

Scanning Electron Microscope (SEM) studies on Radula of the Spider Conch *Lambis lambis* and *Lambis adamii*. (Gastropoda: Prosobranchia: Strombidae) from Thondi Coast, Palk Bay- Tamil Nadu -South East Coast of India.

Estudios de microscopio electrónico de barrido (SEM) en rádula de la caracola araña *Lambis lambis* y *Lambis adamii*. (Gastropoda: Prosobranchia: Strombidae) de Thondi Coast, Palk Bay- Tamil Nadu -Costa sureste de India.

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ABSTRACT

The present study describes the morphology of two species of radula using SEM technique. In both *Lambis* species the radula *Lambis lambis* and *Lambis adamii* is taenioglossate type consist of one median tooth flanked by one pair of lateral teeth with two pairs of marginals on each side (7 teeth per row). In taenioglossan the radular formula is 2+1+1+1+2. In most details the radula of *Lambis adamii* resembles that of *Lambis lambis* but few apparent differences occur. The base of the central teeth is broad in *Lambis adamii* whereas in *Lambis lambis* it was concave. *Lambis adamii* and *Lambis lambis* the subquadrate central tooth with middle six cusps and in *Lambis adamii* the base of the central teeth is concave while in the *Lambis lambis* it was straight. In *Lambis adamii* two to three cusps present in the lateral teeth and it was inclined radular central where as in *Lambis lambis* the inner cusp is longer and slim

RESUMEN

El presente estudio describe la morfología de dos especies de rádula utilizando la técnica SEM. En ambas especies de *Lambis*, la rádula *Lambis lambis* y *Lambis adamii* es de tipo taenioglosado y consta de un diente mediano flanqueado por un par de dientes laterales con dos pares de marginales a cada lado (7 dientes por fila). En taenioglossan la fórmula radular es 2+1+1+1+2. En la mayoría de los detalles, la rádula de *Lambis adamii* se parece a la de *Lambis lambis*, pero se presentan pocas diferencias aparentes. La base de los dientes centrales es ancha en *Lambis adamii* mientras que en *Lambis lambis* era cóncava. *Lambis adamii* y *Lambis lambis* el diente central subcuadrado con seis cúspides medias y en *Lambis adamii* la base de los dientes centrales es cóncava mientras que en *Lambis lambis* era recta. En *Lambis adamii* de dos a tres cúspides presentes en los dientes laterales y estaba inclinado radular central mientras que en *Lambis lambis* la cúspide interna es más larga y delgada.

INTRODUCTION

The morphology of the radula, the chitinous strip of teeth found in mollusks, has traditionally been one of the most commonly used sources of data for studies on molluscan systematics. The shape and form of molluscan radular teeth are typically unique to a species or genus, and some features of the radula, such as tooth numbers, have been used to investigate higher level of molluscan taxonomic relationships. Intraspecific variations in radular characteristics are important and must be documented for molluscan relationships. SEM study is one of the powerful tools to observe the radula structure. Functional morphology of radula study focused on food-preparing and food gathering of teeth and their relationship. The radula study was recognized as one of the important morphological

criteria for the taxonomic allocation of species. Many studies on gastropod radula were made by Fretter & Graham, (1994). Wu (1965a) Radwin and Wells (1968) Isarankura and Runham, (1968) Carriker (1969) Runham Norman (1969), Solem Alen (1972) Freeman and Silva (1973) Fujioka (1984) Houart (1992) Stella (1995), Ragunathan (1996) and Sanjeevi (2001)

Stella and Balalakshmi (2011) and Ravichandran (2012) using SEM studies on the radular morphology of *Chicoreus* species (Gastropods: Muricidae) collected from Palk Bay in Tamil Nadu- South East Coast of India. The morphological features of radula by using SEM technique was described by Arularasan. et.al (2011) in *Strombus canarium*, Junhee Lee, et.al (2013) in *Strombus luhuanus*, Stella.et.al (2014) in *Chicoreus ramosus* Stella, et.al (2015) in *Muricanthus kuesterianus*, Venkatesan, et.al (2016) studied in four species of marine gastropods from the Gulf of Mannar and Stella (2019) in *Pugilinacochlidium*. However, no detailed work has been carried out to study radula, hence the present attempt has been made to study the morphological features of radula in *Lambis lambis* and *Lambis adamii*.

MATERIALS AND METHODS

In the present study, a regular survey was conducted at Thondi coast in Palk Bay area (Lat 9° and 10° and Long 79° and 80°) (Fig. 1). The species of *Lambis lambis* and *Lambis adamii*. are exclusively marine in distribution. The specimens were collected from the trawlers. The animals were brought to the laboratory and the outer hard shells were broken with a hammer. Care was taken not to damage the soft parts. The anterior portion of the proboscis was cut and used for the radular analysis with SEM. The radula removed from the proboscis was kept in a boiling tube containing alkaline solution. Dehydration was done by immersing the radula in increasing concentration of alcohol (50, 70, 90, 100%). Then the dehydrated radulae were brought to the next step of coating making them suitable for SEM observation. The SEM studies were made with the help of TESCAN make Scanning Electron microscope installed at CECRI, Karaikudi. The radular characters were examined using scanning electron microscopy (SEM, LEO-1530; Carl Zeiss, Germany). For the SEM preparation of the radula, a radula ribbon was extracted from the buccal mass of the specimen under stereomicroscope, was then placed in 1M potassium hydroxide solution, and was shaken vigorously to remove extra tissues. Water and ethanol were removed from the radula, dried and the radula was then coated with gold ion particles before the observation of radula morphology using SEM microscope.



Fig. 1. Thondi Study area.

RESULTS

In the present study, the radula of *Lambis lambis* and *Lambis adamii* is very small and it was delicated in large animals. The radula of *Lambis lambis* and *Lambis adamii* is *taenioglossate* type, it consists of flanked median tooth with one pair of lateral and two pairs of marginal teeth on each side. Lateral tooth hook-shaped and curved inwards towards the central tooth. The radular formula of taenioglossan type 2+1+1+1+2. In each row of radula ribbon consists of seven teeth with distinctive shape and tiny cusps on each edge. The centre tooth is called rachidian (R) teeth and each lateral tooth with inner and outer marginal tooth. Central tooth with median cusp, marginals, slender falciform and edge denticulate. Unicuspid marginal teeth and posteriorly bent, sharply pointed radular teeth and sickle –shaped and the basal part attached to the radular membrane. Marginal teeth are longer than central tooth and their bases are broader.

In matured animals the radula length is 1.8 cm in *Lambis lambis* and in *Lambis adamii* it was about 1.3 cm. Figs. 2-4 showed that the central teeth consist of central tooth with seven cusps and one with middle central. Towards the anterior end, there is a sharp and pointed median cusp and the central cusp of the central teeth larger than the lateral cusps. Central and lateral cusps are sharp and pointed and straight towards anterior end. The inner most cusps of the lateral teeth are smaller than central cusps of the central teeth. Each marginal tooth consists of one inner and outer marginal tooth with six cusps. Both inner and outer marginal tooth are sharp and straight along the axis of the radula .

In *Lambis adamii* the radula is similar to that of *Lambis lambis* (Photos.5-7). But there are some few apparent differences in size and shape . Central teeth have broad base in *Lambis adamii* when compare to *Lambis lambis*. Towards the anterior end the base of the median cusp is broad, short, pointed and straight. The lateral cusps are sharp and bent outwards, and the central cusps are longer. Marginal teeth with six cusps longer, broad, pointed and bent towards the central teeth. They are typically sickle shaped with broad strong base with six cusps. In *Lambis lambis* and in *Lambis adamii* consists of subquadrate central tooth with six cusps in the middle. The base of the central teeth in *Lambis adamii* is concave and in *Lambis lambis* it was straight. In *Lambis adamii* two to three cusps present in the lateral teeth and it was inclined radular central where as in *Lambis lambis* the inner cusp is longer and slim.

DISCUSSION

In *Lambis lambis* and in *Lambis adamii* the radula is taenioglossate type and the radular formula is 2: 1: 1: 1: 2. In two species of *Lambis lambis* and in *Lambis adamii* the SEM observation on the radula revealed various morphological feature. There is a close relationship between the radular ribbon and dental conformation was observed in *Lambis lambis* and *Lambis adamii* . Junhee lee. et.al (2013) reported that this similar observation was made in *Strombus (Conomurex) persicus*, *Strombus species S. luhuanus* and in *S. persicus*. In present study the radular ribbon is longer in *Lambis lambis* when it compared to *Lambis adamii*. This similar observation has been made by Ravichandran (2012) and Isarunkura and Runham (1968) in *Chicoreus virgineus ponderosus* and *Siratus virgineus ponderosus*. Morton (1986 a) reported that the smaller size of radular teeth appears to correlate with its environmental condition and food and feeding habits in *Hemifusus ternatanus* (Gmelin, 1791).In the present study the median rachidian of *Lambis adamii* has a broad basal region when compared to *Lambis lambis*. This similar observation has been made by Ravichandran (2012) and Wu, (1965) in *Chicoreus virgineus ponderosus* and *Siratus virgineus ponderosus*. The lateral tooth of these two species of *Lambis lambis* and in *Lambis adamii* resemble with each other. 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, 1894).

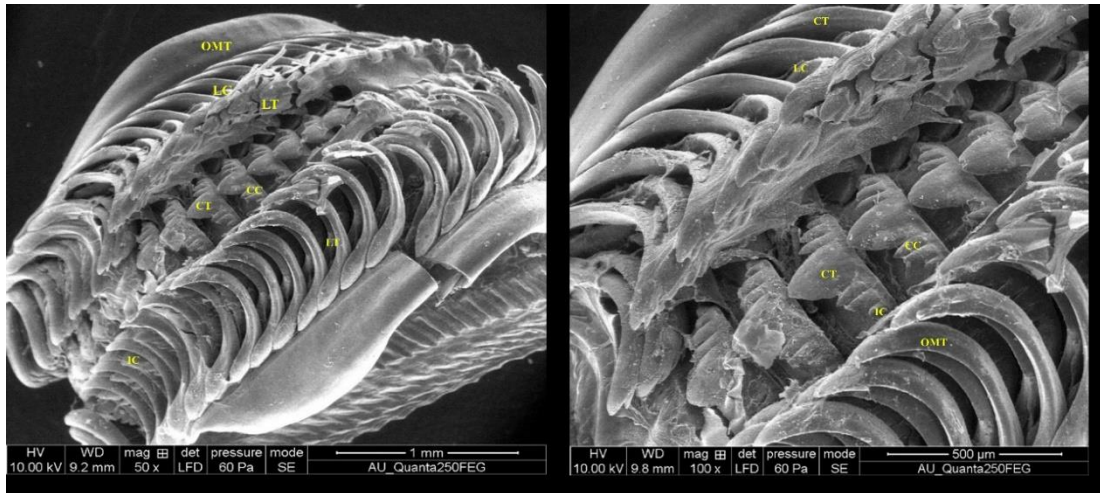


Fig. 2. Radula of *Lambis lambis* anterior region (left); central and lateral teeth (right).

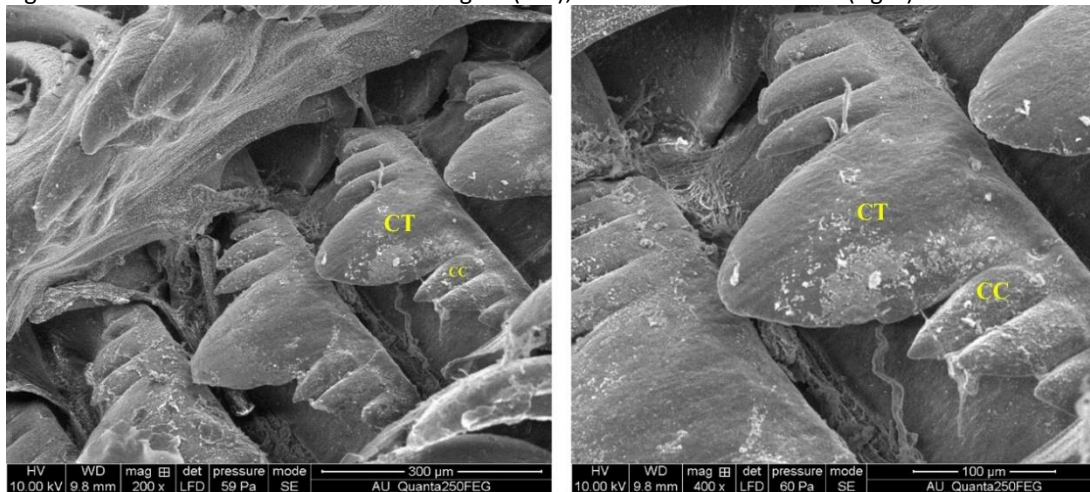


Fig.3. View of central cusps and inner most cusps of central teeth.

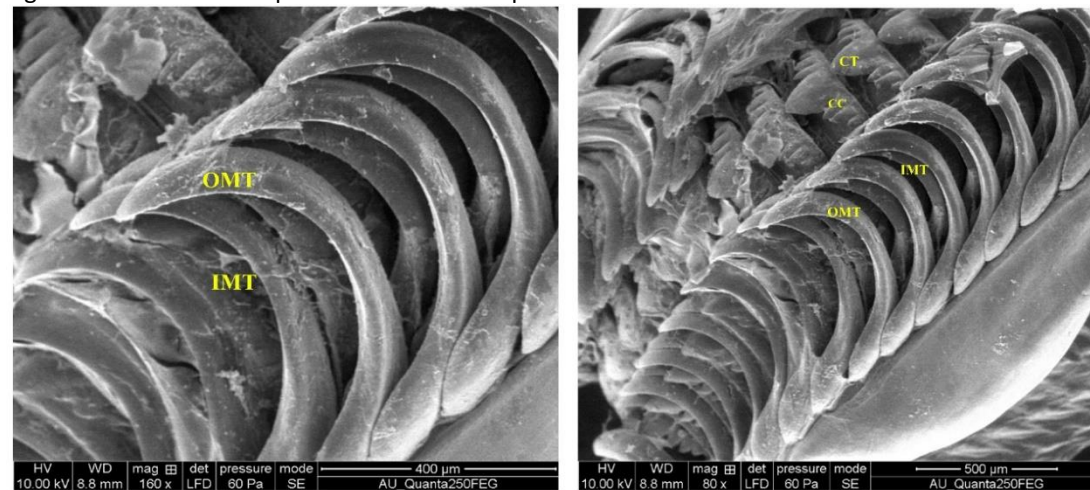


Fig. 4. Teeth: central marginal teeth (left) and posterior region (right).CT- Central teeth ;CC -Central cusps ; LT- Lateral teeth; IC – Inner most cusps; MT- Marginal teeth ;IMT-Inner marginal tooth and OMT- Outer marginal tooth

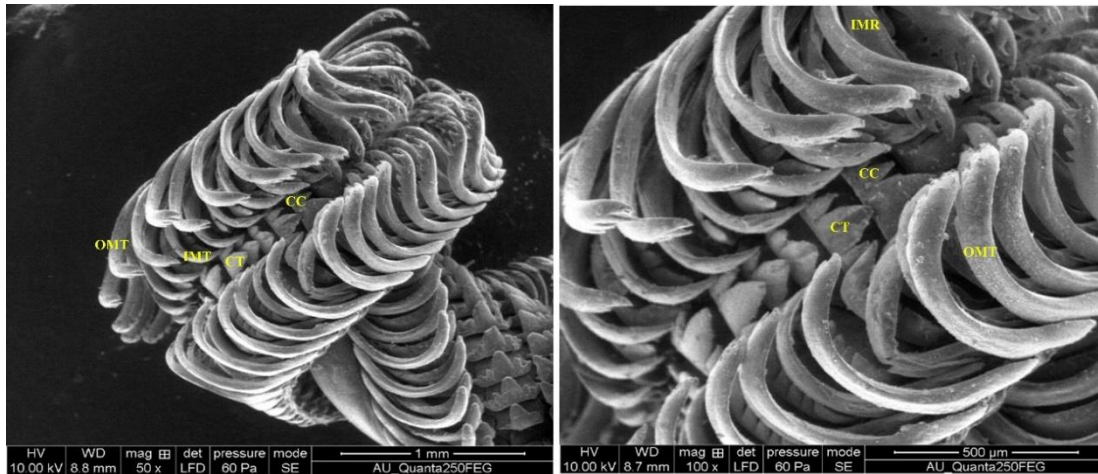


Fig. 5. Radula of *Lambis adamii* anterior region (left); central and lateral teeth (right).

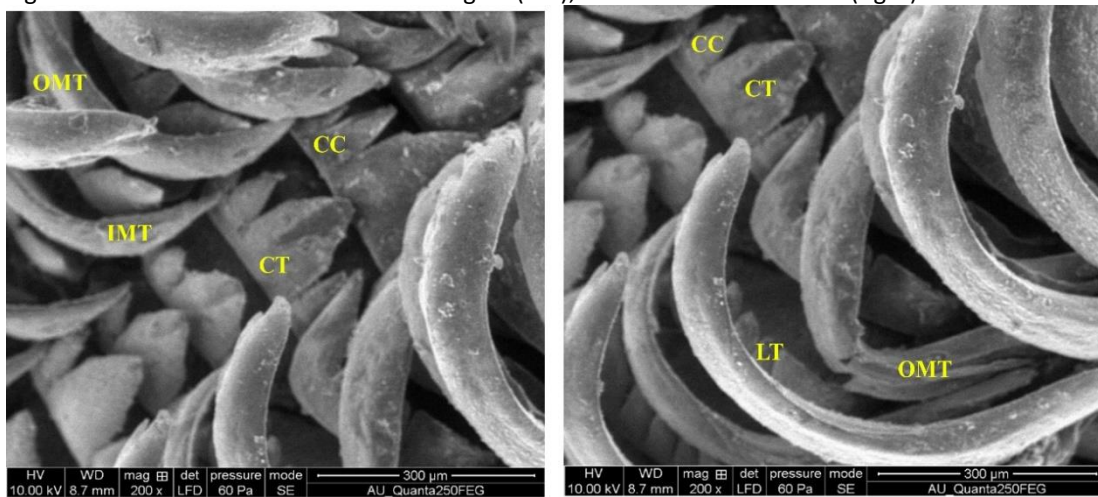


Fig.6. View of central cusps and inner most cusps of central teeth.

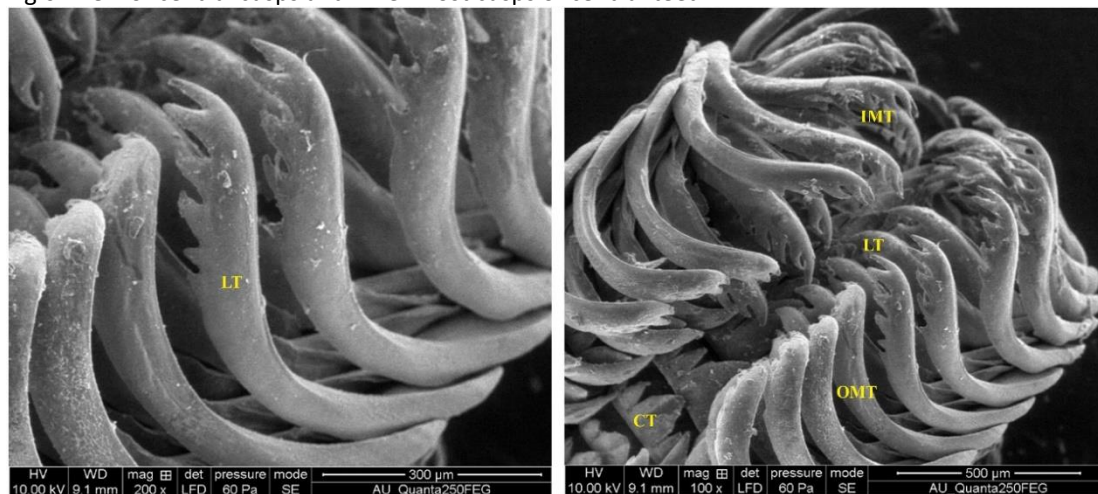


Fig. 4. Teeth: central marginal teeth (left) and posterior region (right).CT- Central teeth ;CC -Central cusps ; LT- Lateral teeth; IC – Inner most cusps; MT- Marginal teeth ;IMT-Inner marginal tooth and OMT- Outer marginal tooth; CT- Central teeth; CC -Central cusps ; LT- Lateral teeth; IC – Inner most cusps; MT- Marginal teeth ;IMT-Inner marginal tooth and OMT- Outer marginal

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