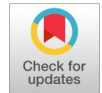


Studies of the Carbohydrates Content in Tissues of Hamster (*Mesocricetus Auratus*) Infected with Hookworm (*Ancylostoma Ceylanicum*)

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



Abstract: Hookworm infections are the 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*. Investigation of the Carbohydrate content of *A. ceylanicum* in *M. auratus* was studied in control and infected ones. 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 estimation of the total carbohydrate content was made. 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 depicted the alterations in the total carbohydrate content in various tissues of the host, *M. auratus* due to the infection of *A. ceylanicum*. The result of the data obtained in the various tissues due to infection was found to be statistically significant. It was further plotted graphically plotted and interpreted. The research work done in the present study helped to understand the biochemical changes taking place in the host, *Mesocricetus auratus* due to hookworm, *Ancylostoma ceylanicum* infection.

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

I. INTRODUCTION

Carbohydrates act as a major 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 the living organism, carbohydrates are catabolized for the release of energy and stored as reserve polysaccharides.

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Under energy conditions, like the non-availability of glucose, the reserve polysaccharides are degraded and used for the release of energy. The major source of energy is contributed by the breakdown of glucose. It is always present in the form of their compounds called mucosubstances. As the normal rate of carbohydrate metabolism is of much importance for the organism and any interference can cause deleterious effects on the bioenergetic system of the animal. The rat intestine reduces the absorptive surface of the mucosa to the tip of the microvilli. An anatomic absorptive area of 1200 cm²/100 mg is reduced to an effective absorptive area of 9.5cm²/100mg whereas an anatomical surface area of 101 cm²/100mg and effective absorptive area of 39 cm²/100mg was found in *Hymenolepis diminuta*. Befus and Podesta reported an effective absorptive layer than the rat intestine in *Hymenolepis diminuta* [1][30][31][32][33][34] The present study has been undertaken to intensively study the carbohydrate content in the tissues of the hamster due to hookworm helminth.

II. REVIEW OF LITERATURE

Carbohydrates are the main 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 *Hymenolepis diminuta* in the rat [7]. Melon *et al.* worked on the infection with *Hymenolepis diminuta* 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 the carbohydrate metabolism in the tissues of the host, *Mesocricetus auratus* infected by hookworm, *Ancylostoma ceylanicum* is 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.



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

norvegicus helminth showed effects on exploratory behaviour and cognitive processes (Blecharz-Klin, 2022). The review of the literature suggests that studies on the carbohydrate metabolism in the tissues of the host, *Mesocricetus auratus* infected by hookworm, *Ancylostoma ceylanicum* is 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 Carroll *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. 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

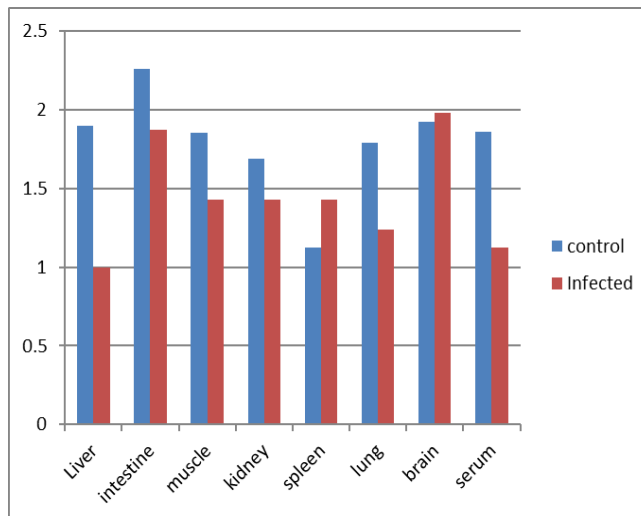
The total carbohydrate content was estimated in various tissues and serum of hamsters infected with hookworm and in infected control. The results are given in Table no.1 and are given in histogram no.1. The results obtained in the various tissues and serum of the control animals are indicated as liver 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, brain 1.982±0.047mg 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

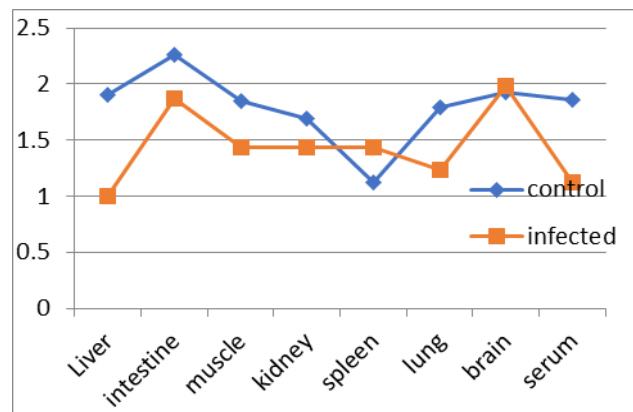
S. No.	Tissues	Group	Mean ±SD	% Change
1	Liver	Control	1.900±0.010	[47.421%]
		Infected	0.999±0.069	
2	Intestine	Control	2.262±0.104	[20.963%]
		Infected	1.870±0.047	
3	Muscle	Control	1.852±0.039	[22.732%]
		Infected	1.431±0.037	
4	Kidney	Control	1.690±0.075	[15.325%]
		Infected	1.431±0.037	
5	Spleen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

The carbohydrate content was found to be increased in the spleen and brain by 27.313 % and 3.122%. However, it has

decreased in the liver, intestine, muscle, kidney, lung and serum by 47.421%, 120.963%, 22.732%, 15.325%, 30.872% and 39.537% respectively. 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 increased carbohydrate content in the spleen and brain. Decreased carbohydrate content was observed in liver, intestine, muscle, kidney, lung and serum. The increase in the level of 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 by *Clonorchis sinensis* [14]. Sawada *et al.* reported increased liver glycogen during *Schistosoma japonicum* infection in mice [15].



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 trigirina*, *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*) were 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 investigate the biochemical consequences of *N. americanus* infection in the hamster. The infection 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 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 show decreased 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 tissues of the host, *Mesocricetus auratus*.

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

VI. CONCLUSION

Hookworms, *Ancylostoma ceylanicum* causes intestinal blood loss during a part of their life cycle. The carbohydrate content in *Mesocricetus auratus*, infected with *Ancylostoma ceylanicum* had been studied and found that 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 tissues of the host. The research undertaken in the present study gives an insight into the carbohydrate content in the tissues of the host, *Mesocricetus auratus* infected with *Ancylostoma ceylanicum*. The study gives an understanding of 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 in various tissues.

DECLARATION STATEMENT

As researchers, we have put considerable effort into doing the research and preparing the research article. We did not receive any financial support for the present research. Our research is based on self-finance. There is no conflict of interest in this research to the best of my knowledge. The article does not require ethical approval and consent to participate with evidence. The source of research data and data access terms and conditions in the article are not relevant. All authors have individual partnerships in this article.

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Conflicts of Interest	No conflicts of interest to the best of our knowledge.
Ethical Approval and Consent to Participate	No, the article does not require ethical approval and consent to participate with evidence.
Availability of Data and Material	Not relevant
Authors Contributions	All authors have equal participation in this article.

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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 is about the nematode, *Ancylostoma ceylanicum*, which is a roundworm of the genus *Ancylostoma*. It is a hookworm, of both humans and of 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, the *A. ceylanicum* is a common parasite of human beings particularly in rural populations of tropical and subtropical regions of the world causing severe anemia, emaciation and general weakness. Around ¼ of the population of the world suffers from hookworm infection. The hookworm infection in humans causes loss of blood and anaemic conditions. The increasing veterinary and medical importance of this parasite has initiated the present research study.

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- 1.G. S. Jyothirmai, K. Geetha, D. Suneeta Devi., P. Manjusha, Ravi Shanker Piska. Ecology and Fisheries Vol. 3 (1): 1- 8.
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Publications

1. Dr. D Prasanna *et.al* (2021). Diversity of bivalve and gastropod molluscans 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.
2. Dr. D Prasanna *et.al.*(2020). Aquatic Entamofauna diversity in Lower Manair Dam, Karimnagar Dt. Telangana state, *India Journal of Entomology and Zoology Studies* 2020; 8(2): 1144-1149E-ISSN: 2320-7078 P-ISSN.



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Publications:

1. Rohini *et al.*(2022). Public - Health and Hygiene, A text book for skill enhancement course SEC (II) for B.Sc. 2nd year, semester III (Zoology) with ISBN number 978-93-91576-15-8, Divya Lakshmi Publishers & distributors (also available on flipkart.com and amazon.)



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

Publications:

- 1.Vanita, M., Aruna, K. and Parvathi, J(2018). Histochemical localizations of proteins in *Schistosoma spindale*. *Journal of Current Science*.

3. Vanita, M. and Aruna, K. (2020). A study of the suckers of *Schistosoma spindale*. *International journal for Innovative Research in Multidisciplinary Field*.6(1):236-240.

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