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Changes in the Total Lipid Content of the Foot and Hepatopancreas of the Slug, *Semperula maculata* with Reference to Thermal

Pushpanjali A. Bidwai

Department of Zoology, Narayanrao Kale SMruti Model College of Arts, Science & Commerce, Karanja (Gh.), District Wardha - 442203
pushpanjalib75@gmail.com

Abstract: **Semperula maculata is most commonly found land slug in Vidarbha region and it is abundantly available in the field andgardens.It is an important species on earth. They play significant role in their ecosystem and serve humans in many ways. Acclimation refers usually to the compensatory change in an organism under maintained deviation of a single environmental factor (usually in the laboratory). Terrestrial animals are subjected too much greater fluctuation in the temperature and their body temperature is closely related to their water balance. Higher utilization of total lipid content in hepatopancreas and foot of the slug, Semperula maculata on warm acclimation (32°C and 36°C). Similarly catabolism and bioconversion of incorporated total lipid content in the hepatopancreas and foot was lowered down at cold acclimated (10°C and 15°C) than at warm acclimated temperature. The findings of total lipid content in the slug, Semperula maculata at cold and warm acclimated temperature suggests that the slug is capable of adapting changes in the environmental temperature by modifying content.**

Index Terms: **Acclimation, Foot, Slug, Thermal, Total lipid**

I. INTRODUCTION

Slugs are members of the phylum mollusk. Mollusks are the animal, which have come on land but are still dependent on the moist environment. Study of living organism would not be completed without proving their relationship with environmental entities. Environment is the sum of many abiotic and biotic factors interacting constantly. The organism not only exists in this dynamic fluctuating complex but also it is a part and parcel of it (Crawford Sidebothen, 1972). A living organism is both structurally and functionally adjusted to the environment in which it is living. It must respond to external stresses in such a way that its internal environment is maintained in the optimum condition for the continuation of its metabolism reactions (Peters & Lovejoy, 1992). The organism has to face a variety of environmental factors like water, organic food, oxygen carbon dioxide, light, pressure, radiation and temperature (Buckland, 1994). Temperature is considered as a critical environmental factor in the ecology of most of the organism (Ahmed & Raut, 1991). The organism has to face a variety of environmental factors like water, organic food, oxygen, carbon dioxide, light, pressure, radiation and temperature (Diaz et al., 1998). The terrestrial mollusks mainly face water scarcity problems in the environment of variable humidity and temperature. The slugs are the most successful Stylommatophora pulmonates as far as their adaptability is concerned (Kulkarni, 1970). The physiological and biochemical changes in the unfavorable conditions have been studied by Florkin & Scheer (1972). The perusal of literature indicates that the study of changes in the lipid content in the hepatopancreas and foot of the slug, Semperula maculata with respect to temperature have great importance because now a day temperature of atmosphere goes on changing. It effects on land slug which play significant role in ecosystem. The rate of chemical reaction increases as the temperature rises (Getz, 1959). The nature of physiological adaptation of poikilotherms to constant temperature has been investigated to some extent by Bullode, 1955, Prosser, 1955, 1958. Biochemical correlation occurs with acclimated temperature (Rao, 1967). Animal expose to temperature disturb the physiological and biochemical process within the organisms. Exposure to different temperature affects biological constituents of slug (Kulkarni et al; 1992) and other terrestrial animals. And this is the current topic of interest because of changing ecological parameter day to day. Normally various sources of energy metabolism are required by the organism to encounter the stress (Horiguchi, 1956). Lipid is also a major source of energy after carbohydrate in animal, as it yields highest amount of energy (9.3Cal/gm), and which is more than double the energy obtained from carbohydrates and

proteins. Considerable work has been carried out on the lipid contents of different organisms indicating that there is influence of various factors such as age, temperature, toxicity etc. on lipid content of the organisms. Lipid and lipid metabolism have important role in the metabolism under stress condition. The storage of lipids is primarily located in the hepatopancreas and muscles, lipidic changes that are likely to occur after exposing the animal to high and low temperature. Effect of temperature on lipid content of slug has been scarcely studied. Hence, it is desirable to observe the changes in the level of total lipids.

II. MATERIAL AND METHODS

Adult fully matured slugs, Semperula maculata were collected from city garden Paratwada and around Paratwada city, Maharashtra, India from July to September. The temperature of the soil at the time of collection varied generally from 26°C to 28°C. 4gm to 5gm weight were noted and a group of 20-60 slugs were taken. The slugs were brought to the laboratory and were maintained in the glass tough containing sufficient moist soil. Tough was covered by muslin cloth. The slugs were kept to total darkness to eliminate the possible photoperiodic influence. The soil was kept moist by spreading water. They were fed once in a day with plant vegetation. Slugs were acclimated at room temperature (26°C to 28°C) for 3 to 4 days. For acclimation slugs were kept inside the BOD incubator at temperature 32°C ± 0.5°C and 36°C ± 0.5°C for warm acclimation and at temperature 15°C ± 0.5°C and 10°C ± 0.5°C for cold acclimation for 10 days. The slugs were gradually warmed or cooled until the desired acclimatized temperature was reached. After every 2 days the soil in jar was replaced with moist soil already brought up to appropriate acclimation temperature. Concomitantly control slug were maintained similarly by keeping animals at a temperature (26°C to 28°C). Hepatopancreas and foot were dissected out from the slug and total lipid content of control and experimental tissue were estimated by the method Barnes, H. & Black Stock, J. (1973).

III. RESULTS AND DISCUSSION

The total lipid content in hepatopancreas and foot on cold and warm acclimation of the slug, Semperula maculat. Prominent changes are observed in the following Table I and figure 1.

Table I. Changes in the total lipid content of hepatopancreas and foot of the slug, Semperula maculata on cold and warm acclimation (mg/gm wet wt. tissue)

Tissue		Cold acclimation		Warm acclimation	
		15^{O}C	10^{O}C	32^{O}C	36^{O}C
Hepatopancreas	C	11.0 ±1. 0	11.50±1.02	11.00±1.0	11.50±1.02
	E	13.05±1.01**	14.92±0.9**	6.78±0.99*	5.12±1.70*
	% change	(18.63)	(29.73)	(-38.36)	(-55.47)
Foot	C	8.55 ±1.12	9.00±1.2	8.55±1.12	9.00±1.2
	E	9.50 ± 1.09**	11.14±1.10**	5.00±1.01*	3.5±2.00**
	% change	(11.11)	(23.77)	(-41.52)	(-61.11)

C=Control, E=Experimental,*p<0.05, **p<0.01, Values in parenthesis are percent change over control. Values are means + SE of 5 individual observations

The total lipid content in cold acclimated tissue like hepatopancreas and foot was found to be increased. The percent change in total lipid content of hepatopancreas at 15°C and 10°C was 18.63 and 29.73 while percent change in foot at 15OC and 10°C was 11.11 and 23.77. Table I and Fig.1 indicates that as cold acclimation temperature falls to 10°C their total lipid content in hepatopancreas and foot was increased than acclimated at 15°C. In warm acclimation the total lipid content in hepatopancreas and foot was found to be decreased. The percent change in total lipid content of hepatopancreas at 32°C and 36°C was -38.36 and -55.47. While percent change in foot at 32°C and 36°C was -41.52 and -61.11. When animal acclimated to 32°C the total lipid content in both the tissues was observed to be depleted. But their depletion was less as compared to acclimation at 36°C.

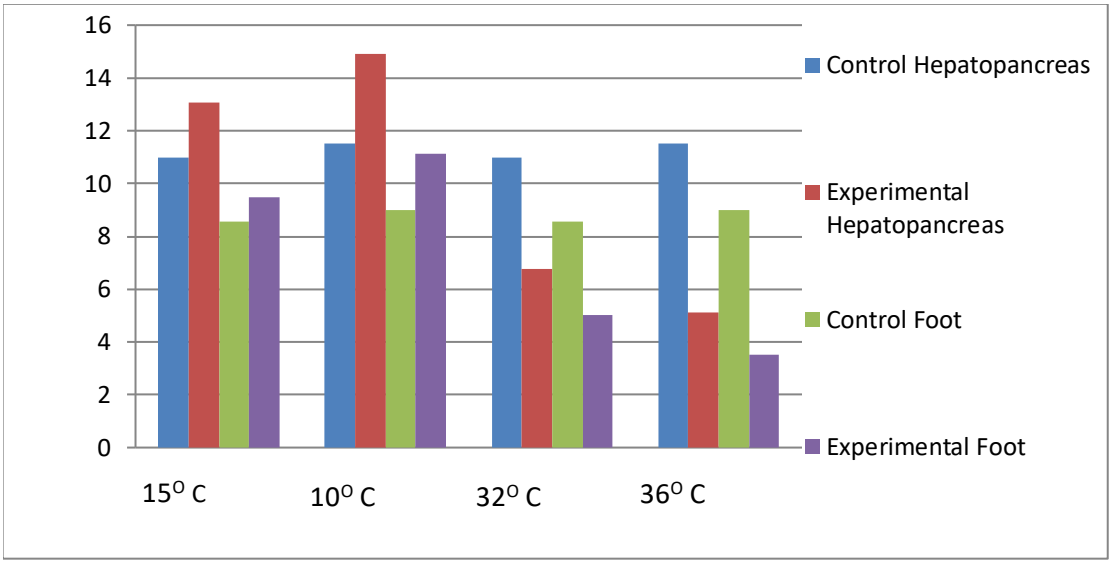

Fig.1 Changes in the total lipid content of hepatopancreas and foot of the slug, Semperula maculata on cold and warm acclimation

Total lipid is the major complex organic constituents of the living organism. Lipid provides rich source of energy to the body. During present study, total lipid content was found to be decreased in warm acclimated slug, Semperula maculata in both the tissues that are hepatopancreas and foot. The change was due to stress condition. More and more lipid was used to counteract the stress. But in cold acclimation (10°C and 15°C) the total lipid content increased because of slow activity of animal. In any animal lipid form the main store of reserve food supply being derived from the carbohydrate and fat diet. It means that under stress condition lipid are utilized for the energy production as an alternative source of carbohydrates. At 20°C and 24°C, the mussels were primarily catabolizing lipids (Bayne & Widdows, 1978). Decrease in fat content with rise in temperature probably due to an elevation in the rate of metabolism Rao et al, (1987) in freshwater bivalve, Indonaia caeraleus; Kulkarni & Baramatiwala (1987) in Bellamya bengalensis. Hawkins (1995) suggested that a reduced temperature dependence of metabolic rate can be selectively advantageous in thermally unstable intertidal environments. L. saxatilis adopted an 'exploitative strategy' that allowed them to utilize resources at a high rate in order to maximize growth and their metabolic rates increase with increasing temperature (Branch et al; 1988). The heat induced metabolic disturbances lead to a progressive discrepancy between energy demand and energy supply. This response is referred to as Homeoviscous adaptation (Hochachka & Somero, 1973,). Lipid synthesis in cold increases. Total lipids lowered since more energy is needed to overcome any stress condition. It might be due to the decrease in glycogen content of the same tissue, which is an immediate source of energy during stress condition. The decrease in the lipid content of tissues indicates the pronounced lipolysis and its utilization during exposure to temperature. Meenakshi (1956); Ansell (1974); Kulkarni (1981) studied changes in lipid content. Changes in biochemical composition of tissues have been reported on other poikilotherms during thermal acclimation (Das and Prosser 1967; Rao, 1967; Das, 1967). It can be safely showed that the neurosecretion centers which undergo alterations following thermal acclimation are implicated in governing the level of the biochemical constituents and possibly other physiological processes (Kale &Rao, 1973). If an animal is kept at the altered temperature for many days its rate function often shows some compensation that is it becomes acclimated. The nature of physiological adaptation of poikilotherms to constant temperature (Prosser, 1955, 1958). If it is now returned to the original temperature the rate function does not returned to the original level but rather to a higher to lower value according to the direction of acclimation (Getz,1959).

CONCLUSION

Higher utilization of total lipid at warm acclimation temperature in hepatopancreas and foot. Catabolism and bioconversion of incorporated total lipid contents in hepatopancreas and foot was lower at cold acclimated (15°C to 10°C) than at warm acclimated (32°C to 36°C) temperatures. Since more energy is needed to mitigate any stress condition, the observed changes in the total lipid contents of the slug, Semperula maculata exposed to different acclimation temperature might be due to the decrease in glycogen content

which in turn shifted to lipids for immediate source of the energy in temperature stress.

On warm acclimation, total lipid contents were decreased whereas on cold acclimation there was increased in the content. This might be because of anabolic activity during cold acclimation. The fall in the organic constituents showed similar trend in both tissues. Since thermal acclimation triggers the significant elevation digression in the different biochemical parameters of the slug, Semperula maculata. The findings of increase or decrease in total lipid from 10°C to 36°C suggests that the slug, Semperula maculata is capable of adapting changes in environmental temperature by modifying contents.

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