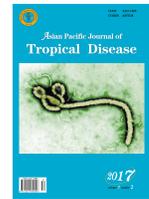


Asian Pacific Journal of Tropical Disease

journal homepage: <http://www.apjtc.com>



Parasitological research <https://doi.org/10.12980/apjtd.7.2017D6-373> ©2017 by the Asian Pacific Journal of Tropical Disease. All rights reserved.

Helminth parasites of *Lemniscomys striatus* (striped grass mouse) and *Cricetomys gambianus* (giant African rat) in Nsukka, Nigeria

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ARTICLE INFO

Article history:

Received 14 Oct 2016

Received in revised form 31 Oct 2016

Accepted 20 Nov 2016

Available online 15 Dec 2016

Keywords:

Lemniscomys striatus

Cricetomys gambianus

Hymenolepis spp.

Capillaria hepatica

Protospirura spp.

Rodent zoonosis

ABSTRACT

Objective: To ascertain the helminth profile of *Lemniscomys striatus* (*L. striatus*) and *Cricetomys gambianus* (*C. gambianus*) in Nsukka, Southeastern Nigeria, and their zoonotic potentials and public health risk.

Methods: A total of 63 rodents were captured during the study period, of which 54 (85.7%) were *L. striatus* and 9 (14.3%) were *C. gambianus*. Following evisceration, various organs from the rodents (the lungs, liver, stomach, small intestines and large intestines) were split open and thoroughly examined under a stereomicroscope. The liver samples were subjected to histopathological processing and examination.

Results: No helminth parasite was found in *C. gambianus* while 44 (81.5%) of *L. striatus* were infected with one or more species of helminth parasites. And 10 (18.5%) and 34 (63%) of *L. striatus* had mixed and single infections, respectively. Three helminth species were recovered during the study. Two nematodes [*Capillaria hepatica* (*C. hepatica*) and *Protospirura* spp.] and one cestode parasite (*Hymenolepis* spp.) were found at prevalence rates of 3.7%, 14.8% and 81.5%, respectively. Histopathology revealed the typical characteristic bipolar plugs of *C. hepatica* ova. There were also massive areas of degenerative necrosis of hepatocytes, fibrous encapsulation of *C. hepatica* ova and infiltration of inflammatory cells.

Conclusions: Two out of the three helminths (*C. hepatica* and *Hymenolepis* spp.) recovered in this study are of serious zoonotic importance and thus pose great public health risk to the community.

1. Introduction

Rodents are widely dispersed in our environs and as a result of their small size, they find their ways into our homes, food stores, silos, farms, etc., where they can cause huge losses and contaminate water, fruits, vegetables and food stuffs. Rodents act as vital components in various ecosystems either acting as a prey or predator

and sometimes as a carrier/reservoir of diseases[1]. An increased rodent population in an area can be directly related to an increase in zoonotic diseases in human population[2]. As it is well recognized that they harbour a number of ectoparasites and endoparasites that pose threats to health of humans who live in close proximity to rodent populations and even greater risks to those who consume them[3]. The helminths of zoonotic importance harboured by rodents include species of *Trichinella*, *Angiostrongylus* and *Capillaria* (nematodes), *Hymenolepis*, *Raillietina* and *Echinococcus* (cestodes), and *Schistosoma*, *Paragonimus* and *Echinostoma* (trematodes)[4].

Lemniscomys striatus (*L. striatus*), also known as striped grass mouse or zebra mouse, is a species of murine rodents from Africa. They have been recorded in over 24 countries in Africa including Nigeria[5]. These rodents inhabit grasslands, secondary forests, open dry forests, savanna and cultivated/farm lands[5]. They are generally considered diurnal, but some species can be active during

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All experimental procedures involving animals were conducted in accordance to the Federation of European Laboratory Animal Science Association and the European Community Council Directive of November 24, 1986 (86/609/EEC) and approved by the Experimental Animal Ethics Committee of the Faculty of Veterinary Medicine, University of Nigeria, Nsukka.

The journal implements double-blind peer review practiced by specially invited international editorial board members.

the night. They are omnivorous in nature, feeding mainly on plants, grassy vegetation, seeds, fruits, but sometimes they also consume insects. On the other hand, *Cricetomys gambianus* (*C. gambianus*), also known as the giant African rat or Gambian pouched rat, is a large murine, nocturnal and fossorial rodent. It is native to Africa and occurs in over 32 countries in Africa (West, East and Central Africa)[6]. They possess very poor eye sight and thus depend on their sense of smell and hearing[7]. The rat is known to be omnivorous as they feed on vegetables, insects, palm fruits and kernels, date palm, etc. The species occurs in various habitats including forest and woodland, as well as farmland, cropland, plantations, rural areas and is considered to be an adaptable species that is even known to invade sewers[6].

In some countries, especially in many African countries, rodents are valued as a delicacy and a source of protein[8]. The study area is known for their consumption of these rodents as a delicacy and an alternative source of protein. There are no reports in available literature on the helminth profile of *L. striatus* and *C. gambianus* in Nsukka and its environment. Hence, the current study investigated the prevalent helminth species in these rodents and their potential zoonotic/public health risks and importance.

2. Materials and methods

2.1. Study area

The study was conducted in Nsukka, Enugu State, Southeastern part of Nigeria between the months of February and April, 2015. The rodents were captured using traps set in farmlands, bushes and near homes, etc. They were subsequently transported to the Department of Veterinary Parasitology and Entomology, University of Nigeria Nsukka, where they were euthanized and eviscerated.

2.2. Sample collection

Various organs from the rodents (the lungs, liver, stomach, small intestines and large intestines) were thoroughly examined for parasites. The recovered worms were preserved in bottles containing 10% formal saline solution. The worms were identified under light microscope by observation of their distinctive morphological features as described by Soulsby[9]. Infections with more than one species of helminth parasites (polyparasitism) were referred as mixed infection. The tubular organs were dissected out and placed into appropriately labeled containers before being cut open longitudinally. The contents were emptied into their containers by washing with a jet of water and gentle scrapping with a finger and the parasites were carefully picked out into appropriately labelled Petri dish containing normal saline. Longitudinal sections were made into the lung and liver tissues, and worms were collected from the tissues with the aid of a forceps and hand lens if present.

The animal experimental protocol was approved by the Experimental Animal Ethics Committee of the Faculty of Veterinary Medicine, University of Nigeria, Nsukka and in compliance with the Federation of European Laboratory Animal Science Association and the European Community Council Directive of November 24, 1986

(86/609/EEC).

2.3. Histopathology

Liver sections obtained from the rodents (*Lemniscomys* spp.) at the time of sacrifice were immediately placed in neutral buffered formalin for fixation. The tissue was dehydrated in graded alcohol, cleared in xylene and embedded in paraffin. Five micrometer thick sections were stained with hematoxylin and eosin.

2.4. Data analysis

Data generated were analysed with SPSS version 15 using descriptive statistics and the results were presented in Tables as percentage prevalence.

3. Results

During the study period a total of 63 rodents were captured out of which 54 (85.7%) were identified as *L. striatus* and 9 (14.3%) as *C. gambianus*.

The overall prevalence of helminths in the captured rodents was 69.8% (Table 1). No helminth was found in *C. gambianus* while 44 (81.5%) of *L. striatus* were infected with one or more species of helminth parasites. Ten (18.5%) *L. striatus* had mixed infections while 34 (63%) had single infections (Table 2). Three helminth species were recovered during the study, which were two nematodes [*Capillaria hepatica* (*C. hepatica*) and *Protospirura* spp.] and one cestode parasite (*Hymenolepis* spp.). The prevalence of the three helminth species found in *L. striatus* were *C. hepatica* (3.7%), *Protospirura* spp. (14.8%) and *Hymenolepis* spp. (81.5%) (Table 3).

Table 1

Prevalence of helminths in captured rodents.

Rodent species	Infected number	Infection (%)
<i>L. striatus</i> (n = 54)	44	81.5
<i>C. gambianus</i> (n = 9)	0	0.0
Total (n = 63)	44	69.8

Table 2

Prevalence of mixed and single infection of endoparasites in the captured rodents [n (%)].

Rodent species	Mixed infection	Single infection
<i>L. striatus</i> (n = 54)	10 (18.5)	34 (63.0)
<i>C. gambianus</i> (n = 9)	0 (0.0)	0 (0.0)

Table 3

Prevalent endoparasites of *L. striatus*.

Organs	Helminth species	Infected number	Prevalence
Lung	Nil	Nil	Nil
Liver	<i>Capillaria</i> spp.	2	3.7%
Stomach	<i>Protospirura</i> spp.	8	14.8%
Small intestine	<i>Hymenolepis</i> spp.	44	81.5%
Large intestine	Nil	Nil	Nil

Liver from a *C. hepatica*-infected *L. striatus* grossly showed marked enlargement (hepatomegaly) with dark necrotic margins and pale areas of yellowish caseous necrosis in the parenchyma (Figure 1). On histopathological examination using a light microscope, there

were numerous polymorphonuclear leucocytes and granulomas formed by fibrotic walling-off of *C. hepatica* ova, massive hepatocytes necrosis and replacement of the liver parenchyma by the ova of the *Capillaria* worms (Figure 2). There were also portions of necrotic liver tissues and a cross section of the adult parasite with the eggs in utero (Figure 2). Some sections of the liver of *L. striatus* showed numerous *C. hepatica* ova at different planes of sectioning and the typical characteristic bipolar plugs (Figure 3). The centre of the field was filled with polymorphonuclear cells, macrophages, necrotic hepatocytes and fibrous connective tissues.

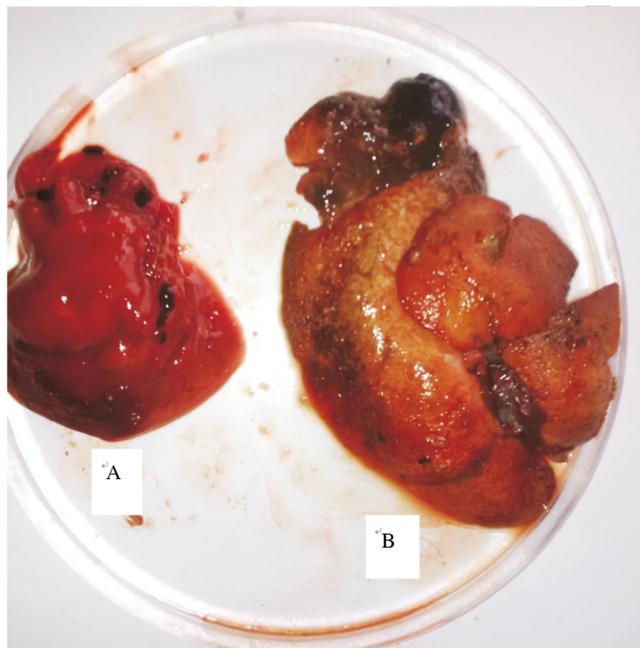


Figure 1. Normal liver and *C. hepatica*-infected liver from *L. striatus*. A: Gross picture of a normal liver from a *L. striatus* without *C. hepatica* infection; B: Gross picture of liver of *C. hepatica*-infected *L. striatus* showing markedly enlarged liver (hepatomegaly) with dark necrotic margins and pale areas of yellowish caseous necrosis in the parenchyma.

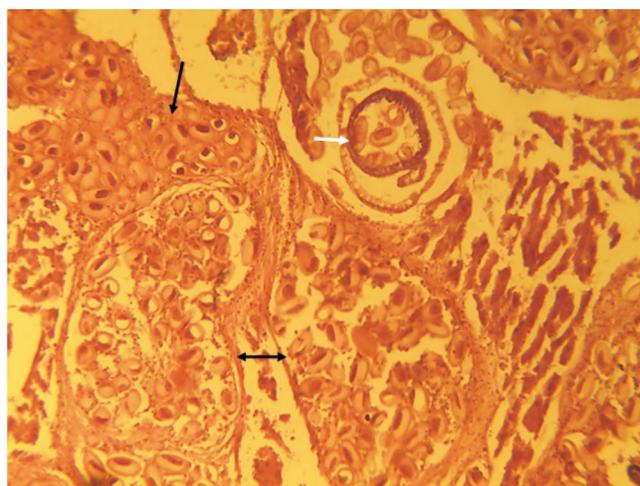


Figure 2. Liver tissue of striped grass mouse (*L. striatus*). Black arrows: Numerous polymorphonuclear leucocytes and granulomas formed by fibrotic walling-off of *C. hepatica* ova, massive hepatocytes necrosis and replacement of the liver parenchyma by the ova of the *Capillaria* worms; White arrow: Some portions of the degenerating liver tissues on the right, and cross section of the adult parasite with the eggs in the uterus that stained with hematoxylin and eosin 100 \times .

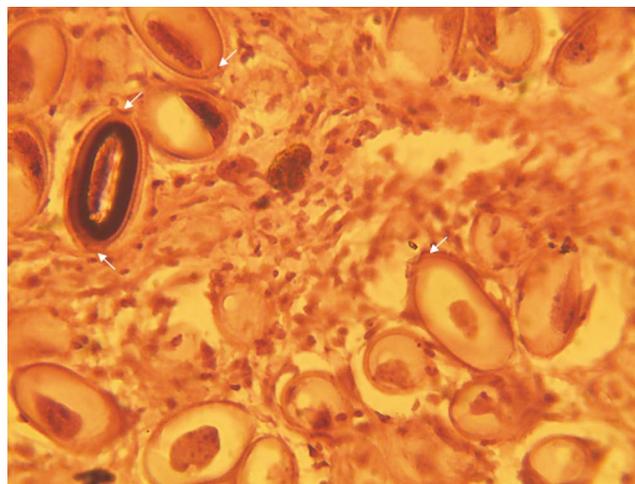


Figure 3. Section from the liver of striped grass mouse (*L. striatus*) showing numerous *C. hepatica* ova at different planes of sectioning. Arrows: The bipolar plugs. The centre of the field was filled with polymorphonuclear cells, macrophages, degenerated hepatocytes and fibrous connective tissues that stained with hematoxylin and eosin 400 \times .

4. Discussion

In this study, no helminth parasite was recovered from *C. gambianus*, which could have been as a result of the small sample size of this rodent caught during the study period.

The prevalence of 3.7% obtained in this present study for *C. hepatica* is comparable to the reports of Sharma *et al.*[1] in Uttarakhand, India, Kia *et al.*[10] in Iran and Onyenwe *et al.*[11] in Nsukka, Nigeria who recorded low prevalence rates of 2.3% in *Rattus rattus* (*R. rattus*), 6.9% in *Meriones persicus* and 5.8% in *R. rattus*, respectively. The high prevalence rate of 81.5% recorded for *Hymenolepis* spp. in this study is also comparable to the findings by Gudissa *et al.*[12] in Addis Ababa, Ethiopia and Sharma *et al.*[1], but they were different from that of Onyenwe *et al.*[11] whose study showed a low prevalence of 19.5%. The prevalence of 14.8% recorded for *Protospirura* spp. in the present study is comparable and in agreement with the findings of Rafique *et al.*[13] who reported a prevalence range of 14%–30% of *Protospirura* in captured rodents (*R. rattus*, *Rattus norvegicus* and *Mus musculus*) in Pakistan.

Two out of the three helminths (*Capillaria* spp. and *Hymenolepis* spp.) recorded in this study were of zoonotic importance and were the same zoonotic helminths as reported by Onyenwe *et al.*[11] in *R. rattus* in Nsukka, Nigeria. Waugh *et al.*[14] reported on the zoonotic potential of helminths of *R. rattus* and *Rattus norvegicus* from Jamaica, recording the presence of six nematodes, two cestodes and an acanthocephalan. Fuehrer[15] reported the occurrence of *Capillaria* and *Hymenolepis* in wild rats in the United Kingdom, while d'Ovidio *et al.*[16] and Garedaghi and Khaki[17] also reported on the presence of *Hymenolepis diminuta* in gray squirrel from Indiana and *Hymenolepis* species in captured rodents in Iran, respectively.

The histopathologic features seen in the liver of the *C. hepatica*-infected *L. striatus* included inflammatory cell infiltrate, degenerating hepatocytes, fibrous encapsulation of *C. hepatica* eggs and necrosis, which is in agreement with the findings of Mowat *et al.*[18] and Berentsen *et al.*[19] in laboratory rabbits in the United Kingdom and *R. rattus* in Diego Garcia and British Indian Ocean territory, respectively. The hepatomegaly recorded in this study for

C. hepatica-infected *L. striatus* and the yellowish caseous necrotic areas on the parenchyma is in agreement with the findings of Berentsen et al.[19].

The finding of *C. hepatica* eggs in the liver of *L. striatus* in this study is considered to be of immense public health importance because human *C. hepatica* infections occur following consumption of food or water loaded or contaminated with embryonated eggs of *C. hepatica*[20]. Hepatic necrosis, parasitic hepatitis, hepatic fibrosis, persistent fever, hepatomegaly and eosinophilia have been recorded in human infections[21]. Also *Hymenolepis* spp. infect humans when food contaminated with rat faeces containing viable eggs are ingested[9]. A heavy human infection with *Hymenolepis* spp. causes catarrhal enteritis with signs of anorexia, vomit, diarrhoea and abdominal pain[22,23].

Based on the results of this study, it was concluded that *L. striatus* in Nsukka is infected with *C. hepatica* (3.7%), *Protospirura* spp. (14.8%) and *Hymenolepis* spp. (81.5%). *C. hepatica* and *Hymenolepis* spp. are zoonotic and of public health importance especially in a population that consumes some of these wild rodents as delicacies.

Conflict of interest statement

We declare that we have no conflict of interest.

Acknowledgments

The authors wish to thank Professor JI Ihedioha, Associate Dean of the Faculty of Veterinary Medicine, University of Nigeria, Nsukka, for a pre-review of this article as well as his constructive criticisms. Special thanks to Mr. BC Chime, the former Chief Technologist of the Department of Veterinary Parasitology and Entomology, for his assistance in identification of the parasites and rodents.

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