



STUDIES ON THE CYTOLOGICAL CHANGES IN THE VITELLOGENIC STAGES OF OOGENESIS IN THE DEVELOPING OVARY OF OTHREIS MATERNA (LEPIDOPTERA: NOCTUIDAE)

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Abstract:

In *Othreis materna*, vitellogenesis commences just after emergence of the moth and terminates in the seven day old moth. During vitellogenesis the developing oocytes showed marked changes in their shape, size and cytological organization. Developmental of terminal oocytes has been divided into five stages: the pre-vitellogenic, the early vitellogenic, the vitellogenic, the late vitellogenic and maturation stage. Day wise histological and cytological changes in the nurse cells, follicular epithelial cells and the size of terminal oocyte follicle have been studied. The average length and width of terminal oocyte follicles of last day pupa to seventh day old adult female were ranged from 142.10 ± 2.3 to 621.20 ± 6.9 μm and 110.60 ± 0.82 to 633.00 ± 2.9 μm , respectively. Weight of the ovary during the process of vitellogenesis was found to be $91.00 \pm 2.0\text{mg}$ in last day of pupa to 374.00 ± 11.7 mg in seventh day old female moth.

Keywords: Fruit Piercing Moths, Genus *Othreis*, oocyte development, vitellogenesis

Introduction:

The fruit piercing moths of Genus *Othreis* (*Eudocima*) have attained great importance amongst Noctuidae because of their notorious habits. They are serious pests of fruit crops throughout tropical and subtropical belt from Africa to Southeast Asia and Australia to the Pacific Islands (Bänziger, 1982; Waterhouse and Norris, 1987). The anatomical organization, morphology and histology of female reproductive system of adult lepidopteran insects have been described in a number of species (Buntin and Pedigo, 1983; Lingren et al., 1987; Yel and Eren, 2000). The oocyte development and vitellogenesis are also studied well by various researchers (Kawooya et al., 1986; Santos and Gregoria, 2000 and Xinquan et al., 2004). No attempt has been made to study the histological changes occurring in the developing oocytes of fruit sucking moth *Othreis materna*.

Material and Methods:

Adult fruit-sucking moths of *Othreis materna* were collected at night from the citrus orchards of different places of Vidarbha region of Maharashtra state with the help of hand nets. The laboratory culture was maintained at room temperature (22-24°C) and relative humidity (60-65%). Adults were kept in specially prepared cages provided with fine wire nets from the sides. The adult moths were fed with ripen oranges (when available) or 10% sucrose solution and honey mixture (3:1). For rearing of the larvae, plastic trays were used. The adult females developed from pupae were separated from the males on the basis of broad abdomen. The female reproductive system was dissected

out on every day since emergence till the control moths undergo oviposition, i.e. Seventh day. The ovaries were fixed in aqueous Bouin's fluid for 18 – 24 hours, washed, dehydrated, cleared in xylene and embedded in paraffin wax (600c). Sections were cut at 4 μm thickness and stained with either Haematoxylin-Eosin or Iron-Haematoxylin staining techniques (Humason, 1962). Histological sections were examined by Labomed Digi-3 compound microscope.

Result and Discussion

The process of oogenesis is often evident in the terminal oocyte of the ovariole of the ovary of insect (Figure. 1). During vitellogenesis the developing oocytes show marked changes in their shape, size and cytological organization. Vitellogenesis takes place through five consecutive vitellogenic stages; pre-vitellogenic, early vitellogenic, vitellogenic, late vitellogenic and maturation. The terminal oocyte follicle of eight day old pupa consist of a group of seven nurse cells dorsally and an oocyte ventrally (Figure. 2A). The oocyte bears a centrally placed large germinal vesicle. The terminal oocyte follicle of last day pupa measures about 142.10 ± 2.3 and 110.60 ± 0.82 μm in length and width respectively. The ovaries of last day old pupa weigh about 91.00 ± 2.0 mg. The terminal oocyte gradually enlarges in size from one day old female to seven day old female. The terminal follicles of first day to seven day old females measures about 181.50 ± 3.9 , 283.30 ± 3.6 , 458.20 ± 3.9 , 489.90 ± 6.9 , 523.70 ± 5.7 , 574.30 ± 2.9 , 621.20 ± 6.9 μm and 158.00 ± 1.50 , 242.40 ± 1.30 , 331.80 ± 2.80 , 401.00 ± 2.10 , 454.40 ± 2.10 , 563.00

$\bar{A} \pm 2.50$, $633.00 \bar{A} \pm 2.90$ $\bar{I} \frac{1}{4}m$ in length and width respectively (Figure. 3). The ovaries of the first day old female to seven day old females weigh about $123.00 \bar{A} \pm 2.0$, $154.30 \bar{A} \pm 5.4$, $181.70 \bar{A} \pm 7.9$, $235.20 \bar{A} \pm 5.6$, $283.10 \bar{A} \pm 4.8$, $324.60 \bar{A} \pm 5.7$, and $374.60 \bar{A} \pm 5.4$ mg respectively (Figure. 4). During early vitellogenic stage the follicular epithelium of *Othreis materna* showed mitotic activity, but in later stages this was not evident, the follicular epithelial cells are columnar up to first five days. In sixth day old adult terminal oocytes showed columnar epithelial cells over the oocyte and cuboidal over the nurse cells. In maturation stage these cells decreased in height but increased in width (Figs. 2B to 2I), similar changes in the follicular epithelium were also

described in *D. melanogaster* (King and Koch, 1963), *Musca domestica* (Adams, 1972), *L. exigua* (Khurad and Thakare, 1980). The follicular epithelial cells in *Othreis materna* remained uninucleate in all stages as reported in *Glossina austeni* (Huebner et al., 1975). The growth of oocytes is due to transfer of the cytoplasmic contents from the nurse cells via ring canals to the oocytes. Thus, the nurse cells strongly support oocyte development by contributing cytoplasmic contents (King and Koch, 1963; Yamauchi et al., 1981; Minkenberg, 1985 and Younes et al., 2009). The vitelline membrane and chorion formation in *Othreis materna* takes place in the maturation stage similar to *Cecropia* moth (Anderson and telfer, 1969).

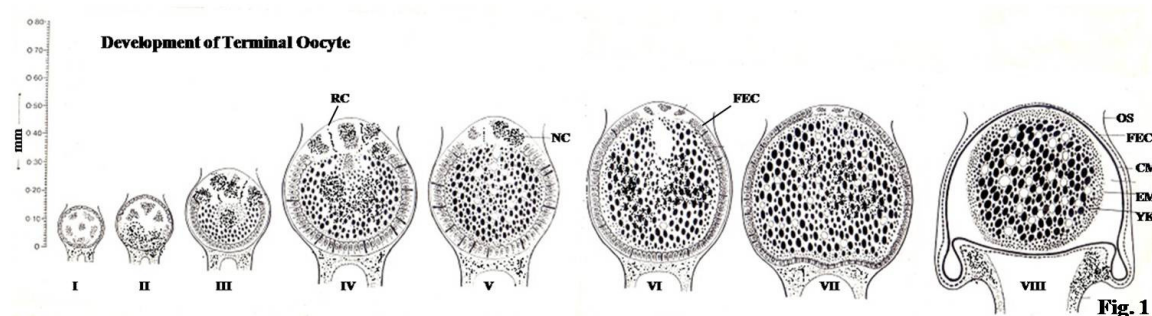


Figure.1. Diagrammatic representation of day-wise development of terminal oocyte follicle CM- Chorion Membrane, EM- Egg Membrane, FEC- Follicular Epithelial Cells, NC- Nurse Cell, OS- Peritonal Sheath, RC- Ring Canal, YK- Yolk.

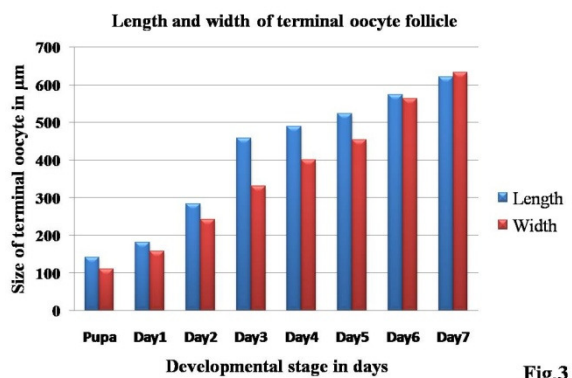


Fig.3

Figure. 3. Length and width of day-wise developing terminal oocyte follicle

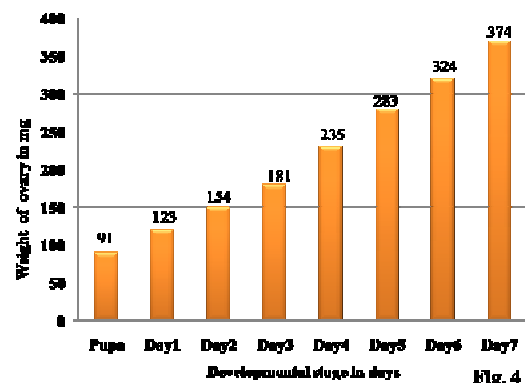


Fig. 4

Figure. 4. Weight of ovary of day-wise developing stages of female moth

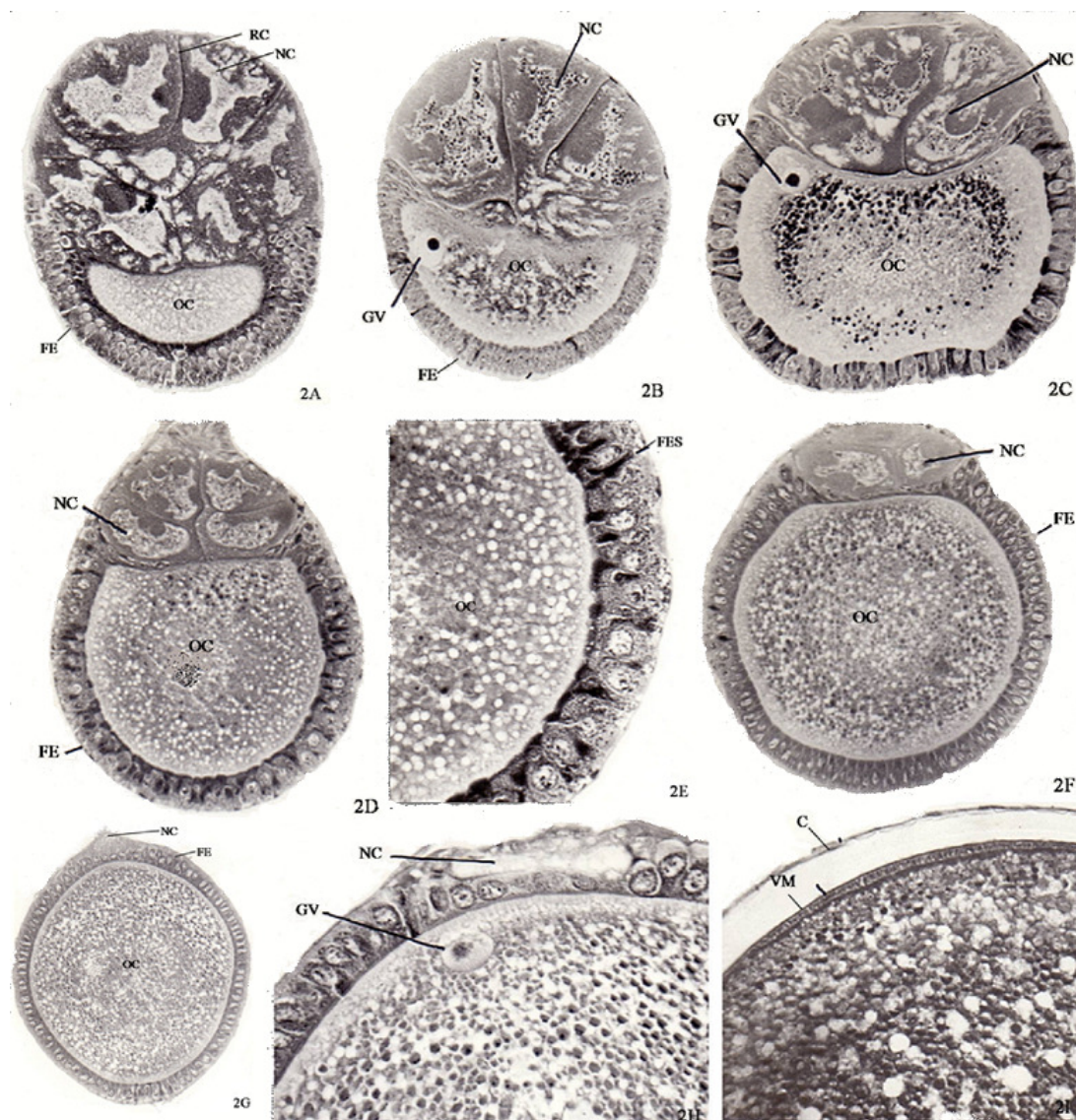


Figure. 2A-2I. Photomicrographs of developing terminal oocyte follicles. (2A) Photomicrograph of pre-vitellogenic oocyte follicle showing large nurse cells and double layer of follicular epithelial cells. (2B) Photomicrograph of early-vitellogenic oocyte follicle showing large nurse cells, double layer of follicular epithelial cells and germinal vesicle. (2C, 2D & 2E) Photomicrographs of mid-vitellogenic oocyte follicle showing equal size of nurse cells and oocyte, columnar follicular epithelial cells. (2F, 2G & 2H) Photomicrographs of vitellogenic oocyte follicle showing reduced nurse cells and large oocyte, columnar followed by cuboidal follicular epithelial cells. (2I) Photomicrograph of maturation stage oocyte follicle showing complete degeneration of nurse cells and formation of chorion membrane. C- Chorion, EM- Egg Membrane, FE- Follicular Epithelium, FES- Follicular Epithelial Space, GV- Germinal Vesicle, NC- Nurse Cell, OC-Oocyte, RC- Ring Canal, VM- Vitelline Membrane, YK- Yolk.

Figures legends

Figure.1. Diagrammatic representation of day-wise development of terminal oocyte follicle CM- Chorion Membrane, EM- Egg Membrane, FEC- Follicular Epithelial Cells, NC- Nurse Cell, OS- Peritoneal Sheath, RC- Ring Canal, YK- Yolk.

Figure. 2A-2I. Photomicrographs

Conclusion:

Histological observations of developing oocytes in *Othreis materna* reveal that the first vitellogenic cycle exhibits pre vitellogenic period in which oocytes are not clearly differentiated while, one and two day old terminal oocytes exhibit early vitellogenic stage in which the nurse cells and an oocytes grow equally. The

accumulation of yolk material occurs during vitellogenic and late vitellogenic stages, when oocytes grow faster and become full of yolk globules. The fast growth of the oocyte during this stage may be due to transfer of cytoplasmic contents from the degenerating nurse cells via ring canals to the oocytes.

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