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ORIGINAL ARTICLE

GRT

ANATOMY AND HISTOLOGY OF EMBRYONIC STAGES OF KATOIKOGENIC SCORPION HETEROMETRUS XANTHOPUS (POCOCK) (SCORPIONIDAE).

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Abstract:

The ovariuterus of H. xanthopus consists of three longitudinal tubes; interconnected by four transverse tubes. The ovariuterus is lined by outer layer of irregularly polygonal cells and the inner germinal epithelium layer with long and thin columnar cells. H. xanthopus is katoikogenic scorpion, the oocyte develop in specialized diverticulum that branch from the female ovariuterus. During development, specialized feeding apparatus called 'bottle and teat' appear between the stomodeum of embryo and hepatopancreas of the mother. It helps the embryo to absorb maternal nutrients. The gestation period of H. xanthopus is June to April (about 11 months).

KEY-WORDS:

Heterometrus xanthopus, katoikogenic scorpion, embryoninc development.

MATERIAL AND METHODS:

The members of the species were regularly collected from Kharadi (18º 32º 50.81N 73º 57' 08.02"E) east of Pune (M/S, India). They prefer to stay in self-made burrows with open holes (Tikader and Bastawade; 1983). The specimens were regularly collected and brought to laboratory and maintained (Candido and Lucas, 2004) for few days. Generally freshly collected specimens were used for histological studies. The specimens were dissected in scorpion Ringer's solution (Ahern and Hadley, 1976) under stereoscopic microscope (wild) to view the minor anatomical structures. The camera lucida diagrams of anatomy of female reproductive system were drawn. The magnification of drawing was also noted. Some of the stages of development were photographed. For histological study the neutral formaline (Sareen M.L. 1961) used as fixative. Tissue-Paraffin blocks were prepared, cut at 5µ- 7µ, and 8-10µ according to need. Longitudinal, transverse, lateral and sagital cuts were taken. Slides were processed in alcohol grades, stained by Delafield's haematoxylin and eosin was used as counter stain, mounted in DPX.

RESULTS:

The ovariuterus of H. xanthopus consists of three longitudinal tubes; interconnected by four transverse tubes. It forms six loops, three on each side. It is present in 3rd mesosoma to 6th mesosoma. The oviduct arises from the anterior angle of each lateral longitudinal ovariuterus tube, proceed anteriorly, forming the receptacle seminalis. The receptacle seminalis open into a genital chamber, which opens to the exterior through the gonopore. Interior to the base of gonopore, parallel to ovariuterus duct, there is a pair of gland called accessory glands. The accessory glands open in receptacle seminalis just interior to genital aperture (Fig. 1).

The observations made from the various stages of development of embryos in different months of years, there was a scope to believe that the fertilization in H. xanthopus takes place in late May or early June

Title : ANATOMY AND HISTOLOGY OF EMBRYONIC STAGES OF KATOIKOGENIC SCORPION HETEROMETRUS XANTHOPUS (POCOCK) (SCORPIONIDAE). Source:Golden Research Thoughts [2231-5063] GIRAMKAR S.V AND BASTAWADE D.B (RD.). yr:2013 vol:2 iss:7

and the development of 25-30 ova gets initiated (Fig: 1). Histologically, the ovariuterus is formed by two layers of cells that surrounding irregular lumen. The outer layer is formed of irregularly polygonal cells (about 55-60µm thick) and the inner layer called germinal epithelium is formed of long and thin columnar cells (about 28-30 µm thick. The fertilized egg pushes its way, towards the outer cellular portion of the ovariuterus, further came toward wall, becomes thin and membranous. All transverse and longitudinal tubes bears about 25-30 outgrowths of embryo appear to develop into initial stages (Fig: 4C.1 to 4) in late May and early June.

The development of embryos was observed in different stages. Most of the embryos were in early stages while about 8-10 embryos were noted in advanced stages of development. It was noticed that, female probably restricts to develop selectively 8-10 ova and only these continue further development. The developing embryo remains in the tip region of the outgrowth called diverticulum (Fig: 5). The connection between developing cells of ovum and ovariuterine duct contains numerous columnar cells with distinct nuclei. These cells are arranged in row to form a canal like structure, which communicate developing cells and lumen of ovariuterus. It encloses liquid material containing developing cells.

When embryos begin to develop there was rapid elongation and enlargement of outgrowths called diverticuli. A developed diverticulum can be divided into three portions: a) basal portion, attached to the ovariuterine wall, b) swollen middle portion, containing developing embryo and c) Appendix, an elongated distal narrowed finger like portion, called Appendix (Fig:6 and 7). This type of development was observed in the month of July and August.

During further development (Fig: 8), the embryo in diverticulum attains elongated shape, the rounded structure of cephalic region/head seems to be developing towards appendix and remaining posterior portion becomes elongated and extend towards ovariuterus. The head region presumed to be in the phase of organogenesis while the posterior portion undergoes segmentation. This type of development was noticed in the month of September to November.

During further development the tubular structure called feeding canal or “bottle and teat” develop at the junction of diverticulum and appendix. (Fig:9). This type of development was noticed in the month of December to February. There is development of unknown cellular structure called Bhushan structure (Fig: 9, 10 and12). This structure is lined with squamous epithelial cells with distinct nuclei (Fig: 10). Its inner portion consists of compact arrangement of columnar cells with distinct nuclei and darkly stained cytoplasm. This structure is attached to the inner lining of diverticulum adjacent to the mouth of embryo. It was noticed that this structure appear to develop during embryonic development in the month of December and remains persistent up to the month of April and disappear in late stage of development.

The diverticuli become broader to accommodate developing embryo (Fig: 11). The embryos observed in quiet advance stage and the eyespots (Es) were noticed externally at the distal end of diverticuli. This type of development was observed in the month of March and April. Internally, the appendix filled with food material, gets communicated towards diverticulum through the thick structure called 'teat'(Fig: 12). It appears that the food material required for the development of an embryo; gets transported in much concentrated form of jelly substances, gets easily pushed through the narrow tube of “Teat”. The Bhushan structure (BS) was noticed attached to the inner lining of diverticulum adjacent to the mouth of embryo as the continuation of cellular mass surrounding the teat.

Later stages of development were studied by removing the coverings enclosing the embryos. It was observed that the embryonic organogenesis takes place in diverticuli. The anterior mouth portion faced in the distal portion of diverticuli while posterior portion faced towards ovariuterus. The body of embryo is divided into three regions, a prosomal rudiment, a mesosomal rudiment, and a metasomal growth zone. Development of prosoma and mesosoma take place in early period where early two eye spots, paired pedipalps, paired chelicerae and four pairs of legs are seen to developed but no development of pectine was noticed. The bilobed structure of venom gland appears at the tip of metasoma (Fig: 13). Mesosoma and metasoma consist of dorsal groove.and a ventral groove (Fig:14), which extends from carapace to the end of metasoma. Metasomal segments become distinct but very short as compare to the mesosoma.

All females of H. xanthopus were undergoing parturition in the first week of May. Unfortunately, actual parturition was not observed, but the early babies of H. xanthopus were observed to be very tiny, with transparent body, measures about 8 to 10 mm in length.

Histology of the accessory gland: the longitudinal section of accessory gland shows that (Fig:15), the outer thick epithelial cells surround inner spongy mass of columnar epithelial cells. The columnar epithelial cells contain large secretory granules stained by haematoxylin. This gland encloses a lumen might be for storage of secretory fluid. The lumen continues towards anterior end and open in anterio-ventral side of receptacle seminalis.

DISCUSSION AND CONCLUSION:

Female reproductive system, embryology, and parturition of scorpions reviewed by Werner F. (1935). According to Mathew 1956 and Francke 1979 family Buthidae have five transverse ovariuterus tubes, whereas all other families have a four transverse ovariuterus tubes. H. xanthopus consists of three longitudinal tubes, interconnected by four transverse ovariuterus tubes.

Farley R.D.(1998) described the early development of embryo in P. mesaensis (Vaejovidae). The ultrastructural study of ovariuterus and oocytes maturation has been studied in Euscorpius carpathicus (L.) (Euscorpiidae) (Soranzo (L). et. al. 2000). Further development of embryos has been studied by many authors (Pavlowsky, 1924, 1925; Mathew, 1948 and 1956, 1957).

According to embryonic development, the scorpions are grouped into apoikogenic and katoikogenic. In Buthidae, Bothriuridae, Chactidae, Chaerilidae, luridae, and Vaejovidae the oocytes are located in follicles that are in direct contact with the ovariuterus. The developmental type of these six families belong is referred to as apoikogenic (Laurie 1896a, b; Farley, 1998), while the Diplocentridae, Ischnuridae, and Scorpionidae is referred as katoikogenic (Mathew, 1948 and 1956).

The oocytes are located within numerous lateral diverticula arising from the branches of the ovariuterus with one embryo developing in each diverticulum. This type of development is referred to as katoikogenic (Laurie 1896a, b). The ova of katoikogenic scorpions are yolkless (Mathew, 1948 and 1956).

H. xanthopus is katoikogenic scorpion, the oocyte develop in specialized diverticulum that branch from the female ovariuterus. The ova of H. xanthopus measures about 28 µm in diameter and alecithal. In later stages of development, the oral feeding mechanism developed in embryo. It helps the embryo to absorb maternal nutrient through an appendix embedded in hepatopancreatic mass. This feeding apparatus is called “bottle and teat”. It is a connection between the stomodeum of embryo and appendix. The specialized feeding apparatus is present in katoikogenic scorpions (Mathew 1957). The appendix is very closely associated with the hepatopancreas of the mother; it receives and transports nutrients from the hepatopancreas to the embryo.

The unknown cellular structure called Bhushan structure (Fig: 9. 10 and 12) attached to the inner lining of diverticulum adjacent to the mouth of embryo. It was noticed that this structure appear to develop during embryonic development in the month of December and remains persistent up to the month of April and disappear in late stage of development before parturition. This type of structure along with embryo has not been mentioned by previous authors. The gestation period of H. xanthopus is June to April (about 11 months). It is notable that some Scorpionid exhibit long gestation period (7-18 months), such as P. imperator (C. L. Koch) (7 months), Heterometrus longimanus (Herbst) (12 months), Scorpio maurus L. (14-15 months), Urodacus manicatus (Thorell) (16 months), U. yaschenkoi (Birula) (18 months). Such long period of gestation appear to have no parallel among other arachnids (Savory 1977) and are longer than those of many vertebrates.

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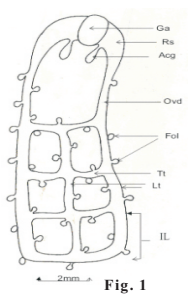
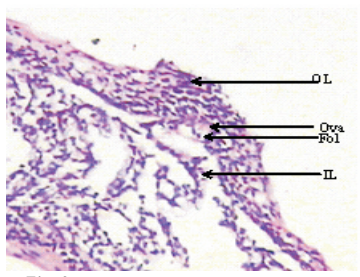


Fig. 1



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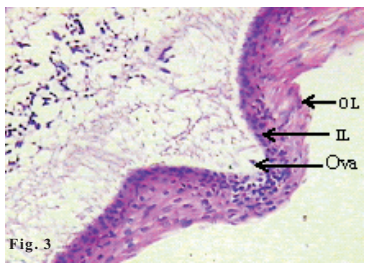

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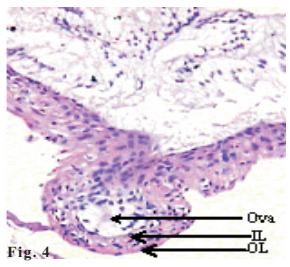

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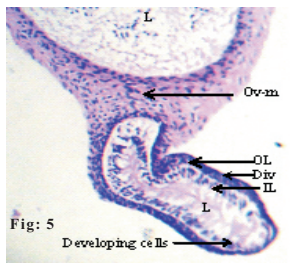

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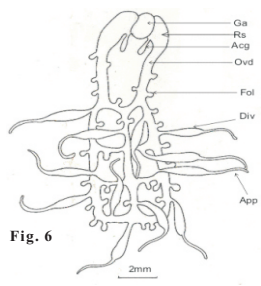

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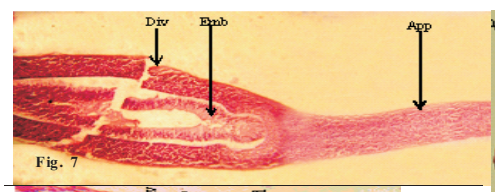

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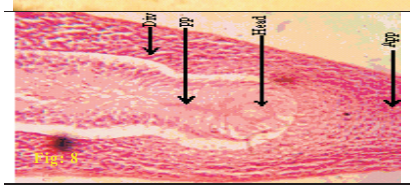

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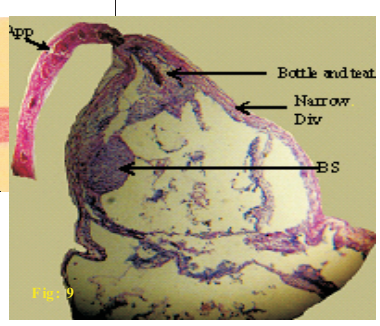

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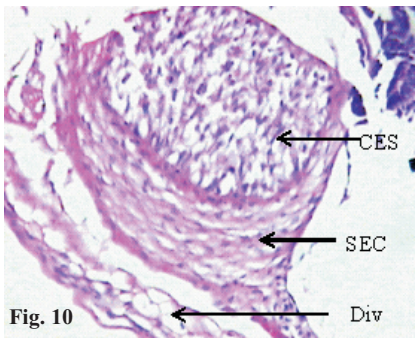

Fig. 10


Fig. 11

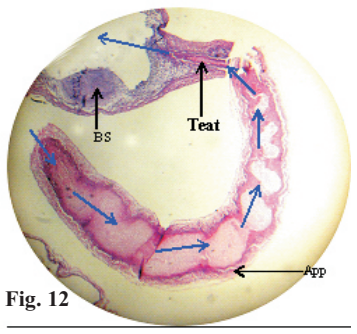

Fig. 12

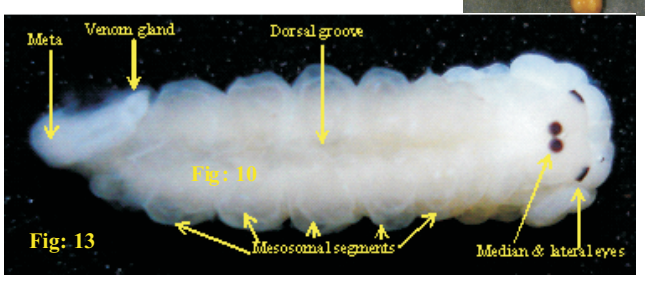

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Fig: 13

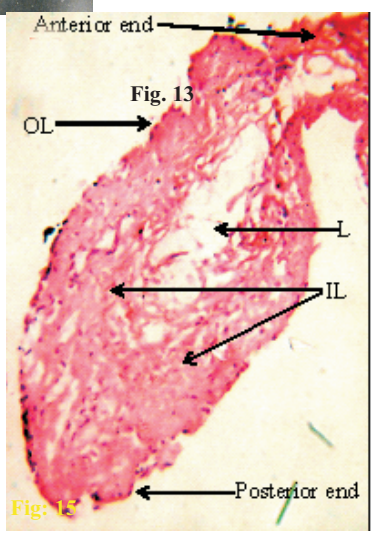

Fig. 13
Fig: 15

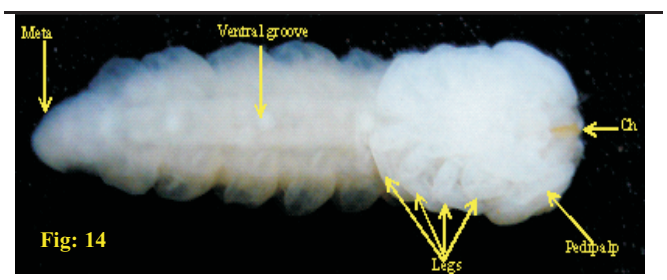

Fig: 14

Fig. 1 and 2: Camera lucida diagram of female reproductive system of *H. xanthopus* showing Acg, Accessory gland; App, Appendix; Div, Diverticulum; Es, Eye spots; developing; Fol, Follicles; Ga, Genital aperture; IL, Individual Loop of ovariuterus; Lt, Longitudinal tube of ovariuterus; Ovd, Oviduct; Rs, Receptacle seminalis; Tt, Transverse tube of ovariuterus.
Photographs showing: App, Appendix; BS, Bhushan Structure, CES, Columnar Epithelial Cells; Ch, Chelicerae; Div, Diverticulum; Emb, Embryo. Fol, Follicle; IL, Inner Layer; OL, L, Lumen; Meso, Mesosoma; Meta, Metasoma; Outer Layer; Ov-m, Ovariuterus membrane; PP, Posterior Portion of embryo; SES, Squamous Epithelial Cell; Blue arrows indicate the route of food passing from appendix towards the mouth of embryo through teat.