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Research Paper

INSECT REPELLENT INDUCED GLYCOGEN DIVERSIONS OF *PERIPLANETA AMERICANA*

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In the present study we investigate the changes of Glycogen content in Cockroach *Periplaneta americana* exposed to insect repellent allethrine. After 4, 8, 12, 16, 20 days the Glycogen content was decreased in both the male and female cockroaches.

Keywords: *Periplaneta americana*, Insect repellent, Allethrine, Glycogen

INTRODUCTION

Pesticide research and development has brought a large number of chemicals in protecting the crop against insect pests. However, these chemicals have posed a grave environmental problem due to their indiscriminate usage in fields (Tillman and Mulrooney, 2000). Insecticides are also toxic to many nontarget organisms (Nath *et al.*, 1997; Suh *et al.*, 2000). Pyrethrum is botanical insecticide which is derived from the flowers of *Chrysanthemum*, primarily from *Chrysanthemum cinerariaefolium*. Pyrethrum is toxic to most of insect pests. Pyrethrum lacks persistence in the field because of its breakdown in sunlight; thus it leaves no harmful residues. It acts almost as a contact poison.

One of the most fundamental criteria to understand stress condition is to study the alteration in the level of different biochemical.

Since these organic cellular component control the formation of intermediate metabolites which are indispensable to all the normal physiological processes. Hence, to study the changes in the levels of glycogen is also a potent approach to assess the toxicity of pyrethroid repellent – “Tortoise”.

Carbohydrates play not only a structural role in every cell, but serve as reservoir of the chemical energy to be increased or decreased according to the organism's needs. Metabolic changes in the insects are generally accompanied in the process of chitin synthesis and energy liberation.

The impairment of carbohydrate metabolism has been observed in the variety of physiological disorders and pathological conditions (Lanter, 1975). This may prove to be negative survival value for the affected organisms. Different

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pesticidal administrations leads to an increase in blood glucose level and decrease in glycogen content was recorded by Swami *et al.* (1983), Patil and Lomte (1989), Chaudhari and Lomte (1992) and Rao *et al.* (1995).

MATERIALS AND METHODS

The cockroaches, *Periplaneta americana* were collected from vicinity of household environment, sewage tunnels and from drainage pipes. During the experiment they were kept in well cages and fed with ground-nut cake and garbage material of vegetables.

The cockroaches were acclimatized to the laboratory condition. They were exposed "Tortoise" (manufactured by Bombay chemicals Ltd.129, M G Road, Mumbai 400 023)-mosquito repellent coil available in the market. The tortoise mosquito repellent has a pyrethroid "Allethrine" (2-allyl-4 hydroxy-3 methyl-2 cyclopentane-1- one ester of chrysanthum monocarboxylic acid) *a.i.* 0.2% w/w as a chemical component. Every day for a period of 2 h, during evening from 7 to 9 o'clock, the smoke was administered in cages containing experimental cockroaches, *Periplaneta americana*. Experimental duration was for 20 days. After 4, 8, 12, 16, and 20 days of exposure period cockroaches were sacrificed and separated into male and female groups, containing at least 20 individuals each. A simultaneous set of male and female cockroaches of same number without toxic smoke exposure was maintained which acts as concurrent control. After sacrificing cockroaches from control and exposure groups, their body parts were isolated and dehydrated in hot air over at 70°C for 3 days and then made into fine powder with the help of mortar and pestle. This

dry powder was subjected to analysis of glycogen. The total glycogen was estimated according to the method of Kemp and Kits (1954). The observations of proteins estimation was confirmed by repeating it atleast for three times. The difference in control and treated values was tested for significance using student's 't' test (Bailey, 1965). The percentage difference was also calculated for each value.

RESULTS

Changes in the carbohydrate metabolism of cockroach, *Periplaneta americana* due to allethrine stress was noted. For studying the effect of allethrine, the smoke was generated by burning of mosquito repellent coil was administered daily for two hours during 7 to 9 o'clock at evening. These results are compared with normal ones and were summarized in Table 1.

Glycogen content was found to be decreased in both the sexes of cockroach, *Periplaneta americana* due to allethrine stress. The glycogen content of the control male cockroach is 23.854 ± 2.19 mg/g dry wt. The maximum decrease was noted after 20 days of exposure (13.174 ± 1.12 mg/g dry wt.) and is 44.77% than the control. Similarly in control females, it was 23.340 ± 2.08 mg/g dry wt. and depleted to its maximum after 20 days of exposure (14.19% ; $P < 0.001$).

DISCUSSION

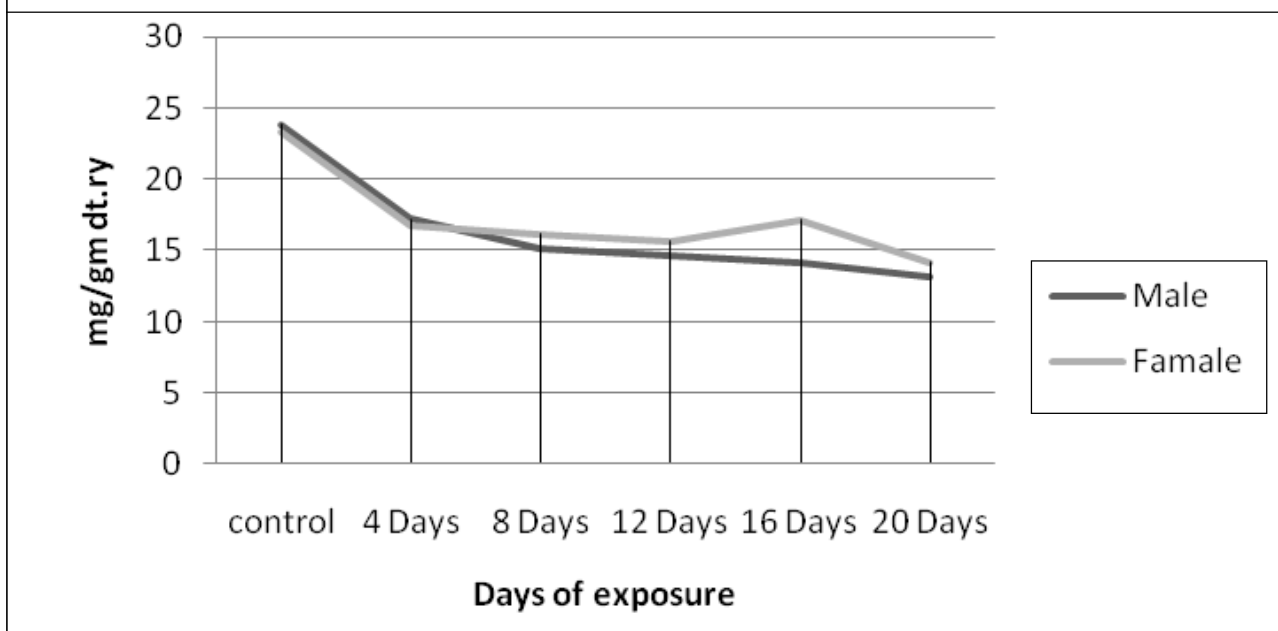
Glycogen is an important nutrient which supplies energy for the different metabolic processes of the body and also during flight in many insect species. It is also utilized for chitinsynthesis and histolysis and histogenesis of insect tissues (Chippendale, 1973). Hence, glycogen is

Table 1: Effect of Allethrine on Glycogen Content of *Periplaneta Americana*

Sex	Control	Periods of Allethrine Exposure				
		4 days	8 days	2 days	16 days	20 days
Male	23.854	17.214	15.211	14.701	14.193	13.174
	± 2.19	± 1.62	± 1.54	± 1.39	± 1.28	± 1.12
	%	-27.83	-36.23	-38.36	-40.49	-44.77
		P<0.001	P<0.001	P<0.001	P<0.001	P<0.001
Female	23.340	16.737	16.228	15.71	17.15	14.193
	± 2.08	± 1.98	± 1.54	± 1.86	± 1.69	± 1.43
	%	-28.28	-30.46	-32.65	-37.73	-39.18
		P<0.001	P<0.001	P<0.001	P<0.001	P<0.001

Note: All the values are expressed in mg/gm dry wt.

Figure 1: Glycogen level (%) of *Periplaneta americana* Exposed to Allethrine After 4, 8, 12, 16, 20 days



considered to be the major source of glycogen reserves is an essential feature of the normal organismal metabolism (Turner and Manchester, 1972). Allethrine stress appeared to cause depletion in the level of the carbohydrate reserves in cockroach, *Periplaneta americana*. Similar

results were found by Suryawanshi Ranjit (2009), in cockroach, *Periplaneta americana*, Sarika Fulpagare, in fresh water snail, *Lymnea accumulata* (2009) and Islam and Roy (1983), in the bug, *Chrysocoris stollii*. This depletion in glycogen level might be due to the stress condition

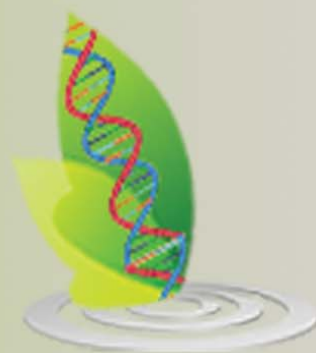
which is known to increase carbohydrates consumption or prevalence of anoxic or hypoxic condition due to pesticidal exposure which may be inferred from decrease rate of cellular respiration (Bhagyalakshmi, 1981) or due to increase in glycogen synthesis (Rao *et al.*, 1995). Besides these reasons, the depletion in glycogen reserves of the repellent exposed cockroaches, *Periplaneta americana* might be due to greater breakdown to contribute the energy liberation to meet the increasing energy demands of the animals undergoing stress condition.

CONCLUSION

Carbohydrate metabolism is mainly involved in energy supply in the animal tissue and also in chitin synthesis. Allethrine stress caused depletion in the level of total carbohydrate reserves along with the inhibition of the activities of amylase and invertase enzymes to some extent. The decreased rate of cellular respiration and glycogen synthesis along with its greater breakdown to meet the increasing energy demand is the reason behind it.

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