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ANATOMICAL STUDIES ON *DICTYOPTERIS POLYPODIOIDES* (PHAEOPHYCOTA) FROM THE COAST OF KARACHI, PAKISTAN

ALIA ABBAS[1*] AND MUSTAFA SHAMEEL[2]

[1]*Department of Botany, Federal Urdu University of Arts, Science and Technology, Gulshan-e-Iqbal, Karachi-7530*
[2]*Department of Botany, University of Karachi, Karachi -75270, Pakistan*
[*]*Corresponding author's e-mail: abbasalia@ymail.com*

Abstract

Dictyopteris polypodioides (Dc.) Lamouroux, a thin and flexuous brown alga, was collected from the Arabian Sea coast at Karachi during March 2008 and investigated for its morphology, anatomy and reproductive structures in detail. In the present study the characters such as number of layers, shape of the cells, presence and absence of intercellular spaces between layers of thallus are described. This is the first detailed study of this species from the coast of Pakistan.

Introduction

Dictyopteris Lamouroux is a commonly occurring genus of thalloid brown algae growing the sub-littoral rocks of Karachi, Pakistan. Begum & Khatoon (1988) reported for the first time the occurrence of *D. polypodioides* (Dc.) Lamouroux from the coast of Karachi. Although, its growth was further recorded from other areas as well (Khatoon & Begum, 1990; Shameel & Tanaka, 1992; Begum, 2010), but no detailed investigation of this species was ever made. Therefore, the present study was undertaken to know its internal structures. A parallel investigation of an allied species *D. divaricata* (Okamura) Okamura has recently been made from this area (Abbas & Shameel, 2010). This is a continuation of such studies.

Materials and Methods

The specimens were collected during March 2008 as drift material from Buleji coastal area of Karachi, Pakistan. They were brought to the laboratory and preserved in 4% formaldehyde-seawater solution after thorough washing. Some of them were used for herbarium preparations, which were deposited in the Herbarium (FUU-SWH), Federal Urdu University of Arts, Science and Technology, Karachi. Rest of the specimens were used for general study, where cross sections (C. S.) from different portions of thallus were obtained by free-hand cutting with shaving blades, stained in aniline blue and mounted in glycerine. The slides were sealed with nail polish and examined under a Nikon PFX microscope. The seaweed sections were photographed with the help of a Nikon PFX camera and developed in a photolab with *hp* scanner. The photographic plates were prepared in Adop Photoshop 7.0 with the help of a computer.

Results

The following taxonomic characters and anatomical features were observed on general investigation and microscopic examination of the collected specimens.

***Dictyopteris polypodioides* (Dc.) Lamouroux 1809:332**
Basionym: *Ulva polypodioides* Dc. *in* Lamarck *et* De Candolle 1805: 15.

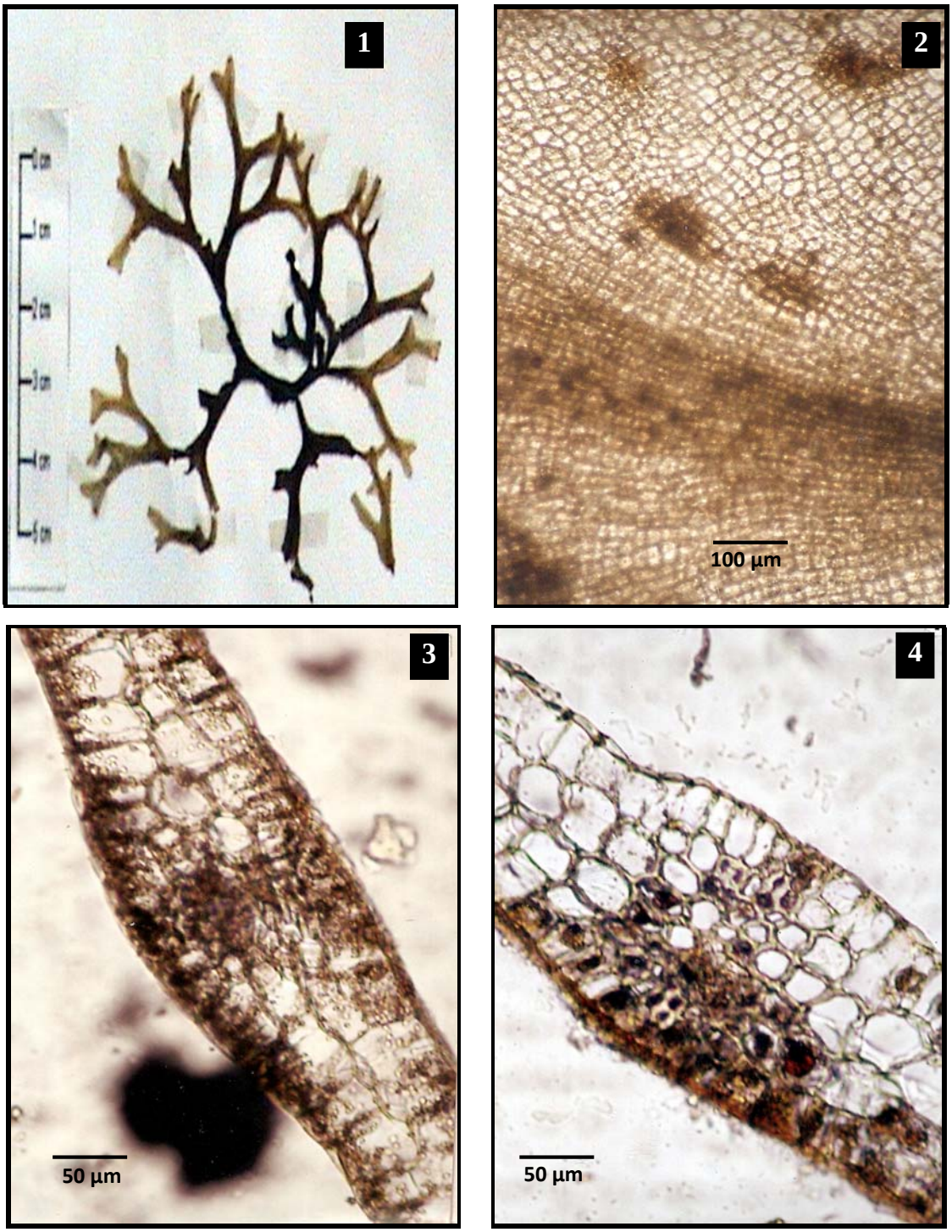
Synonyms: *Fucus polypodioides* Desf. 1799: 421, *Fucus membranaceus* Stackhouse 1809: 97, *Polypodoidea membranacea* Stackhouse 1809:97, *Haliseris polypodioides* (Dc.) C. A. Agardh 1820: 142, *Dictyopteris membranacea* (Stackhouse) Batters 1902: 54.

References: Durairatnam, 1961: 35; Misra, 1966: 152, 1967: 233; Nizamuddin, 1981: 21; Silva *et al*., 1987: 74, 1996: 584; Womersley, 1987: 222; Begum & Khatoon, 1988: 294; Khatoon & Begum, 1990: 86; Shameel & Tanaka, 1992: 37; Begum, 2010: 145.

Morphological characters: Thallus dark brown and thick in lower part and greenish brown in upper portion, erect, thin, flexuous, flat; dichotomously or sub-dichotomously branched into leafy segments, dichotomy 0.9 – 2.0 cm apart; fronds 15 cm in length, 4 mm broad at the base, 5 – 6 mm broad at dichotomy and 2 – 4 mm broad at apex; apex bifid, margins entire or wavy or lacerated, surface smooth, apices rounded; midrib more prominent at lower portion of the branches, 1- 2 mm broad; lowermost part forming a small compact, discoid holdfast with velvety, fibrous rhizoids (Fig. 1).

Anatomical features: In surface view: peripheral cells in upper side of the thallus light brown or greenish brown and in lower side dark brown or reddish brown, cubical or slightly elongated, thin walled, 10 – 30 µm in length and 10 – 25 µm in breadth; in the center midrib region contains dark brown cells, on both sides of the midrib sporangial sori arranged in longitudinal rows (Fig. 2). Morphologically thallus divided into three portions: central broad midrib and two wings; in midrib region thallus composed of 4 – 6 layers, number of layers increase from wings to midrib; in wings two layers of cells present.

In apical portion: midrib consists of peripheral layers containing palisade like cells, dark coloured, 20-75µm in length and 40-45µm in breadth; below epidermis first 2-3 layers consist of small, oval, circular, polygonal and thick walled cells, 25-50µm long and 12.5-32.5µm broad (Fig. 3); in wings two layers are present, cells palisade like, both layers equal in size, 25-40µm in length and 47.5-60.0µm in breadth, cell-wall thickness 5µm.

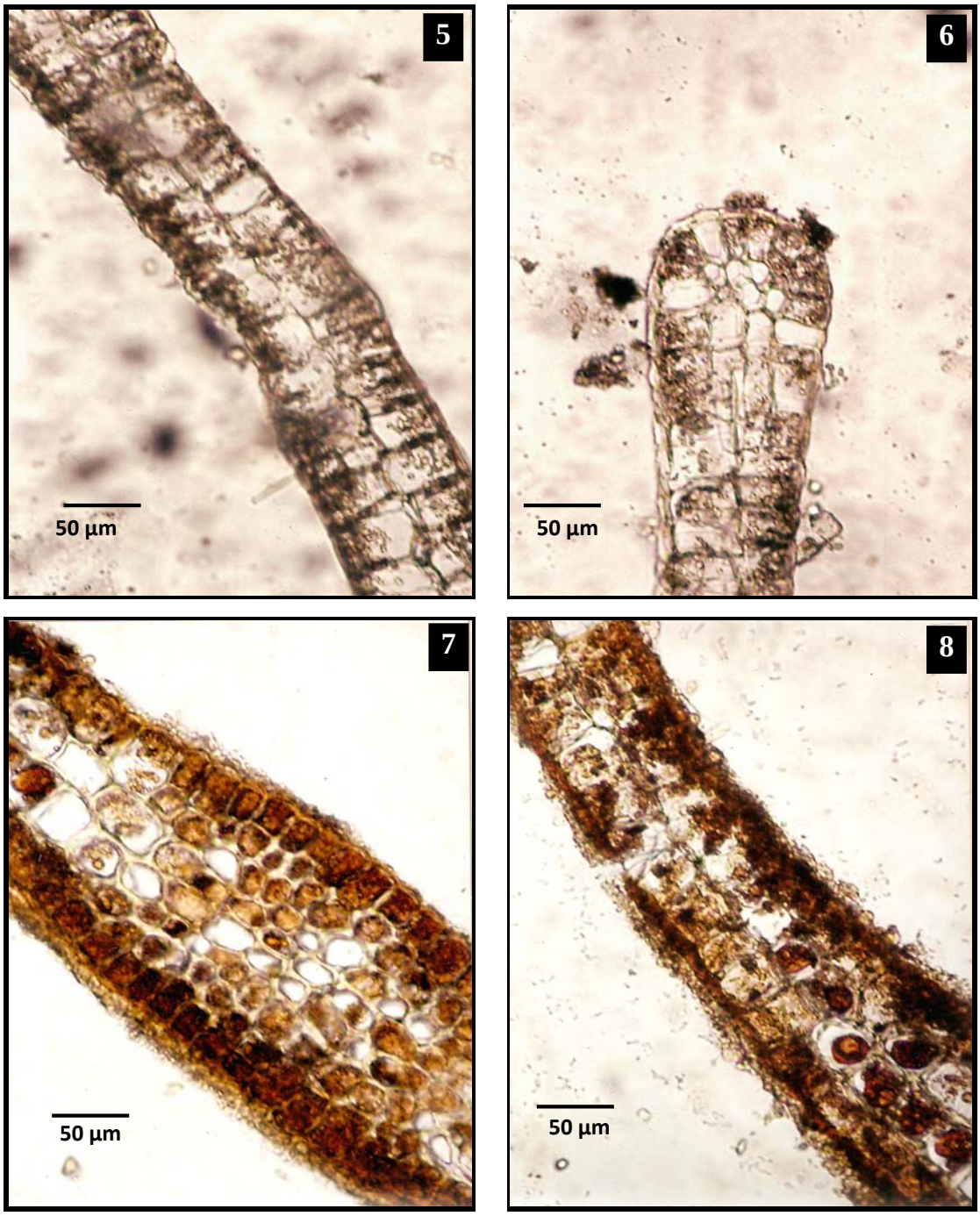


Figs. 1-4. *Dictyopteris polypodioides*: 1. Habit of the thallus, 2. Surface view of the thallus, 3. C.S. of apical portion exhibiting margin, 4. C.S. of apical part showing midrib.

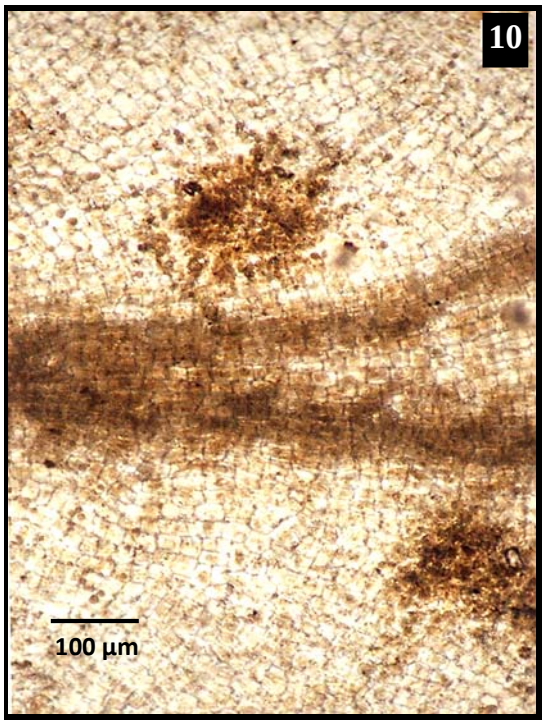
In the middle part: midrib composed of 2 peripheral layers and 5-6 central layers; peripheral cells palisade like, with dense phaeoplasts, 25.0-27.5µm long and 50-55µm broad; below epidermis 5-6 layers present, consisting of rounded, cubical, squarish shaped cells, dark brown, thin walled; number of layers decreases from centre to wing, 12.5-50.0µm long and 12.5-30.0µm broad (Fig. 4); two layers of wing consist of slightly elongated cells, with dense phaeoplasts, 25.0-32.5µm long and 50-55µm broad (Fig. 5); margin composed of palisade like, long peripheral cells, enclosing 4-8 marginal cells, thin walled, polygonal, intercellular spaces absent (Fig. 6).

In the basal portion: midrib consists of two peripheral and 6 central layers; peripheral layers consist of palisade like cells, with dense phaeoplasts, 25.0-37.5µm in length and 17.5-30.0µm in breadth; 6 layered central region consisting of polygonal, rounded, loosely arranged cells, with intercellular spaces, 12.5-40.0µm long and 15-30µm broad (Fig. 7); wings consist of 2 layers, cells palisade like, dark brown, thick walled, 22.5-37.5µm in length and 40-50µm in breadth (Fig. 8); margin composed of long, palisade like, peripheral layer, enclosing 6-10 marginal cells, thin walled, cubical or polygonal in shape, intercellular spaces absent (Fig. 9).

Reproductive structures: Sori prominent, black, large, oval in shape; arranged in 1– (2) longitudinal rows on either side of the midrib, at upper to middle part of the thallus, found mostly on the upper surface of the thallus or on the same place at lower surface of the thallus (Fig. 10). Tetrasporangia round, blackish brown, small, 65.5-70.0µm in length and 55–60µm in breadth.



Figs. 5-8. *Dictyopteris polypodioides*: 5. C.S. of middle part at wing, 6. C.S. of middle portion at margin, 7. C.S. of basal part showing midrib, 8. C.S. of basal portion at wing.



Figs. 9-10. *Dictyopteris polypodioides*: 9. C.S. of basal part exhibiting margin, 10. Sori arranged on the surface.

Type locality: Mare Numidico, Algeria.

Habitat: Collected as drift material from Goth Haji Ali, Buleji (*Leg.* Alia Abbas 14-3-2008).

Local distribution: Karachi: Manora and Buleji.

Distribution in the Indian Ocean: India, Kenya, Pakistan, Persian Gulf, Seychelles, South Africa, Sri Lanka and Tanzania.

Discussion

Dictyopteris polypodioides is a brown alga of the family Dictyotaceae (order Dictyotales, class Dictyophyceae, phylum Phaeophycota; *fide* Shameel, 2008). Begum & Khatoon (1988) as well as Shameel & Tanaka (1992) did not mention characters of the species, while, Khatoon & Begum (1990) reported only general morphology of the thallus but did not describe its anatomy in detail, and its reproductive structures were also not investigated. In this initial study the number of layers, shape of the cells and the presence of intercellular spaces in the thallus were also not mentioned, furthermore the peripheral or assimilatory cells were described as 45 µm in length and 30 µm in breadth. The measurements of midrib or medullary cells were shown as 18 µm long and 25 µm broad and those of parechymatous or cortical cells as 45 µm in length and 40 µm in breadth (Khatoon & Begum, 1990) In the present study all the above mentioned characters such as number of layers, shape of the cells, presence and absence of intercellular spaces between layers of thallus are described in detail, some differences in the cell measurement have also been noticed such as 20–75 µm length and 17.5–50.0 µm breadth in the peripheral cells, and 12–50 µm length and 12–30 µm breadth in the medullary cells. So there is a big difference in the size of the cells, as compared to the previous observations (Khatoon & Begum, 1990).

The confused status of this species has been discussed in detail by Silva *et al*., (1996). *Dictyopteris polypodioides* and *D. membranacea* are usually considered as conspecific, but they have been reported from various parts of the world as separate species. While describing Dictyotales of Libya, Nizamuddin (1981) distinguished the 2 species on the basis of the arrangement of tetrasporangial sori on the blade, in *D. membranacea* the sori are said to be scattered on either side of the midrib, while in *D. polypodioides* they are linearly arranged on its either side. But such differences was not found in Karachi specimens, where sori were found arranged in 1 or 2 longitudinal rows on sides of the midrib. Specimens with scattered sori were not observed.

Although, *Fucus polypodioides* Desfontaines 1799 was the first suggested name of the species, but it is not a legitimate name, being a later homonym of *F. polypodioides* S. Gmelin 1768. Therefore, it cannot be considered as basionym of the present species. *Ulva polypodioides* De Candolle 1805 is considered as a legitimate new name even though its intended basionym is illegitimate. The Art. 58. 3 of ICBN has been invoked to find a legitimate name for later homonym among intended combinations (Silva *in* Silva *et al*., 1996).

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