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Proximal Changes During Reproduction Process of the Penaeid Prawn, *Penaeus monodon*

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Abstract: The ovarian development is of immense physiological importance. Present study reveals the changes in the proximate chemical composition, fresh mass, water content, ash content, organic constituents, lipid and protein contents and energy levels of penaeid prawn, *Penaeus monodon* during different reproductive stages. The reproductive stages were divided into 5 different stages, each is characteristic in its colour, histology and visual appearance. The results obtained in the present investigation showed the significance and also the alterations in the water, protein, inorganic and organic components in different reproductive stages of prawn Penaeus monodon.

Key words: Ovarian development % Prawn % *Penaeus monodon* % Proximal changes % Reproduction

INTRODUCTION

The penaeid prawns are considered to be one of the most important group of cultivable organisms which has attracted the several entrepreneurs for going for culture of these species because of their high growth rates, adoptability and tolerance to varied environments and popular food materials in different parts of the world. The juvenile tropical penaeid prawns *Penaeus monodon*, *P. indicus*, *Metapenaeus monoceros* are most abundant littoral penaeids found in the inshore and estuarine environments. But, mature prawns are commonly present in deeper offshore areas adjacent to the juvenile habitats. Despite in relative abundance, constituting over 75% of all prawn catches, the *Penaeus monodon* has received scant mention. With the exception of cursory investigations of its general biology, little data is available on reproductive physiology. Since the ovarian development is of immense physiological importance, the present study was initiated to investigate changes that may occur in mass and tissue composition during different reproductive stages. When comparing the changes in the biochemical composition of animals relative to various physiological phenomena, expression of results is of critical importance. Generally, results of this nature have been expressed as changes in percentage composition [1]. Although there is a wide variety of biological and fishery data on this prawn resource, the biochemical data relative to the reproductive biology of the penaeid prawn, *Penaeus monodon* [2]. Knowledge of the biochemistry and metabolic processes that occur during the reproductive cycle are essential for a complete understanding of crustacean reproduction. Therefore, biochemical changes during maturation, molting and reproduction have been examined for a number of crustacean species [3-6]. Many of these studies concerned lipid dynamics, since the accumulation and mobilization of these organic reserves constitutes one of the most significant metabolic events in the physiology of crustaceans [7]. The present study was carried out to evaluate the proximal changes during the reproductive process in the selected prawn species.

MATERIALS AND METHODS

Collection and Preservation: Immature *Penaeus monodon* were collected from nearly estuaries. Mature animals were collected from trawlers. The carapace length (distance between the Post-orbital notch and the posterior mid-dorsal margin of the carapace) and fresh mass were recorded for each prawn immediately on capture. The prawns were sexed and where analysis could not be undertaken immediately eg. with mature females trawled at sea, they were frozen pending analysis.

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Ovarian Development: The ovaries of adult females were classified into five distinct developmental stages based on an increase in ovary size and changing colour. Since *Penaeus monodon* can spawn a number of times once maturity has been attained, difficulty was experienced in distinguishing between a stage II ovary which was developing for the first time and a stage V or recently evacuated ovary which was re-developing after spawning had taken place. As the macroscopic appearance of these two stages is very similar, it was presumed that the size of first-spawners would be smaller relative to those which had spawned more than once. For this reason, prawns with a carapace length greater than 38 mm and having flacid ovaries were all classified as stage V to distinguish them from stage II ovaries in prawns with a carapace length of less than 38 mm.

Body Composition: After determining the stage of ovarian development, the prawns were paper dried and weighed and the carapace length was recorded. Most analysis was undertaken using intact individual prawns. Prawns were oven dried at 80° C for 48 hr, re-weighted and the loss of water recorded, as the water content. The dry carcass was then homogenized and stored in a deep freeze pending analysis. Protein was estimated using a standard Kjeldahl titrametric technique. Lipid determination followed a modified method of Bligh and Dyer [8]. Ash content was determined by combustion of 0.5 g homogenized aliquot for 4 hrs in a muffle furnace. Energy was determined using Bomb Calorie Meter and expressed in Joules.

Calculations: Standard animal of 38 mm is taken to describe changes attributed to ovarian development since a prawn of this size can be expected to have undergone at least one full cycle of reproductive development. Regression equation was derived from the relationship between carapace length and various tissue constituents. These data incorporate all stages of ovarian development.

Statistical Analysis: The experiments were done in triplicate. Data are expressed as the means±SD (standard deviation).

RESULTS

Changes in Proximate Composition During Ovarian Development Stages: Changes that occur in major tissue constituents of an adult female *Penaeus monodon* both during ovarian maturation (Stage I to IV) (Table 1) and immediately after spawning (Stage V) were shown in Figures 1-6. The fresh mass of prawn decreases significantly ($p<0.001$) during ovarian maturation from Stage I to stage IV (Fig. 1). The fact that lipid and protein increase from stage I to IV suggests that the loss in fresh mass is a function of water loss. This is confirmed in figure 2, which illustrates that the water content drops significantly ($p<0.001$) from stage-I to stage IV ($P < 0.001$). A trend of a significant increase ($p<0.001$) in body protein during ovarian development is apparent, similarly lipid levels also increase significantly from 0.685 g at Stage I to 0.995 at a stage IV (Fig. 3 and 4). These increases are reflected in a total energy increase of 24.58 KJ (Fig. 5). The inorganic content, as expected does not change during ovarian development (Fig. 6). After spawning (Stage V) there is an appreciable decline in the content of all body constituents except ash of these the decline in lipid content is significant, which emphasizes the importance of this constituent during egg development. Both protein, lipid and consequents energy tend to return to a pre developmental level similar to that at the onset of ovarian maturation while the water content remain at a lower value.

Table 1: Criteria for staging Ovarian development in *Penaeus monodon*

Stage of Development	Description of Ovary
I	Opaque – slender
II	Yellow – green – slightly distributed
III	Lime to dark green – distended
IV	Dark green and granular - Fully distended
V	Orange / yellow - Flacid

An additional fact arising from the analysis of sexually mature *P. monodon*, was that no developing or mature ovaries were found in either molt stages D_4 or A (data not shown) suggesting that molting takes precedence over Ovary development. This is not unexpected since antagonism between these two functions has been reported for a variety of crustaceans [9, 10]. The lack of development at these pre-and post ecdysial stages suggests that for ecdysis to occur ovarian re-absorption must take place since stage III and stage IV ovaries have been found in prawns. This is in agreement with the findings of Armitage *et al*. [11], who reported that in the crayfish, *Orconnects nais* associated with low or decreasing ovarian masses. It is not yet apparent why ecdysis cannot occur during ovarian development since re-absorption seems an unnecessary expenditure of energy. Development of a fully ripe ovary seems to occur in a relatively short time since stage IV ovaries have been found in prawns. The rapidity of development suggests that the re-absorbed ovarian constituents are stored so that soon after ecdysis these can be mobilized for synthesis of ovarian tissue.

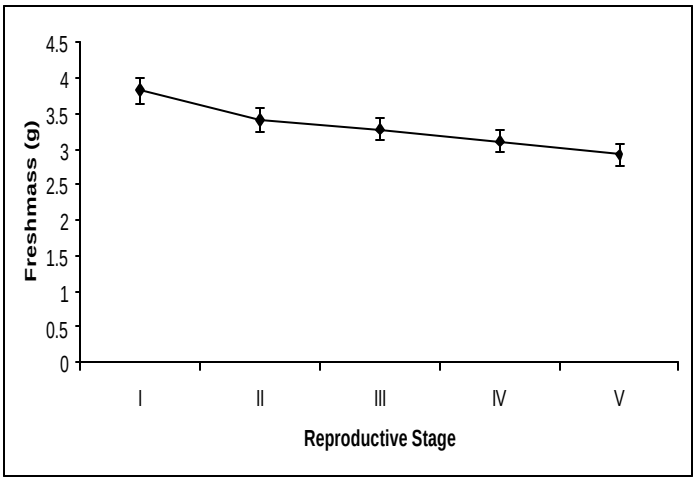

Fig. 1: Changes in freshmass (g) in different reproductive stages of the prawn *Penaeus monodon*

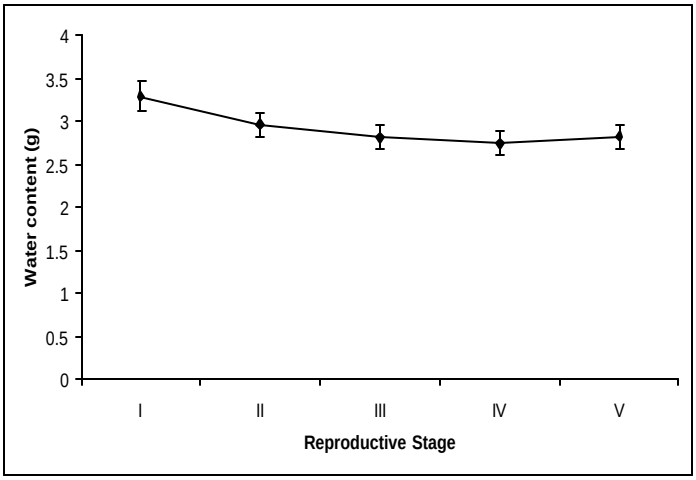

Fig. 2: Changes in water content (g) in different reproductive stages of the prawn *Penaeus monodon*

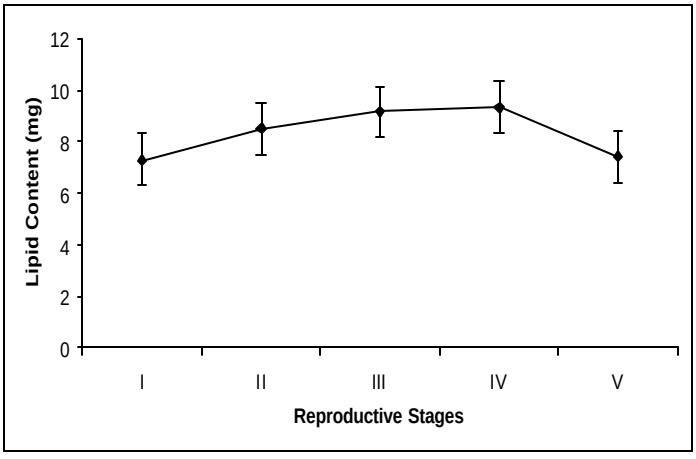

Fig. 3: Changes in lipid content (mgs) in different reproductive stages of prawn *Penaeus monodon.*

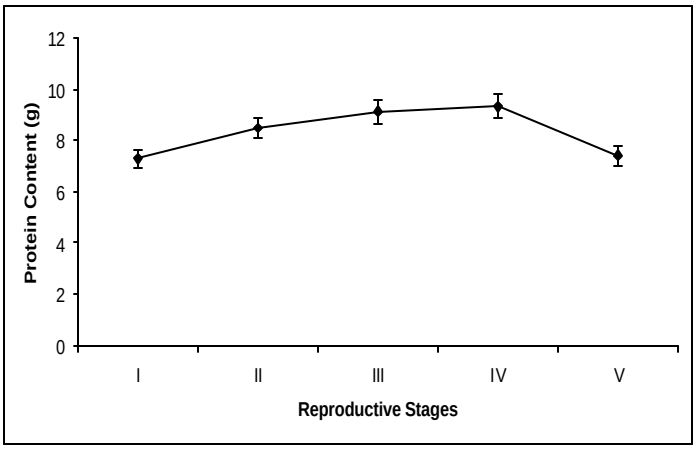

Fig. 4: Changes in protein content (g) in different reproductive stages of prawn *Penaeus monodon*

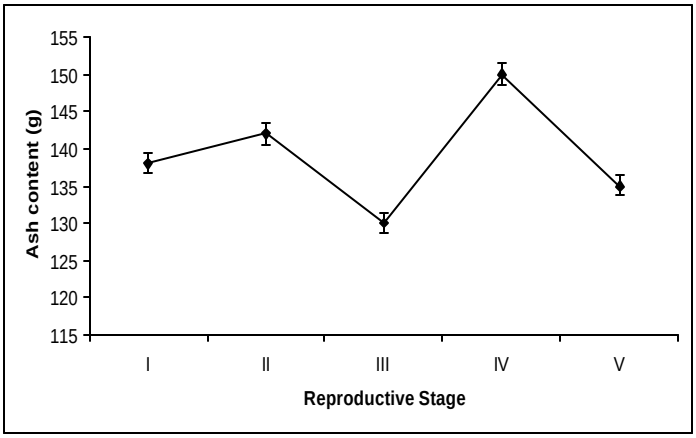

Fig. 5: Changes in ash content (g) in different reproductive stages of prawn *Penaeus monodon*

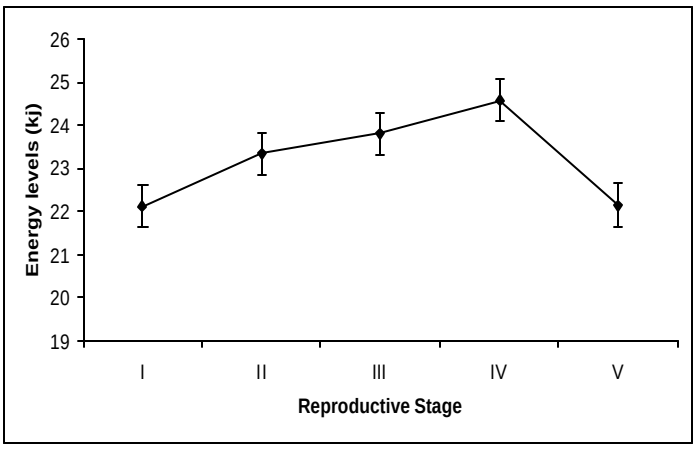

Fig. 6: Changes in energy levels (KJ) in different reproductive stages of prawn *Penaeus monodon*

In conclusion this study has shown that expression of the result on an absolute basis has enabled quantitative percentage differences during ovarian development. Of the changes in mass and chemical composition, the varying water content has proved the most revealing. The results obtained in the present investigation through light on the significance of water, protein, inorganic, organic components and energy levels in different reproductive stages of the prawn, *Penaeus monodon*.

REFERENCES

1. Johnson, J.T. and T.L. Hopkins, 1978. Biochemical components of the mysid shrimp Taphromysis, J. Exp. Mar. Biol. Ecol., 31: 1-9.
2. Tuck, I.D., C.J. Chapman and R.J.A. Atkinson, 1997. Population biology of the Norway lobster, Nephrops norvegicus (L.) in the Firth of Clyde, Scotland - I: Growth and density. ICES, J Mar. Sci., 54: 125-135.
3. Gehring, W.R., 1974. Maturational changes in the ovarian lipid spectrum of the pink shrimp *Penaeus duorarum* Burkenroad. Comp. Biochem. Physiol., 49A: 511-524.
4. Read, G.H.L. and M.S. Caulton, 1980. Changes in mass and chemical composition during the moult cycle and ovarian development in immature and mature *Penaeus indicus* Milne Edwards. Comp. Biochem. Physiol., 66A: 431-437.
5. Galois, R.G., 1984. Variations de la composition lipidique tissulaire au cours de la vitellogenese chez la crevette *Penaeus indicus* Milne Edwards. J. Exp. Mar. Biol. Ecol., 84: 155-166.Galois 1984;
6. Castille, F.L. and A.L. Lawrence, 1989. Relationship between maturation and biochemical composition of the gonads and digestive glands of the shrimps *Penaeus aztecus* Ives and *Penaeus setiferus* (L) J. Crustacean Biol., 9(2): 202-211.
7. Teshima, S., A. Kanazawa, S. Koshio and K. Horinouchi, 1989. Lipid metabolism of the prawn *Penaeus japonicus* during maturation: variation in lipid profiles of the ovary and hepatopancreas. Comp. Biochem. Physiol., 92B: 45-49.
8. Bligh, E.G. and W.J. Dyer, 1959. A rapid method for total lipid extraction and purification. Can. J. Biochem. Physiol., 37: 911-917.
9. Skinner, D.M., 1985. Molting and regeneration. In: The Biology of Crustacea. Integument, Pigments and Hormonal Processes, Eds., Bliss, D.E. and L.H.Mantel, Vol. 9. Academic Press Inc, New York, pp: 14-128.
10. Adiyodi, K.G., 1985. Reproduction and its control. In: The Biology of crustacean, Eds., Bliss, D.E. and L.H.Montel, 9: 147-215, New York.
11. Armitage, K.B., A.L. Buikema and N. Williams, 1978. Organic constituents in the annual cycle of the crayfish, *Orconectes nais*. Comp. Biochem. Physiol., 45: 825-842.