

The structure of Calcareous Rings in *Stichopus hermanni* Semper and *Holothuria atra* Jaeger

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ABSTRAK

Cecincin kapur dua spesies timun laut tempatan, *Stichopus hermanni* Semper dan *Holothuria atra* Jaeger telah dikesan, dibedah, dikeluarkan dan direkod. Setiap satu cecincin kapur kedua spesies ini mempunyai sepuluh kepingan diikat rapi oleh tisu perantara. Kepingan radial *H. atra* berbentuk segi empat tepat dengan satu tonjolan di bahagian anterior sedangkan pada *S. hermanni* ianya berbentuk seakan segi empat terdiri daripada 4 alur di bahagian anterior dan satu lekuk di bahagian posterior. Kepingan antara radial kedua-dua spesies adalah lebih kecil dari kepingan radial. Satu alur terdapat di bahagian anterior kepingan antara radial pada cecincin kapur *H. atra*. Pada *S. hermanni* pula, alur yang terdapat pada bahagian anterior kepingan antara radial adalah nipis dan jelas. Di bawah mikroskop elektron imbasan kepingan cecincin kapur dari kedua-dua spesies timun laut itu memperlihatkan mosaik yang mengandungi banyak spikul kecil terikat rapi antara satu sama lain.

Kata kunci: *Holothuria atra* Jaeger, *Stichopus hermanni* Semper, timun laut, cecincin kapur, mikroskop elektron imbasan.

ABSTRACT

The calcareous rings of two species of local sea cucumbers, *Stichopus hermanni* Semper and *Holothuria atra* Jaeger, were located, dissected, exposed and recorded. The calcareous rings of both species each composed of ten plates knit together by connective tissues. The radial plate of *H. atra* was a square with a notch at the anterior part whereas in *S. hermanni* it was squarish consisting of 4 ridges in the anterior part with a notch at the posterior part. The interradial plates of both species were smaller than the radial plates. A ridge was present at the anterior part of the interradial plate in *H. atra*. In *S. hermanni*, the ridge at the anterior part of the interradial was thin and prominent. Under the scanning electron microscope the calcareous rings from the two species exhibited a mosaic of small, numerous spicules bound to each other.

Key words: *Holothuria atra* Jaeger, *Stichopus hermanni* Semper, sea cucumber, calcareous rings, scanning electron microscope.

INTRODUCTION

Sea cucumbers are an extant class of echinoderms which comprise about 1400 living species (Gilliland 1993). These marine animals are found at all depth of the sea from the tidal zone to deep sea, and are distributed over all latitudes from the poles to the tropics. Paleontologically the most important feature of these marine animals is their skeleton. The two main components of the skeleton of holothuroid comprise a calcareous circum-oesophageal ring (calcareous ring) and calcareous sclerites (spicules) of various shapes and sizes. Different shaped spicules can occur in the same species, and similar forms are found in distant related taxa. Sclerites are used in the classification of many genera and species, whilst the calcareous ring is useful particularly for distinguishing families and orders. Many studies on the skeleton of holothurians were focused on sclerites or spicules (Frizzel & Exline 1966; Rowe & Doty 1977; Pawson 1980), and only a few were on the calcareous ring (Hyman 1955; Pawson & Fell 1965; Pawson 1977; Liao 1980; Gilliland 1992). The tissues of Aspirochirotida especially from genus *Stichopus* are often used as the main ingredients in Malaysian traditional medicine (Tarlochan 1987; Ridzwan et al. 1993; Hawa et al. 1999; Fredalina et al. 1999). Certain species from genus *holothuria* secrete toxic compounds known as holothurin. It is therefore, sometimes crucial to identify the species

or genus of sea cucumbers which are not intact. The purpose of this study is to assist in identifying species of holothurians from the pieces of tissues available, especially the calcareous rings of two species of sea cucumbers, *Stichopus hermannii* and *Holothuria atra*.

MATERIALS AND METHODS

Samples of fresh *Stichopus hermannii* and *Holothuria atra* (Figure 1) were collected from Pulau Pangkor, Malaysia, and immediately immersed into 10% formalin. Later, the calcareous rings were dissected out and their morphology recorded. For scanning electron microscopy studies the calcareous rings were digested in sodium hypochlorite, fixed in formalin, washed in two changes of distilled water, passed through two changes of absolute alcohol, critical point dried (CPD) and fixed to a stub. They were then coated with gold, observed under the scanning electron microscope and recorded.

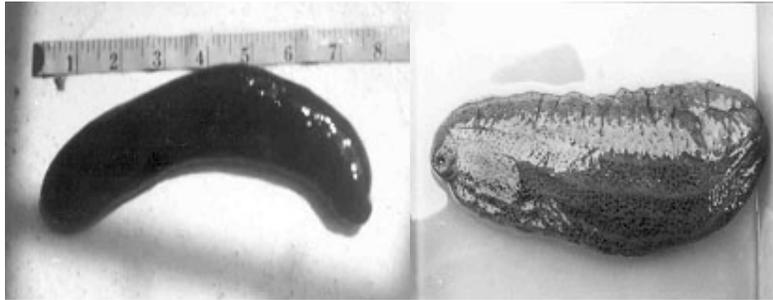


FIGURE 1. Local sea cucumbers *Holothuria atra* (a) and *Stichopus hermannii* (b)

RESULTS

The calcareous ring was composed of distinct plates joined together by connective tissue. It was divided into radial and interradial plates. In both the species there were ten plates in the calcareous ring, five radials and five interradials. The radial plates were larger than the interradial plates. These plates were squarish with the long axis parallel to the body.

In *Holothuria atra* the radial plates were square with a notch at the anterior part (Figure 2a). The interradials had a short ridge at the anterior part. In *Stichopus variegatus* the radial plates were squarish with four ridges at the anterior part and a notch at the posterior part (Figure 2b). The interradial plates were shorter with a tall, thin, prominent ridge at the anterior part. The calcareous ring of *H. atra* was obviously larger than that of *S. hermannii*. Under the scanning electron microscope the plates of the calcareous rings consisted of a mosaic of many tiny spicules bound to each other (Figures 3a and b).

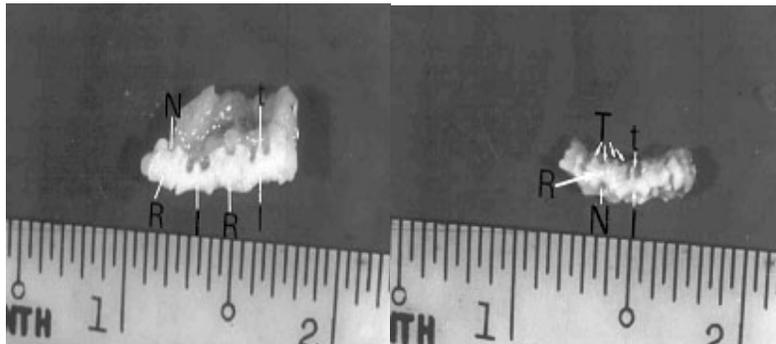


FIGURE 2. Calcareous rings of (a) *H. atra* and (b) *S. hermanni*. In *H. atra* a notch N was clearly seen at the anterior part of the radial plate (R). A ridge (t) was shown on the anterior part of the interradial plate (I). In *S. hermanni* four ridges (T) were shown at the anterior part of the radial plate (R) and a notch (N) at the posterior end. The interradial plate (I) had a thin, prominent ridge (t)

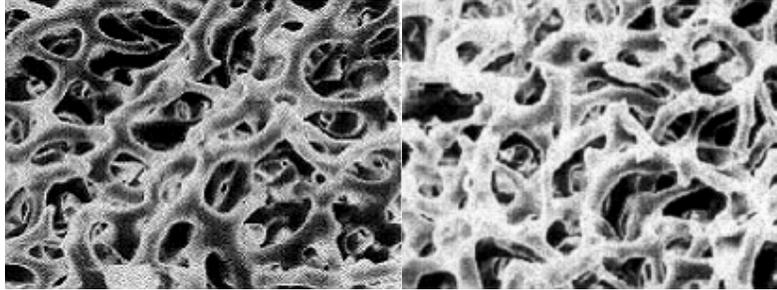


FIGURE 3. Electron micrographs showing the tiny spicules from the calcareous rings of (a) *H. atra*, (b) *S. hermanni*

DISCUSSION

The gross morphology of the calcareous ring has been considered from the point of view of ontogenic change, relative size and shape of different constituent elements and interspecific variation. The stereome structure varies in different calcareous rings even in one element. Our studies showed that the calcareous rings of the two species of the local sea cucumbers had a stereome architecture similar to that found in many other species (Hyman 1955; Thandar 1987). Due to the underlying pentaradial body plan, there were ten plates in a calcareous ring (five radials and five interradials). In most species the radial plates were larger than the interradials. Occasionally the ring comprised a mosaic of numerous pieces as reported by Pawson (1977). The calcareous ring has been studied mostly with respect to taxonomy, for which it is considered to be highly important (Pawson & Fell 1965). There are major differences in the calcareous rings of various and often between those of different families. The calcareous ring may be also useful in differentiating genera and species but apparently only in certain families (Hyman 1955; Liao 1980; Thander 1987). From our observation the calcareous ring of *H. atra* seemed to be larger than that of the *S. hermanni*. It also differed from the observation made by Thander (1987). The radial plate in *H. atra* had a notch at the anterior part as similarly observed by Thander (1987) whereas the radial plate of *S. variegatus* had four ridges at the anterior end with a notch at the posterior part and a prominent ridge in the interradial plate as in the *S. flaccus* (Liao 1980). Gilliland (1993) reported that these typical characteristics of the calcareous plates in *Stichopus* could be used to differentiate the genus and species of holothuroid.

The only histological and ultrastructural study to date is that of Moss and Murchison (1966) on the calcareous ring of *Actinopyga mauritiana*. Our observation on the ultrastructure of the plates also showed numerous tiny spicules bound together.

CONCLUSION

There was a difference in the shape of the calcareous rings between the two species of sea cucumbers studied. The distinctive shape of these plates in both the species, therefore, will be an additional key in taxonomic feature for the identification of sea cucumbers.

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