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The relative studies on the development of oocytes and corpora allata in female *Poeciloceris pictus* (Fabr.)

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Abstract : *Poeciloceris pictus* has one pair glandular corpora allata (CA) on the lateral sides of the fore gut behind the corpora cardiaca (CC). The corpus allatum is connected with nervi coporis allati (NCA-I) which are formed by the axons of NCC-I and NCC-II. The size of the CA varies with the cycle of secretory activities of the glands. The corpora allata is one of the important endocrine glands which play a role in the development of oocytes. The females of *P. pictus* were reared with castrated males or without males. The size of primary oocytes and size of corpora allata became affected in comparison to those reared with normal males. In freshly moulted females, the size of primary oocytes and size of CA are smaller than that of the gravid females. The size of primary oocytes gradually developed and attained maximum in size in 32 days old females of *P. pictus*.

Key words: Corpora allata, corpora cardiaca, nervi coporis allati, primary oocyte and castration

INTRODUCTION

A pair of ovaries is bilaterally located at the anterior part of the abdominal cavity above the intestine of *P. pictus*. Each ovary is composed of a number of ovarioles. Each ovariole is divided into many zones that contain oocytes in various stages of development and maturation. The corpora allata (CA) of female insects are the most important endocrine organs which play a central role in the development of oocytes (Highnam et al 1963, Pener 1965 and 1967)^{1,2,3}.

A neuroendocrine relationship exists between corpora allata and oocyte growth in female locust, *Schistocerca* (Highnam and Haskel 1964, Strong 1965 and Mordue 1966)^{4,5,6}. The histo-morphology of the CA of grasshoppers and locusts has been studied (Geldiay 1957, Odhiambo 1966, Dogra and Ewen 1970 and Raziuddin et al 1978)^{7,8,9,10}. Readio and Meola (1999)¹¹ have described the biosynthesis of yolk in relation of the hormone of CA in female insects. Tatar and Slow (2001)¹² have described

the diapause of grasshoppers and their developments. Kiyoto Maekawa et al (2009)¹³ have described the juvenile hormone titers and vitellogenin gene expression related to ovarian development in primary reproductives compared with nymphs and nymphoid reproductives of the termite *Reticulitermes speratus*. Karry and Lusia (2010)¹⁴ have described the ultra structure of the corpora allata and their activities on the metamorphosis and mating behaviour of the female locust *Schistocerca gregaria*. In the present work, a relative studies were undertaken on the development of oocytes and their corpora allata of the adult female grasshopper, *Poeciloceris pictus*.

MATERIAL AND METHODS

Freshly moulted adults of both sexes of *Poeciloceris pictus* were obtained from the stock culture and were kept in the experimental cages for observations. The sites of collections and rearing techniques of the grasshoppers as well as the method of gonadoectomy have already been described (Hassan and Khan, 1992)¹⁵. Four experimental cages were established in laboratory for investigation of primary oocytes and corpora allata (CA). Adult individuals were dissected in Ringer solution under a binocular

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dissecting microscope. For whole mount preparation, the brain along with corpora cardiaca (CA) and ovaries were dissected out at different time of intervals and fixed in 10% formalin saline or aqueous Bouins fluid for 24 hours and the brain along with CA were stained with performic acid victoria blue (PAVB); (Dogra and Tandon, 1964)¹⁶. For histological slides, the corpora cardiaca and oocytes of ovarioles were embedded in paraffin wax (m.p. 62°C). The brain with corpora allata (CA) and the ovarioles were cut at 6µ to 8µ and stained with paraldehyde fuchsin (PF) stain for studies of the CA and the sections of ovarioles were also stained with hematoxylin - eosin stain for studies of primary oocytes in multiple mated, single mated, pseudomated and unmated females of *Poecilocera picta*.

RESULTS AND CONCLUSIONS

The morpho-histology of the primary oocytes and corpora allata of *P. pictus* were studied under the following parameters:

1. In multiple mated females:

Ten (10) freshly moulted (01 day old) females of *P. pictus* were kept with ten (10) freshly moulted males of *P. pictus* in experimental cage and were allowed to mate throughout their life. In freshly moulted females, the average length of the primary oocyte was 2.50 mm and width 1.50 mm. (Table-1). At this stage, the average size of corpora allata was small (CA) and measured 410µ x 225µ in the largest cross section area (Table- 2). The female *P. pictus* became non receptive to courting at this time. In the nine (09) days old mated female, the primary oocyte measured 3.80 mm in length and 2.20 mm in width. At this time, the females became receptive to courting with mature males and mating continued for 10 to 12 hours. The average size of corpus allatum was 430µ x 230µ. In 18 days old gravid females, the primary oocyte measured 6.00 mm in length and 3.20 mm in width with well developed yolk. At this time, the corpus allatum (CA) was measured 460µ x 250µ. In 27 days old females, the length of primary oocytes was 7.20 mm and width 3.40 mm in average. At this time, the primary oocyte was mature with chorion and heavy yolk. The average size of corpora allata was measured 480µ x 260µ. In 32 days old ovipositing females, the well developed primary oocytes were observed in the ovarioles. The average length of mature eggs was measured 7.40 mm and width 3.50 mm.

The size of corpora allata (CA) has markedly regressed in size and measured 465µ x 250µ. It was interesting to note that the size of eggs increased while the size of CA decreased in comparison to 27 days old female *P. pictus*. (Graph- 1&2)

2. In single mated females:

One (01) freshly moulted female was kept with one (01) freshly moulted male in experimental cage. The male *P. pictus* was removed from the cage after termination of the first (single) mating. The size of primary oocyte and size of corpora allata (CA) were similar to a multiple mated female. In 09 days old copulated females, the average length of primary oocytes was 4.20 mm and width 2.50 mm. The average size of CA was 442µ x 236µ.

In 18 days old gravid females, the primary oocytes were well developed with yolk and chorion. The average size of primary oocyte was 6.80 mm in length and 3.50 mm in width. At this time, the average size of CA was 485µ x 265µ. In 27 days old females, the primary oocytes were fully mature with heavy yolk and chorion. The size of oocytes increased and measured 8.00 mm in length and 3.80 mm in width while the size of corpora allata (CA) was 500µ x 280µ. In the 32 days old oviposited females, the average length of fully mature eggs was measured about 9.00 mm and width 4.00 mm. At this time, the corpora allata were regressed in size and measured 480µ x 260µ and females were ovipositing in position for lying of eggs.

3. In pseudomated females:

Ten (10) freshly moulted females were kept with ten (10) freshly moulted and castrated males in experimental cage. They were allowed to mate throughout their life. The size of primary oocytes and corpora allata were similar as a multiple mated females. In 09 days old pseudomated females, the size of primary oocytes as well as corpora cardiaca was similar as 1st group of females. In 18 days old gravid females, the size of primary oocytes and size of CC were decreased. The average size of primary oocyte was 5.80 mm in length and 3.00 mm in width while the average size of CC was 450µ x 240µ. In 27 days old females, the size of primary oocyte also slowly increased and measured 6.70 mm in length and 3.30 in width whereas the size of CC was measured 480µ x 260µ. In 32 days old ovipositing females, the size of egg was 7.00 mm in length

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and 3.40 mm in width while the average size of CC was measured 450 μ x 240 μ which was regressed in size and similar as 18 days old females (Graph- 1 & 2).

4. In unmated females:

Ten (10) freshly moulted females were kept in an experimental cage without males till the egg laying. The size of primary oocytes and the size of corpora allata (CC) were similar as the 1st group of freshly moulted females. In 9th days old females, the size of primary oocytes was similar as the primary oocytes of pseudo mated females while the size of CC were 425 μ x 228 μ in an average. In 18 days old females, the size of primary oocytes was 5.60 mm in length and 3.00 mm in width while the size of CC was slightly increased and measured 450 μ x 240 μ .

In 27th days old females, the size of primary oocytes was 6.40 mm in length and 3.20 mm in width while the size of CC was measured 460 μ x 250 μ . In 32nd days old ovipositing females, the size of mature primary oocytes was 6.80 mm in length and 3.30 mm in width. The size of eggs was smaller than the other experimental eggs of *P. pictus* while the corpora allata were regressed in size and measured 450 μ x 240 μ like the size of 18 days old females (Graph- 1 & 2).

The present studies of the different groups of females indicated the close morphological and histological resemblances with other grasshoppers and locusts such as *Melanoplus sanguinipes* (Dogra and Ewen, 1970)⁹,

Acridium aegyptium (Geldiay, 1957)⁷, *C. tarsalis* (Young and Downe, 1983)¹⁷ and *Grylloides sigillatus* (Subramaniam and Pandian, 1988)¹⁸. A similar conclusion has been drawn by Highnam (1962)¹⁹, Strong (1965)²⁰, Leopard (1976)²¹ and Panov (1980)²² in freshly moulted to ovipositing females of grasshoppers. The size of oocytes was increased with the ages in multiple mated females which were reported in *Drosophila* (Partridge *et al* 1987)²³ and *Crickets* (Simmons, 1989)²⁴. However, such a syncytial nature of CA has also been reported in other insects (Odhiambo, 1967 and Scharrer, 1969)^{25,26}. After fledging, the CA of *P. pictus* remain inactive but show progressive increase in size with the size of primary oocytes. However, when the primary oocytes were fully mature then the CA were regressed in size. Multiple mated females and single mated females were contributed to the fertility of eggs in comparison to the pseudomated and unmated eggs of female *P. pictus* It resemblances with Greenberg and Tobe (1985)²⁷ and Elliot Stay (2007)²⁸ of *Reticulitermes flavipes*. Zahao and Mala (2000)²⁹ have reported the relationship between vitellogenesis and their neurosecretion in *Periplaneta americana*.

In the pseudomated and unmated females, the size of primary oocytes and size of corpora allata (CA) have lesser growth than multiple mated females. Thus, the role of CA, NSC as well as CC was found to be actively involved in the development of oocytes in *P. pictus*.

Table -1 Morphometry of primary oocytes in adult female *P. pictus* under following parameters (size in mm)

S.No.	Name of Experiments	1 day old	9 days old	18 days old	27 days old	32 days old
1.	Multiple mated female	2.50 x 1.50	3.80 x 2.20	6.00 x 3.20	7.20 x 3.40	7.40 x 3.50
2.	Single mated female	2.50 x 1.50	4.20 x 2.50	6.80 x 3.50	8.00 x 3.80	9.00 x 4.00
3.	Pseudomated female	2.50 x 1.50	3.80 x 2.20	5.80 x 3.00	6.70 x 3.30	7.00 x 3.40
4.	Unmated female	2.50 x 1.50	3.80 x 2.20	5.60 x 3.00	6.40 x 3.20	6.80 x 3.30

Table-2: Morphometry of corpora allata (CA) in adult female *P. pictus* under following parameters (size in μ):

S.No.	Name of Experiments	1 day old	9 days old	18 days old	27 days old	32 days old
1.	Multiple mated female	410 x 225	430 x 230	460 x 250	480 x 260	465 x 250
2.	Single mated female	410 x 225	442 x 236	485 x 265	500 x 280	480 x 260
3.	Pseudomated female	410 x 225	430 x 230	450 x 240	480 x 260	450 x 240
4.	Unmated female	410 x 225	425 x 228	450 x 240	460 x 250	450 x 240

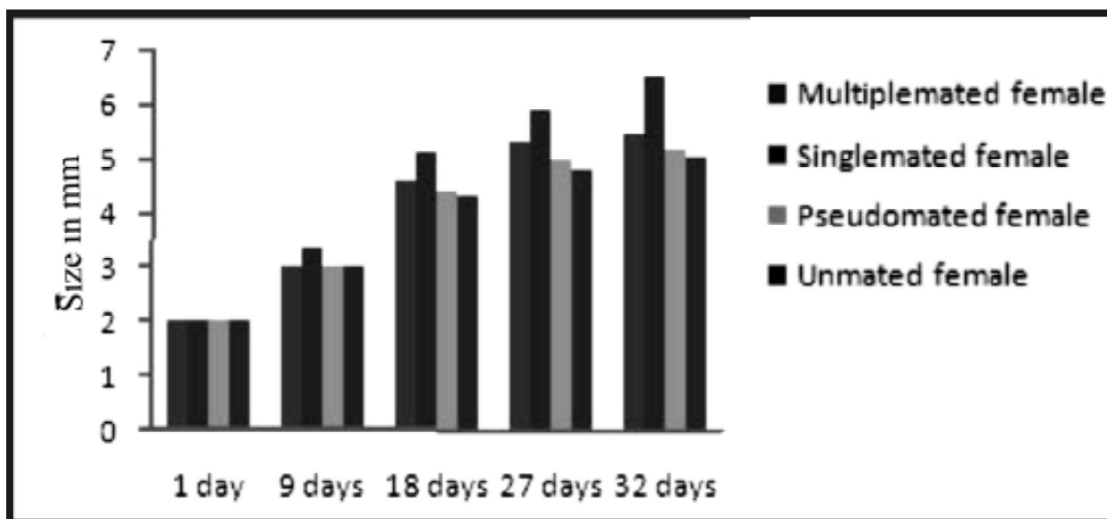


Fig.1. Histogram shows the size of primary oocytes in different ages of adult female, *P. pictus*.

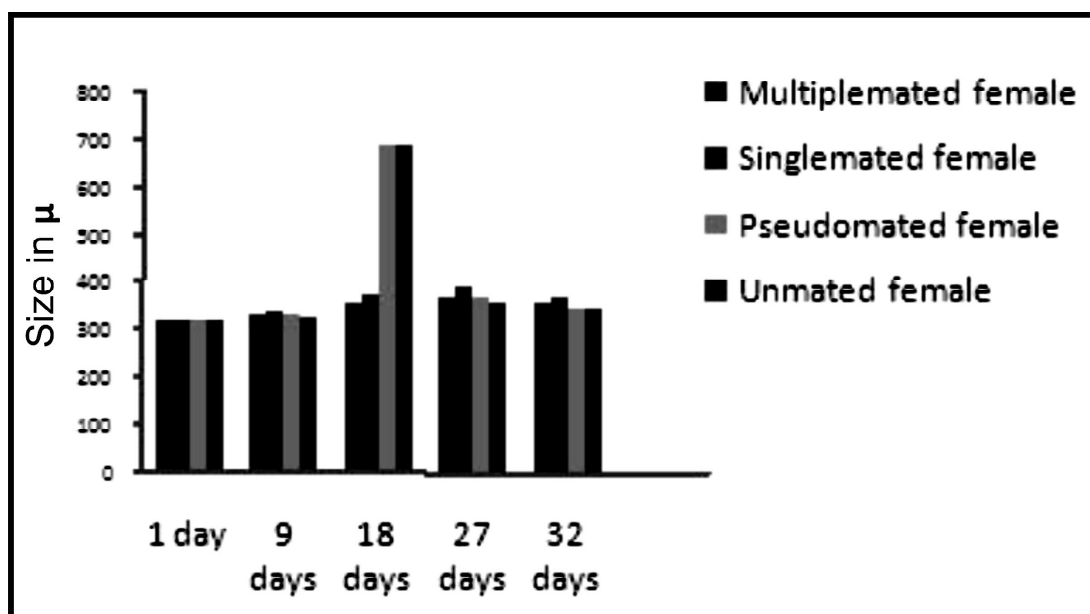


Fig.2. Histogram shows the size of corpora allata (CA) in different ages of adult female, *P. pictus*.

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