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STT No.: 1692/SK/Dipen PPG/
STT/1993 tanggal 6 Juli 1991
ISSN 0855-7260.

THE SPECIES OF ENTEROMORPHA FROM REDCLIFFE,
SOUTHERN QUEENSLAND

(JENIS-JENIS ENTEROMORPHA DARI REDCLIFFE,
QUEENSLAND SELATAN)

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Abstract

Nine species and one subspecies of Enteromorpha from Redcliffe have been
recorded, and identified as Enteromorpha cintia, E. intestinalis, E. compressa, E. clathrata,
E. intermedius, E. obtusa, E. fissuosa and E. fusiformis subsp. fusiformis.
The last five species and one subspecies mentioned above have not been recorded before.
Identification has been based on morphological and anatomical characters.

Keywords : Enteromorpha, identification, morphological and anatomical characters

Abstrak

Sembilan jenis dan satu subjenis Enteromorpha telah diidentifikasi
sebagai Enteromorpha cintia, E. intestinalis, E. compressa, E. clathrata, E. intermedius,
E. obtusa, E. fissuosa dan E. fusiformis subsp. fusiformis.
Lima jenis dan satu subjenis yang disebut terakhir belum pemerintah.
Identifikasi mendapatkan dari morfologi dan anatomi.

Kata kunci : Enteromorpha, identifikasi, morfologi dan anatomi

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Introduction

The genus Enteromorpha belongs to the family Ulvaceae, and is characterized by the monostromatic tubular thallus of the majority of the species (Newton, 1931; Smith, 1944).

The species of Enteromorpha are widely distributed along marine shores to the intertidal zones, particularly along those that provided solid anchorage. The genus is generally considered marine in habitat, but several species thrive in salt spring, brackish and estuarine waters, and occasionally in freshwater (Conover, 1958; Bernstein, 1967; Kapraun, 1970; Wilkinson, 1980; Round, 1981).

Although members of the genus are very common in Queensland, growing abundantly in coastal waters, detailed study of it has not been undertaken there. Records of species belonging to the genus in this region are relatively few. This might be due to the difficulties encountered in separating the species, as most of the species are highly polymorphic. Enteromorpha is one of the taxonomically troublesome genera, the determination of the species presenting difficulties on account of the variations in morphological and anatomical characters consequent on variation in environmental conditions, and the age of plants (Womersley, 1956; Burrows, 1959; Papenfuss, 1960; Kapraun, 1970).

The present work concerns the identification of species from a limited area of Southern Queensland, - Redcliff, and to a certain extent assesses the value of characters commonly used in systematics of the genus.

Methods

Although most of the species are polymorphic, in the present work for practical reasons, identification of collected materials has been based on morphological and anatomical characters as well.

Collections were made as frequent as possible, - scheduled fortnightly over a 28 month period, so that any change in morphological as well as anatomical features due to environmental conditions could be noticed. Specimens were collected from brackish stream, mangrove swamps and down to the site near the Hornbrook Bridge, Clontarf Beach, Woody Point, Margate Beach and Redcliffe Point.

The position relative to the tidal levels for each species were recorded. The specimens were examined in the living state for identification. Photomicrographs were mostly obtained from semi permanent slides, For this purpose the specimens were fixed in 4% seawater-formaline for about 1 - 2 hours and mounted in glycerine-jelly.

Result and discussion

Nine species and one subspecies of Enteromorpha from the intertidal zone of Redcliffe marine shore have been recorded, those are Enteromorpha raffsii, E. intestinalis, E. compressa, E. clathrata, Enteromorpha sp, E. linza, E. albemulana, E. prolifera, E. flexuosa and E. flexuosa subsp. linzeiformis. The first four species mentioned above have been previously recorded from South-Eastern Queensland (Bailey, 1912; Cribbs, 1950). E. punianus has been recorded by these two authors as well, but has not been recorded during the present work.

E. linza has not been recorded before. Because of the flattened and distromatic blade, and hollow only at the margin and stipe, E. linza was previously described as an intermediate genus between Enteromorpha and Ulva (Silva, 1952; Papenfuss, 1960). Prior to Bielding's cultural studies (Bielding, 1963), E. linza had been the cause of a great deal of disagreement, as to its generic position in Enteromorpha or Ulva. Newton (1931), Chapman (1954) and some other phycologist had placed E. linza in the genus Ulva under the name Ulva linza. However, Doty (1947), mentioned that the hollow margin with more than three marginal cells have already served as characters useful in separating E. linza from species of Ulva. The collected material has shown the same features as mentioned by Doty (1947), therefore it has been considered as E. linza. (Fig. 1)
rhizoids and the production of new branches which grew out from below the cut surface and reached the dimension of the original plant. Accordingly the branched plant on the shore might have originated from unbranched juveniles which had been damaged. Hence, it has been suggested that *E. compressa* and *E. intestinalis* are two forms of one species, *E. intestinalis*, as other features in both species are similar to each other. Doty, (1947), however, mentioned that *E. intestinalis* is well separated from *E. compressa*, the cells of *E. intestinalis* lying nearer to the external surface of the membrane, so that in cross-section of the blade the inner portion of the membrane appears slightly thicker than the outer one. While that of *E. compressa* the inner and the outer portion of the membrane in cross-section are equally thick. The collected material identified as *E. intestinalis* and *E. compressa* have the similar characteristic mentioned by Doty (1947) (Fig. 2 and 3).

**Figure 2. Enteromorpha intestinalis**

Cross-section of the blade
1 = inner portion, and
2 = outer portion of the membrane
Cross-section of the blade
1 = inner portion and
2 = outer portion of the membrane

As the above-mentioned characters, such as morphological as well as anatomical features may be inadequate to delimit the collected species satisfactorily, culture studies in stable condition should be conducted to determine the constancy of the characters used for identification, and to obtain information about other characters.

Key to the species in the area studied

1. Thalli unbranched or occasionally with a few microscopic proliferation near the base ................................. 2
2. Plants filamentous, consisting of four longitudinal rows of cells, up to 2 cm long .............................. E. ralfsii
3. Plants tubular throughout even diameter or broadening distally, or with tubular stipe and flat frondlets ............................. 3
4. Thalli with short tubular stipes and flat broad frondlets, hollow margins ............................................... E. linearis
5. Thalli tubular throughout of even diameter or broadening distally ......................................................... 4
6. Cells not in distinct order in most part of thallus, chloroplast with one pyrenoid ......................... E. intestinalis
7. Cells in distinct order in most part of thallus, chloroplast with one or more pyrenoids ...................... 5
8. Thalli more than 5 cm long, cells in longitudinal rows, sometimes also in transverse rows .......... Enteromorpha sp.
9. Thalli more than 5 cm long, up to 15 cm, cells in longitudinal rows ................................................. 6
10. Chloroplast with one pyrenoid ................................................. E. prolifera
11. Chloroplast with 2-7 pyrenoids .............................................. E. flexuosa subsp. liniformis
12. Pyrenoid never more than one per cell .................................................................................................. 8
13. Pyrenoid more than one per cell .............................................................................................................. 9
14. Cells in distinct rows in most part of thallus ......................................................................................... E. ahlneri
15. Cells not in distinct rows in most part of thallus .................................................................................. 8
16. Branches tapers towards apex .............................................................................................................. 9
17. Branches tapering towards base ............................................................................................................ E. flexuosa

Descriptions of the species

1. Enteromorpha prolifera (Müller) J. Agardh


Thalli dark green, tubular, of even diameter or broadening distally, occasionally slightly compressed, narrow towards the base, 7-20 cm long, 2-10 mm wide; cells in narrow parts arranged in longitudinal rows, the
rows often becoming indistinct in broader part; cells in surface view, quadrangular, rectangular or polygonal, 9-27 x 9-15 μm; chloroplast parietal, located in the upper part and covering the upper surface of the cell, with one pyrenoid; membrane in cross-section 18 μm thick, cells squarish, protoplast height 12 μm, outer and inner cell wall equally thick.

Habitat: attached to rocks, bivalvia or arthropod’s shells, and other hard substrate.

Local distribution: Clontarf Beach among E. lignosa, and in a freshwater stream, in which the salinity is 6 ppt at low tide periods; Woody Point in sandy areas.

This species is very common in the above localities, occurring near HWM, 0.5 - 0.60 m above LWM.

2. Enteromorpha intestinalis (Linnaeus) Link.


Thalli unbranched or with a few microscopic proliferation near the base, 5 - 10 cm long, 2 - 10 mm wide, tubular, of even diameter or broadening distally, often slightly compressed, light or bright green in colour; cells not in distinct rows, except in the narrow parts; cells in surface view, polygonal with rounded corners, 6 - 12 μm in diameter; chloroplast parietal, located in the upper part and covering 2/3 of the upper surface of the cell, with 1 pyrenoid; membrane in cross-section; 27 μm thick, cells elongated, protoplast height 18 μm outer cell wall 3 μm and inner cell wall 6 μm.

Habitat: attached to rocks and stones.
Local distribution: Clontarf Beach and Woody Point.
Occurring near HWM, 0.60 m above LWM.

3. Enteromorpha compressa (Linnaeus) Greville.


Thalli light green or bright green, tubular, broadening distally, branches tapering towards the base, arising from the narrow stipe of the main axis, 1-5 cm long, 0.5-3 mm wide; cells not in distinct rows; cells, in surface view, polygonal or quadrangular, 9-15 μm in diameter; chloroplast parietal, located in the upper part and occupying 1/3 of the upper surface of the cell, with one pyrenoid; membrane in cross-section 18 μm thick, cells somewhat squarish in shape, protoplast height 12 μm, inner and outer cell wall equally thick.

Habitat: attached to rocks and stones.
Local distribution: Clontarf Beach and Woody Point.
Occurring near HWM, 0.60 m above LWM.


Thalli 5-17 cm long, 0.5-2 mm wide, tubular, with even diameter or broadening distally; branches arising from the lower 1/3 of the thallus, reaching the dimension of the main axis or smaller, narrow towards the base; cells in narrow parts arranged in longitudinal rows, becoming irregularly arranged in broader parts; cells in surface view, quadrangular or rectangular, 12-27 x 6-18 μm; chloroplast parietal, located in the upper part of the cells, occasionally with a net-like appearance in surface view, with 2-4 pyrenoids; membrane in cross-section 31 μm thick, protoplast height 12 μm, inner and outer cell wall equally thick.

Habitat: attached to rocks and other hard substrate.
Local distribution: Margate Beach and Woody Point, occurring near HWM, 0.30-0.80 m above LWM.

4.b. Unbranched population

Thalli tubular, broadening distally, often becoming slightly compressed, grass green in colour, 5-20 cm long and 0.5-20 mm wide; cells
arranged in longitudinal rows, which are often indistinct in broader part; cells in surface view, quadrangular, rectangular, squarish, 9 - 15 µm; chloroplast parietal, located in the upper part and covering the upper surface of the cell, with 2 - 4 pyrenoids; membrane in cross-section 30 µm thick, proplastid height 24 µm, inner and outer cell wall equally thick.

Habitat: attached to rocks, bivalve or arthropod's shells.
Local distribution: Brighton (in the brackish water stream), Clontarf Beach and Woody Point.

This population is very common in the above localities, occurring near HWL, 0.40 - 0.60 m above LWM.

In morphology and anatomy, this population is similar to E. flexuosa subsp. limiformis described by Bliding (1963).

5. Enteromorpha sp.

Thalli 1 - 4 cm long, 1 - 3 mm wide, tubular, broadening distally and tapering towards the apex, simple or occasionally with a few microscopic proliferation arising from the cylindrical stipe, light to bright green in colour; cells arranged in longitudinal rows, and in narrow parts in transverse rows as well; cells in surface view quadrangular, 9 - 15 X 6 - 15 µm; chloroplast parietal, located in the upper part and covering the upper surface of the cell, with 1 - 3 pyrenoids; membrane in cross-section 27 µm thick, proplastid height 21 µm, inner and outer cell wall equally thick.

Habitat: attached to arthropod's shells.
Local distribution: Brighton, occurring at HWL, 0.60 m above LWM, not common.

This population is similar to E. tubulosa as reported by Smith (1944) except in pyrenoid number, Smith reporting only one pyrenoid.

6. Enteromorpha linearis (Linnaeus) J. Agardh


7. Enteromorpha rafisii Harvey

References: Newton, 1931, p. 38; Bliding, 1963, p. 43-45.

Thalli filamentous, unbranched, up to 2 cm long, consisting of 4 rows of cell surrounding a narrow cavity of 6 X 9 µm, filaments often twisted or curled, dark green in colour; cells in surface view rectangular, 9 - 12 X 9 - 15 µm; chloroplast almost filling the cell, with 2 pyrenoids.

Habitat: attached on mangrove roots among E. clathrata and on rocks.
Local distribution: Brighton, occurring near HWL, 0.70 m above LWM.

8. Enteromorpha clathrata (Roth) Creville


Thalli tubular, 20 - 70 cm long, the main axis of even diameter 0.5 - 2 mm wide, yellowish green in colour, repeatedly branched, branches throughout the whole, branches ending in 4 - 6 celled monosporate apices.
branchlets of the second order very fine; cells arranged in longitudinal rows throughout except in the lowest part; cells in surface view rectangular, 15-24 X 15-27 μm; chloroplast parietal, located in the upper part of the cell, often extending in the lateral part, with 2-5 pyrenoids; membrane in cross-section 30 μm thick; proenolast height 21 μm, inner and outer cell wall equally thick.

Habitat: entangled on mangrove roots.
Local distribution: Brighton in mangrove swamp.

On the basis of the branchlet's apices, this taxon is similar to: E. clathrata type 1, as reported by Biding (1963), E. clathrata var. planonata Kütz as reported by Chapman (1954) and E. clathrata (Robb) Grev. as reported by Doyt (1947).

9. Enteromorpha abiliniana Biding


Thalli tubular, slightly broadening distally, branched, with a distinct main axis, branches tapering towards the base, dark green in colour, 7-15 cm long, 2-3 mm wide; cells arranged in longitudinal rows; cells in surface view, quadrangular, rectangular, 9-15 X 6-18 μm; chloroplast parietal, in surface view forming a cup-shaped appearance, with 1 pyrenoid; membrane in cross-section 27 μm thick, proenolast height 21 μm, elongated, inner and outer cell wall equally thick.

Habitat: attached in rocks on sandy areas.
Local distribution: Brighton, occurring at HWM, 0.70 m above LWM. Not common.

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