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MATURATION OF OOCYTES AND VITELLOGENESIS DURING THE DEVELOPMENT OF OVARY IN THE HOUSE CRICKET *GRYLLODES SIGILLATUS* (WALKER) ORTHOPTERA : GRYLLIDAE)

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SUMMARY

In *G. sigillatus*, the ovaries are panoistic type in which the ovarioles exhibit a progressive increase in dimension as the development proceeds. The yolk deposition was found to commence on the 4th day of adult emergence in the basal oocyte which attained a fully mature stage on day 8. During this process, considerable changes were observed in both the oocytes and the follicular cells from the second day of female adult emergence. In the earlier adult instars, yolk spheres appeared in the cortical region of the ooplasm and large yolk spheres in the central region during vitellogenic phase. At the time of vitellogenesis, the follicular epithelial cells of the basal oocytes were tall and columnar with intercellular spaces. As the vitellogenesis progressed, the cells became cuboidal and the oocytes developed vitelline membrane and chorion. The present study also reveals that vitellogenesis in *Gryllodes sigillatus* occurs both in the penultimate and basal oocytes simultaneously.

Key words : *Gryllodes sigillatus*; Oocyte maturation; Vitellogenesis.

INTRODUCTION

The aspects of oogenesis, ovarian growth, site of yolk synthesis for the growing oocytes and mode of uptake of yolk precursors from the site of origin are available for cockroaches, grasshoppers and dragon flies (1-6) and not for house crickets. The ovarian development with reference to oogenesis and vitellogenesis has been described only in the field cricket *Plebeiogryllus guttiventris* (7). Therefore, an attempt has been made to study the maturation of oocytes and vitellogenesis in the ovary of female house cricket, *Gryllodes sigillatus*.

MATERIALS AND METHODS

The adult crickets were collected from their habitats, brought to the laboratory and maintained in rectangular glass jars (20x20x18 cms), for the purpose of oviposition. The hatched young ones were maintained in separate containers. The adults and nymphs were fed *ad libitum* with moist dog biscuit. The intermoult 8th and 9th instar nymphs and the adults of 1st - 8th days were chosen for the study. The females and instars were identified by the presence of ovipositor that appears on the emergence of 8th instar nymph.

A few (4 number of each nymph and adult) were dissected out, ovaries were removed and sections of 8 μ thickness were made (8), stained with Delafields haematoxylin and alcoholic eosin. Morphometric measurements were carried out using ocular micrometer fitted with stereoscopic compound microscope.

RESULTS AND DISCUSSION

The female reproductive system of *G. sigillatus* consists of a pair of panoistic type of ovaries each of which having 32-48 ovarioles. The oogonia are successively produced from the distal germarium and they increase in size gradually while passing down the vitellarium. The oocytes are linearly arranged with various stages of development. The first zone of vitellarium consists of immature oocytes usually 10 in number, with little quantity of cytoplasm and without follicular cells. The second zone also consists of immature oocytes but the number is less (3-4) without fully surrounded by follicular cells. The third zone includes the penultimate oocytes and the fourth zone basal oocytes (Fig. 1). The ovarioles exhibit a progressive increase

Table 1 : Morphometry of the ovarioles in various instars of female *G. sigillatus*.

Instars	Germarium		Vitellarium	
	Length(μ)	Width(μ)	Length(μ)	Width(μ)
8th intermoult nymph	210 50 ± 9 90	14.84 ± 1.89	592 12 ± 31.56	67.52 ± 1.84
9th intermoult nymph	312.12 ± 18.82 (48.27)	37.00 ± 2 14 (149.32)	991 43 ± 28.00 (67.44)	9.105 ± 4.24 (34.84)
0 day adult	496.20 ± 13.30 (58 97)	40 60 ± 4.70 (9.72)	1457 00 ± 69.00 (46.95)	97.00 ± 4.00 (6.53)
2 day adult	512.00 ±38.00 (3.18)	42.00 ± 5.00 (3 45)	1793.00 ± 65.00 (23.06)	101.00 ± 9.40 (4 12)
4 day adult	640.00 ± 31.56 (25.00)	42.00 ± 2.80	1919.00 ± 33 00 (7.03)	180.00 ± 13.00 (78.22)
6 day adult	760.00 ±30.64 (34.37)	42.40 ± 1.40 (0.95)	3826.00 ± 62.00 (99.37)	390 00 ± 18.90 (116.66)
8 day adult	866.00 ±85 23 (13 95)	45 30 ± 3.50 (6.84)	4594.00 ± 88.50 (20.07)	558.00 ±32.00 (43.07)

Each value is the mean ± SD of 15 observations All values are significant at $P<0.05$. Values in parenthesis indicate % increase over previous instar.

Table 2 : Morphometry of penultimate oocyte and nucleo-cytoplasmic ratio in different instars of female *G. sigillatus*.

Instars	Length(μ)	Width(μ)	Nucleo-cytoplasmic ratio
8th intermoult nymph	68.43 ± 711	48 84 ± 6 89	0.452
9th intermoult nymph	140.46 ± 19.28 (105.26)	66 81 ± 6.46 (36.79)	0 209
0 day adult	263.00 ± 64.10 (87.24)	71 14 ± 4.45 (6.48)	0.118
2 day adult	313 70 ± 15.39 (19.28)	71.43 ± 4.10 (0 40)	0.104
4 day adult	376.63 ± 27.10 (20.06)	75.25 ± 7.33 (5.35)	0.0.94
6 day adult	451.60 ± 19.26 (19.91)	95.43 ± 5 24 (26 82)	0.059
8 day adult	548.80 ± 24 00 (21 52)	116.00 ± 8.34 (21.56)	0.022

Each value is the mean ± SD of 10 observations.

All values are significant at P<0.05. Values in parenthesis indicate % increase over previous instar.

Table 3 : Morphometry of basal oocyte and nucleo-cytoplasmic ratio in different instars of female *G. sigillatus*.

Instars	Length(μ)	Width(μ)	Nucleo-cytoplasmic ratio
8th intermoult nymph	83.68 ± 7.25	42.86 ± 3.65	0.204
9th intermoult nymph	241.52 ± 14 92 (188 62)	61 65 ± 5.41 (43 84)	0 102
0 day adult	393.75 ± 30.24 (63.03)	78 00 ± 4.24 (26.52)	0 070
2 day adult	430 80 ± 49 66 (9 92)	111.00 ± 15.10 (42 30)	0 034
4 day adult	576.63 ± 63.80 (33 85)	157.50 ± 9 50 (41.89)	0 020
6 day adult	1568 00 ± 250.67 (171 92)	311 00 ±27.70 (97 46)	0.0004
8 day adult	1793.70 ± 240.60 (14 39)	340.00 ±38.00 (9 32)	0 0003

Each value is the mean ± SD of 10 observations.

All values are significant at P<0 05 Values in parenthesis indicate % increase over previous instar.

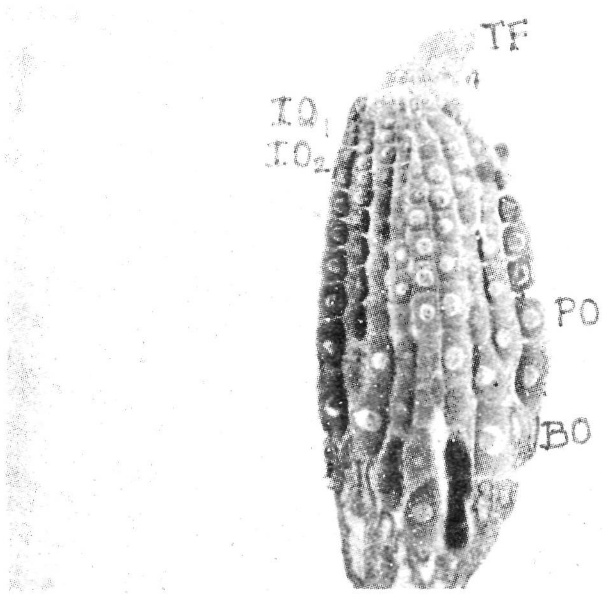

Fig. 1 : L. S. of ovary showing terminal filament (TF), immature oocytes of zone I (10_1,) immature oocytes of zone II (IO_2), penultimate oocytes (PO) and basal oocytes (BO). X100.

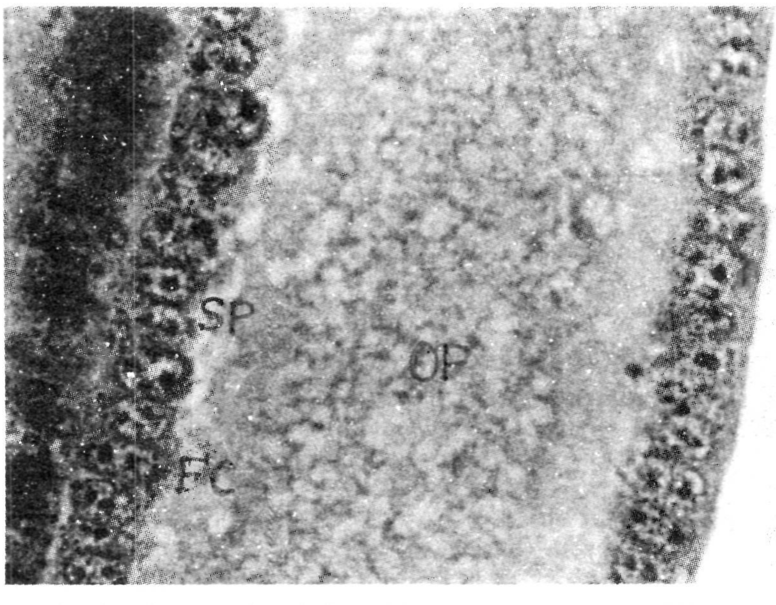

Fig. 2 : L. S. of 2-day basal oocyte (previtellogenic) showing clear space (SP) between ooplasm (OP) and follicular epithelium (FC). X400

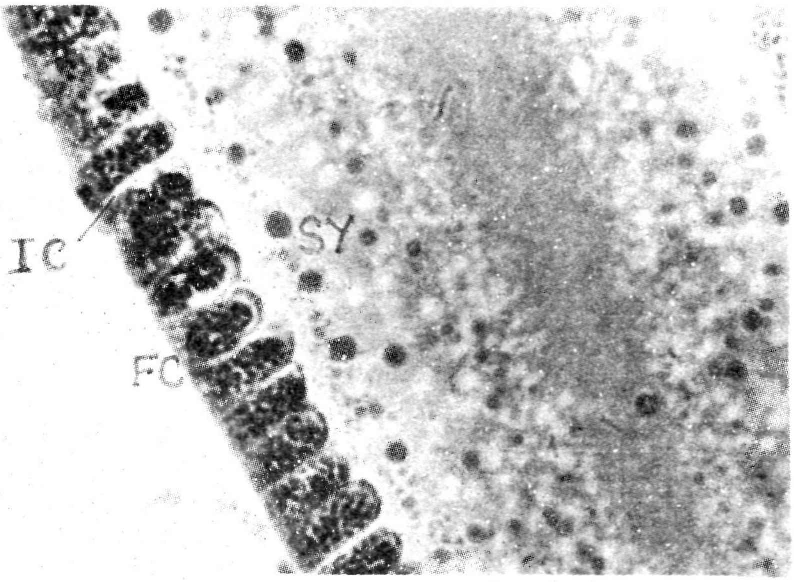

Fig. 3 : L. S. of early vitellogenic oocyte showing follicular epithelium (FC), intercellular space (IC) and small yolk spheres (SY). X400.

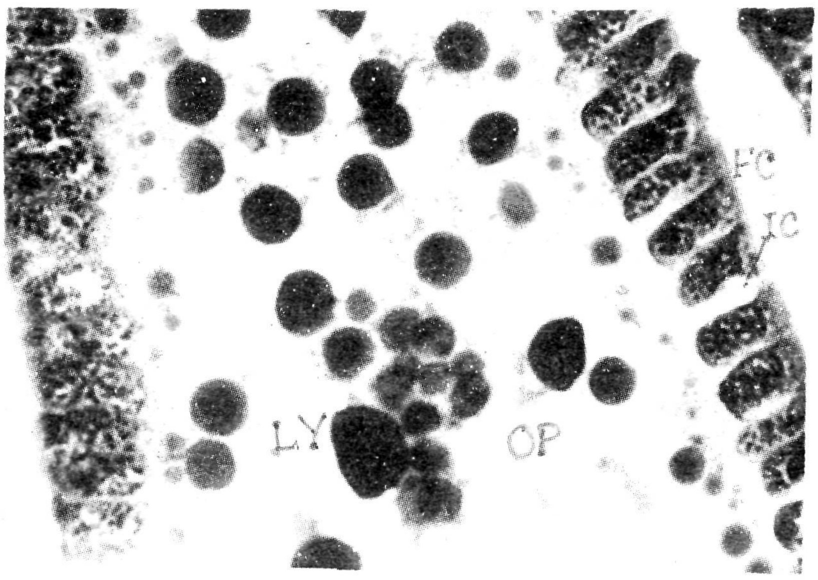

Fig. 4 : L. S. of midvitellogenic oocyte showing ooplasm (OP) with yolk spheres (LY) and follicular epithelium (FC) with intercellular spaces (IC). X400.

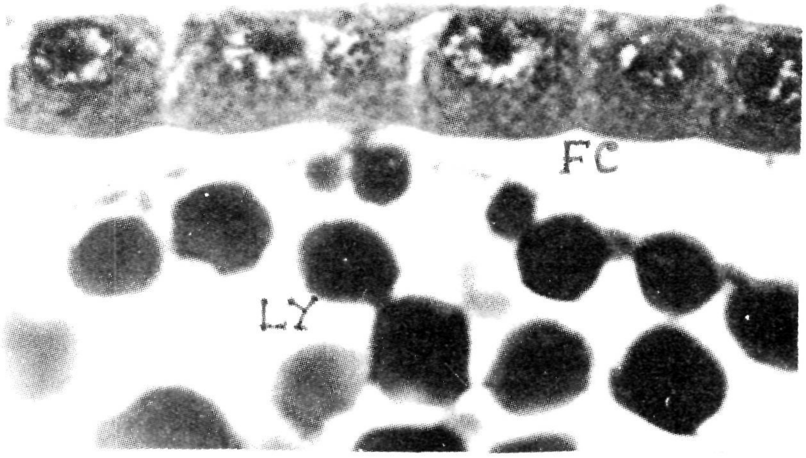

Fig. 5 : L. S. vitellogenic oocyte showing large yolk spheres (LY) and flat follicular epithelial cells (FC). X100.

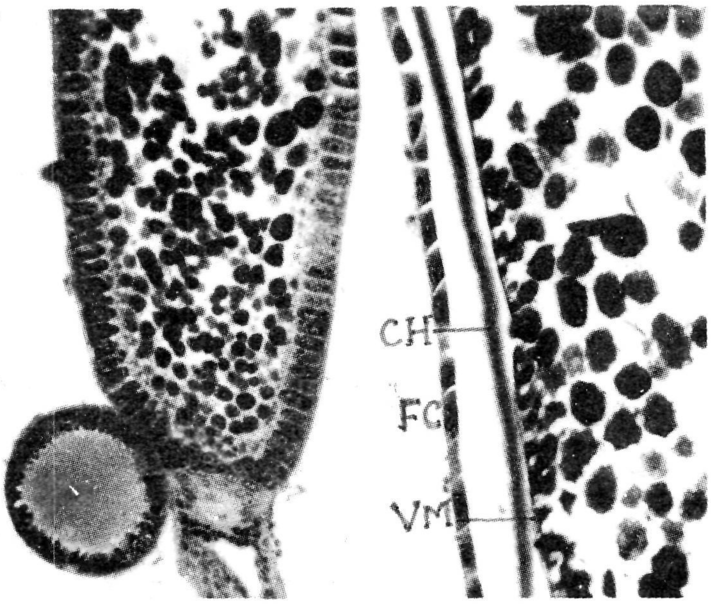

Fig. 6 : L. S. of late vitellogenic oocytes showing vitelline membrane (VM), chorion (CH) and flat follicular epithelial cells (FC). X100.

in dimension as the development proceeds (Table 1). These observations corraborate with the findings of many other orthopteran insects. (9,12)

It is evident that the penultimate and basal oocytes increase in their dimension whereas, the nucleocytoplasmic ratio decreases during the progress of development of *G.sigillatus.* (Tables 2 and 3). These could be due to vitellogenesis and maturation of oocytes in the vitellarium. In the present study, the yolk deposition in the basal oocyte is found to commence on the 4th day of adult emergence and a fully mature stage is attained on the 8th day.

Elliott and Gillott(6) have shown that a clear space appears shortly before vitellogenesis between the apical regions of the follicular cells and ooplasm in *Melanoplus sanguinipes.* The same is also true in *G.sigillatus* in which the basal oocyte contains ooplasm with clear spaces all along the epithelial lining and central vacuolated region without yolk granules. The follicular cells are coloumnar and compactly arranged without intercellular space. (Fig. 2)

In the present experimental insect, considerable changes have been observed both in the oocytes and in the follicular epithelial cells from the 2nd day of adult female emergence onwards. The differentiation of follicular epithelium is to be an essential pre-requisite for yolk deposition (13,14). Follicular cells of the basal oocytes of *G.sigillatus* are tall columnar type with intercellular spaces at the time of vitellogenesis (Fig. 3). These intercellular spaces could provide a passage for the uptake of extraovarian protein into the oocytes as observed in many orthopteran insects (15). The presence of yolk granules in the apex of the follicular cells observed in the present study (Fig. 3) supports the concept of intracellular pathway for protein accumulation inside the oocyte. Several investigators have reported that during the formation of yolk, proteins from haemolymph are transported through the intercellular spaces of follicular cells to the developing oocytes in insects (16-18). The same could also hold good in the present study where the follicle cells could play a decisive role in vitellogenesis by transporting substances from haemolymph into oocytes.

It has been recorded that yolk vesicles that appear in the periphery of the oocyte coalese to produce large yolk spheres in insects (19,20). In *G.sigillatus* also yolk spheres appear in the cortical region of the ooplasm at initial adult stages (Fig. 4) and large yolk spheres in the central region of the ooplasm in the vittelogenic phase (Fig. 5). As the vitellogenesis progresses, the epithelial cells become cuboidal or squamous in the basal oocyte (Fig. 6.). This change in the configuration of the follicular cells is associated with the change in the nucleo - cytoplasmic ratio. This falls in line with the findings of Elliott and Gillott (6) and Sareen and Thukral (14) in orthopteran insects. At this stage, the follicular cells become secretory and the oocyte develops vitelline membrane (1μ in thickness) and chorion (3-4μ in thickness) (Fig. 5) in between follicular cells and ooplasm.

In locusts, deposition of yolk occurs only in the basal oocytes and in the penultimate oocytes after the release of basal oocytes from the ovary (5,6,20). However, in *G.sigillatus* the penultimate oocyte also contains small yolk spherules near the apices of the follicular epithelium even when the basal oocytes with yolk spheres remain in the ovary. This suggests that vitellogenesis occurs both in penultimate and basal oocytes simultaneously in the selected species of house cricket; probably as an adaptation for higher fecundity.

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