps (occasionally poison {wartarin}) were used to trap/catch the pouched rats (Pecella *et al.,* 2006). Some pouched rats were caught alive using unbaited snap trap used by setting up the traps with groundnut cake and fried fish pieces near houses/residential places and in farm lands around evening or at night hours as shown by Ekeh (2009). After trapping, 86 Emini's pouched rat sample for the required specimens were caught/trapped and then brought to Biology laboratory of Federal University Dutsin-Ma for analysis.

Measurement of Pouched Rat samples

The rat samples were weighed using a standard lever balance, measured lengthwise (from nose tip- tail base). The length and weight of the rats were taken using meter rule to the nearest 0. 00cm and beam balance to the nearest 0.1gram respectively. The sex (male and female) of these animals was determined by examining the reproduction organism which was easily determined externally as described by Kataramouski *et al*. (2010).

Dissection of Pouched Rat samples

Pouched rat samples alive were freshly killed and anesthetized using chloroform/formaldehyde solution; later dissected using sharp/burnt straight blade dissecting knife and coarse scissors, and then tongs were used to remove the contents of gut and abdominal cavity regions (viscera). The alimentary canal was removed in portions (esophagus, stomach, small intestine, large intestine and rectum for dissection). All fecal matters were packed in to a cleaned petridishes containing physiological saline (0.85 % NaCl) and examined and identified under the dissecting microscope.

Fixing and Identification of Intestinal Helminthes Parasites

The contents of each portion in the intestine were washed with saline solution and inspected for the presence of parasitic helminthes with aid of Biconvex hand lens and binocular dissecting microscope (stereoscopic dissecting microscopic) (paramount psm-12% 25). Each parasitic helminthes recovered during the research work was preserved in 70% alcohol, 10% glycerol. The helminth worms were sorted out, washed and left in tap water for sometimes to relax the muscles (particularly cestodes).Some of the worms (particularly nematodes) were stained in acetocamine for easy viewing through the internal structures, permanent preparations were made and microphotographs taken. All recovered gut parasites were identified to species level (Owen, 1972 and Ajayi *et al*., 2007).

Identification of the parasite was base on morphology and configuration of specimens by comparison with museum types specimens as shown by Anderson (1992).

Data Analysis

Data was analyzed using descriptive statistics along with analysis of variance (ANOVA).

RESULTS

About 86 pouch rats sampled were used during this study, 43.02% were males and 56.98% were females. Sixty pouch rats (69.77%) were infected with at least two or more parasites. A higher incidence of infection was noted in the males compared to the female adult pouch rats (Table 1) with similar numbers of male and female infected immature/juvenile sub-adult rats.

Table 1: Incidence of intestinal helminthes infection in rats of different sex

	Males (%)	Females (%)	Combined (%)
No of Pouch Rats	37/86 (43.02)	49/86 (56.98)	86/86 (100)
Infected	25/37 (67.57)	35/49 (71.23)	60/86 (69.78)
Non-infected	10/37 (27.03)	24/49 (48.98)	26/86 (30.23)
Immature sub-adult	17/37 (45.95)	16/49 (32.65)	41/86 (47.67)
Infected	11/17 (64.71)	16/24 (66.67)	27/41 (58.54)
Non-infected	7/17 (41.18)	9/24 (37.50)	14/41 (34.15)
Adults	21/37 (56.76)	24/49 (48.98)	45/86 (52.33)
Infected	17/21 (80.95)	20/24 (83.33)	37/45 (82.22)
Non-infected	3/21 (14.26)	6/24 (25.00)	9/45 (13.33)

The total number of eight parasite species was found, namely: two cestode species- *Hymenolepis diminuta* and *Rodentolopsis fraterna*. There are six other nemode species discovered, which include: *Heterakis spumosa*, *Ascaridia collumbae*, *Capillaria collumbae*, *Aspiculuris* sp., *Trichuirs trichuira* and *Strongyloides* sp. These parasite species were found to invade the gut parts of the rats sampled out. Data on the quantity of infection of gastrointestinal cestodes and nematodes in male and female pouch rats are presented in Table 2.

Table 2: Quantitative indices of helminthes infection of *Cricetomys emini*

Helminth species	N	T	1%
Hymnolepsis diminuta	34	86	39.53
Immature sub-adult	14	41	34.15
Adult	20	45	44.44
Rodentolopis fraterna	22	86	25.58
Immature sub-adult	6	41	14.63
Adult	16	45	35.56
Heterakis spumosa	31	86	36.05
Immature-subadult	11	41	26.83
Adult	18	45	40.00
Ascaridia columbae	26	86	30.23
Immature sub-adult	8	41	19.51
Adult	18	45	40.00
Capillaria columbae	16	45	35.56
Immature sub-adult	16	86	9.76
Adult	12	45	26.67
Aspiculuris sp	10	86	11.63
Immature Subadult	3	41	7.32
Adult	7	45	15.56
Trichuiris trichuira	3	86	3.49
Immature sub-adult	1	41	2.44
Adult	2	45	4.44
Strogyloides sp	5	86	5.81
Immature Subadult	2	41	4.88
Adult	3	45	6.67

(N= number of pouch rats infected, T= total number of rats, 1% = incidence).

Multiple infections were noted with up to four helminth species per host. Association involving in a species was found in 51.67% of the infected pouch rats. Three gastrointestinal helminth species were found in 16.67% and four parasites species were

found in 5.00% of the hosts indicating high incidence ($p > 0.05$). This indicates the incidence index of the intestinal helminthes of the pouch rats in different sex as presented in Table 3.

Table 3: Incidence of intestinal helminthes infection in different sexes of the *C. emini*

Total No. of Rats (86)	Non -infected	Infected	Number of parasite species hosts 1	2	3	4
Number of Pouch rats	26	60	31	16	10	3
Percentage (%)	(30.23)	(69.77)	(51.67)	(26.67)	(16.67)	(5.00)
Immature sub-adult	(41)					
Number of Pouch Rats	15	27	14	7	4	1
Percentage (%)	(36.59)	(65.85)	(34.15)	(17.07)	(9.76)	(2.44)
Adults	(45)					
Number of Percentage (%)	9	37	18	10	6	2
Pouch Rats	(20.00)	(82.22)	(40.00)	(22.22)	13.33)	(4.44)

DISCUSSION

It has been established in this research that rampant areas, old empty domiciles, underneath roofing in the markets and gardens and abandoned farm lands might be responsible in providing/giving room for the Emin's pouch rats (*Cricetomys emini*) to inhabit or invade the area, the environment might appeared to have influence the helminths in the ratswhere they make large holes for their residence. This survey is in line with the work of (Behind *et al*., 2011) who noticed that the gradual increase in human population and development of towns along with human population have resulted in an increase of garbage and refuse which create a favorable conditions for the proliferation of giant Gambian rats, and rarely remain uninfected or harbor just a simple species infection in nature.

It was revealed from this study that *Cricetomys eminis* is a pouch rat species, that contained in it lot of intestinal endoparasites and the potential agents of these parasites poses a threat to the rats and even public health. This study, however, recorded data on the intestinal helminth parasites of Emin's pouch rats which are hosts to two (2) cestode species (*Hymenolepis diminuta* and *Rodentelopsis fraterna*) found in the stomach and intestine regions, mostly seen coiled and compacted at the lumen of the cardiac and pyloric spinter of the stomach leading to intestine blockage, they were also discovered. A total of six (6) nematode species (*Heterakis spumosa*, *Ascaridia collumbae*, *Capillaria collumbae*, *Aspiculuris* sp, *Trichuiris trichuira* and *Strangyloides* sp) examined in the stomach, lumen of large intestine, small intestine, caecum and rectum and were seen to occurred mostly at the anterior region of the small intestine; where they embedded the mucosa of the host and sucked blood by means of armed buccal cavity. This correlates with the work of Bellocq (2003) who reported that the monoxenous nature of the life cycle of the tape worm, *Taenia saginata* and nematode *Ascaris suum* may be responsible for parasitic group dominating the helminth community of small mammals worldwide, especially rodents. Parasite with simple and direct life cycle may have more chance of following the dispersion of their hosts than parasites with indirect life cycles. The longevity of *Hymenolepis diminuta* in its normal mammalian host can cause a high incidence of infections. Once established, it can live as long as the host (Read, 1967).

The cestode, *Hymenolepis diminuta* (39.53%) and the nematode *Heterakis spumosa* (36.05%) recorded in this work, as the frequent occurred or most incidents in the gut

parts of the host which might be responsible for more parasitic load and infection to the pouch rats. Higher incidence of intestinal helminthes was observed to be superior over in male adult pouch rats (80.95%) than in female adult ones (25.00) least in infection.

Visceral organ distribution of the helminths indicated that all the helminths were more prevalent in the gut regions (small intestine, large intestine, stomach) than in any other organ. Stomach has the highest number of nematode and cestode, followed by the small, large intestine, caecun and rectum.

This is probably due to the food of rats, especially garbage and food particles from sewers influencing the type of parasites acquired by the pouch rats. And it could be seen that the female rats are more infected than the male in both pouch rats. The incidence of helminthic infections between the rats, suggested that *C. cricetomys* were heavily infected with many helminth species of medical importance (80.92 and 82.22%).

This could be explained by the fact that infected males have larger territories than uninfected males, and that the home range of males tends to overlap which could increase their exposure to infection while reproductive females show a stronger site–specific organization. This corresponds with the work of Falstad *et al*. (1992) who investigated male hormone testosterone and later analyze that it has a negative effect on the immune function. Another hypothesis assumes that among mammals the larger bodies of males are easier targets for endoparasites (Arneberg, 2002).

The incidence and abundance of helminthes surveyed in the semi-arid zones may also be influenced by the various types of association between species of parasites, which can be both synergistic (positive) and antagonistic (negative). Such association can arise for ecological behavioral reasons, although there remains the possibility that the host immune system may be involved. In the same study, the most frequent infection type was the *H. diminuta* and *R. fraterna* combination, which is probably a consequence of the fact that these are the two most incident parasite followed by the nematodes combination in this study.

It is that possible that these parasites are in positive associations because they located and examined in different parts of host gut parts; the cestodes were localized in the alimentary canal (stomach), and so the interaction is minimized and competition is reduced.

The negative associations between *H. spumosa* and *A. collumbae* occurring frequently may be the result of competition between them or in the different seasons of the year when significant infection occurs ($p > 0.05$) leading to loss of weight and poor feeding as observed. For the *Ascaridia* species, *T. trichuira* and *Strangyloides* species have less significant difference, in the association of the first alternative is less probable, which might be due to the fact that the species are located in different part of the host's gut parts. Neva and Brown (1994) reported that *Capillaria hepatica* and *Ascaridia* larvae are cosmopolitan and are found in the liver and stomach of many species of rodents. The worms have also been reported as the cause of liver disease in a wide variety of mammals including man (Ajayi *et al*., 1978).

Other parasites and simpler worms (acanthocephalans and trematodes) not recognized during the practical analysis was because of the smaller number of the pouch rats and this is because of the difficulty in collecting them.

CONCLUSION

From the research it coud be deduced that, common intestinal helminthes that associated with Emin's Pouched Rat (*Cricitomys emini*) are tapeworms and roundworms. These worms cause serious infections such as blocking the intestinal passage and other

intestinal disorders which in include loss of weight, poor feeding, reduced growth in the development of rats and other rodents in general.

RECOMMENDATIONS

- Regular veterinary inspection of rat/rodents to ensure healthy wild life by the government
- Regular de-worming of infected giant rats and other rodents in the houses
- Proper toilet habits and control of indiscriminate passing of stool around residential areas and to reduce harboring of many rat species
- Proper sanitation to prevent soil pollution which is the main source of infections
- Construction of proper disposal containers in order to reduce the residential for rats to harbor.
- Damping of garbage and refuse as a result of urbanization should be discouraged.

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