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RESEARCH ARTICLE

EFFECT OF ZINC ON HISTOLOGICAL CHANGES IN THE FAT BODY OF THE ADULT MALE *Odontopus varicornis* (HETEROPTERA: PYRRHOCORIDAE) IN RELATION TO REPRODUCTION

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ABSTRACT

The fat body of insect is functioning as a food reservoir and it serve as the precursor for metabolism in other tissues. It has derived from the mesoderm walls of coelomic cavities. The fat body of *Odontopus varicornis* is transparent yellow colored mass. The fat body contains three types of cells namely trophocyte, urocyte and mycetocyte. The fat body showed some marked changes in insects exposed to zinc. The vacuoles of trophocytes are disintegrated. swollen and irregular shaped nuclei are conspicuous. Mycetocytes are decreased in size. Urocytes are mostly disintegrated.

INTRODUCTION

The fat body of insects serves as the storage organ, lipid, glycogen and protein are deposited in the fat bodies (Chapman, 1972). The insect fat body is responsible for a wide range of activities; such as the metabolism of carbohydrates, lipids and nitrogenous compounds (Kilby, 1963; Wyatt and Pan, 1978; Wyatt, 1980). Fat body is the most conspicuous organ of the hemocoel, filling the space between the other organs of prime importance such as gonads, muscle fibers and trachea (Nair and Karnavar, 1966; De Loof and Lagasse, 1970) Locke (1984) and Dean et al. (1985) have reported that the nuclei of the fat body cells are spherical or oval but latter often become ribbon shaped structure. The effect of toxic materials and insecticides on fat body was observed in various insects such as *Odontopus varicornis* (Jayakumar, 1988); *Aspongopus janus* (Thiruvasagam, 1994) and *Periplaneta americana* (Ramanathan, *et al.,* 1997) and (Prakash, 1990). These findings led to investigate the effect of heavy metal zinc on the fat body of *Odontopus varicornis.*

MATERIALS AND METHODS

The adult control and treated *Odontopus varicornis* were kept separately after 48 hours, they were dissected under binocular microscope by using Ringer solution (Emphrussi and Beadle, 1936). The Ringer was subsequently removed and the tissue was fixed in Bouin's fluid for 24 hour. Later, the tissue was processed by adopting standard histological techniques (Gurr, 1958). The nuclear volume and diameter of fat body were calculated using a compound microscope fixed with a range of stage micrometer and an ocular micrometer. Statistical calculations were done according to Rao (1952) and Student's 't' tests were applied.

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RESULTS AND DISCUSSION

The fat body tissues of *Odontopus varicornis* occur as a transparent yellow mass of cells. The fat body is enclosed in a membranous sheath and loosely suspended in the hemolymph. There are two types of fat bodies, parietal fat body is located below the integument and the visceral fat body is situated around the digestive and reproductive systems. The structure of the fat body is appear to be ribbon shaped.

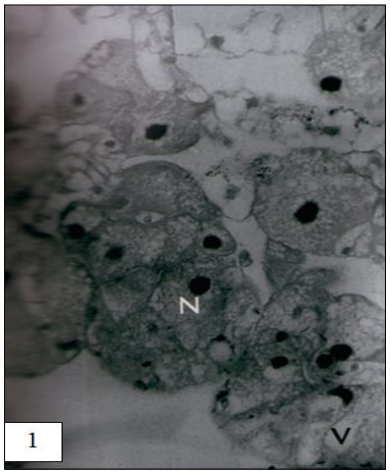
Fat body contains three types of cells. The first type is the trophocyte and it functions as a storage organ. The second type is the urocyte with large membrane bound vacuoles with uric acid. The third type is the mycetotype with intercellular symbiotic microorganisms. The cytoplasm of the trophocyte is intensely stained with eosin and exhibits more granular organization. Cytoplasmic vacuoles and cell boundaries are distinct in some trophocytes of fat body (Figs 1 and 2). The fat body of metal treated insect shows the presence of many vacuoles in the cytoplasm and less granular stored nutritive substance in the trophocytes. The nuclei are less intensely stained with hematoxylin and found to be disintegrated. The nuclei appear to be enlarged when compared to the control insects (Figs. 3 and 4). The nuclear diameter and nuclear volume of fat body are decreased in the treated insects than in the control insects by about 0.055 ± 0.016 to 0.040 ± 0.0011 and 62.56 ± 0.041 to 29.09 ± 0.0130 mm. The nuclear diameter and the nuclear volume of small ovoid secretary cells of treated insects show atrophy (Table 1).

The cells of the fat body have distinct cytoplasmic vacuoles and nutrient substances such as lipids, proteins and glycogen as it has been reported for the fat body cells of *Gryllotalpa africana* and *Periplaneta americana* (Cochran *et al.,* 1979).

Table 1 Cytometric data of the fat body and small avoid secretory cells of adult male in *Odontopus varicornis* treated with heavy metal zinc

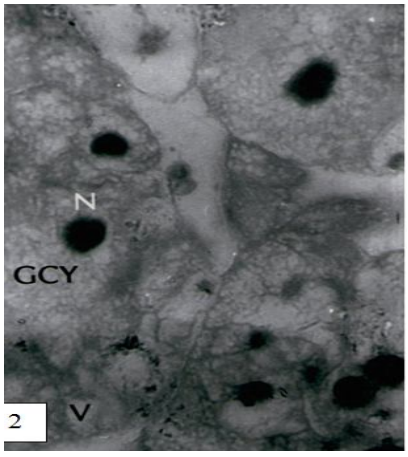
Tissue	Aspects	Control	Treated
Fat body	Nuclear diameter (mm)	0.055 ± 0.016	0.040 ± 0.0011
Fat body	Nuclear volume (mm^3)	62.56 ± 0.041	29.09 ± 0.0130
Small ovoid secretory cells	Nuclear diameter (mm)	209.56 ± 5.4092	Cell atrophy
Small ovoid secretory cells	Nuclear volume (mm^3)	209.56 ± 5.4092	Cell atrophy

The fat body of treated insects showed the presence of many vacuoles in the cytoplasm with less granular stored nutritive substance in the trophocytes. In *Rhodinus prolixus,* the occurrence of cytoplasmic vacuoles and food reserves in the fat body was reported by Wigglesworth (Wigglesworth, 1967) during feeding than prolonged starvation.



V – Vacoules, N – Nucleus

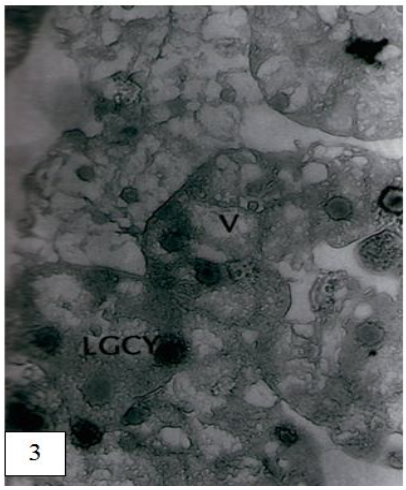
Fig. 1 Transverse section of the fat body of control insect showing trophocytes XCa 200



GCY– Granular cytoplasm, V-Vacuoles, N – Nucleus

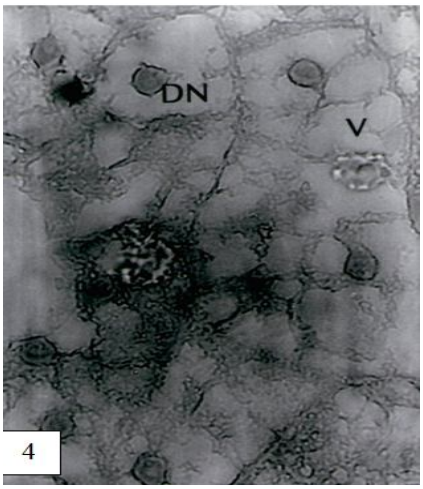
Fig. 2 Transverse section of the fat body of control insect showing trophocytes XCa 40

In general lyses of nuclei and cytoplasm in the fat body cells have been reported in *Pediculus humanus* when treated with carbon tetrachloride (Hopp, 1953). Pyrethrum treated fat body cells showed nuclear pycnosis in *Corethra plumicornis* (Hartzell and Scudder, 1942). Complete cell damage, cell lyses and an increased cytoplasmic vacuolization are some of the important changes reported after 48 hour of treatment with dimethoate in the fat body cells of *Odontopus varicornis* (Jayakumar, 1988), *Pheropsophus hilaris* (Rajasekara Pandian *et al.*, 1993) exposed to dimethoate, and *Gryllotalpa africana* (Sumathi *et al.,* 2001) exposed to endosulfan.



LGCY- Less granular cytoplasm, V - Vacuoles

Fig. 3 Transverse section of the fat body of treated insect showing trophocytes XCa 20



DN - Disintegrated nucleus, V - Vacuoles

Fig. 4 Transverse section of the fat body of treated insect showing trophocytes XCa 40

Radhika (1992) also observed similar changes in the fat bodies of *Gryllotalpa africana* after 120 hour of injection with monocrotophos. The nucleus of the fat body cells was found to increase in *Aspongopus janus* when treated with nimbecilin (Thiruvasagam, 1994) and *Periplaneta americana* treated with *Pongamia glabra* leaf extract (Ramanathan, 1995). The boundary of the fat body cells of *Aspongopus janus* was found to be distorted when treated with dimethoate (Kennadi, 1993).

Treatment with methoprene also caused an increased nuclear size in the fat body cells of *Locusta migratoria* (Cotton and Anstee, 1991).

The present investigation shows that the size of the nucleus of the fat body cells increased in the zinc treated insects indicating generally highly physiological activity of fat body cells to synthesize nutritive substance when the animal is under metal stress. This observation is in consistent with the works of Jayakumar (1988) in *Odontopus varicornis*, Balakrishnan (Balakrishnan, 1990) in *Pheropsophus lissoderus*, Thiruvasagam (1994) in *Aspongopus janus*, Ramanathan (1995) in *Periplaneta americana* and Sumathi *et al.* (2001) in *Gryllotalpa africana.*

Evidently, heavy metal zinc has potential effect to induce histopathological changes similar to those produced by other chemicals such as carbon tetrachloride, pyrethrum, dimethoate, phosphamidan, nimbecilin and *Pongamia glabra* leaf extract. Further, the action of zinc appears to be direct, as evidenced by the occurrence of histopathological changes in the fat body of *Odontopus varicornis.*

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