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Scanning electron microscope (SEM) studies of Radula of the Dog Conch *Strombus canarium* (Gastropoda: Prosobranchia: Strombidae)

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ABSTRACT

The radula has been recogonised as an important morphological criterion for the taxonomic allocation of species. The radula in general vary within a subclass that of prosobranch gastropods. The scanning Electron microscope (SEM) is one of the powerful tool in the studies of radula. In the present study the structural morphology of Strombus canarium radula were photographed on an scanning Electron microscope. The radula of S. canarium is typically of taenioglossate type with one median tooth flanked by one pair of lateral tooth and two pairs of marginals on each side (7 teeth per row). The lateral tooth is hook-shaped and curved inwards towards the central tooth. In taenioglossan snails, the radular formula is 2+1+1+1+2. The length of the radular ribbon measured 18 mm in S. canarium. The radula consists of seven teeth in each row, but each of these teeth has a distinctive shape and a specific number of tiny cusps on edges. The tooth in the centre is called center teeth or rachidian (R) teeth. Beyond each lateral, there is an inner marginal and outer marginal. It is obviously observed in the radula of herbivorous animals.

Keywords: gastropod, radula, taenioglossan, *Strombus canarium*, SEM.

INTRODUCTION

The most characteristic feature of the buccal cavity is the presence of radula, one of the hallmarks of the phylum. It is a chitinous ribbon bearing many transverse rows of firmly fixed teeth. Each row of teeth on the radula normally repeats precisely the number and shape of the teeth in the rows in front of it and behind. The Scanning Electron Microscope (SEM) permits the examination of radula with higher magnification without elaborate preliminary preparation and without squashing or fragmentation. The radular teeth are usually in odd numbers because the

row consists of a single tooth centrally placed, which is a central or rachidian teeth, with a series of others on either side broadly known as lateral teeth.

The radula has been frequently investigated because of its importance as a tool in supraspecific systematic to diagnose the species. The radula has also been recognized as an important morphological criterion for the taxonomic allocation of species. It shows general similarities at family and generic levels with consistent differences at the species level. The respective similarities and differences have been utilized to an increasing extent in the classification of strombid gastropods as the shape of the radula teeth is directly related to the kind of food, which the gastropods eat, and the way in which it is manipulated. The radular teeth of gastropods are adapted for a variety of feeding methods in different species.

The principles, on which the SEM is based, have been described by Oatley *et al.* (1965). Runham and Thornton (1967) used SEM to examine the radula of *Patella vulgata* and *Agriolimax reticulatus.* Radwin and Wells (1968) described the comparative, radular morphology of eleven species of muricid gastropods. The radulae of marine gastropods have been described by Freeman and Silva (1973) using SEM technique. The comparative radular morphology of 17 species of *Chicoreus* was described using SEM by Houart (1992). The most obvious use of SEM in the study of gastropod radulae is to investigate the cusp structures and patterns of tooth wear (Carriker, 1969), normal tooth functioning position (Carriker, 1969; Runham *et al.*, 1969), chemical composition of the teeth (Runham *et al.*, 1969) and radular growth (Isarankura and Runham, 1968). Recently, Stella (1995) observed the structural morphology of 4 species of *Chicoreus* radulae through SEM studies. Ragunathan (1996) described the radular morphology of *M. tribulus* and *C. virgineus.* Sanjeevi (2001) studied the radula pattern of herbivorous mesogastropod *L. lambis.* Studies on strombids are limited and the present study on *Strombus canarium* is the first work on Indian strombids.

Study Area

The snails were collected from the Mandapam coastal waters of the Gulf of Mannar for the radular study.

MATERIALS AND METHODS

Specimens of *S. canarium* measuring 75 – 80 mm in total length were collected. The outer hard shells were broken without any damage to the soft parts. The anterior portion of the proboscis was excised, the radula with adjoining tissues were removed from the proboscis and boiled with alkaline iodide solution until the dissolution of all the muscle fibres attached to the radulae. The radula thus obtained was then dehydrated by immersing in increasing concentration of alcohol (50, 70, 90 and 100%). The dehydrated radulae were prepared with coating for making them suitable for SEM observation.

Principally coating the radula consists of placing the specimen in a vaccum evaporator, pumping the chamber down to a vaccum level equivalent to that in the SEM specimen chamber and heating the conductive metal (gold) to the point that it vapourizes. A small part of the cloud of metallic vapour hits and sticks to the surface of the object to provide a thin metallic coating over it. Continuous tiltation and rotation of the specimen facilitated the metallic vapour to cover all

the sides of the specimen. Then the specimens were mounted in SEM stub and the observations were made with different magnifications for making electron micrographs by using JEOL JSM 35 CF Scanning Electron Microscope.

RESULTS

The radula of *S. canarium* is present in the buccal mass at the distal end of the long cylindrical muscular proboscis, which is an extension of the head. The buccal armature consists of a pair of laterally placed chitinous jaws and the odontophore is covered with cuticle to which the radula is fused and contains a number of skeletal structures called cartilages. These provide surfaces for the origin and insertion of a complex array of muscles involved in the feeding process. The radula runs dorsally over the buccal mass, but posteriorly it plunges down and the radular sac curves back dorsally, thus forming an 'S' curve. The radula is very small and delicate in large animals. In *S. canarium*, the radula is typically of taenioglossate type with one median teeth flanked by one pair of lateral tooth and two pairs of marginals on each side (7 teeth per row). The lateral tooth is hook-shaped and curved inwards towards the central tooth. In taenioglossan snails, the radular formula is 2+1+1+1+2. The length of the radular ribbon measured 18 mm in *S. canarium*. The radula consists of seven teeth in each row, but each of these teeth has a distinctive shape and a specific number of tiny cusps on edges. The tooth in the centre is called center teeth or rachidian (R) teeth. Beyond each lateral, there is an inner marginal and outer marginal (Plate 1). Central tooth has strong median cusp, marginals, falciform slender, edge more or less denticulate. It is obviously observed in the radula of herbivorous animals. The marginal teeth are unicuspid and bent posteriorly. The radular teeth are sharply pointed and sickle –shaped with the basal part attached to the radular membrane. Marginal teeth are longer than rachidian tooth and their bases are broader. The chemical composition of the radula was analyzed under SEM. As many as 9 elements were observed which have been listed in Table 1. Among the minerals, observed copper (33.55%) was predominantly present in the radula of *S. canarium* next to sodium (22.81%). Calcium, aluminium and magnesium were also present in appreciable levels. Potassium and manganese were present in lower levels.

Fig. 1. Mineral content in radula of *S. canarium*

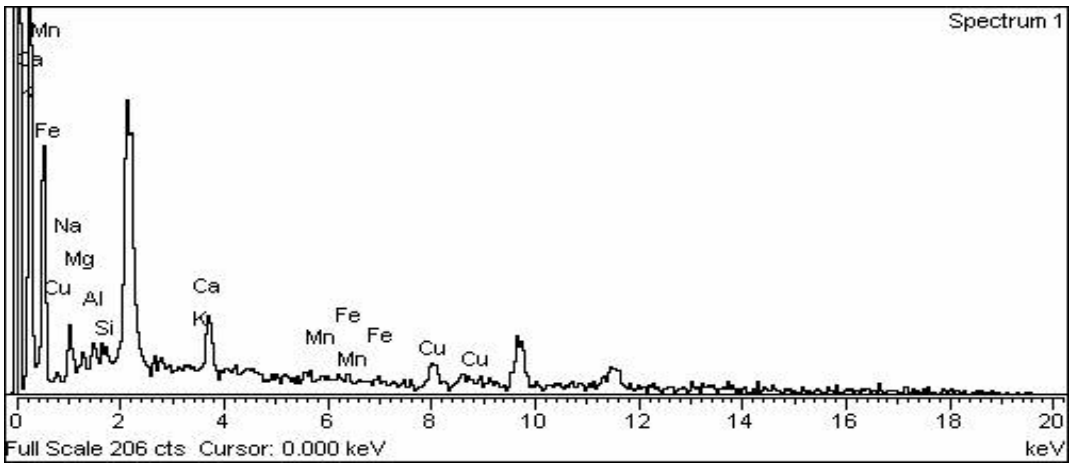


Table 1. Minerals present in radula of *S. canarium*

Element	Weight%
Na K	22.81
Mg K	7.84
Al K	9.82
Si K	2.34
K K	1.01
Ca K	18.30
Mn K	0.84
Fe K	3.50
Cu K	33.55
Total	**100.00**

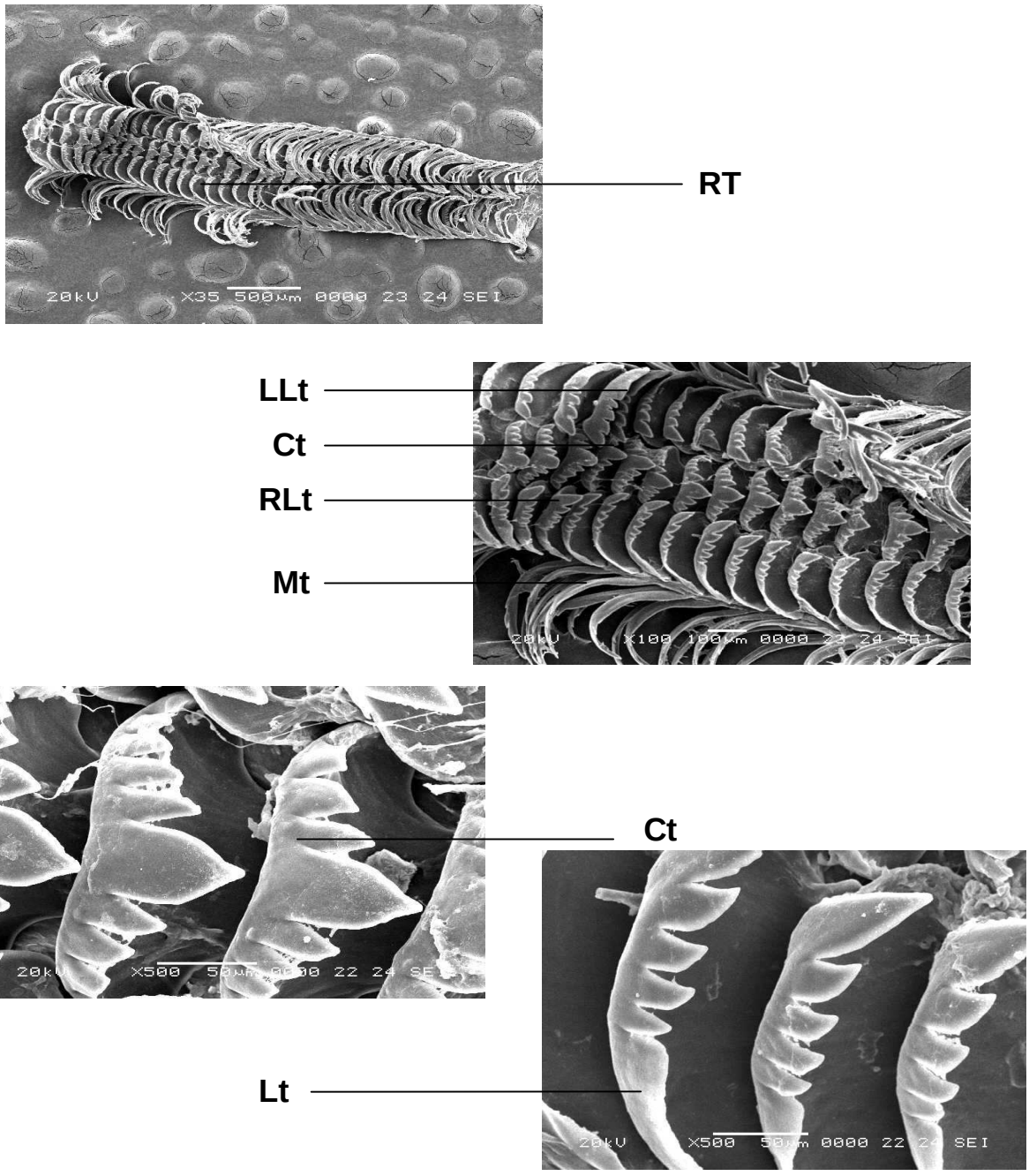
DISCUSSION

SEM observations on the radula of *S. canarium* elucidated various morphological features. The comparison of the radular morphology with the feeding habits and feed preference of strombid species presumably showed correlations, which reflect the fundamental role of radula. The radula of this species is proved to be typical taenioglossate type showing the radular formula of 2+1+1+1+2. In general, the radular ribbon is longer in *Strombus* species. The radular ribbon length is longer in the present species. Similar observation was made by Isarankura and Runham (1968) in gastropods. He also reported that the radular replacement was more and the reduction in size of radular teeth had correlation with its food and feeding habits. A long radula is favoured where wear and tear is extensive and it is shorter where its usage is less (Fretter and Graham, 1962).

According to Fretter and Graham (1962), the median or central teeth of taenioglossate radula helps in collecting the food, while the pleurocuspid marginal and laterals have more area for collecting particles by their splaying action (Steneck and Walting, 1982). Rosewater (1980) stated that in *Littorina* sp., taenioglossate radular type may be adapted for feeding on the algal flora of mangroves, driftwood and marsh grass. In *Strombus* spp. there is a close relationship between the radular ribbon and dental conformation. Similar observation was made in four other genera of the strombidae namely *Lambis, Rostellaria, Tibia* and *Terebellum.* Species of these genera have radula of the same general type (Cooke, 1895). Huxley (1853) observed in *Lambis* spp. that the radula moves back and forth over the ends of the bolters like rope over a pully. The rachidian teeth are pointed sharply with hooked marginal teeth, which are broad basally, and pointed distally in this species. The present study reveals that *S. canarium* has a generalized taenioglossate type of radula.

Chemical composition of the teeth showed the presence of copper, sodium and calcium compared to other elements. Extensive studies were done by Runham *et al.* (1969) on mineralization and hardness of radula in *Patella vulgata.* Since the copper content is more, the radula is harder and helps in building of strong cusps. These minerals also support in growth of the radulae. From the above study, it is clear that the mineral composition of the radulae is similar to that of minerals present in the body tissue. The presence of elements shows the hardness of the buccal cavity, which is of help in scraping the algal matter such as seaweeds and seagrass.

Plate 1: SEM showing the Radular teeth of *S.canarium*



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