Research Paper

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Role of Androgenic Gland on the Reproduction of the Male Marine Prawn, Penaeus Canaliculatus

Zoology

KEYWORDS : Androgenic gland, testicular acini, testicular index

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ABSTRACT

Penaeus canaliculatus is a commercially important decapods crustacean due to its high nutritional contents. The lack of information about the species and catching of only some commercially important crustacean species and neglecting other could account for falling marine catch. As small decapods and other organisms being the food for fishes, help the growth of fishes in that catchments area. The study has been carried out at Dahanu which is a town on the border of Gujarat and Maharashtra. The present study was executed on the androgenic gland of marine prawn, Penaeus canaliculatus to study location, morphology, histology and its role in annual reproductive cycle. The area of androgenic gland was increased in the reproductive period of the prawn. The total number of acini and the testicular index were also maximum during this period. The maximum area attained by the androgenic gland 56.2±2.74 in the month lo July and the total numbers of testicular acini were maximum 39.3±3.27 in the same month. The androgenic activity was decrease in non-reproductive period of the prawn. The testicular index and the total number of acini in testis was also lagged behind in the sperm production. These results suggest that there is direct relation between the androgenic gland and the spermatogenesis of the prawn.

Introduction

The role of androgenic gland in musculization was studied in *Orchestia gammarella* (Charniaux-Cotton 1954, 1957, 1962, 1963). Charniaux-Cotton and her co-workers (1966) reviewed the location, morphology and histology of this gland in various crustaceans. Carpenter and Roger (1970) studied the morphology and histology of the androgenic gland in crayfish, *Ornectes nais*. Mirajkar et al., (1984) studied the location, morphology and histochemistry of the androgenic gland, its probable role in the control of gametogenesis and annual reproductive cycle in the freshwater prawn, *Macrobrachium kistnenis*. Experiments were also carried out on sex deviation in the giant freshwater prawn, *Macrobrachium rosenbergii* through application of the androgenic gland hormone (Janssen and Prachuab – Lumubol, 1988). On the other hand, in prawn *Penaeus japonicus* a study on the organogenesis and differentiation of genital organs and the androgenic gland put in a question the role of the androgenic gland in the differentiation of the gonads (Nakamura, 1992, Nakamura et al., 1992) The differentiation of genital organs and androgenic gland in Kuruma prawn, *Penaeus japonicus* were studied by Nakamura (1992). In decapod crustaceans, the morphological and physiological effect of androgenic gland have been described by Taketomi et al 1990, 1996; Fowler and Leonard, 1999; Khalaila et al. 1999. In *P. clarkii*, a study of the effect of androgenic gland on the development of secondary sexual characteristics showed that androgenic gland implantation into immature female resulted in masculization of the first abdominal appendages. This procedure also leads to the inhibition of vitellogenesis (Taketomi and Nishikawa, 1996). The purification, characterization, sequencing and cloning of an androgenic gland hormone was described (Okuno et al., 1997; 1999; Martin et al. 1998, 1999). Suzuki and Yamasaki (1998) found that repeated implantation of ethanol treated androgenic gland into young females at different stages of sexual development caused gonad sex reversal at critical stage. Taketomi et al., (1996) described a histological study in the crayfish *Procambarus clarkii* at an early development stage showed a high correlation between the differentiation of the androgenic gland and testes. Awari and Kiran (1999) observed the histological and histochemical study of androgenic gland of *M. rosenbergii* and described three types of cells in it, and supported the idea of a proteinaceous androgenic hormone. Sun Piera et al. (2000) observed the development changes in structure and polypeptide profile of the androgenic gland of the freshwater prawn, *Macrobrachium rosenbergii*. Karplus et al. (2003) observed the influence of androgenic gland implantation on agonistic behavior of female crayfish (*Cherax quadricarinatus*) interaction with males. Barki et al. (2003) reported male like behavioral patterns and physiological alternations induced by androgenic gland implantation in female crayfish. The survey of literature reveals that in the marine prawn there is very few information about location, structure and role of androgenic gland in the annual reproductive cycle. Therefore the present study was executed on the androgenic gland of marine prawn, *Penaeus canaliculatus* to study location, morphology, histology and its role in annual reproductive cycle.

Material and methods

The marine prawn *Penaeus canaliculatus* were collected from Dahanu coast (Maharashtra) during the year 2002. The males were separated and the vas deferens along with seminal vesicles was carefully removed, after cutting coxopodite of the fifth walking leg. For histological studies the androgenic glands attached to vas deferens were fixed in Bouin's fluid. After 24 hours of fixation, the tissues were dehydrated in alcohol grade series and were paraffin embedded (58-60°C). The sections were cut at 6 to 7 mm thickness and stained with Harri's haematoxylin – eosin and mounted in D.P.X. The morphological changes in androgenic gland were observed. The testicular index was calculated by following formula (Giese, 1959).

$$\text{Gonad index} = \frac{\text{Wet weight of gonad}}{\text{Wet weight of animal}} \times 100$$

Result

Morphology of androgenic gland

In marine prawn *Penaeus canaliculatus*, the androgenic gland found near the seminal vesicle and along the vas deferens. It was not a compact structure but rather a diffused. The vas deferens was also diffused structure. The diameter of the androgenic gland near the vesicle could be measured (35-64µ). In whole mounts the androgenic gland was transparent and nuclei stained pink.

Role of androgenic gland in breeding cycle of prawn

Data in the form of seasonal morphology and histology of the androgenic gland of prawn, *Penaeus canaliculalus* was presented in Table-1. The androgenic gland was composed of only a smaller number of cells associated with vas deferens in the youngest prawn during the month of April and May. The size of androgenic gland increased through June and July. The activity of androgenic gland can be correlated with the activity of the testis. The maximum size attained by the androgenic gland was 56.2 µ during the month of July and in the same month, the maximum number of acini (39.3 ± 3.27) were observed in testis. The activity of the cells was decreased slowly. The cell wall collapsed by the end of August same pattern was repeated in November and December (Table –1). The testis also

lagged behind in its sperm production after the end of August. The androgenic gland activity was decreased in non-reproductive period of the prawn. From these results it can be concluded that the androgenic gland activity always related with the testis activity.

Table 1. Correlation between androgenic gland and testicular activity in *Penaeus canaliculatus* during the year 2002

Month	Androgenic gland area (μ) (mean ± S.D.)	Androgenic gland secretory activity	Total number of testicular acini ± S. D.
January	7.2 ± 2.14	Androgenic gland cells were not active	11.6 ± 2.35
February	3.9 ± 1.02	The few cells were not active	7.2 ± 2.82
March	- - -	- - -	- - -
April	- - -	- - -	- - -
May	9.4 ± 1.38	The cells were increased	11.8 ± 3.14
June	41.6 ± 2.21	The AG cells compactly arranged and secretory in nature	16.2 ± 2.45
July	56.2 ± 2.74	Well developed cells with dense cytoplasm	39.3 ± 3.27
August	27.8 ± 3.13	Completely regressed AG in degenerating condition	31.2 ± 3.05
September	18.1 ± 2.07	Degenerated androgenic gland with mass of tissue.	20.6 ± 2.52
October	13.6 ± 2.96	The cells were not active	7.4 ± 1.20
November	27.3 ± 3.22	The cells were increased in number.	12.7 ± 1.61
December	30.7 ± 4.83	The cells were increased in number and synthetic activity also.	17.3 ± 1.34

Discussion

In marine prawn, *Penaeus canaliculatus* androgenic gland is located near seminal vesicle along the vas deferens and it is a diffused structure. The androgenic gland composed of cord of cell, which are loosely arranged, with dark blue-black nuclei and has less cytoplasm. Katakura (1960) reported that young females of *Armadillidium vulgare* into which the androgenic gland was implanted became musculinized almost completely. The progeny of normal female were heterogametic females (Katakura, 1961 a, 1961 b, 1967). He explained that this sex distribution is genetic mechanism and needs further analysis. In eyestalk of ablated zoea of *Rhithropanopeus harrisi* and megalopa of *Callinectes sapidus*, hypertrophy of androgenic gland was observed (Payen et al 1971). Mirajkar et al (1984) in *Macrobrachium kistnensis* reported that removal of the androgenic gland resulted in drastic effects on the spermatogenesis. All acini were destroyed and only mass of tissues remained. The injection of androgenic gland into the female prawns completely changed the structure of the ovary and it turned to a mass of tissue. Manor et al. (2004) studied the effect of AG on growth together with the molecular study on vitellogenin gene expression and demonstrated that the AG both promotes growth and inhibits female reproduction. In the present investigation, the structure and possible function of androgenic gland of prawn *Penaeus canaliculatus* was examined. The androgenic gland become highly active at the onset of spermatogenesis. When the androgenic gland activities decrease, the testis also lagged behind in its sperm production. Hence there is direct relation between androgenic gland activity and spermatogenesis in prawn.

Conclusion

The androgenic gland of *Penaeus canaliculatus* was located near the seminal vesicle and along vas deferens of male prawns. The activity of the androgenic gland cells was high in the month of July and August i.e. major reproductive peak. The number of testicular acini, were increased with the activity of the androgenic gland cells in prawn. It shows the relation between the androgenic gland activity and spermatogenesis.

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