

**HAEMOGLOBINOPATHY IN WILD RATS, *RATTUS RATTUS* (LINNAEUS) INFECTED WITH A CESTODE PARASITE, *HYMENOLEPIS DIMINUTA* (RUDOLPHI)**Sudheer Kumar<sup>1</sup>, Dileep Kumar Gupta<sup>1</sup> and Neelima Gupta<sup>2\*</sup><sup>1</sup>Department of Zoology, Bareilly College, Bareilly 243005. UP. India.<sup>2\*</sup>Department of Animal Science, MJP Rohilkhand University, Bareilly 243006. UP. India.**\*Correspondence for Author: Prof. Dr. Neelima Gupta**

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**ABSTRACT**

The study was conducted to observe the influence of a cestode parasite, *Hymenolepis diminuta* on the haemoglobin concentration and extent of haemoglobinopathy of the common house rat, *Rattus rattus* Linnaeus, 1758 from Bareilly, Uttar Pradesh, India. Examination of *Rattus rattus* (n=109) revealed *Hymenolepis* infection (prevalence 24.50%; intensity 1-4 parasites per host) from the small intestine of the host. The parasites were fixed, dehydrated, stained and mounted as per routine techniques. The haemoglobin values were evaluated in two groups (Group A: control; Group B: *Hymenolepis* infected) of male and female hosts. The results indicated significantly lower values of haemoglobin concentration in rats infected with cestodes which indicates that the parasite interacted with the host's metabolism. The percentage fall in males was 33.08% and 34.67% in females. The fall in haemoglobin concentration recorded from the infected male and female rats may be attributed to the various types of anaemia, haemorrhage and haemolysis (erythrocyte destruction). The findings reveal that haemoglobinopathy expresses itself as a pathological manifestation in *Rattus rattus* infected with *Hymenolepis*.

**KEYWORDS:** *Rattus rattus*, *Hymenolepis diminuta*, weight groups, haemoglobin.**INTRODUCTION**

*Rattus rattus* is cosmopolitan in distribution. Although the species is believed to be native to India and possibly other Indo-Malayan countries, it has been introduced through human travel overseas to all continents. It is generally found in any area that can support its mainly vegetarian diet. The species is known to harbor and serve in the transmission of human helminth infections worldwide.

The parasites do not have the capability to obtain food directly from the ecosystem and hence they adapt themselves to live in or on some other organisms and derive their food either ecto or endo parasitically from them.

Rat organs may be parasitized by various groups of parasites, which may cause metabolic changes in the host. These changes are sharply reflected in the host blood. Parasitic transmission may affect the blood biochemistry of the host. For performing normal physiological functions, it is necessary for every individual to maintain the haematological values within certain limits.

*Hymenolepis diminuta* (the rat tapeworm) occurs in rats, mice and has been recorded in man. In heavy infections, the parasite can cause diarrhea and abdominal pain in

humans, in rodents, the parasite may cause slow growth and pot belied syndrome. Cestodes inhabit the lumen of vertebrate's intestine where they take their food from nutrients absorbed through the tegument. There are different ways in which parasites including cestodes inflict mechanical injury to their host. Haematological alterations due to helminthic infections have been studied extensively in different hosts.<sup>[1-4]</sup> By calculating the haemoglobin percentage in blood of the host, the amount of cell deficiency or efficiency can be observed, i.e. whether the host is anaemic or not.

Haemoglobinopathy in *Rattus rattus* due to *Hymenolepis* infection remains an unsolved enigma. Keeping this in view, the present venture was undertaken.

**MATERIALS AND METHODS****Animal sampling and processing**

Wild rats (*Rattus rattus*) (n=109) were trapped from the different areas of Bareilly. They were maintained in cages (2-3 rats per cage) in the laboratory of the Department of Zoology, Bareilly College, Bareilly (U.P.) (28.35°N; 79.42°E) under ideal conditions of food and water till sacrificed for investigations. The experiments were conducted according to the prevailing guidelines for animal care.

To avoid stress effect on the body and other parameters, rats were dissected and examined within 24 hours from capturing time. Prior to dissection, the weight and sex of the animals were recorded.

#### Collection of blood and haemoglobin estimation

Blood was collected from the heart or tail tip and immediately transferred into a sterilized vial containing a mixture of ammonium oxalate and potassium oxalate as anticoagulant.<sup>[5]</sup> Haemoglobin was estimated by Sahli's acid haematin method.

#### Post mortem examination

Subsequent to blood sampling, rats were anaesthetized in mild chloroform by holding them in glass jars till they were unconscious and failed to respond to touch stimuli. They were sacrificed and their alimentary canal was removed in portions (oesophagus, stomach, small intestine, large intestine and caecum/rectum). The contents of each portion were washed with saline, inspected for the presence of helminth parasites and carefully extracted with the help of needle and brush to remove the worms intact without damaging the scolex.

The parasites were pressed between two slides and fixed in AFA and stained in Borax Carmine as per routine techniques. After dehydration and staining, cestodes were examined under the microscope and identified with the help of keys, related literature and description.<sup>[6]</sup>

### RESULTS AND DISCUSSION

The cestode parasite, *Hymenolepis diminuta* Rudolphi 1819 was discovered from the small intestine of *Rattus rattus*.

#### Parasite Profile

Type Host: *Rattus rattus* Linnaeus, 1758  
 Parasite: *Hymenolepis diminuta* Rudolphi 1819  
 Type Locality: Bareilly (U.P.), India (28.35°N; 79.42°E)  
 Prevalence: 24.50%  
 Intensity: 1-4 parasites/host

In Group A, haemoglobin value was found to be  $13.6 \pm 0.07$  gm/dl in male and  $12.4 \pm 0.08$  gm/dl in female whereas in Group B, it depleted up to  $9.1 \pm 0.03$  gm/dl in male and  $8.1 \pm 0.03$  gm/dl in female rats. The percentage fall in overall values was found to be 33.08% in male and 34.67% in female rats as compared to the normal values.

**Table 1: Haemoglobin values in uninfected and infected *Rattus rattus*.**

Host	Group	Sex	Haemoglobin (gm/dl)	% fall
<i>Rattus rattus</i>	Group A	Male	$13.6 \pm 0.07$	-
		Female	$12.4 \pm 0.08$	-
	Group B	Male	$9.1 \pm 0.03$	33.08%
		Female	$8.1 \pm 0.03$	34.67%

Haemoglobin is a conjugated protein. Each erythrocyte contains about 100 million haemoglobin molecule. When haemoglobin content of blood is reduced, the result is anaemia. Haemoglobin is not only a carrier of O<sub>2</sub> and CO<sub>2</sub> but it is also one of the buffering agents of the blood.

Reduction in haemoglobin concentration was reported due to infection of *Fasciola gigantica* in different live stocks.<sup>[2,7,8]</sup> A decline in haemoglobin values in camels infected with helminth parasite in the Gassim region of central Saudi Arabia was reported.<sup>[9]</sup> A significant fall in TEC, Hb concentrations and Hct values in donkeys infected with *Trypanosoma congolense* was also recorded.<sup>[10]</sup> The haemoglobin level among school children infected with helminth parasites in Egypt also declined.<sup>[11]</sup>

Anaemia and iron deficiency were detected in the children infected with *Schistosoma* in East Africa.<sup>[12]</sup> The total erythrocyte counts, haemoglobin concentration and haematocrit values during bladder worm (*Cysticercus fasciolaris*) and protozoan infections in *Rattus norvegicus* also reduced.<sup>[13,14]</sup> TEC and Hb concentration in sparrows infected with *Heterakis gallinea* and *Ascaridia gallinae* decreased.<sup>[3]</sup> Significant lower values of haemoglobin percentage, RBC and WBC counts in children and adult infected with *Hymenolepis* were reported.<sup>[15]</sup> Significant lower values of haemoglobin concentration in male and female rats infected with *H. diminuta* and *H. nana*<sup>[16]</sup> and wild and laboratory rats infected with *H. diminuta*<sup>[17]</sup> and mice<sup>[18]</sup> were also observed by different workers. Similar results were obtained for TEC, Hb, PCV of rats infected with cestodes.<sup>[19]</sup> The serum chemistry of non-pregnant and pregnant female *Rattus rattus* in different weight groups (A: 50-100gm, B: 100-150gm and C: 150-200gm) under uninfected and infected (*Trypanosoma* and *Cysticercus*) conditions were performed reporting significant changes (P<0.05) in hemoglobin in parasitized rats showing a maximum fall of 36.63% in pregnant *T. lewisi* infected rats weighing 100-150 gms.<sup>[4]</sup> The authors further concluded that glucose and hemoglobin were the most vulnerable biochemical constituents to parasitism. The same parasites also affected the condition factor, hepato and splenosomatic indices of *Rattus rattus*.<sup>[20]</sup> Severe anaemia in humans was manifested by multiple intestinal helminth infestation.<sup>[21]</sup>

Findings of present study as well as above observations clearly indicate reduction in the values of haemoglobin concentration due to parasitic infections in different types of hosts.

Assessment of haemoglobin concentration can be used to determine the extent of deleterious effects of parasites on blood constituents of an animal. It can also be used to explain blood relating functions of chemical compounds including toxicants released from parasites. The low concentration of haemoglobin observed in the infected

groups maybe due to acute haemolysis resulting from growing infection. Previous studies have shown that infection with blood parasites resulted in increased susceptibility of red blood cell membrane to oxidative damage probably as a result of depletion of glutathione on the surface of red blood cell.<sup>[22,23]</sup> Some parasite derived attractants indicate both chemotaxis and chemokinesis effect resulting in a low concentration of haemoglobin in parasitized rats.

Due to the presence of the intestinal parasite as observed in the present study, the intestinal wall of the host gets injured due to mechanical injury caused by the penetration of the parasite into the villi of the host.<sup>[24]</sup> This results in excessive blood loss leading to anaemia. There is a significant alteration in various other parameters including haemoglobin depicting the immune status of the traumatized host and the ensuing haemoglobinopathy expresses itself as a pathological manifestation in the parasitized host.

### CONCLUSION

*Rattus rattus* infected with *Hymenolepis diminuta* showed a significant decline in haemoglobin concentration both, in male (33.08%) as well as female (34.67%) hosts and is suggestive of haemoglobinopathy. The fall may be attributed to the blood loss (various types of anaemia and haemorrhage), erythropoietin deficiency, haemolysis (erythrocyte destruction), malnutrition (nutritional deficiency of iron, folic acid, vitamin B<sub>12</sub> or Vitamin B<sub>6</sub>) or some other factors.

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