



# Taxonomy of the Genus *Colpomenia* (Laminarophyceae, Phaeophycota) from the Coast of Karachi

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**Abstract:** Four globular, convoluted, hollow species of brown algal genus *Colpomenia* (Endlicher) Derbès et Solier were collected from different coastal areas of Karachi (Pakistan) at northern Arabian Sea and taxonomically investigated in detail. They included one new species, *C. hasanainii* Aisha et Shameel, which differed from all the existing species. Most of these species are reported and taxonomically described for the first time from the coast of Pakistan.

**Keywords:** Algae, Phaeophycota, *Colpomenia*, taxonomy, morphology, anatomy, reproduction

## 1. INTRODUCTION

The genus *Colpomenia* is of common occurrence at the north Arabian Sea coast of Pakistan. The species *C. sinuosa* was reported to occur at the coast of Karachi [1, 2], which was later on taxonomically described by several workers [3,6]. Although some other species were also observed to grow in this area, but no composite information was available about the growth of this genus at the seashore of Pakistan. Therefore, a long survey was made to collect brown algae from various coastal areas of Karachi and taxonomically investigated. As a result of that four species of *Colpomenia* were found to grow in this area, which are being described here.

## 2. MATERIALS AND METHODS

Algal thalli were detached from the rocks at mid and lower littoral zones from the coast of Karachi, Pakistan. They were brought to the laboratory and preserved in 4% formaldehyde. Different parts of thalli were cut into thin slices with the help of shaving blade by free hand section cutting technique. Sections were stained in 1% aniline blue for 5-10 minutes, one or two drops of 1M hydrochloric acid were added for 30 seconds and

washed with seawater. The sections were then mounted in a solution of 75% glycerin with aniline blue (75 mL Gly + 20 mL aniline blue + 5 mL distilled water). Finally, the slides were sealed with the sealing material (Cutex) and observed under microscope (Nikon, Japan).

## 3. RESULTS AND DISCUSSION

*Colpomenia* (Endlicher) Derbès et Solier 1851:95 is a brown alga of the family Scytosiphonaceae (order Scytosiphonales, class Laminarophyceae, Phylum Phaeophycota; *fide* [7, 8]). Taxonomic examination of the collected specimens from various coastal areas of Karachi (Pakistan) revealed the following characters of this genus.

Thallus globose, globular, hollow, lobed, convoluted, yellow to dark brown in colour, thick, membranous or thin; attached to the substratum with its lower surface; 5-7 layers thickened, peripheral layer consists of small squarish cells; outer cortex polygonal in shape, whereas inner cortex with irregular large thin-walled cells; phaeoplasts discoid, many, physodes formed; phaeophycotean hairs present, single or in group in cavities; growth intercalary or trichothallic; plurilocular sporangia cylindrical, club-shaped, uniseriate; paraphyses present, globose to oblong, club-shaped; sporangia in sori, sori scattered all

over the thallus surface. Its four species were found to occur at Karachi Coast, which are distinguishable as follows:

1. Phaeophycotean hairs absent in cavities also in sori-----2  
Phaeophycotean hairs present in cavities ---3
2. Thallus showing globose appearance-----  
-----*Colpomenia ecuticulata* (1)  
Thallus showing tubular appearance-----  
-----*Colpomenia hasanainii* (2)
3. Sori without cuticle and diffusely spreading-----*Colpomenia peregrine* (3)  
Sori covered by cuticle and surround central hair tuft-----*Colpomenia sinuosa* (4)

### 3.1. *Colpomenia ecuticulata* Parsons 1982:297

**References:** Parsons 1982: 297, Womersely 1987:298, Begum & Khatoon 1988: 300, 1992: 24, Shameel & Tanaka 1992: 40, Silva et al 1996: 626 [4, 9-13].

**Morphological characters:** Thallus globular, sometime very much lobed, thick, 8-10 cm in diameter; yellowish brown in colour; attached to rocks by its lower surface; sometime epiphytic on *Sargassum* sp. and *Cystoseira indica* (Thivy et Doshi) Mairh.

**Cytological features:** Thallus composed of six to seven layers of cells; single layer of small squarish assimilatory cells at periphery, 6-9  $\mu\text{m}$  in length and 6-9 (-12)  $\mu\text{m}$  in breadth; outer two layers of cortical cells rectangular to polygonal in shape, towards the medullary part or inner cortical cells increased in size and irregular in shape, 9-16  $\mu\text{m}$  long and 12-41  $\mu\text{m}$  broad; phaeoplasts dense in peripheral layer, by moving towards the inner cortical cells become few in number until the innermost cortical cells without any phaeoplast.

**Reproductive structures:** It reproduces by plurilocular sporangia, which are cylindrical, mostly uniseriate but sometimes biseriata, 9-19  $\mu\text{m}$  in length and 3-6  $\mu\text{m}$  in breadth; sori not covered by a cuticle, reticulate surface pattern formed by the sori; unilocular sporangia were not observed; paraphyses found in between sori, club-shaped, 1-2 (-3) celled, 31-43  $\mu\text{m}$  in long and 9-12  $\mu\text{m}$  broad.

**Growth:** The growth is diffuse.

**Type locality:** Takatu Peninsula, North Island, New Zealand.

**Habitat ecology:** It was found growing epilithic on the rocks at littoral region. The vegetation of this species was so massive that it formed mats on the rocks of the coast.

**Local distribution:** Manora (*Leg. Aisha* 29-12-1990); Sandspit (*Leg. Aisha* 28-1-1991); Buleji (*Leg. Aisha* 23-1-90; 29-12-1990).

**Geographical distribution:** Australia, New Zealand and Pakistan.

**Remarks:** The specimens collected during this survey were identified as *Colpomenia ecuticulata* on the basis of three characters *i.e.* absence of soral cuticle; presence of globose paraphyses and the reticulate surface pattern formed by the sori [9, 10, 14], which differ from all other species of *Colpomenia* found along the coast of Karachi.

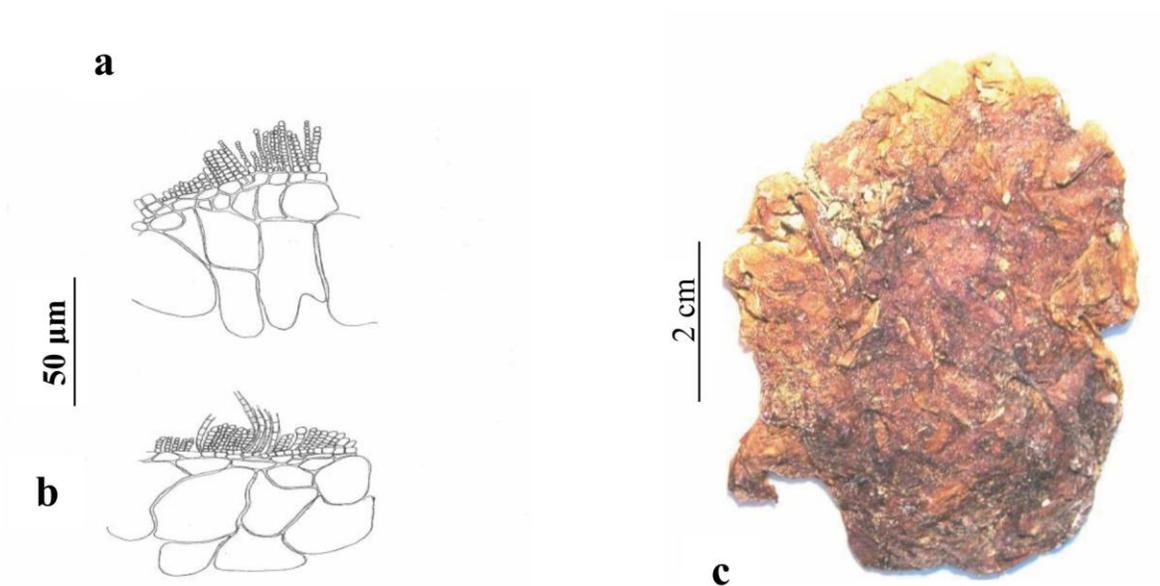
### 3.2. *Colpomenia hasanainii* Aisha et Shameel, *sp. nov.*

**Diagnosis:** *Thallus dimidio convolvulatus et dimidio tuberculatus, sporangia plurilocularis uniseriatis et cylindricae sine cuticula, pilis phaeophycoteanis carens et oblongus paraphyses.*

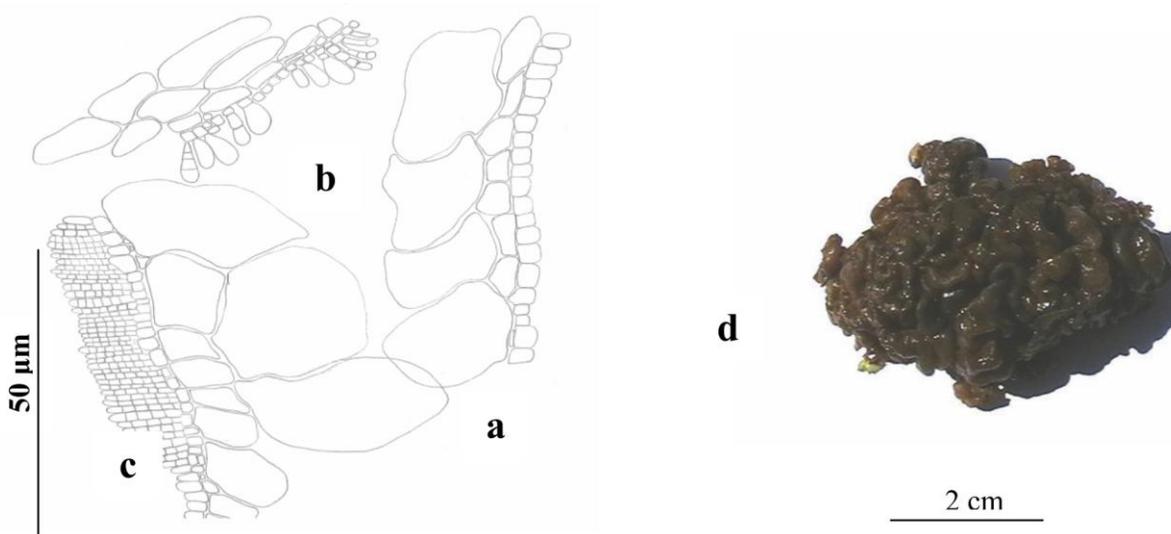
**Morphological characters:** Thallus epilithic on rocks, 5-7 cm in diameter, light brown in colour, thin, irregularly lobed; attached to substratum by large lower surface; half part of the thallus convoluted and half with tuberculae which appear like *Iyengaria*.

**Cytological features:** Thallus composed of 3-4 layers of cells; cells of single peripheral layer small, squarish, densely filled with granular phaeoplasts, 6-9  $\mu\text{m}$  in length, 6-12  $\mu\text{m}$  in breadth; cortical region consists of two parts, outer part having single layer of small cells, which are angular, 9-15  $\mu\text{m}$  high, 15-27  $\mu\text{m}$  wide, inner part having large cells with no definite shape, filled with less number of phaeoplasts, 12-18 (-37)  $\mu\text{m}$  long and 21-58 (-61)  $\mu\text{m}$  broad; phaeophycotean hairs were not recorded.

**Reproductive structures:** It reproduces by plurilocular sporangia, which are cylindrical, usually uniseriate, 19-31  $\mu\text{m}$  long and 6  $\mu\text{m}$  broad; cuticle absent; unilocular sporangia were not recorded; paraphyses oblong in shape, 2-3 celled, 16-19  $\mu\text{m}$  in length and 6  $\mu\text{m}$  in breadth.



**Fig. 1.** *Colpomenia ecuticulata* Parsons: **a.** Transverse section of thallus showing uniseriate plurilocular sporangia, **b.** transverse section with uniseriate plurilocular sporangia, paraphyses and tuft of phaeophycotean hairs, **c.** *Colpomenia ecuticulata* Parsons: Herbarium specimen.



**Fig. 2.** *Colpomenia hasanainii* Aisha et Shameel: **a.** Transverse section of thallus with cortical and peripheral cells, **b.** transverse section showing uniseriate plurilocular sporangia, **c.** transverse section of thallus with uniseriate plurilocular sporangia and paraphyses, **d.** *Colpomenia hasanainii* Aisha et Shameel: Type specimen.

**Growth:** The growth is diffuse.

**Type locality:** Buleji, Karachi, Pakistan.

**Habitat ecology:** It was found epilithic on the rocks of the Karachi Coast which were exposed to mostly low tides.

**Local distribution:** Buleji (Leg. Aisha 29-12-1990).

**Remarks:** These specimens were characterised by a thallus half convoluted and half with tuberculae, uniseriate and cylindrical plurilocular sporangia without cuticle, phaeophycotean hairs absent and paraphyses oblong. In these characters they differed from all the other known species described previously. Therefore they have been considered as a new species *Colpomenia*

*hasanainii*, which is named in the memory of late Prof. Dr. Syed Zulfiqar Hasanain, the pioneering professor of Botany at University of Karachi.

### 3.3. *Colpomenia peregrina* Sauvageau 1927: 321

**References:** Sauvageau 1927:321, Hamel 1937:201, Rosenvinge & Lund 1947:37, Blacker 1967:5, Womersley 1967:244, 1987:298, Parsons 1982:295, Shameel *et al.* 1996:227, 2000:85, Silva *et al.* 1996:627, Shameel 2000:52, [9,10, 13, 15-21].

**Morphological characters:** Thalli epilithic yellowish brown in colour, fertile parts dark brown in colour, less convoluted, thin and globular, 5-10 cm in diameter.

**Cytological features:** Thallus composed of five to seven layers of cells, single peripheral layer of squarish cells, 9 - 16  $\mu\text{m}$  in length and 9 - 16  $\mu\text{m}$  in breadth, densely filled with phaeoplasts; cortical portion may be divided into two parts, outer cortex consists of small polygonal cells, (9-) 12 - 25  $\mu\text{m}$  long and (12-) 16 - 37  $\mu\text{m}$  broad, less number of phaeoplasts within the cells; inner cortex with large irregular cells, 46 - 62 (-108)  $\mu\text{m}$  long and 53 - 108 (-142)  $\mu\text{m}$  wide, without any phaeoplast or physode; phaeophycotean hairs present mostly in groups and originate from outer cortical cells, 77 - 87  $\mu\text{m}$  long and 6 - 9 (-12)  $\mu\text{m}$  broad.

**Reproductive structures:** Phaeophycotean hairs and sori in separate groups distributed on thallus surface, sori usually made up of plurilocular sporangia which are uniseriate or biseriate, somewhat club-shaped or elongate, 19 -25 (-28)  $\mu\text{m}$  in length and 6-9  $\mu\text{m}$  in breadth; unilocular sporangia were not observed in these specimens (sometimes the plurilocular sporangia seem to be gametangia); paraphyses present in between plurilocular sporangia, oblong to globose in shape, 16 - 122  $\mu\text{m}$  in length and 9 - 16  $\mu\text{m}$  in breadth.

**Growth:** The growth is diffuse, may be trichothallic in the parts of phaeophycotean hairs.

**Syntype localities:** Various in Atlantic Europe.

**Habitat ecology:** It was growing epilithic on the rocks which were exposed to low tides.

**Local distribution:** Buleji (*Leg.* Aisha 14-11-1993).

**Geographical distribution:** British Isles,

California, China, Japan, Mediterranean Sea, Naples, New Zealand and South Australia.

**Remarks:** The specimens gathered from Buleji Coast were thin, yellowish brown in colour, plurilocular sporangia were club-shaped, paraphyses mostly single celled, oblong to globose in shape, rarely 2-3 segmented and phaeophycotean hairs arise from sub-cortical part. These characters are similar to the species described as *Colpomenia peregrina* by several workers [9,10,14, 17,19]. It is morphologically quite similar to *C. ecuticulata* and *C. sinuosa*, but differs from them in shape of paraphyses, origin of phaeophycotean hairs and above all the absence of cuticle. This taxon was initially proposed with alternative names *C. sinuosa* var. *peregrina* and *C. peregrina* [15]. As the publication was prior to first January 1953, both these names are valid in accordance with Art. 34.2 of ICBN [13]. Therefore, it is advisable to use the binomial *C. peregrina* Sauvageau, as was originally suggested.

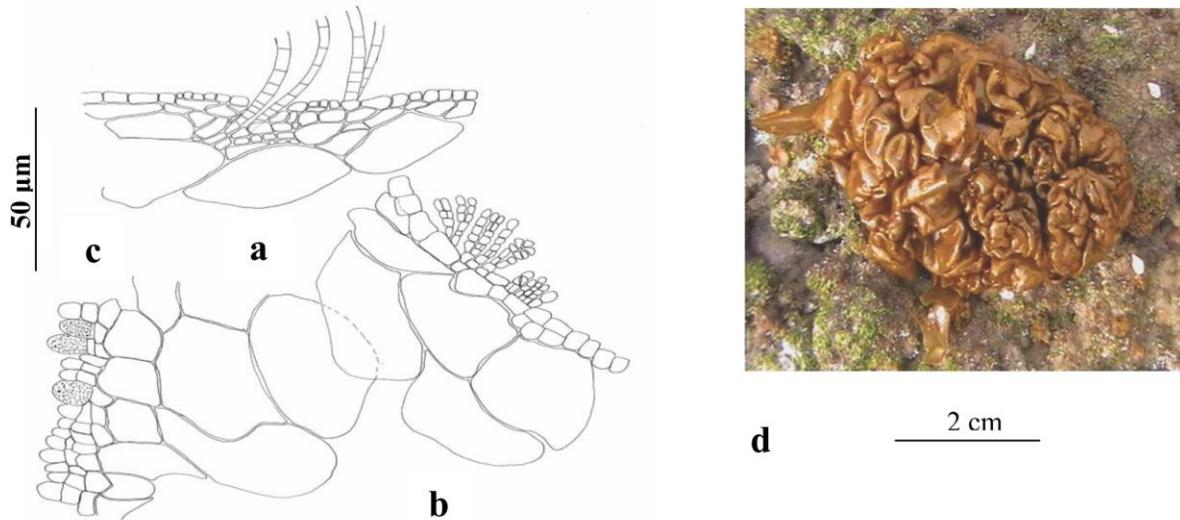
### 3.4. *Colpomenia sinuosa* (Mertens ex Roth) Derbès et Solier in Castagne 1851:95

**Basionym:** *Ulva sinuosa* Mertens ex Roth 1806:327.

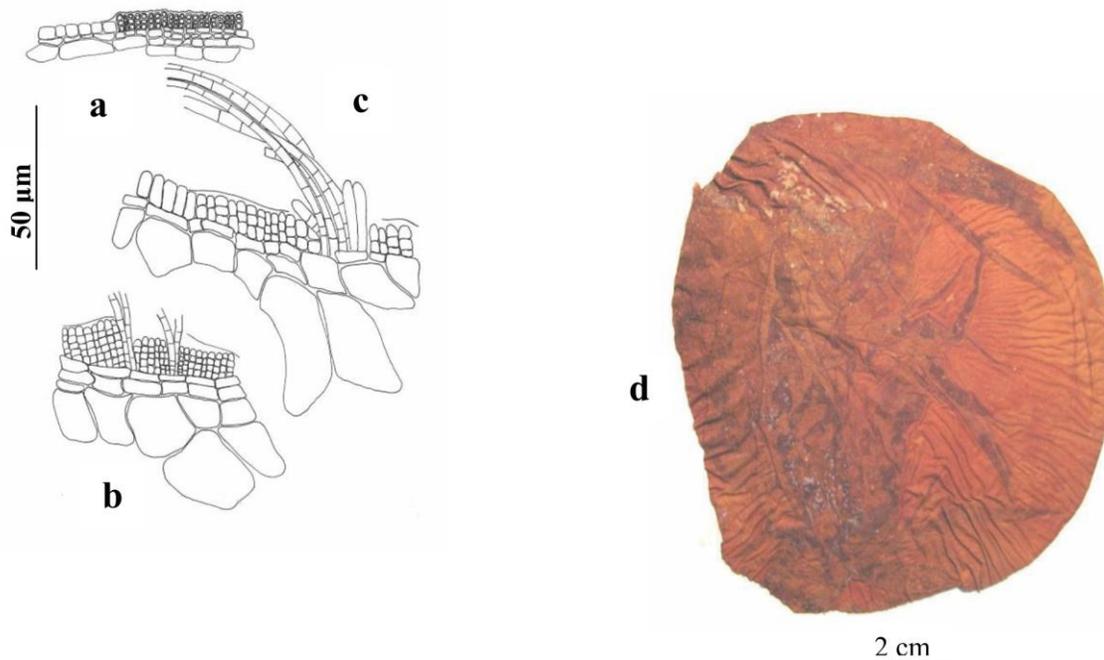
**Synonyms:** *Encoelium sinuosa* (Mertens ex Roth) C. Agardh 1820:146, *Aperococcus sinuosa* (Mertens ex Roth) Bory de Saint-Vincent 1832:326, *Encoelium vesicatum* (Harvey) Kützinger 1849:552.

**References:** Børgesen 1934:25, 1935:34, 1939:89, 1941:61, Durairatnam 1961:32, Misra 1966:115, 1967:232; Womersely 1967:244, 1987:297, Krishnamurthy & Joshi 1970:12, Nizamuddin & Gessner 1970:6, Saifullah 1973:141, Islam 1976:43, Jaasund 1976:47, Nizamuddin & Begum 1978:318, Shameel 1987:513, 2000:52, Shameel & Afaq-Husain 1987:295, Silva *et al.* 1987:80, 1996:627, Begum & Khatoon 1988:300, 1992:23, Shameel & Tanaka 1992:40, Shaikh & Shameel 1995:27, Shameel *et al.* 2000:86, Abbas & Shameel 2007:1921[1-6, 10-13, 9,21-35].

**Morphological characters:** Thallus epilithic on rocks, globular, broad, irregularly lobed, thick, sometimes membranous, 3-12 cm in diameter, light brown in colour; attached to substratum by large lower surface.



**Fig. 3.** *Colpomenia peregrina* Sauvageau: **a.** Transverse section of thallus with plurilocular sporangial initials, **b.** transverse section with uniseriate and biseriata plurilocular sporangia, **c.** transverse section of thallus with tuft of phaeophycotean hairs, **d.** *Colpomenia peregrina* Sauvageau: Herbarium specimen.



**Fig. 4.** *Colpomenia sinuosa* (Mertens ex Roth) Derbès et Solièr: **a.** Transverse section of thallus with plurilocular sporangia, **b.** transverse section showing plurilocular sporangia, paraphyses and tuft of phaeophycotean hairs, **c.** transverse section of thallus with plurilocular sporangia and tuft of phaeophycotean hairs, **d.** *Colpomenia sinuosa* (Mertens ex Roth) Derbès et Solièr: Herbarium specimen.

**Cytological features:** Thallus composed of six layers of cells; cells of single peripheral layer squarish in shape, densely filled with phaeoplasts, 3-9 µm in length, 3-6 µm in breadth; outer two layers of cortical cells polygonal in shape, 6-12 µm long and 12-28 µm wide, with few

phaeoplasts; inner three layers of cortical cells irregular and large, without phaeoplast, (25-) 34-182 µm in length and 43 - 74 (-108) µm in breadth; septate phaeophycotean hairs present in group, found within sori and cryptostomata, 53-108 µm long and 9 µm broad.

**Reproductive structures:** It reproduces by plurilocular sporangia, cylindrical, usually uniseriate, rarely biseriate, 28-46 µm long and 3-6 µm broad; cuticle present; unilocular sporangia were not recorded; paraphyses globose in shape, 2-3 celled, 25-46 µm in length and 6-9 (-12) µm in breadth.

**Growth:** The growth is diffuse may be trichothallic in the parts of phaeophycotean hairs.

**Type locality:** Near Cádiz, Spain.

**Habitat ecology:** It was found drift as well as epilithic on the rocky places of the Karachi Coast.

**Local distribution:** Manora (*Leg. Aisha* 11-11-1989, 29-12-1990, 28-1-1991); Buleji (*Leg. Aisha* 9-12-1989, 29-12-1990, 14-11- & 30-11-1993); Nathiagali (*Leg. Aisha* 14-11-1989).

**Geographical distribution:** Andaman Islands, Australia, Bahrain, Bangladesh, Brazil, California, England, Florida, India, Indonesia, Iran, Japan, Kenya, Kuwait, Laccadive Islands, Madagascar, Malaysia, Mauritius, Mexico, Pakistan, Réunion, Rodriguez Island, Saudi Arabia, Seychelles, Singapore, Somalia, South Africa, Sri Lanka, Tanzania, The Philippines, West Indies and Yemen.

**Remarks:** The specimens of Karachi are globular, hollow and have cylindrical plurilocular sporangia with cuticle, cellular hairs and paraphyses. In these characters it showed similarities with the species described by pioneering workers [1-3], therefore it was identified as *Colpomenia sinuosa*. It differed from *C. peregrina* in lacking thin thallus, single celled paraphyses and plurilocular sporangia without any cuticle, it may also be differentiated from *C. ecuticulata* by not having globular paraphyses and in the presence of cuticle covering the sori.

#### 4. ACKNOWLEDGEMENTS

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