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HISTOANATOMY OF ANDROGENIC GLAND OF A BRACHYURAN CRAB, *PARASESARMA PLICATUM* (LATRIELLE, 1803)

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ABSTRACT

The present study was executed on the androgenic gland of mangrove crab *Parasesarma plicatum* to study the morphology, histology and its function in male reproduction. Morphologically, the androgenic gland is attached to wall of the ejaculatory duct. The light microscopic study showed two cell types. Type 1 cells are small with large nucleus and small amount of cytoplasm. Type 2 cells occupy more space in the glandular region. These are larger cells with basophilic nuclei and involve in secretary activity. This suggests the function of androgenic gland in male reproduction of crabs.

Key words: Androgenic gland, Morphology, Histology, *Parasesarma plicatum*.

INTRODUCTION

The androgenic gland has been established as the endocrine gland which is responsible for the differentiation of the primary and secondary sexual characters in malacostracan crustaceans (Charniaux-Cotton, 1960 and 1964; Payen, 1973; Charniaux-Cotton and Payen, 1985; Sagi *et al.*, 1990 and 1997, Taketomi and Nishikawa, 1996; Okumura and Hara, 2004). Male morphogenesis and spermatogenic activity occur only in the presence of androgenic gland, whereas, in its absence, female morphogenesis occurs (Charniaux-Cotton and Payen, 1983 and 1985). Spermatogonial proliferation and initiation of meiosis in the testis of the brachyuran crab, *Potamon koolooensi* are suggested to be under the control of androgenic gland (Joshi and Khanna, 1982).

Most of the studies on the androgenic gland in decapods have been focused on shrimps and cray fishes. In crabs, the structure of androgenic gland was described in *Pachigrapsus crassipes* (King, 1964), *Ocypode platytarsis* (Thampy and John, 1970), *C. sapidus* (Payen *et al.*, 1971), *Ranina ranina* (Minagawa *et al.*, 1994) and *Scylla paramamosain* (Liu *et al.*, 2008). Seasonal changes in androgenic gland in relation to male reproduction have been reported in the brachyuran crab *Metopograpsus messor* (Joseph, 2007), the crayfishes such as *Orconectes nais* (Carpenter and DeRoos, 1970) and *Procambarus clarkii* (Taketomi, 1986; Taketomi *et al.*, 1996), the freshwater prawn *Macrobrachium kistnensis* (Mirajkar *et al.*, 1984), the marine shrimp *Penaeus chinensis* (Li and Li, 1993) and the isopod, *Armadillidium vulgare* (Katakura, 1984).

The releasing type of androgenic gland is holocrine (Charniaux-Cotton, 1962), and it is commonly reported that the nature of androgenic hormone in decapod crustaceans is protein or polypeptide (King, 1964; Sun *et al.*, 2000). The morphological and physiological effects of the androgenic gland on decapod crustaceans have always been topics of concern (Taketomi *et al.*, 1990; Taketomi *et al.*, 1996; Fowler and Leonard, 1999; Khalaila *et al.*, 1999). Although the function of the androgenic gland has been well demonstrated by such studies as those cited above, the number of studies on the structure of the androgenic gland and the nature of its secretory products in brachyuran crabs is lacking (Awari and Dube, 1999). As such, it was deemed worthwhile to determine the location and histology of the androgenic gland, and the nature of androgenic hormone in *Parasesarma plicatum*, a brachyuran crab species that is commonly seen in estuaries and mangroves. This study could also serve as a basis for future aquacultural research on brachyuran crabs.

MATERIALS AND METHODS

The brachyuran crab, *P. plicatum*, inhabits the muddy substratum of estuarine and mangrove environments and enjoys a wide range of distribution in the tropics. Adult males of carapace width 1.6 cm to 2.2 cm were collected from Manakudy estuary of Kanyakumari District, Tamil

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Nadu. Animals were handpicked or collected by bait. After examining the moult stages (Suganthi and Anilkumar, 1999), the crabs were reared in the laboratory in plastic cisterns and were fed ad lib on clam meat and (boiled) egg white. Inter-moult crabs were used for the light microscopic studies. The male reproductive system of the *P. plicatum* was dissected by cutting open the dorsal portion of the carapace. The dissection was performed under a dissection microscope in a medium of 0.9% physiological saline. For histological studies, the tissues were fixed in Bouin's Fluid. Paraffin sections of 5-7µm thickness were stained in Harris Haematoxylin and counter stained with 1% alcoholic eosin (Humason, 1967). The stained sections were viewed and photomicrographed.

RESULTS

Morphology

The androgenic gland housed on the surface of the ejaculatory duct (ED) and appears as a strand of transparent cord tissue. This glandular structure is seen from anterior to the middle portion of the ED. (Figure 1 and 2).

Histology

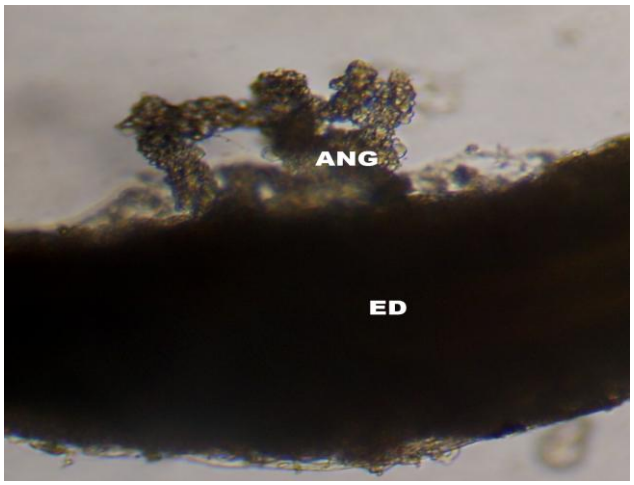
This gland histologically exhibited two cell types as type 1 and type 2.

Type 1 cells

The type 1 cells are single type, irregular, slightly polygonal, measuring 8-13 µm with a spherical nucleus (2-4 µm in diameter). These cells are compactly arranged with uni or sometimes with few bi-nucleated cells (Figure 3). The nucleus is mostly centrally located and basophilic in nature.

Type 2 cells

The type 2 cells are larger than type 1, measuring 17-23µm. These cells form the bulk of the glandular cells. The cytoplasm stains lightly with haematoxylin and toluidine blue (Figure 4). The basophilic nucleus occupies central or peripheral position. Type 2 cells appear to have vacuoles in their cytoplasm. They produce and accumulate secretory product in the cytoplasm (Figure 5). Vacillations occurs in the cytoplasm was clear with the toluidine blue staining (Figure 6) The appearance of the glandular cells were found to vary depending the seasons.



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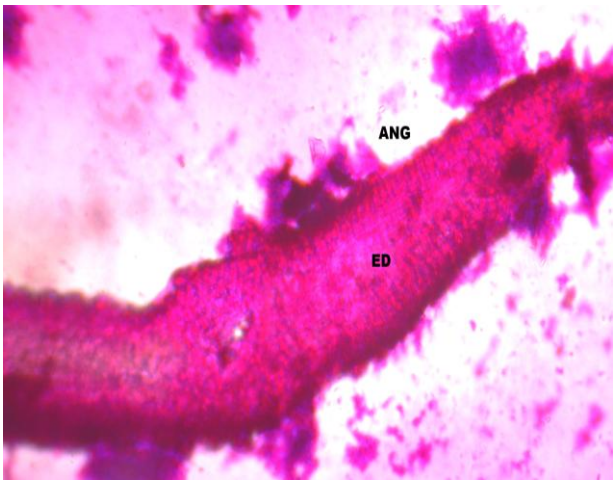

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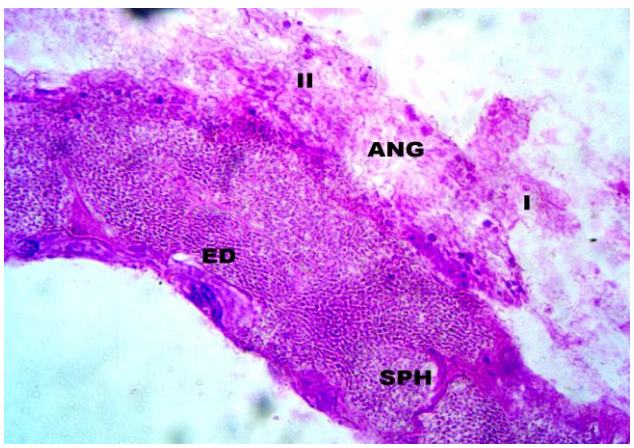

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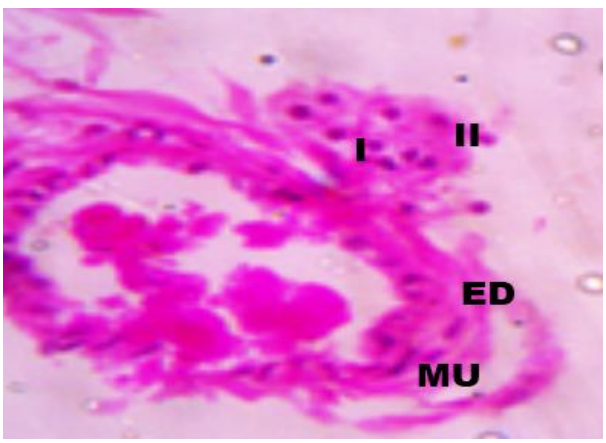

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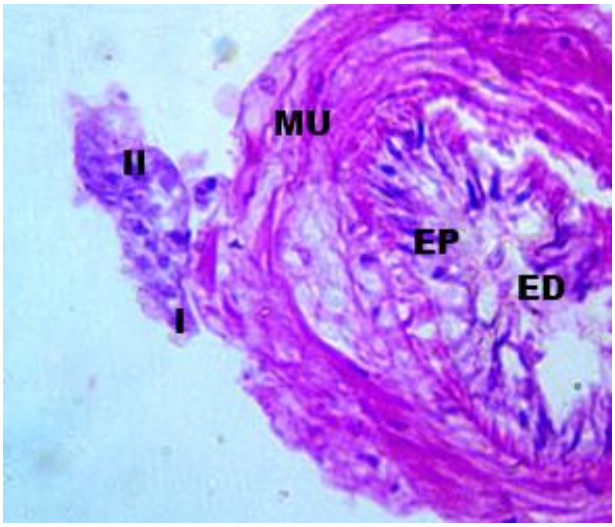

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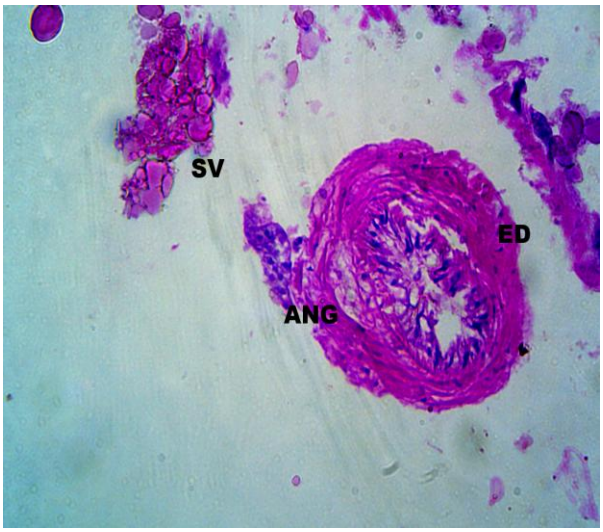

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Figure 1. The ejaculatory duct(ED) with androgenic gland (ANG). **Figure 2.** The stained androgenic gland lodged over ED. **Figure 3.** The histological horizontal section of ED with ANG. **Figure 4.** The cross section of Ejaculatory duct (ED) with androgenic gland (ANG). The gland shows type 1 and type 11 cells. **Figure 5.** The magnified image of ANG with two types of cells. ED exhibits columnar epithelium (EP) and muscle layer (MU). **Figure 6.** The androgenic gland (ANG) with secretory vesicles (SV).

DISCUSSION

The androgenic gland was first reported by Cronin (1947) and Charniaux-Cotton (1954) explained the androgenic gland in amphipods and later found in isopods and decapods (Charniaux-Cotton *et al.*, 1966) and believed it to be related to sexual differentiation. In *P. plicatum* the androgenic gland is housed immediately exterior to the ED as in other brachyurans (Kon and Honma, 1970; Thampy and John, 1970; Joseph, 2007;Devi and Smija, 2014), whereas it is attached to the PVD in few crabs (Joshi and Khanna, 1982; Minagawa *et al.*, 1994; Liu *et al.*, 2008; Erkan *et al.*, 2010). The type 1 and type 2 of androgenic gland cells of *P. plicatum* were comparable to those of *S. paramamosain* (Liu et al., 2008) and *Travancoriana schirnerae* (Devi and Smija, 2014).

The androgenic gland was composed of two cell types in *Procambarus clarkii* (Taketomi, 1986), *Eriphia verrucosa* (Erkan *et al*., 2010) which corroborates with our present study. On the other hand *Ocypode platytarsis* (Thamphy and John, 1970) *Travancoriana schirnerae* (Devi and Smija, 2014) and *Scylla paramamosain* (Liu *et al*., 2008) ,three cell types could be distinguished in the androgenic gland and five cell types in *Orconectes nais* (Carpenter and De Roos, 1970).

Only two types of cells are identified in *E. verrucosa* (Erkan *et al.*, 2010) which corroborates with our present results. On the contrary, three types of cells are found in *S. paramamosain* (Liu *et al*., 2008); *O. platytarsis* (Thampy and John, 1970); *Macrobrachium rosenbergii* (Veith and malecha, 1983) and *T. schirnerae* (Devi and Smija, 2014).

In *P. plicatum*, the androgenic gland cells are irregular or polygonal with a central nucleus; a few cells, however, exhibit bi-nucleated condition. Similar nature is being reported in *M. brachydactyla* (Simeo *et al.*, 2009). These cells might form simple strands, as in most brachyurans, lobules as in Majoidea, or cords as in penaeids. In addition, they sometimes show anastomosis (Charniaux-Cotton and Payen, 1985); however, they all are covered with connective tissue externally. In type 2 cells in the androgenic gland in *Eriphia verrucosa*, vacuoles are mostly observed after high secretion activity during the mating season like our present study. There are significant differences in the activation and release of secretory material according to season (Carpenter and DeRoos, 1970; Liu *et al.*, 2008). The androgenic gland of the crab *Scylla paramamosain* is largest during the major mating season (July- September) (Liu *et al.*, 2008). Fingerman (1992) reported that there is no consensus among researchers concerning the chemical structure of androgenic hormone. King (1964) reported that the androgenic hormone in *Pachygrapsus crassipes* is proteinaceous in crustaceans.

CONCLUSIONS

The two distinct cell type in the androgenic gland of *P. plicatum* was based on the differences in the size, shape of nuclei and presence or absence of secretory vesicles. It is suggested that the structural differences exhibited between cell type 1 and type 2 in the present study may be due to different stages in the secretory activity. However, a comprehensive understanding of the structure of the AG in crabs is limited.

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REFERENCES

Awari, S.A. and Dube, K., 1999. Histological and histochemical study of androgenic gland of *Macrobrachium rosenbergii* (de Mann). *J. Aquacult. Trop*., 14, 101-112.

Carpenter, M.B. and De Roos, R., 1970. Seasonal morphology and histology of the androgenic gland of the crayfish, *Orconectes nais*. *Gen. Comp. Endocrinol*., 15, 143-157.

Charniaux-Cotton, H., 1964. Endocrinologie et genetique du sexe chez les crustaces superienrs. *Ann. Endocrinol*., 25, 36-42.

Charniaux-Cotton, H. and Payen, G., 1985. Sex differentiation. *In: The biology of Crustacea.* Vol. 9. pp. 217-299. DE Bliss, LH Mantel. (Eds.). New York, Academic Press.

Charniaux-Cotton, H., 1960. Sex determination. In: Physiology of Crustacea-Metabolism and Growth. Vol. 1, pp. 411-414. Waterman T. H. (Eds.). Academic Press, New York.

Cronin, L.E., 1947. Anatomy and histology of the male reproductive system of *Callinectus sapidus* (Rathbun) *J. Morphol*., 81, 209-240.

Devi, A.R.S. and Smija, M.K., 2014. Seasonal changes in the structure and secretory activity of the androgenic gland of *Travancoriana schirnerae*. *Cent. Eur. J. Biol.* 9(1), 70-79.

Erkan, M., Tunali, Y., Balkis, H. and Oliveira, E., 2009. Morphology of testis and vas deferens in the xanthoid crab, *Eriphia verrucosa* (Forskal, 1775) (Decapoda: Brachyura). *J. Crust. Biol*., 29, 458-465.

Fingerman, M., 1992. Glands and Secretion. In: Microscopic Anatomy of Invertebrates (Eds Harrison, F.W. and A.G. Humes,), Vol. 10, Decapod Crustacea. Wiley-Liss, New York, pp. 345-394.

Fowler, R.J. and Leonard, B.V., 1999. The structure and function of the androgenic gland in *Cherax destructor* (Decapoda: Parastacidae). *Aqua*., 171, 135-148.

Humason, L., 1967. Animal tissue techniques. Fourth Edition. W.H. Freeman and Company, San Franscisco.

Joseph, B., 2007. Studies on the hormones controlling reproduction in male decapod crustaceans. Ph.D. Thesis, Calicut University, Kerala, India.

Joshi, P.S. and Khanna, S.S., 1982. Structure and seasonal changes in the testes in freshwater crab, *Potamon koolooense* (Rathbun). *Proc. Indian Acad. Sci.* (Anim. Sci.), 91(5), 439- 450.

Katakura, Y., 1984. Sex differentiation and androgenic gland hormone in the terrestrial isopod, *Armadillidium vulgare*, an isopod crustacean. *Sym. Zool. Soc. Lond.* 53, 127-142.

King, D.S., 1964. Fine structure of the androgenic gland of the crab, *Pachygrapsus crassipes*. *Gen. Comp. Endocrinol*. 4, 533-544.

Kon, T. and Honma, Y., 1970. Studies on the maturity of the gonads in some marine invertebrates. IV. Seasonal changes in the testes of the tanner crab. *Bull. Jap. Soc. Sci. Fish.* 36, 1028-1033.

Li, X. and Li, G.Y., 1993. An androgenic gland of *Penaeus chinensis*: a new discovery. *J. Dalian Fish. Coll.* 8, 17-21.

Liu, H., Cheung K.C. and Chu, K.H., 2008. Cell structure and seasonal changes of androgenic gland of the mud crab, *Scylla paramamosain* (Decapoda: Portunidae). *Zool. Stud*., 47, 720-732.

Minagawa, M., Chiu, J.R., Cudo, M. and Takashima, F., 1994. Male reproductive biology of the red frog crab, *Ranina ranina* off Hachijojma, Izu Inlands, Japan. *Mar. Biol.* (Berlin), 118(3), 393-401.

Mirajkar, M., Sarojini R. and Nagabhushanam, R., 1984. Histophysiology of the androgenic gland in freshwater prawn, *Macrobrachium kistnensis*. *J. Anim. Morphol. Physiol., 31*, 211-220.

Okumura, T. and Hara, M., 2004. Androgenic gland cell structure and spermatogenesis during the molt cycle and correlation to morphotypic differentiation in the giant freshwater prawn, *Macrobrachium rosenbergii*. *Zool. Sci*., 21, 621-628.

Payen, G., 1973. Etude descriptive des principales étapes de la morphogenèse sexuelle chez un crustacé décapode à développement condense, Ecrevisse *Pontastacus leptodactylus leptodactylus* (Eschscholtz, 1823). *Ann. Embryol. Morphol.*, 6, 179-206.

Payen, G., Costlow, J.P.Jr. and Charniaux-Cotton, H., 1971. Comparative study of the ultrastructures of the androgenic glands of normal crabs and crabs undergoing bilateral eyestalk removal during larval life or after puberty in the species, *Rhithropanopeus harrisii* and *Callinectes sapidus*. *Gen. Comp. Endocrinol*., 17, 526-542.

Sagi, A., Cohen, D. and Milner, Y., 1990. Effect of androgenic gland ablation on morphotypic differentiation and sexual characteristics of male freshwater prawn, *Macrobrachium rosenbergii*. *Gen. Comp. Endocrinol*., 77, 15-22.

Sagi, A., Anir, E. and Khalaila, I., 1997. Sexual differentiation in decapods crustaceans: role of the androgenic gland. *J. Invert. Reprod. Dev*., 31, 55-61.

Simeo, C.G., Ribes, E. and Rotllant, G., 2009. Internal anatomy and ultrastructure of the male reproductive system of the spider crab *Maja brachydactyla* (Decapoda: Brachyura). *Tissue Cell*, 41, 345-361.

Suganthi, A.S. and Anilkumar, G., 1999. Moult-related fluctuation in ecdysteroid titre and spermatogenesis in the crab, *Metopograpsus messor* (Brachyura: Decapoda). *Zool. Stud.,* 38, 313-320.

Sun, P.S., Weatherby, T.M., Dunlap, M.F., Arakaki, K.L., Zacarias, D.T. and Malecha. S.R., 2000. Development changes in structure and polypeptide profile of the androgenic gland of the freshwater prawn, *Macrobrachium rosenbergii*. *Aquacult. Int*., 8, 327-334.

Taketomi, Y., 1986. Ultrastructure of the androgenic gland of the crayfish, *Procambarus clarkii*. *Cell Biol. Int.*, 10, 131-137.

Taketomi, Y. and Nishikawa, S., 1996. Implantation of androgenic glands into immature female crayfish, *Procambarus clarkii*, with masculinization of sexual characteristics. *J. Crust. Biol.,* 16, 232-239.

Taketomi, Y., Murata, M. and Miyawaki. M., 1990. Androgenic gland and secondary sexual characters in the crayfish, *Procambarus clarkii*. *J. Crustac. Biol*., 10, 492-497.

Taketomi, Y., Nishikawa, S. and Koga, S., 1996. Testis and androgenic gland during development of external sexual characteristics of the crayfish, *Procambarus clarkii*. *J. Crus. Biol.,* 16, 24-34.

Thampy, D.H. and John, P.A., 1970. On the androgenic gland of the ghost crab, *Ocypode platytarsis* (M. Edwards) (Crustacea: Brachyura). *Acta Zool*., 51, 203-210.

Veith, W.J. and Malecha, S.R., 1983. Histochemical study of the distribution of lipids, 3α and 3β hydroxysteroid dehydrogenase, in the androgenic gland of the cultured prawn, *Macrobrachium rosenbergii* (De Mann) (Crustacea: Decapoda). *S. Afr. J. Sci*., 79, 84-85.