Asian Journal of Bio Science, **Vol. 3 No. 2 : 304-307 (October, 2008)**

Impact of heavy metal mercury on the ovary of adult female *Odontopus varicornis* (Dist.) (Hemiptera : Pyrrhocoridae)

T. RAMESH KUMAR*, D. MERIN EMERALD AND SELVISABHANAYAKAM
Department of Zoology, Annamalai University, ANNAMALAINAGAR (T.N.) INDIA

(Accepted : August, 2008)

The female reproductive system of the adult female *Odontopus varicornis* is composed of two ovaries, each consists of five telotrophic type of ovarioles. The ovary during fully mature turn into yellow in colour due to heavy accumulation of yolk spheres in the terminal oocytes. Telotrophic ovarioles contain a single usually huge cluster of germ cells. The cluster consists of several oocytes that are linked to a common, ovarioles located, trophic compartment, usually including numerous trophocytes. The ovary showed some remarkable changes in the insects treated with sublethal concentration of mercury (25 ppm for 48 h). In treated insects the *Tunica propria* and other epithelial sheath of the terminal filament exhibited disintegration of oogonial cells, nutritive cord, trophocytes and cytoplasmic vacuolization.

Key words : *Odontopus varicornis*, Oogonial cells, Nutritive cord, Trophocytes.

INTRODUCTION

Insect ovaries are composed of several ovarian tubules termed ovarioles, the classification of the ovary type is essentially based on the general architecture of the ovariole but most of all on the analysis of the ultimate fate of the developing germ cells (King and Devine, 1958; Bunning, 1994). The panoistic ovarioles all germ cells can become oocytes and consequently egg cells. In meroistic ovaries divisions of cells are followed by incomplete ctokineses so that cluster (clones) of sibling cells (cystocytes) are formed. The cystocytes within the cluster remain connected by intercellular bridges forming a specialized syncytium. Nevertheless their forming germ cells do not share a common fate but become diversified into oocytes and nurse cells (trophocytes). The trophocytes are usually polyploidy and synthetically active. Their primary function is to supply the growing oocytes with various macromolecules (mainly RNPs). Within meroistic ovaries, two basic categories have been distinguished, polytrophic and telotrophic. In polytrophic ovaries, each ovariole houses several distinct clusters that together with their somatic follicular coverings form separate functional subunits, termed egg chambers. Within each egg chamber only one oocytes develops, being connected with a group of its own nurse cells. Telotrophic ovarioles contain in a single usually huge, cluster of germ cells. The cluster consists of several oocytes that are linked to a common, anteriorly located, trophic compartment (tropharium), usually including numerous trophocytes.

A great deal of work has been undertaken to understand the structural organization of insect ovaries. This includes the investigation of Rajender (1984), Sarnal (1982), Dhanam (1984), Kalavathy (1988), Nagappan (1989) and Rajasekara Pandian (1994) on Panoistic ovaries, King and Devine (1958), Ramalingam (1971) and Matsuzaki (1978) on polytrophic ovaries and Teresa Szklarzewioz *et al.* (1992) on telotrophic ovaries of insects.These studies have elucidated the histoarchitecture of ovarian tissues, the role of follicle cells, nurse cells and oocytes in vitellogenesis and the neuroendocrine regulation of ovarian development. Several studies had been undertaken to understand the histopathological changes in different tissues of insects due to treatment with toxicant such as endosulfan (Sabesan and Ramalingam, 1979), malathion (Kabeer Ahmad Sahib *et al.*, 1980), monocrotophos and bendiocarb (Rajender, 1984, 1986 a), sevin (Khillare and Wagh, 1989) and endosulfan (Sumathi *et al.*, 2001). The observation led to investigate the effect of heavy metal mercury on the ovary of adult female *Odontopus vacicornis*.

MATERIALS AND METHODS

The adult control and treated *O. varicornis* were kept separately after 48 hours, they were dissected under binocular microscope by using Ringer solution (Ephrussi 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).

* Author for correspondence.

RESULTS AND DISCUSSION

The female reproductive system of the adult *O. varicornis* is composed of two ovaries, each consist of five telotrphic type of ovarioles. The two lateral oviducts leading from each ovary unite to form the median common oviduct. The common oviduct runs backwards and open to the exterior behind the 8th sternum. There is a spermatheca attached at the posterior part of the common oviduct. The terminal filament represents the first zone of the ovariole. It is long thread like structure with a broad base and a tapering tip. A transverse septum separates it from the germarium. It is double membraned structure with an inner membrane of tunica propria and an outer epithelial sheath. Anteriorly; the terminal filaments of all ovarioles of the ovary are connected together to form a suspensory ligament which is attached with the dorsal region of the first abdominal segment. The terminal filament is followed by the germarium in the anterior most part of the ovariole (Fig. 1). The germarium is composed of oogonial cells and the cells of the trophic tissue. It has a central core of cytoplasm surrounded by densely packed cells of the trophic tissue, the trophocytes.

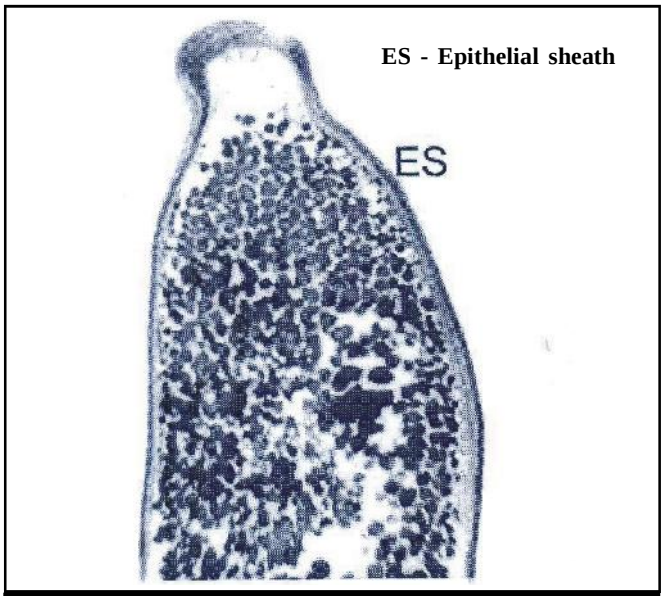
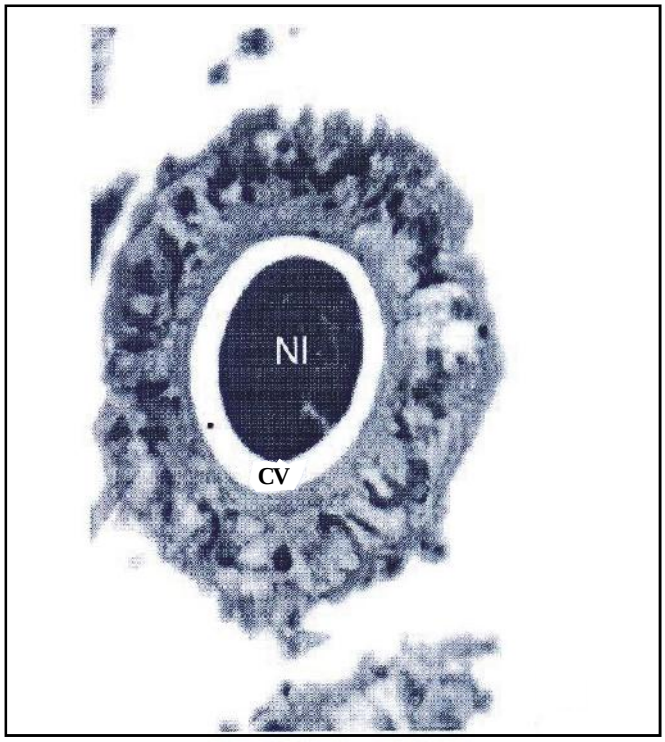


Fig. 1 : Longitudinal section of the anterior

The developing oocytes are oval shaped each with a deeply stained nucleus surrounded by ooplasm. The nucleus is spherical shaped with a distinct nuclear membrane (Fig. 2). A thin vitelline membrane is present below the developing oocyte and the follicular epithelial layer. At the posterior end of the vitellarium is a basal plug which disintegrates before the discharge of the



NI - Nucleus CV - Cytoplasmic vaculoes

Fig. 2 : Cross section of the terminal oocyte of control insect

oocytes.

In sublethal concentration at 48 hours of exposure, the tunica propria and outer epithelial sheath of the terminal filament showed disintegration of oogonial cells, degeneration of nutritive cord, trophocytes and cytoplasmic vacuolization (Fig. 3, 4, 5 and 6). Certain empty spaces between oocytes and follicular epithelium were observed. Disintegration of follicular epithelial cells and folded follicular epithelium and degeneration of interfollicular plug.

The histological findings on the general organization of the ovary of *Odontopus varicornis* have shown that it belongs to telotrophic type and is similar to that of *O. varicornis* (Saradha, 1985), *Chrysocoris purpureus* (Madhavan, 1964) and *Belostoma indicum* (Kaushik, 1970). The ovarian tissues of *Laccotrephes ruber* show the remarkable histopathological changes such as disintegration of oogonial cells, degeneration of nutritive cord, trophocytes and cytoplasmic vacuolization.

The degenerative effect has also been noticed in the interfollicular plugs. In addition to these changes, oocytes are seen to have fused with each other to form a mass of cells when treated with sublethal concentration for 48 hours of duration. Thus, Saradha (1985) has reported the trophic core and nutritive cords have been damaged due to treatment with the pesticide dimethoate

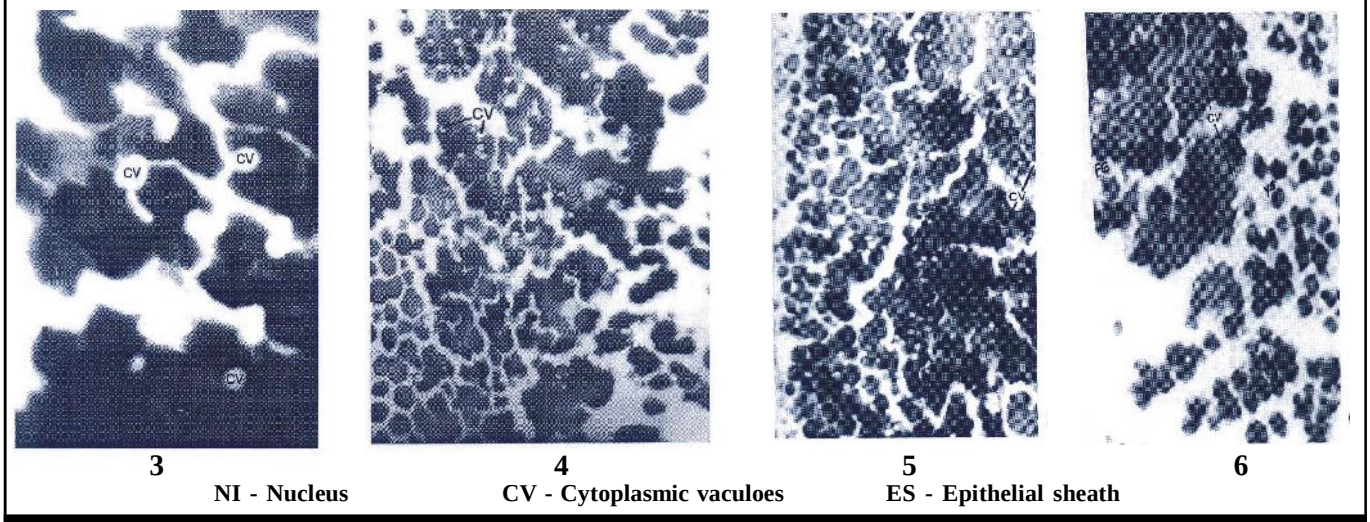


Fig. 3, 4, 5 and 6. Longitudinal section of ovary of treated insect

in *Odontopus varicornis*. This degenerative change of the follicular epithelium due to treatment with the chemosterilant tepa and the chemical substance calcium chloride has been reported for *Locusta migratoria* (Nath and Sharma, 1977). Several other studies have revealed the occurrence of this histopathological changes in different insects such as *Cadea cantella* exposed to 2 per cent apholate (Gangrade and Pant, 1970), *Poekilocerus pictus* exposed to dimethoate (Saradha, 1985) and *Gryllotalpa africana* exposed to monocrotophos (Rathika, 1992).

Further, it has been shown in *O. varicornis* that the cytoplasmic organizations of oocytes have been affected by the formation of vacuoles of different sizes (Fig. 5 and 6). Insects treated with sublethal concentrations for 48 hours of duration also exhibit signs of cytoplasmic vacuoles in oogonial cells and follicle cells. Thus, the formation of cytoplasmic vacuoles has been reported for the ovary of *Gryllotalpa africana* exposed to monocrotophos (Rathika, 1992), *Odontophs varicornis* exposed to monocrotophos and *Cadea cantella* exposed to 2 per cent apholate for 48 hours (Gangrade and Pant, 1970).

Thus, similar histopathological changes have been reported to occur in the ovary of *Musca domestica* exposed to sodium oxide solution (Thakur and Mann, 1982) and *O. varicornis* exposed to dimethoate (Saradha, 1985). Other toxicants such as SAN 322 and DDVP have also produced similar changes in the germarium of *Mylabris pustulata* (Sanjeewani *et al.*, 1988). Nakayama (1977) has observed drastic reduction in the size of oocytes in *Callosobechus chinensis* treated with metapa and hempa, as in the case of *O. varicornis* treated with dimethoate (Saradha, 1985), *Gryllotalpa africana* exposed to monocrotophos (Rathika, 1992); *Dysdercus koenigii* exposed to x-irradiation (Srivastava and Despande, 1983). Thus, the heavy metal mercury exerted its action directly on ovarian tissues reducing drastically the reproductive potentials of *O. varicornis*.

REFERENCES

Bunning, J. (1994). The insect ovary. Ultrastructure, Previtellogenic growth and evolution, Chapman & Hall, London.

Bunning, J. (1998). The ovariole : Structure, type and phylogeny. In : Locke, M., Harrison, H. (Eds.) : *Microscopic Anatomy of Invertebrates*. Viley - Liss, New York, **lc** : 897-932.

Dhanam, M. (1984). Studies on histomorphology of ovary and the effect of juvenile hormone analogue hydropyrene on ovarian tissues in the rice weevil, *Sitophilus oryzae*. M.Phil. Thesis, Annamalai University.

Ephrussi, B. and Beadle, G.W. (1936). A technique of transplantation for *Drosophila. Amer. Nat.*, **70** : 218-225.

Gangrade, G.A. and Pant, N.C. (1970). Effect of apholate on reproductive organs of almond moth, *Cadra cantella* (Walker) (Lepidoptera: Phycitidae). *Indian J Ent.*, **32** (2) : 134-139.

Gurr, E. (1958). *Methods of analytical and histochemistry*. Leonard Hill (Books) Letd., London.

Kabeer Ahamad Sahib, I., Swami, K.S. and Raman Rao (1980). Regulation of GDH, ammonia and free amino acids in the tissues of the teleost *Tilapia mossambica* (Peters). Consequent to sublethal malathion exposure. A time course study. *Curro Sci.*, **49** : 779-782.

Kalavathy, S. (1988). Studies on histological changes of ovary, fat body and yolk synthesis during ovarian development in *Gryllotalpa africana* (Palisot de Beauvois) (Orthoptera:Gryllotalpidae). M. Phil. Thesis, Annamalai University.

Kaushik, S.C. (1970). Anatomy and histology of the male and female internal reproductive organs of the gaint water bug *Belostma indicum*. Lep & Servo (Heteroptera : Belostomatidae). *Bull. Ent.*, **11** (2) : 169-180.

Khillare, Y.K. and Wagh, S.B. (1985). The origin and functioning of insect oocytes and nurse cells. In : Kerkut, G.A., Gilbert, L.1. (Ed.) : *Comprehensive insect physiology, Biochemistry and Pharmacology,* Pergamon Press, Oxford, **1**: 37-82.

King, R.C. and Devine, R.L. (1958). Oogenesis in adult *Drosophila melanogaster* VII. The submicroscopic morphology of the ovary. *Growth*, **22** : 299-326.

Madhavan, K. (1964). Studies on the corpus allatum and ovary in *Chrysocoris purpureus* (Westw). Ph.D. Thesis, Annamalai University.

Matsuzaki, M. (1978). Developing ovarian follicles during early oogenesis in the adult green lacewing *Chrysopa septempuntata* Wesmael (Neuroptex : Chrysopidae). *Ann. Zoo. Japan*, **51**: 222-235.

Nagappan, P.R. (1989). Studies on neuroendocrine reproductive physiology in the adult female, *Thermobia domestica* (Pack). Ph.D. Thesis, Annamalai University.

Nath, V. and Sharma, G.P. (1977). Effects of cadmium chloride on the glands of *Locusta migratoria*. U.S. PL 480 Research Project A 7-ENT-117.

Rajasekara Pandian, M. (1994). Histological, histochemical and biochemical studies during oocytes development in the adult *Pheropsophus hilaris* (Fabr.) (Coleoptrea: Carabidae). Ph.D. Thesis, Annamalai University.

Rajender, K. (1984). Effect of heavy metals on the esterase pattern in haemolymph and nervous tissue of *Periplaneta americana. Bull. Pure Appl. Sci.*, **3A** (2) : 92-95.

Rajender, K. (1986a). Effect of certain insecticides on the electrophoretic mobility pattern of haemolymph and nervous tissue proteins of cockroach, *Periplaneta americana*. *Indian J. Com. Anim. Physio.*, **4** (1) : 25-28.

Ramalingam, N. (1971). Studies on ovarian development and neuroendocrine system in *Chrysomia megacephala* (Fabr.). Ph.D. Thesis, Annamalai University.

Rathika, S. (1992). Influence of organophosphorus pesticide monocrotophos, on testis, ovary and fat body in *Gryllotalpa africana* (Pa1isot de Beauvtoris) (Orthoptera : Gryllota1pidae). MPhil. Thesis, Annama1ai University.

Sabesan, S. and Rama1ingam, N. (1979). Effect of endosunfan on the median neurosecretory cells of adult male *Odontopus varicornis* (Dist). *Entomon.*, **4** : 223-227.

Sarna1, M.M. (1982). Histopathological studies on the acrotrophic ovary and neurodocrine system *Serinetha angur* (Fabr.) (Heteroptera : Coreidae). Ph.D. Thesis, Annama1ai University.

Saradha, T. (1985). Studies on the effects of the insecitide dimethoate on ovarian tissues in *Odontopus varicornis* (Dist.) (Hemiptera: Pyrrocoridae). MPhil. Thesis, Annamalai University.

Srivastava, K.P. and Deshpande, D.I. (1983). Histopathological effects of x-irradiation on the ovaries of the red cotton bug, *Dystercus koenigii* Fabr. (Heteroptera : Pyrrhocorridae). *Entomon.*, **10** (2) : 145-149.

Sumathi, S., Selvisahanayakam and Mathivanan, V. (2001). Effect of endosulfan on histological changes in the fat body of adult male, *Gryllotalpa africana* (Orthoptera: Gryllotalpidae). *Indian J. Environ. & Ecoplan*, **5** (2) : 261-264.

Terasa Szklarzewioz, Ewa Szelendak, Boczek, Jan and Bilinski, Szczepan (1992). Oogenesis in the lesser grain bores, *Rhizopertha dominica* Fabr. (Coleoptera: Bostrichidae). *Int. J. Insect Morpho. Embryol.*, **21** : 63-76.

Thakur, N.J. and Mann, S.K. (1982). Morphological and histological study of reproductive organs of normal and sodium azide treated *Mosca domestica* L. *Indian J. Eng.*, **44** (3) : 219 - 224.