Growth of potentially edible crab, Albunea Symmista(Decapoda:Anomura) with reference to Its reproduction

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Abstract

In the anomuran crab Albunea symmista, the extent of epidermal retraction and the developmental changes of setae on the pleopods were used to define the molt cycle stages. The female crab Albunea symmista exhibits reproductive and non-reproductive molt. Hence, it shows antagonistic relationship with molting and reproduction. Thus in the case of anomuran crab Albunea symmista spawning is always followed by two successive molt. The ovary of reproductive molt remains in the spent stage. It does not undergo any further development, awaiting for the embryo development on the pleopod and hatching out from the brood at the time of the early remount stages. The ovary of non reproductive molt does not completes its maturation in the next post molt stage. As the ovarian development proceeds, the animal gets molted and it does not undergo continuous spawning in this stage. The matured ovary spawns in the late postmolt or early intermolt during reproductive molt cycle and the cycle continues.

Introduction

Among arthropods, crustaceans occupy both aquatic and terrestrial habitats with tremendous adaptive diversity[3]. In accordance with their adaptive nature, it shows variety of reproductive strategies that enable them to successfully colonise in their respective habitats. Decapod crustacean species are distributed in the tropical and sub-tropical regions of the world.

Growth in crustaceans includes all physiological, biochemical and morphological changes that occur during the periodic shedding and reformation of exoskeleton. In crustaceans, three types of relationship exists between molting and reproduction[1]. In crabs and lobsters where the reproduction starts during the intermolt period. Isopods, amphipods and shrimps show synchronization of both molting and reproduction. Cirripedes require several molt cycles to complete the reproduction. In freshwater prawn *Palaemon serratus*, the vitellogenic period, ordinarily extends through the period of three molt cycles. The relationship between molting and reproduction is much more evident in the females as vitellogenesis as well as secretion of a new cuticle occurred during molting[12].

It is evident that there is little information available with reference to the growth and reproduction of anomuran crabs with an exception of the genus Emerita. Therefore an attempt has been made throw more light into the mechanism of growth and reproduction of the anomuran crab, *Albunea symmista*.

Materials and Methods

Molting Stages

The molting stages were characterized based on the criteria of Drach[4]. As the pleopod of the animal is relatively transparent, they were used to classify the molting stages. The moulting stages in this animal are characterized by observing the level of retraction of the epidermis from the cuticle. The terminal part of a pleopod is cut with scissors and placed in a drop of clean seawater on a microscopic slide covered with a cover slip and examined through a compound microscope.

Ovarian Stages

The ovarian stages of *Albunea symmista* were classified based on the criteria as adopted by Kerr[8], Wolin et al.[14]. The crab was cut opened and the ovaries were removed carefully for observation. The color of the ovaries was taken as one of the criteria to determine the ovarian developmental stage.

Results

Characterization of Molting Stages

The molting stages in *Albunia symmista* were identified by the changes in the epidermal layer of pleopods and uropods. External characters such as shell hardness remains an unreliable indicator of molt stages.

The molt stages in *Albunea symmista* have been determined and classified into four major stages namely post molt, intermolt, premolt and ecdysis with several sub stages based on the retraction of epidermis and formation of new setae.

Postmolt

Post molt occurred immediately after ecdysis. The cuticle is completely soft and smooth. The pleopod is soft and transparent. This stage is divided into A and B.

Stage – A

This stage was characterized by the soft and smooth carapace. Microscopical examination of the pleopod shows distribution of granular matrix in the pleopod as well as in the setal lumen.

Stage – B

In this stage, carapace continues to be hardened but the lateral side of the carapace can be compressed with the finger pressure. The nature of the pleopod remains same as like that of the stage A. (Fig .1)

Fig. 1: Post molt.

Intermolt

During this stage, the carapace becomes progressively hard and calcified. The intermolt stage can be divided into two sub stages namely C1 and C2 based on the setagenic events in the pleopods. The granular matrixes of the setal lumen retract and form cones and these setal cones are prominently seen during this stage.

Stages – C1

Completely hardened exoskeleton was observed in this stage. The cellular matrix of the setal lumen condenses and forms the setal cone and this setal cone was prominent during the stage C1.

Stages – C2

Retraction of setal cone continues and it forms the condensed setal cone in the stage C2 and the exoskeleton remains hard.

Fig. 2: Intermolt.

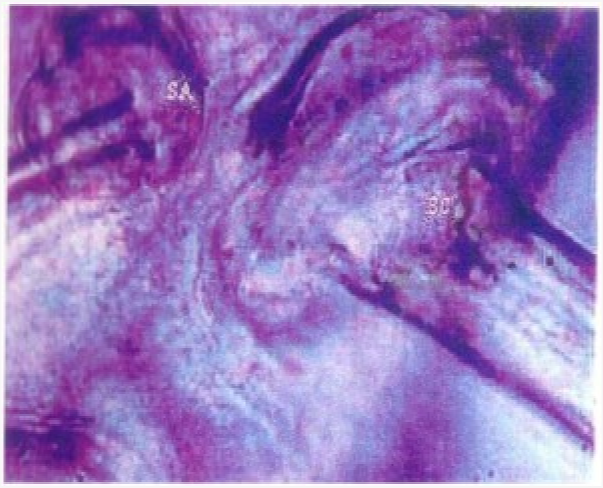

Fig. 3: Intermolt.

Stages – C2

Retraction of setal cone continues and it forms the condensed setal cone in the stage C2 and the exoskeleton remains hard.

Premolt

It is the preparatory stage for molt. This stage was subdivided into five sub stages namely D0, D1, D2, D3, and D4. This classification is mainly based on the retraction of epidermis and formation of a new cuticle.

Stages – D0

Exoskeleton remains hard in this stage. The wavy groove formed at the posterior end of the pleopodal lumen. Setal groove further moves towards the apical tip of the pleopod during this stage.

Stages – D1

The epidermis is clearly retracted from the pleopod tip. Apolysis is evident in this stage which is characterized by the formation of a small gap.

Stages – D2

Retraction of epidermis further widens in this stage as a result of which a small gap is formed between old and new cuticle. Newly formed setal groove protrudes into this retracted zone. (Fig 4).

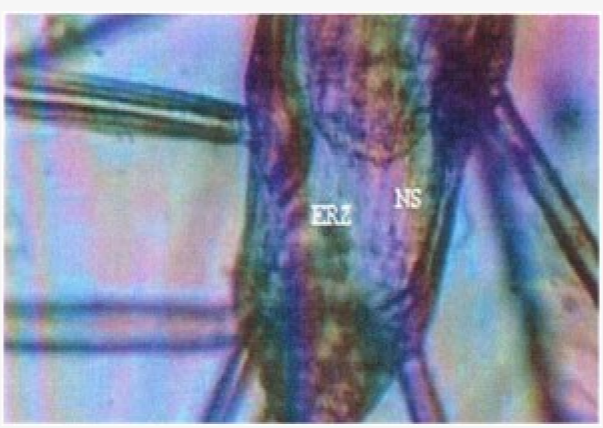

Fig. 4: Premolt.

Stages – D3

In this stage the exoskeleton can be compressed by finger pressure. Setal articulation can be prominently seen at the base of new juvenile setae.

Stages – D4

Exoskeleton becomes soft and it become brittle on compression. Setal development is completed in this stage. The new cuticle begins to absorb the water as a result of which the body cavity swells from its original size. (Fig 5).

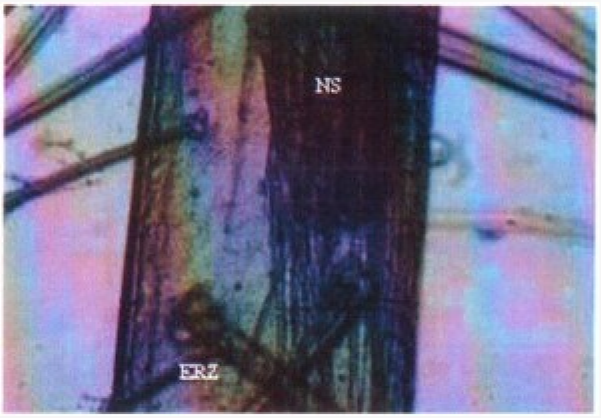

Fig. 5: Premolt.

Ecdysis

The animal starts absorbing water which is distributed within the body. The carapace because of increased the hydrostatic pressure lifts decalcified ecdysial suture which is formed at the thoraco-abdominal membrane (Fig. 6). When this ecdysial suture ruptures, the carapace is lifted and the animal swings forward to come out of the old exoskeleton. A freshly moulted*Albunea symmista* remains sluggish. It finds difficult to burrow in the sand. Freshly moulted animal was reddish in colour (Fig. 7).

Fig. 6: Ecdysis.

Fig. 7: Ecdysis.

Characterization of Ovarian Stages

There are four major stages of ovary in the anomuran crab *Albunea symmista* such as immature (stage –I), maturing (stage-II) mature (stage (III) and ripe (stage-IV) classified based on the ovary colouration and yolk accumulation.

Stage-I

This immature ovary is white in color and no traces of yolk were observed.

Stage–II

In this stage, the ovary acquires a yellow color due to the accumulation of yolk granules to one quarter of the oocyte.

Stage–III

Ovary turns to light orange in colour as most of the maturation of oocyte completes in this stage. Only one quarter of the oocyte remains unloaded with yolk granules.

Stage–IV

The ovary attains the ripe stage is dark orange in color shows, completion of maturation occurs in this stage.

Discussion

The growth and development in crustaceans are characterized by an unique process called molting in which the old exoskeleton is shed and replaced by a new cuticle.

Generally eyestalk ablated decapods show accelerated growth. These decapods crustaceans molt more frequently and increase in size during each molt when the eyestalk are abalated .Whereas in the case of *Albunea symmista*, even though there is a complete obliteration of both eyes and eyestalk for the adult, it takes longer duration to complete its molt cycle when compared to the other eyestalk ablated crustaceans. This might have been due to the incorporation of eyestalk neural elements into the brain of *Albunea symmista*[7].

The blind crab, *Albunea symmista* shows priority for its growth rather than its reproduction. *Albunea symmista* takes longer duration of about three months to complete its molt cycle. The first pubertal molt in *Albunea summista* occurs at a length of 27 mm. Reproductive activities start after the pubertal molt. Crabs with carapace length lesser then 27mm undergoes molting frequently so as to increase their size.

Albunea symmista exhibits antagonistic relationship with molting and reproduction. There is no synchronization of both molting and reproduction process in this crab. During reproductive molt, reproductive process such as vitellogenesis, spawning, embryogenesis and hatching occurs. Secondary vitellogenesis is postponed until hatching of the first brood. During the process of embryogenesis the ovary remains in the spent stage. The ovary did not undergo any further development. After successful hatching, the animal enters into molting. Whereas, during non-reproductive molt, the secondary vitellogenic process continues and the reproductive activities such as vitellogenesis, spawning, embryogenesis and hatching are interrupted during this cycle.

The adult crab, *Emerita asiatica* undergoes continuous molting and reproduction throughout the year[10116]. The crab mateusually spawns during the postmoult stage. Subsequently, it undergoes embryogenesis in the intermolt.

An interesting feature is that the ovary undergoes concurrent development with the ovarian index. During the time of hatching at D_1 stage, the ovary remains in the ripe condition and it enters into molt[6].

The female lobster *Homarus americanus* spend two years to complete its reproductive cycle successfully. The female molts and mates in during first summer, spawns in the following summer and it carry the eggs on her pleopods until they hatch by third summer[13].

Eyestalk ablated female *Palaemon serratus* complete its vitellogenesis in a single moult cycle. However, it takes three molt cycles to complete a vitellogenic cycle[5]. Further, unilateral eyestalk ablation increases the fecundity rate of the first spawner. But, it had no effect on spawning of female that had spawned previously[9].

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APPENDIX 1

Abbreviation Used:-

SA – Setal articulation, GM – Granular matrix, SC – Steal cone, ERZ – Epidermal retraction zone, NS – New setae.

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