New records of two red seaweeds from Kerala coast, India

Yadav, S.K., Palanisamy*, M. & Murthy, G.V.S.

Botanical Survey of India, Southern Regional Centre, T.N.A.U. Campus, Coimbatore - 641 003, Tamil Nadu, India.

*[E-Mail: samy_bsi@yahoo.co.in]

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Present paper reports the occurrence of two red seaweeds i.e. *Catenella impudica* (Mont.) J. Agardh and *Meristotheca papulosa* (Mont.) J. Agardh (Order Gigartinales) for the first time from Kerala coast. Therefore, these are new additions to the seaweed flora of Kerala. Detailed taxonomic account of these two taxa have been provided for easy identification.

**Keywords:** *Catenella impudica*, *Meristotheca papulosa*, Red seaweeds, New records, Flora, Kerala coast

**Introduction**

A perusal of literature reveals that the coastline of Kerala, Fig.1, (8° 18'–12° 48' N latitude and 74° 52'–77° 22' E longitude), has been explored sporadically and there is no comprehensive account of the seaweed resources of the state. An annotated list of 34 species of seaweeds from Kerala (including Kanyakumari coast of Tamil Nadu) was published1. The extended distribution of a red seaweed *Porphyra kanyakumariensis* from Calicut, Kannur, Varkala and Mullur coasts of Kerala was reported2. Later, 52 species of seaweeds, comprising 22 species of Rhodophyceae, 20 species of Chlorophyceae and 10 species of Phaeophyceae was documented3, followed by a taxonomic account of several red seaweeds from Kerala coast4-6. The extended distribution of a red seaweed *Gracilariopsis lemaneiformis* was reported from certain backwaters of Kerala7.

During the course of exploration to Kerala coast, two red seaweeds *Catenella impudica* and *Meristotheca papulosa* were found, which were previously reported from other parts of the Indian coasts. Therefore, these two taxa are reported here as new records to the seaweed flora of Kerala.

**Materials and Methods**

In the present study, 8 field tours were undertaken from 2011 to 2015 and a total of 149 coastal localities were surveyed throughout the state. The seaweed samples were collected from all the possible seaweed substrata such as rocks, bedrocks, artificial cement boulders, cliffs, molluscus shells and coastal wastes like nets, plastics, cloths etc. by scrapping with hands and molluscus shells without damaging the specimen. The collected samples were kept in the plastic zipped covers and containers of various sizes. While making

![Fig. 1 – Map showing collection sites in Kerala coast](image-url)
collection, important field details such as habit, habitats, nature of the coast, locality and its GPS position, vegetation were noted. The habit, habitats and coastal natures were photographed using the underwater camera (Olympus Digital) and digital camera (Nikon COOLPIX L120). All the collected seaweeds were thoroughly washed without damaging the specimens and herbarium sheets were prepared following the standard herbarium techniques\textsuperscript{8-9}. The representative samples were also preserved in 4% formalin - seawater for microscopic studies in laboratories. Each specimen was examined carefully and hand sections were observed under the light microscope (OLYMPUS SZ51) and compound microscope (NIKON SMZ1500 & NIKON ECLIPSE 50i) coupled with computer attached digital sight DS–Fil camera. All the materials are deposited at Madras Herbarium (MH), Botanical Survey of India, Southern Regional Centre, Coimbatore.

Identifications of the samples were confirmed based on the field observation, critical examination of morphological and anatomical characters, following the standard references namely Phycologia Indica: The Icons of Indian Seaweeds\textsuperscript{8,10}, Rhodophyta\textsuperscript{11-12}, Catalogue of the Benthic Marine Algae of the Indian Ocean\textsuperscript{13} and other online resources\textsuperscript{14-16}.

Results and Discussion

Based on the critical examination of fresh specimens and perusal of literature pertaining to Kerala coast, it is reported here that two red seaweeds belonging to the division Rhodophyta and order Gigartinales \textit{i.e.} \textit{Catenella impudica} (Mont.) J. Agardh and \textit{Meristotheca papulosa} (Mont.) J. Agardh are additions to the seaweed flora of Kerala coast. These seaweeds were collected from Kadalundinagaram and Thirumullavaram coasts of Kerala respectively (Figs. 2 & 4). A detailed taxonomic account of these two taxa are given below:

\textbf{Catenella Grev.} (Family: Caulacanthaceae)

Presently, there are 6 species of the genus \textit{Catenella} in world\textsuperscript{17}, of which 3 species \textit{i.e} \textit{C. caespitosa, C. impudica} and \textit{C. nipae} have been reported from India\textsuperscript{18}. Among these, \textit{C. caespitosa} was reported from the coasts of West Bengal, Gujarat, Maharashtra and Goa whereas \textit{C. nipae} from Sundarbans of West Bengal\textsuperscript{19}.

\textit{C. impudica} was first reported from Gopnath coast, Gujarat\textsuperscript{20}, followed by from Bhitarankanika mangrove area Odisha\textsuperscript{21}, Godavari estuary, Andhra Pradesh\textsuperscript{22} and recently from the Maharashtra coast\textsuperscript{23}. The present study reports its occurrence in Kerala, which shows its extended distribution in the south west cost of India.


\textit{Catenella impudica} (Figure 3): Thallus blackish to dark-purple red in colour, foliose or frondose, 0.5-2.5 cm long, creeping, decumbent, fragile, epilithic, attached by discoidal haptera at nodes. Holdfast discoid, fimbriate or branched, up to 2 mm long and 180-300 µm wide, delicate, firmly attached on calcareous substrata in the intertidal regions. Stipe minute, indistinct. Fronds articulated, irregularly di-trichotomously branched; branches usually sparse below and profuse towards apex; differentiated into nodes and internodes; internodal segments slender to slightly flattened in young stage, later become spindle or sickle shaped, 1-7 × 0.3-2 mm, deeply constricted at nodes; surface smooth; margins entire, apex irregularly forked with acute to acuminate tips, 410-1240 × 180-290 µm. \textit{Microscopic}: Cells in surface view usually spherical, 8-15 µm across, irregularly or sparsely arranged. In cross section, thallus up to 1.3 mm thick, differentiated into outer cortical region and central hollow or loosely interwoven medullary region. Spermatangia scattered over the surface; carposporangia develop in chains; tetraspore sporangia zonate, scattered or embedded in cortical region.

Fig. 2 — Kadalundinagaram coast, showing exposed bedrocks during low tide
Occurrence: Rare, monsoon season.

Distribution: Kerala – Malappuram distr. – Kadalundinagaram coast. India: Andhra Pradesh, Gujarat, Maharashtra, Odisha and Tamil Nadu.

Notes: This species is usually found growing in small crevices and grooves on bedrocks in shallow intertidal region. It is differentiated from other two species by its irregular branching and prolonged acuminate tips. The type locality of this species is Cayenne, French Guiana.

Use: Recently, the antimicrobial activity of this seaweed has been found against a Gram negative bacterium *Aeromonous hydrophilia* and opined that seaweeds can be a potential source for the development of anti-pathogenic agents against many microbial populations.


*Meristotheca* J. Agardh (Family: Solieriaceae)

Presently, there are 12 taxa in world, of which only 1 has been reported from India.


*Meristotheca papulosa* (Figure 5): Thallus dark–rose red in colour, frondose, flat, 5–20 cm long and 2–7 cm wide, cartilaginous, fleshy, erect, epilithic. Holdfast small, crustose or discoid, 0.5-2 mm across, firmly attached on bedrocks and coralline stones in intertidal zones. Stipe small, cylindrical to slightly compressed, gradually flattened upwards, up to 1 cm long and 1-5 mm broad, sometimes indistinct. Fronds foliose, up to 18 cm long, tufted, irregularly pinnately–palmately dissected, lobed; lobes usually uniformly flat, elongate or irregular, surface usually smooth in young thallus and rough or enrolled in mature thallus; margins entire to irregularly proliferated; apex obtuse, acute or narrow lobed.

Microscopic: Cells in surface view squarish, spherical or elongated, 2.5–12 µm across, irregularly arranged. In cross section, thallus 200–500 µm thick, multi–
layered, consisting of outer epidermal layer, middle 5–7 layered cortex and central medulla; epidermal cells small, isodiametrical, 8–14 µm across, compact; cortical cells spherical to stellate, outer cortical cells comparatively smaller, 12–25 µm across, inner cells progressively increasing towards medulla, subspherical to elongate, 25–45 µm long; medulla 120–250 µm thick, cells elongated–tubular, sometimes spathulate, joined, loosely interwoven, 70–200 × 6–25 µm. Carpogonial branches usually developing on ultimate laterals, 3 celled; cystocarps borne along the margins and on marginal proliferations, oval to spherical, rarely variable, 200–920 µm across.

Occurrence: Common, all seasons.


Notes: This is the type species of the genus Meristotheca. It was established by J. Agardh in 1872 with just two species. However, Montagne (1850) first described this species as Kallymenia papulosa from Yemen in the Red Sea, which is currently treated as the basionym of the species M. papulosa. In nature, it is usually found growing in association with Asparagopsis taxiformis, Bryopsis plumosa, Caulerpa peltata, Gelidium micropterum and Valoniopsis pachynema in small crevices on coralline rocks in surf-exposed areas.

Use: It is an edible seaweed and is popularly used for food in Japan.


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