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Studies of the Carbohydrates Content in Tissues of Hamster (*Mesocricetus Auratus*) Infected with Hookworm (*Ancylostoma Ceylanicum*)

Rajani, P.S., Jyorthirmai, G.S., Prasanna, D., Rohini, V., Vanita Malewar

Abstract: ***Hookworm infections are helminthic infection that affects tropical and subtropical areas. Several laboratory animals have been infected with hookworms. Due to parasitic infection, the structure and function of tissues undergo severe derangements and metabolic disorders. In the present study, a hamster, Mesocricetus auratus, was infected with a hookworm, Ancylostoma ceylanicum. The carbohydrate content of A. ceylanicum in M. auratus was studied in both control and infected individuals. Understanding the level of pathogenicity caused by an A. ceylanicum infection can be aided by examining the total amount of carbohydrates present in the tissues of the host, M. auratus. A biochemical analysis was performed to determine the total carbohydrate content. The brain and spleen were found to have higher carbohydrate contents. There was decreased carbohydrate activity in the kidney, liver, gut, and muscle. The present study describes the alterations in total carbohydrate content in various tissues of the host, M. auratus, resulting from infection with A. ceylanicum. The results obtained from multiple tissues due to infection were statistically significant. It was further plotted graphically and interpreted. The research conducted in the present study helped to understand the biochemical changes occurring in the host, Mesocricetus auratus, due to hookworm infection, Ancylostoma ceylanicum.***

Keywords: ***Ancylostoma Ceylanicum, Hamster, Mesocricetus Auratus, Infection, Hookworm***

I. INTRODUCTION

Carbohydrates act as a significant source of energy in all organisms. Carbohydrates are defined as the chemical derivatives of polyhydric alcohols, and the most common carbohydrate reserve in animal tissue is glycogen. In living organisms, carbohydrates are catabolized to release energy and stored as reserve polysaccharides.

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**Correspondence Author(s)*
Dr. P.S. Rajani, Department of Zoology, Government Degree College for Women, Affiliated to Osmania University, Begumpet, Hyderabad (Telangana), India. Email: annapoornarajani005@gmail.com
Dr. G.S. Jyothirmai, Department of Zoology, Government Degree College for Women, Affiliated to Osmania University, Begumpet, Hyderabad (Telangana), India. Email: drgjyothi@gmail.com
Dr. D. Prasanna, Department of Zoology, Government Degree College for Women, Affiliated to Osmania University, Begumpet, Hyderabad (Telangana), India. Email: prasanna.amulya@gmail.com
V. Rohini, Department of Biotechnology, Government Degree College for Women, Affiliated to Osmania University, Begumpet, Hyderabad (Telangana), India. Email: rohini.biotech@gmail.com
Dr. Vanita Malewar*, Department of Zoology, Osmania University, Hyderabad (Telangana), India. Email: vanita7m@gmail.com, ORCID ID: 0000-0001-9563-5890

Under energy conditions, such as the non-availability of glucose, reserve polysaccharides are degraded and utilised for energy release. The breakdown of glucose contributes the primary source of energy. It is always present in the form of their compounds called mucosubstances. The normal rate of carbohydrate metabolism is of great importance to the organism, and any interference can cause deleterious effects on the animal's bioenergetic system. The rat intestine reduces the absorptive surface of the mucosa to the tip of the microvilli. An anatomic absorptive area of 1200 cm^2/100 mg is reduced to an effective absorptive area of 9.5 cm^2/100 mg. In contrast, an anatomical surface area of 101 cm^2/100 mg and an effective absorptive area of 39 cm^2/100 mg were found in *Hymenolepis diminuta*. Befus and Podesta reported an effective absorptive layer in the rat intestine in *Hymenolepis diminuta* [1]. The present study was undertaken to investigate the carbohydrate content in the tissues of hamsters infected with the hookworm helminth.

II. REVIEW OF LITERATURE

Carbohydrates are the central energy reserve in parasitic helminths. Von Brand [2] and Bernard [3] demonstrated the presence of carbohydrates in helminths while Weinland [4, 5] made conclusive quantitative and qualitative observations of carbohydrate metabolism in helminths. Numerous carbohydrate molecules are nutrients of endoparasites, where they metabolize both under aerobic and anaerobic conditions [6]. Quinnell *et al.* investigated the host age and the growth and fecundity of *Hymenolepic diminuta* in the rat [7]. Melon *et al*. worked on the infection with *Hymenolepis diminuta, which* is more effective than daily corticosteroids in blocking chemically induced colitis in mice [8] to study the carbohydrate content in the tissues of hamsters (*Mesocricetus auratus*) infected with hookworm (*Ancylostoma ceylanicum*) in the present study. Kapczuk *et al.*investigated the selected molecular mechanisms involved in the host-parasite system [9]. *Hymenolepis diminuta-Rattus norvegicus* helminth showed effects on exploratory behaviour and cognitive processes [10]. The review of the literature suggests that studies on carbohydrate metabolism in the tissues of the host, Mesocricetus auratus infected with hookworm, Ancylostoma ceylanicum, are meagre. Therefore, the author has attempted to study the carbohydrate content in the tissues of hamsters (*Mesocricetus auratus*) infected with hookworm (*Ancylostoma ceylanicum*) in the present study.

Norvegicus helminth showed effects on exploratory behaviour and cognitive processes (Blecharz-Klin, 2022). The review of the literature suggests that studies on carbohydrate metabolism in the tissues of the host, Mesocricetus auratus infected with hookworm, Ancylostoma ceylanicum, are meagre. Therefore, the author has attempted to study the carbohydrate content in the tissues of msters.

III. METHODOLOGY

The total carbohydrate content was determined using the Caroll *et al.* method [11]. The TCA solution was used to homogenize the tissue. After 15 minutes of centrifugation at 1000 rpm, the supernatant was collected. 5 millilitres of Anthrone reagent were added to 1 millilitre of supernatant, and the mixture was cooked for 15 minutes. The room temperature was used to cool the tubes. After setting the spectrophotometer to zero using the blank, the colour developed was measured at 620 nm. The amount of total carbohydrates is given as mg of glucose per gram of wet tissue weight.

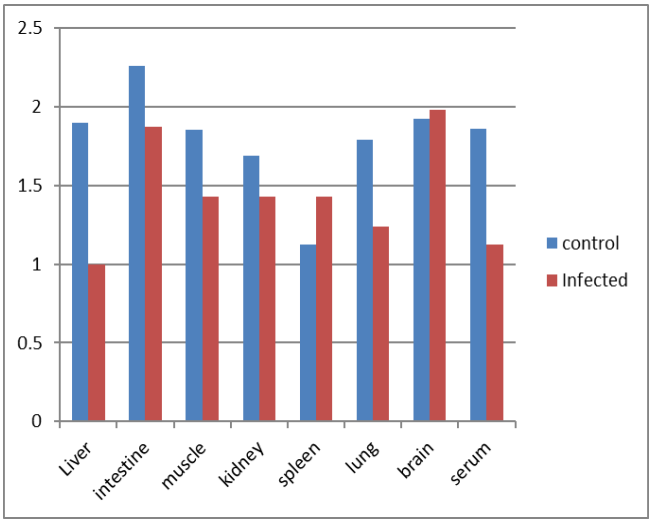
IV. RESULTS

The total carbohydrate content was estimated in various tissues and serum of hamsters infected with hookworms and in infected control animals. The results are given in Table no.1 and are given in histogram no.1. The results obtained in the various tissues and serum of the control animals are indicated as liver 1.900±0.010, intestine 2.262±0.104, muscle 1.852±0.039, kidney, 1.690± 0.075, spleen 1.124± 0.105, lung 1.788± 0.073, brain 1.922± 0.021 mg glucose/g wet weight of tissue respectively in serum level is 1.859± 0.057mg glucose/100ml of serum. The values in the different tissues and serum of the infected host, as indicated, are liver 0.999±0.069, intestine 1.870±0.047, muscle 1.431±0.037, kidney 1.431±0.037, spleen 1.431±0.037, lung 1.236±0.116, and brain 1.982±0.047 mg glucose/g wet weight of tissue, respectively. In serum, it is 1.124±0.105 mg glucose/100ml of serum.

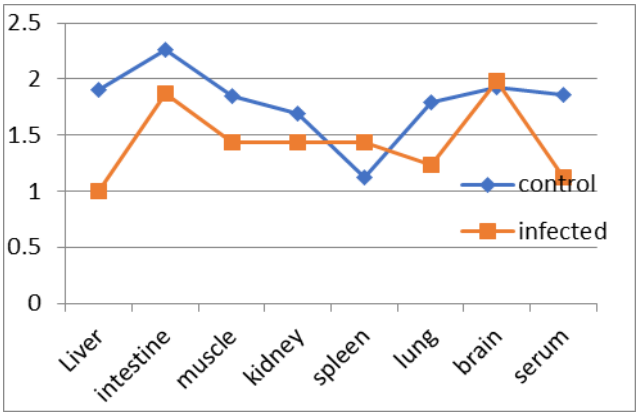
Table 1. Total Carbohydrate Content in the Various Tissues and Serum of Mesocricetus auratus Induced with Ancylostoma Ceylanicum Infection

S. No.	Tissues	Group	Mean ±SD	% Change
1	Liver	Control	1.900±0.010	[47.421%]
	Liver	Infected	0.999±0.069	
2	Intestine	Control	2.262±0.104	[20.963%]
	Intestine	Infected	1.870±0.047	
3	Muscle	Control	1.852±0.039	[22.732%]
	Muscle	Infected	1.431±0.037	
4	Kidney	Control	1.690±0.075	[15.325%]
	Kidney	Infected	1.431±0.037	
5	Spleen	Control	1.124±0.105	[27.313%]
	Spleen	Infected	1.431±0.037	
6	Lung	Control	1.788±0.073	[30.872%]
	Lung	Infected	1.236±0.116	
7	Brain	Control	1.922±0.021	[3.122%]
	Brain	Infected	1.982±0.047	
8	Serum	Control	1.859±0.057	[39.537%]
	Serum	Infected	1.124±0.105	

The carbohydrate content was found to be increased in the spleen and brain by 27.313% and 3.122%, respectively. However, it has decreased in the liver, intestine, muscle, kidney, lung, and serum by 47.421%, 120.963%, and 22%, respectively, as well as in the following percentages: 732%, 15.325%, 30.872%, and 39.537%. The alterations in the total carbohydrate content were statistically significant.



Histogram No.1 Carbohydrate Content in the Various Tissues and Serum of *Mesocricetus Auratus* Induced with *Ancylostoma Ceylanicum* Infection.



Graph No.1: Total Carbohydrate Content in the Various Tissues and Serum of Mesocricetus Auratus Induced with Ancylostoma Ceylanicum Infection

V. DISCUSSION

The results showed an increase in carbohydrate content in the spleen and brain. A decreased carbohydrate content was observed in the liver, intestine, muscle, kidney, lung, and serum. The increase in carbohydrate content in various vertebrate hosts due to helminth infection has been observed by several investigators. Uyeno [12] and Kawal [13] observed an unusual sugar tolerance in rabbits infected with *Clonorchis sinensis.* Kuwamura observed an increased glycogen content in the liver of rabbits infected with *Clonorchis sinensis* [14]. Sawada *et al.* reported increased liver glycogen during *Schistosoma japonicum* infection in mice [15].

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Rubaj and Furmaga reported glycogen deposition in the liver lobules of the sheep experimentally parasitized by liver fluke [16]. Kameshwari reported an increase in the glycogen content in the liver of *Rana tigrina* in *Calotes versicolor* with helminth infection [17]. Sulochana [18] demonstrated an increase in the total carbohydrates and glycogen content in the intestine of *Channa striatus, Clarius batrachus, Rana trigrina, Natrix piscator, Rhinopoma kinneri* and *Calotes versicolor* with variety of helminth infection. Kaul et al. studied the changes in carbohydrate metabolism in hamsters infected with hookworm (*Necator americanus*) and examined [19]. The infection induced abnormal results in an intraperitoneal glucose tolerance test (GTT), an increase in plasma free fatty acids and a decrease in liver glycogen. There was a significant correlation between worm load and the fall in liver glycogen or haemoglobin levels. Murlidhar reported an increase in the total carbohydrates in the liver of *Melanostictus* (Schneider) with different helminth infections [20]. *Schistosoma japonicum* caused a reprogramming of glycolipid metabolism in the liver [21]. Wang et al. [22] investigated the metabolic effects of *Necator americanus* infection in hamsters. Urine and serum NMR spectroscopic analysis and multivariate data analysis methods to analyse the biochemical consequences of *N. americanus* infection in the hamster. The disease was characterized by altered energy metabolism consistent with anaemia.

In addition, *N. americanus* infection was associated with disruption of intestinal microbial activity, which was reflected in changes in the composition of microbial-mammalian metabolites. Correlation between worm burden and metabolite concentrations also reflected altered energy metabolism and gut microbial status.

Whagmare *et al*. [23] investigated the quantitative assessment of carbohydrate metabolism, in cestodes of the species *Gallus gallus domesticus*. Carbohydrate metabolism activity was observed in the intestinal parasite Cotugnia digonopora, which was able to extract the nutrients from its host, and the host showed a high level of carbohydrate metabolism. The results of the present study indicate a decrease in carbohydrate content in various tissues of the infected host. The result could be attributed to the parasitic adaptation of the hookworm, *Ancylostoma ceylanicum*, in the host, Mesocricetus auratus, causing physiological alterations in the carbohydrate content of the host's tissues.

Ancylostoma ceylanicum is an endoparasitic helminth of the vertebrate host, *Mesocricetus auratus.* As it resides in the alimentary canal, it affects the host directly by injuring the walls of the canal and absorbing readily available digested food. It deprives the host of its digested food, and the absorption of other nutrient molecules by the host is interfered with by the presence of the parasites. Several physiological changes occur in the host, *Mesocricetus auratus,* due to *the presence of Ancylostoma ceylanicum.* A variety of structural, functional, and pathological changes in the various tissues of golden hamsters (Mesocricetus auratus) have been observed in the hosts' gastrointestinal tract, inflicted by the helminth *Ancylostoma ceylanicum*. Multiple investigators have reported pathogenic conditions in the hamsters under helminth infection [24, 25, 26, 27, 28, 29].

VI. CONCLUSION

Hookworms, *specifically Ancylostoma ceylanicum, cause* intestinal blood loss during a part of their life cycle. The carbohydrate content in *Mesocricetus auratus infected with Ancylostoma ceylanicum has been studied, and it was found that the liver, intestine, muscle, kidney, lung,* and serum had low carbohydrate content. An increased carbohydrate content was found in the spleen and brain of the infected host tissues. The research undertaken in the present study provides insight into the carbohydrate content in the tissues of the host, Mesocricetus auratus, infected with *Ancylostoma ceylanicum.* The study provides insight into the physiological changes in the host, Mesocricetus auratus, infected with *Ancylostoma ceylanicum*. The adaptation of the parasite Ancylostoma ceylanicum in the host Mesocricetus auratus causes alterations in the carbohydrate content of various tissues.

DECLARATION STATEMENT

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Availability of Data and Materials	Not relevant
Authors Contributions	All authors have equal participation in this article.

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AUTHORS PROFILE

Dr. P.S. Rajani is an Associate Professor at Government Degree College for Women, Begumpet, Hyderabad. Her research work focuses on Parasitology. She has researched some of the parasites for the morphological study. The present paper concerns the nematode Ancylostoma ceylanicum, a roundworm of the genus Ancylostoma. It is a hookworm that infects both humans and other mammals, such as dogs, cats, and golden hamsters. It causes ancylostomiasis in humans. The larval *Ancylostoma ceylanicum* infests the intestine of human beings. The adult of this larval nematode, A. ceylanicum, is a common parasite of humans, particularly in rural populations of tropical and subtropical regions worldwide, causing severe anaemia, emaciation, and general weakness. Approximately one-quarter of the world's population is affected by hookworm infection. The hookworm infection in humans causes blood loss and anaemic conditions. The increasing veterinary and medical importance of this parasite has initiated the present research study.

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Dr. G. S. Jyothirmai is an Associate Professor in Zoology, Government Degree College of Women, Begumpet, Hyderabad**.** Her research work includes a critical and comprehensive study conducted on various biostatic parameters of the helminth parasite population of the freshwater fish hosts *Heteropneustes fossilis*, *Rita rita* and *Notopterus notopterus* of Nizamabad district of AP in India. The hosts form a source of helminth fauna and serve as integrated ecological units or polycyclic units. These poikilothermic vertebrates harbour different types of helminthocoenosis in their biotopes. The host fish have significant economic value, as they form a source of protein in the diet.

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Dr. D. Prassana is an Assistant Professor of Zoology at the Government Degree College for Women, Begumpet, Hyderabad. Her research areas are Entomology and Parasitology. Her work in the Carbohydrate metabolism of the infected and control, Golden hamster has helped in the physiological study of the paraShe is a member of the editorial committee, for academic Publications in the International Journal of Entomology Research, a Fellow Member of The Society of Entomology and Zoology Research and entitled F.S.E.Z.R**.** She is a Member of Osmania

Graduates Association (OGA), Life member Indian Red Cross society, Life member Indian Journal of Sericulture. She has published YouTube video lessons and PowerPoint presentations on the SlideShare website. She has rendered services at various levels, including Academic Coordinator, Coordinator of the Student Career Guidance Cell, Head of the Department of Zoology, State-level Jignasa Coordinator, Yuvatarangam Coordinator, Student Council Coordinator, and N.S.S. Program Officer.

Publications

1. Dr. D Prasanna *et.al* (2021). Diversity of bivalve and gastropod molluscs at Lower Manair Dam from Karimnagar district, Telangana State., *International Journal of Entomology Research* ISSN: 2455-4758. Volume 6; Issue 1; 2021; Page No. 79-83.
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V. Rohini is an Assistant Professor in Biotechnology at the Government Degree College for Women, Begumpet, Hyderabad. Her research areas are Biotechnology and Parasitology. She has over a decade of experience teaching Biotechnology to degree students. Her research areas have focused on parasite studies and the study of hookworm Ancylostoma ceylanicum. Research on carbohydrate metabolism in the infected host, the golden hamster, when compared to the control, has paved the way for understanding physiological alterations in carbohydrate metabolism due to parasitic infection.

Publications:

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Dr. Vanita Malewar is a Researcher in Zoology. Her core areas of research are in Parasitology. Some of the research topics focused on the study of parasites, including Schistosoma and Ancylostoma. Her research areas include studies related to the dynamics of host-parasite relationships. I have contributed to my research in the area of studying carbohydrate metabolism in the host, Mesocricetus auratus, infected with *Ancylostoma ceylanicum*. In the present study, I conducted research with my co-researchers on carbohydrate metabolism in the host, Mesocricetus auratus, infected with *Ancylostoma ceylanicum*. The present paper aims to study whether parasitic infection by Ancylostoma ceylanicum in *Mesocricetus auratus* induces any physiological alterations. An investigation into the carbohydrate content was conducted in the control and infected *Mesocricetus auratus.*

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