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ANATOMY OF *DICTYOPTERIS DIVARICATA* (PHAEOPHYCOTA) FROM THE COAST OF KARACHI

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Abstract

Dictyopteris divaricata (Okamura) Okamura, a dichotomously branched brown alga of the family Dictyotaceae, was collected from Buleji, the coastal area of Karachi (Pakistan) during March 2008 and April 2010. It was investigated in detail for its morphology, anatomy and reproduction. Surface cells and internal structures of the thallus were studied in detail for the first time. This is the first detailed study of this species from the coast of Karachi.

Introduction

Dictyopteris Lamouroux, *nom. cons.* is a commonly occurring genus of brown algae, which grows epilithic on the sub-littoral rocks of Karachi, Pakistan. Nizamuddin & Saifullah (1967) reported for the first time the occurrence of *D. divaricata* from the coast of Karachi. Although, its growth was further recorded by Saifullah (1973), Begum & Khatoon (1988) and Shameel & Tanaka (1992) from other areas, but no detailed study of this species was ever made. Therefore, the present investigation of its internal structures was undertaken.

Materials and Methods

The specimens were collected as drift material from Buleji, a coastal area near Karachi (Pakistan) during March 2008 and April 2010 and fixed in 4% formaldehyde-seawater solution. For internal structures, cross sections (C. S.) were obtained by freehand cutting with shaving blades, which were stained with aniline blue and mounted in glycerine. Semi-permanent slides were sealed with nail polish and examined under microscope (Nikon PFX, Japan). The photographs were taken by Nikon F 601 camera. The herbarium sheets of the material have been deposited in the Herbarium (FUU-SWH), Department of Botany, Federal Urdu University of Arts, Science and Technology, Karachi, Pakistan.

Results and Discussion

The general observation and microscopic examination of the collected specimens revealed the following characters.

***Dictyopteris divaricata* (Okamura) Okamura 1932: 75**

Basionym: *Haliseris divaricata* Okamura 1907: 57.

References: Nizamuddin & Saifullah, 1967: 172; Saifullah, 1973: 140; Silva *et al.,* 1987: 74, 1996: 582; Begum & Khatoon, 1988: 293; Shameel & Tanaka, 1992: 36; Begum, 2010: 135.

Morphological characters: Holdfast 1 cm long, 0.5 cm broad, from holdfast 4–5 branches arise; thalli up to 25 cm long, margin smooth at lower side or slightly undulate, surface smooth; dichotomously branched, dichotomy 2.0–5.5 cm apart, lower portion of branches thick and upper membranecous; mid-rib 1–2 mm broad, lateral lines arise from mid-rib; margin slightly undulate at upper side; small, rounded, brown sori scattered on both sides of mid-rib; small or large proliferations arise from mid-rib apex; lobes of apex obtuse (Fig. 1).

Anatomical features: In surface view: peripheral cells cubical or slightly elongated, thin-walled, arranged in vertical rows; small oil globules accumulated with the walls; cells 25 .0–37.5 µm in length and 25–50 µm in breadth (Fig. 2).

In apical portion: thallus width 125–150 µm, thallus divided into two parts: mid-rib and wings; mid-rib consists of three parts, peripheral layer with cubical or slightly elongated, thin-walled cells, containing dense phaeoplasts, 12.5–17.5 µm in length and 10–20 µm in breadth (Fig. 3); below epidermis 2–3 layered cortex, having large, irregular in shape, thin-walled cells, poor in contents, with intercellular spaces, cells 7.5–25.0 µm in length and 12.5–22.5 µm in breadth; in the center 4–5 layered medulla, cells small, thin-walled, with dense phaeoplasts, 7.5–22.5 µm in breadth; wings consist of 2 layers, both layers more or less equal in size, intercellular spaces absent, with or without phaeoplast, cells 10–30 µm in length and 12.5–27.5 µm in breadth (Fig. 4).

In the middle part: thallus width 200–225 µm; mid-rib consists of peripheral layers, with cubical or quadratic, dark brown cells, with dense phaeoplasts, thin-walled, some cells slightly rounded, 25.0–37.5 µm in length and 25.0–37.5 µm in breadth; below peripheral layer on both sides of medulla 7–9 layered cortex present, cells closely packed, small, cubical or some cells polygonal, thick-walled, poor in contents, intercellular spaces absent, horizontally arranged, cells 25–50 µm in length and 17.5–37.5 µm in breadth; in the center 3–4 layered medulla, cells small, thick-walled, dark coloured, with dense phaeoplasts, cells 12.5–37.5 µm in length and 12.5–37.5 µm in breadth (Fig. 5); wings consist of 2–3 layers, cells large, cubical or vertically elongated, without intercellular spaces, having dense phaeoplasts, cells 12.5–30.0 µm in length and 10–30 µm in breadth (Fig. 6).

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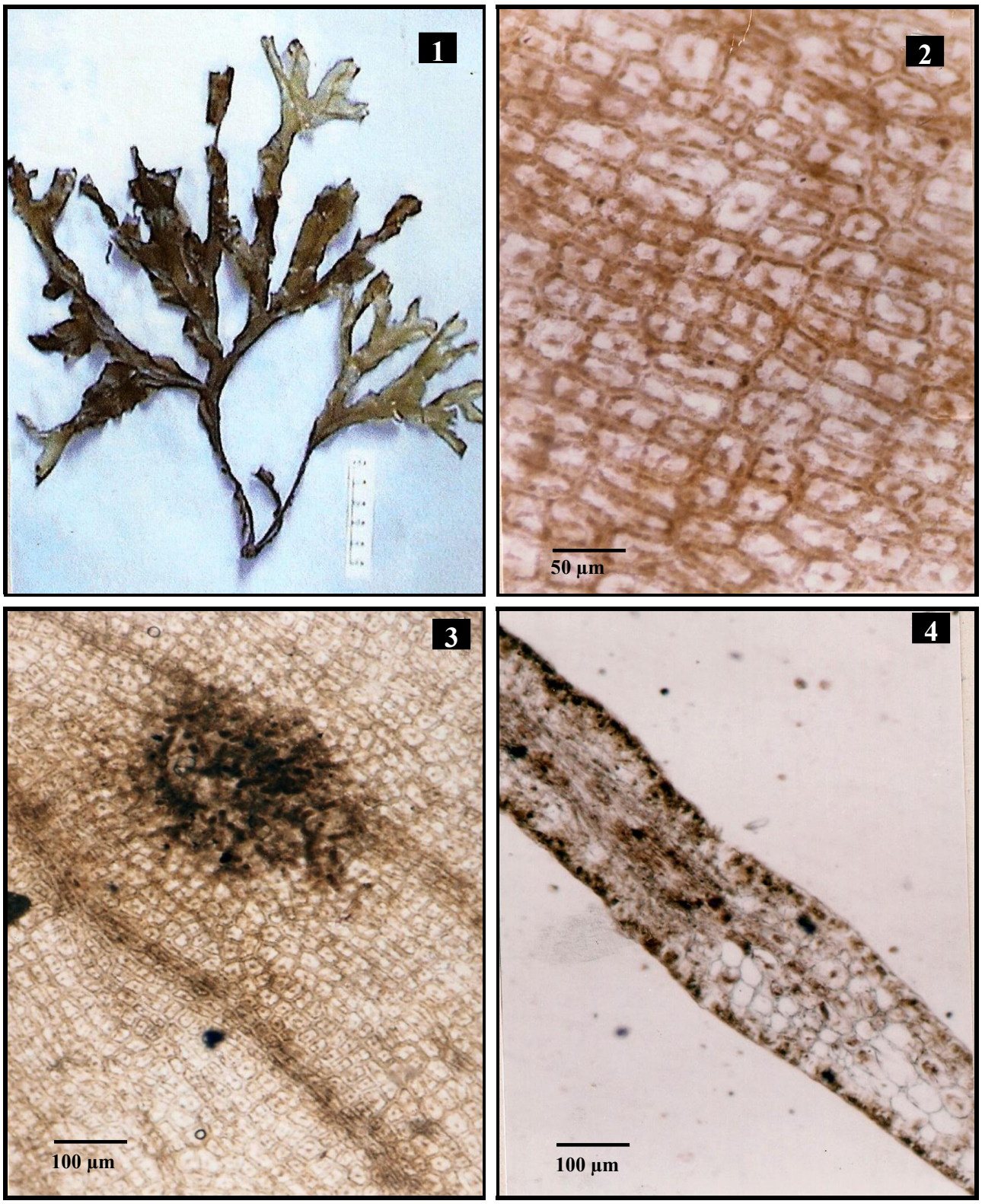
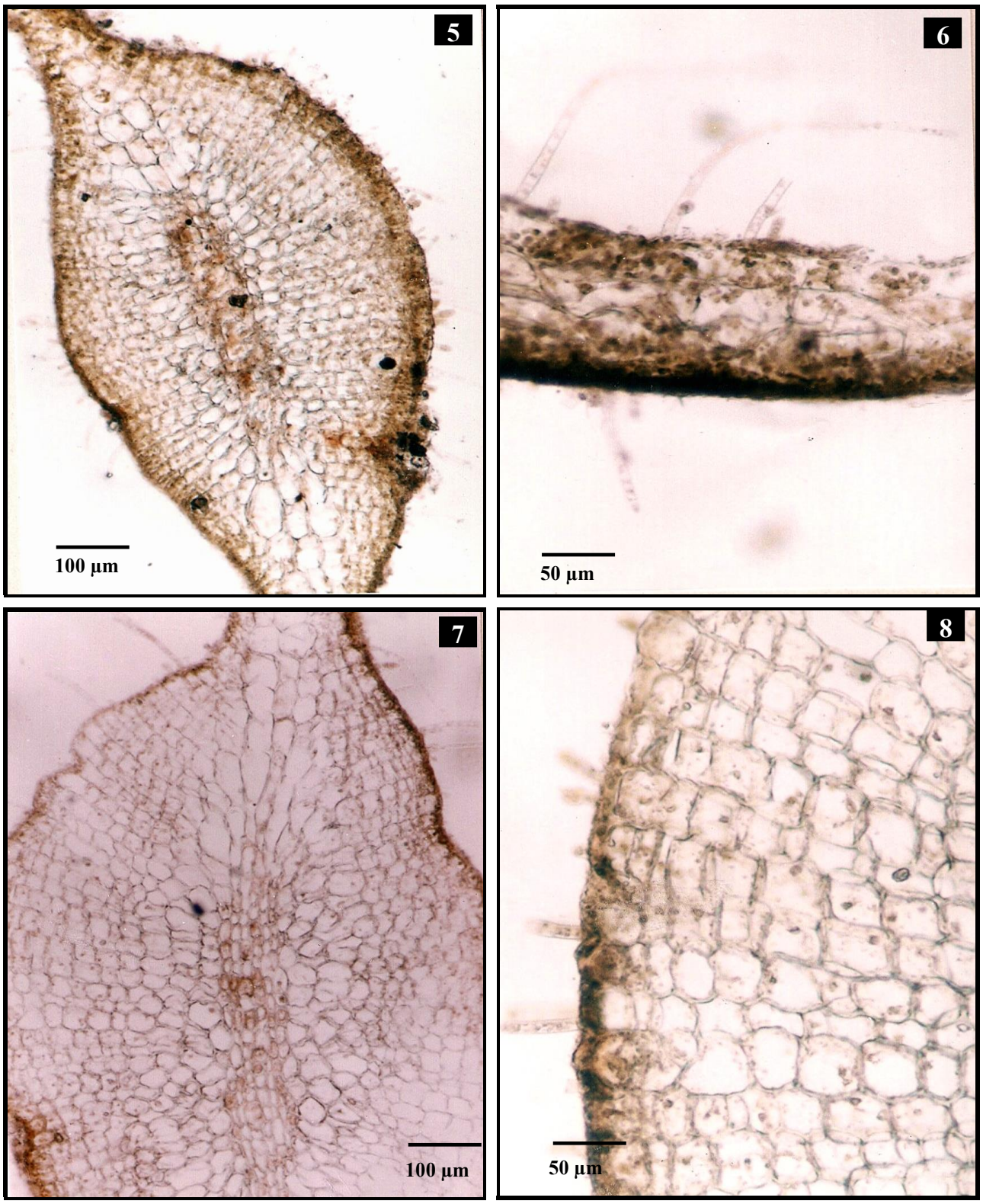


Figs. 1- 4. *Dictyopteris divaricata*: **1.** Habit of the thallus, **2.** Surface view of the thallus, **3.** Surface view with a sorus, **4.** C.S. of apical portion.

In the basal portion: thallus consists of 26–28 layers; peripheral layers consist of cubical, or quadratic or slightly elongated, thin-walled cells, with no intercellular spaces, having dense phaeoplasts, thick deposition on the surface, cells 25.0–37.5 µm in length and 25–30 µm in breadth (Fig. 7); on both sides of medulla, 10–12 layered cortex, cells small, thin-walled with no intercellular spaces, without or with a few phaeoplasts, rounded or cubical or quadratic, horizontally arranged, cells towards medulla of comparatively large size, polygonal, or some cells palisade like, 25.5 – 28.0 µm in length and 25–50 µm in breadth, cell-wall thickness 5 µm; in the center 6–7 layered medulla, cells small, thick-walled, dark brown in colour, without intercellular spaces, cells 30–50 µm in length and 10–25 µm in breadth (Fig. 8); wings toward mid-rib consists of 3–4 layers and in the center composed of 2 layers, cells large, polygonal or rounded or cubical, thick-walled, with dense phaeoplasts, cells 20.0–65.5 µm in length and 27.5–45.0 µm in breadth.



Figs. 5-8. *Dictyopteris divaricata*: **5.** C.S. of mid-rib from middle portion, **6.** C.S. of middle part exhibiting wing, **7.** C.S. of mid-rib from basal portion, **8.** C.S. of basal part showing peripheral cells and cortex of mid-rib.

Reproductive structures: Reproductive bodies aggregated in the form of sori, which are scattered over the surface of wings (Fig. 3).

Syntype localities: Cape Iwai, Miyage Prefecture and Hakodate, Hokkaido, Japan.

Habitat: Collected as drift material at Goth Haji Ali, Buleji (*Leg.* Alia Abbas 18-3-2008, 31-3- & 17-9-2009, 14-3- & 22-4-2010).

Local distribution: Karachi: Manora and Buleji.

Distribution in the Indian Ocean: Madagascar and Pakistan.

Remarks: It was found to be a brown alga of the family Dictyotaceae (order Dictyotales, class Dictyophyceae, phylum Phaeophycota; *fide* Shameel, 2008). Nizamuddin & Saifullah (1967) reported only general morphology of

the thallus but did not describe its anatomy, and its reproductive structures were also not investigated. Other workers (Saifullah, 1973; Begum & Khatoon, 1988; Shameel & Tanaka, 1992) have simply mentioned its occurrence in various areas of Pakistan. This is the first and detailed study of the anatomical structures of the specimens collected from the coast of Pakistan. It was observed that lateral lines arise from the mid-rib. The presence or absence of marginal veins are of great significance in the species of *Dictyopteris* (Phillips, 2000; Wysor & De Clerck, 2003).

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