Comparative Study of Organic Components Present in Haemolymph of Male Millipedes

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Abstract
This study examined the effects of high temperature and differences between two millipede species on the organic components of the haemolymph of the male millipedesMordonius importatus and Anoplodesmus tanjoricus.The observations show that high-temperature exposure affects the organic components of haemolymph. After exposure to high temperature, the haemolymph totalproteins, total carbohydrates and total lipids show a gradual decrease in both species.
Keywords: *Millipedes, Mordanius Importatus, Anoplodesmus tanjoricus, Haemolymph.*

Introduction

Millipedes represent one of the largest animal groups within the phylum Arthropoda. As primary decomposers of wood and leaf litter in tropical forest ecosystems, they play a vital role in soil formation. Furthermore, millipedes are a common and conspicuous component of the fauna inhabiting the upper soil and litter layers across tropical, subtropical, and temperate forest regions worldwide.

In India, particularly in its western regions, the study of millipedes has received significantly less attention compared to other arthropod groups. Therefore, this study was undertaken to analyze the organic components in the haemolymph of the millipede *Mordanius importatus* and *Anoplodesmus tanjoricus*. This research helps enhance our understanding of its taxonomic and ecological significance for both academic and research purposes.

M. importatus and *A. tanjoricus*. is a pantropical millipedes found abundantly on grassy ground, particularly in cotton fields during the rainy season (from June to October). Rajulu (1974) studied the organic components of the hemolymph of the millipede *Cingalobolus bugnioni* and the centipede *Scutigera longicornis* to determine the phylogenetic relationship between Myriapoda and other arthropods. Similarly, Deshmukh (2007) examined the organic components of the hemolymph in the millipede *Anoplodesmus tanjoricus* as well as the effects of temperature on them, while Crawford (1978) observed seasonal variations in the hemolymph composition of *Orthoporus ornatus*.

Material and Methods:

The millipedes *Mordonius importatus* and *Anoplodesmus tanjoricus* were collected from rural areas surrounding Amravati city (Maharashtra, India). All collected specimens were maintained in glass containers provided with moist soil. Groups of 5–7 millipedes, selected according to size, were transferred to glass jars covered with muslin cloth for acclimatization. These jars were placed in an incubator set at a high temperature (40°C) for exposure durations of 5, 10, and 15 days. To analyse the organic components of the haemolymph, the fluid was collected using a fine syringe after pricking the head region of each millipede.

- Method used for estimation of total protein in the haemolymph of control as well as experimental male and female millipedes was estimated by using Biuret method.
- Method used for estimation of haemolymph total carbohydrate was described by Carrel et. al. (1958).
- Method used for estimation of haemolymph total lipids was described by Folch et. al. (1957).

Observation and Results:

Millipedes Species	Proteins				Carbohydrates				Lipid			
	Control (At Room Temperature)	5 Days (40˚C)	10 Days (40˚C)	15 Days (40˚C)	Control (At Room Temperature)	5 Days (40˚C)	10 Days (40˚C)	15 Days (40˚C)	Control (At Room Temperature)	5 Days (40˚C)	10 Days (40˚C)	15 Days (40˚C)
A. tanjoricus	1242 ±12.50	1351 ±25.86	1044 ±31.26	868*** ±13.39	720 ± 20.39	805 ±16.52	1313 ±17.66	1054** ±27.21	740 ± 80.62	1540 ±25.19	2320 ±20.83	1641*** ±34.47
M. importatus	1023.83 ±10.02	1383.83 ±1.121 **	1172.1 ±2.287 *	799.7 ± 3.571	755.8 ± 2.564	878.7 ± 2.251	1266.7 ± 1.358*	908.4 ± 1.886	876± 1.535	1726. 33± 1.381	2121.1 ± 2.651* *	1945.3 ± 2.145**

In the present study, experiments were conducted to investigate the organic components of the haemolymph—specifically total protein, total lipid, and total carbohydrate—in the male millipedes *Mordonius importatus* and *Anoplodesmus tanjoricus*. Table 1 presents the concentrations of these components in the haemolymph of male *M. importatus* and *A. tanjoricus* at room temperature, along with the effects of high-temperature exposure (40°C) on them.

Table 1:- Haemolymph organic component in the millipede *Mordonius importatus* and *Anoplodesmustanjoricus* effect of high temperature (40˚C) on it (values expressed in mg/100 ml). Values are mean ± SE of five individual observations M – Male.

Discussion

In the millipede *M. importatu* and *A. tanjoricus*, male shows higher level of total protein and total carbohydrates compared to total lipid. Rajulu (1972), reported total protein, total carbohydrate and total lipid components in haemolymph of millipede *Arthrosphaera lutescen*. She also observed that male shows higher level of total protein and total carbohydrates. During investigation we found that in both millipedes species *M. importatus* and *A. tanjoricus* , the level of total protein and total carbohydrate in the male was higher, whereas the level of total lipid was lower in male. Rajulu (1976) observed remarkable similarity between the insects and the diplopoda as well as in the onychophoran species is the presence of high concentration of total protein. Temperature is one of the important ecological factor to which the living organism must adjust to live successfully in this environment. Millipede can sustain within temperature range from 0°C- 40°C. Temperature plays a major and important role in regulation physiology of millipede.

After exposure of millipede *M. importatus*and *A. tanjoricus*to the high temperature (40°C) for 5-15 days, the level of the total protein, total carbohydrates and total lipid was gradual decreases as compared to control (room temperature). These observations are in agreement with Deshmukh (2007) in millipede A. tanjoricus and Pant (1979) in insects. The organic components of haemolymph was decrease probably due to decrease in metabolic activity as well as low activities of enzymes.

Conclusions:

After exposure to high temperature, the level of organic components of haemolymph was decreases probably due to decrease in metabolic activity.

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