# FIRST RECORD OF *CHAETOMORPHA MINIMA* (COLLINS & HERVEY, 1917) ASSOCIATED WITH THE MANGROVE STANDS IN THE SANDSPIT BACKWATERS, KARACHI – PAKISTAN

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**ABSTRACT**

**This research paper report and discuss the first record of *Chaetomorpha minima* from Pakistan. The study sheds light on the fine aspects of the surface and interior structures of the species thorough morphological assessment of the taxonomic aspects. The cosmopolitan genus *Chaetomorpha* is commonly known as "Spaghetti algae". It is a green alga belongs to the family Cladophoraceae. The specimen was collected from nutrient-rich, shallow environment of Sandspit backwaters mangrove area which is connected with the Arabian Sea through Manora Channel. Mangrove forest comprises of only one species *Avicennia marina* andprovides good feeding, sheltering and breeding ground for many species of birds giving significant importance by providing a representative wetland ecosystem close to the mega city.**

**Keywords: Green algae, *Chaetomorpha minima,* backwaters mangroves, new record, Pakistan**



# اول تسجيل للطحلب *CHAETOMORPHA MINIMA* (COLLINS & HERVEY, 1917) المرتبط مع أشجار ايكة الساحلية في المياه الشاطئية الرملية، كراشي باكستان

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**المستخلص**

**في هذه الدراسة تم تسجيل لـ*Chaetomorpha minima* لأول مرة في باكستان. تسلط الدراسة الضوء على الجوانب الدقيقة للتركيبات السطحية والداخلية للأنواع مع تقييم مورفولوجي شامل للجوانب التصنيفية .يُعرف جنس*Chaetomorpha* العالمي باسم "طحالب السباغيتي ."وهي طحالب خضراء تنتمي إلى فصيلة Cladophoraceae. تم جمع العينة من بيئة ضحلة وغنية بالمغذيات في منطقة أشجار الماغروف في المياه الشاطئية الرملية والتي ترتبط ببحر العرب عبر قناة مانورا .تتكون غابات الماغروف من نوع واحد فقط وهو*Avicennia* Marina ، وتوفر تغذية ومأوى وأرضية تكاثر جيدة للعديد من أنواع الطيور، مما يعطي أهمية كبيرة من خلال توفير نظام بيئي تمثيلي للأراضي الرطبة بالقرب من المدينة الضخمة.**

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## INTRODUCTION

The cosmopolitan genus *Chaetomorpha* commonly known as "Spaghetti algae", a green alga belongs to the family Cladophoraceae. Members of the *Chaetomorpha* are also referred by their common name "Sea Emerald". Members of this taxon can be found in marine and brackish intertidal water (22). *Chaetomorpha* algae are generally found in nutrient-rich, shallow environments such as tidal pools and rocky shorelines. They play an important role in maintaining the health of the surrounding environment. It absorbs excess nutrients like nitrates and phosphates, also preventing the growth of dangerous algae and keeping the water clean and clear (1). The genus *Chaetomorpha,* (Kützing, 1845), was preceded by Kutzing's *Spongopsis* (Kützing, 1843) and (14) *Chloronitum*. Due to the general acceptance of the name *Chaetomorpha,* (38) proposed that it be conserved. The proposal was accepted and listed under "Generica Conservada" in the International Code of Botanical Nomenclature (41). Algae of this genus are made up of macroscopic filaments of cylindrical cells. The genus is characterized by its unbranched filaments, making it distinctive; its closest relatives are branching species of the genus *Cladophora*. *Chaetomorpha* is unbranched uniseriate filament, free-living organism, attached by the base rhizoids. This genus has very basic morphology, with few features that allow it to be distinguished from different species, such as attached or unattached growth forms, cell diameter, cell shape and size of basal cells, length/diameter ratio of cells, and the presence ofconstrictions between cells (22). An overwhelming bloom of ephemeral green seaweeds like *Ulva, Cladophora*, and *Chaetomorpha* is referred to as a "green tide" and can occur anywhere in the world. Although the effects of the green tide are generally acknowledged to be negative (8,19, 21, 23, 24, 26, 27, 47), some of the seaweeds that make up the green tide have positive ecological and social effects (6, 10, 11, 25, 30, 43, 44, 45). *Chaetomorpha* is well known for its quick growth in marine environment and a popular macroalga for their applicability in integrated aquaculture with marine animals (11,44). The most frequent *Chaetomorpha* species are *Chaetomorpha linum, Chaetomorpha spiralis*, and *Chaetomorpha crassa*. These species all look the same and provide the same broad functions in aquaria. This prolific seaweed is recognized for its rapid growth and ability to sequester large amounts of minerals (7, 12). The cosmopolitan genus *Chaetomorpha* is containing 99 taxa reported so far, ofwhich only 70 are currently accepted taxonomically (16, 17). From Kenya coastal waters 8 species of this genus reported are; *Chaetomorpha aerea, Chaetomorpha antennina, Chaetomorpha brachygona, Chaetomorpha crassa, Chaetomorpha gracilis, Chaetomorpha linum, Chaetomorpha minima* and *Chaetomorpha spiralis*(5). *Chaetomorpha minima* reported from Malaysia (20). From West Bangal, India *Chaetomorpha aerea, Chaetomorpha crassa* and *Chaetomorpha gracilis* and *Chaetomorpha tortuosa* were reported (46). *Chaetomorpha aerea, Chaetomorpha antennina, Chaetomorpha brachygona,Chaetomorpha californica, Chaetomorpha crassa, Chaetomorpha gracilis* and *Chaetomopha linum* from the southern coast of Iran, Persian Gulf and Oman (15, 39, 40). The North Arabian Sea is a unique for studying marine plant resources and their products (42). Sandspit, Buleji, Hawks Bay, Paradise Point, Pacha, Cape Monze, Manora, Korangi Creek, and Rehri are all home to a variety of marine benthic algae (36). In Pakistan, there are ten (10) distinct *Chaetomorpha* species; *Chaetomorpha aerea*, found in Karachi; (Nizamuddin and Begum, 1973), *Chaetomorpha crassa,* and *Chaetomorpha gracilis*, at Buleji, Kemari and Sonmiani *Chaetomorpha indica*, found at Manora, and *Chaetomorpha linum, Chaetomorpha prostrata* found at Kemari and Sonmiani,Manora, Cape Monze, Gadani and Sonmiani and *Chaetomorpha torta* from Manora and BhitKhori, *Chaetomorpha media, Chaetomorpha antennina* discovered from Kemari, Manora and Buleji, Cape Monze, Sonmiani and Ras Malan **(**2, 29, 33, 34, 35, 36, 37) while *Chaetomorpha spiralis* found from Buleji and Manora (32). The present study reports first record of *Chaetomorpha minima* from Pakistan bordering northern

Arabian Sea. The aim of the present study is to provide taxonomic description of *chaetomorpha minima* collected from Sandspit back waters mangroves at Karachi coast.

## MATERIALS AND METHODS

**Study area:** The Sandspit backwaters (24°50'20''N and 66°54'54''E) (Fig.1, 2) comprises of shallow tidal lagoons, intertidal mudflats, saltpans and mangrove swamps of approximately 400 ha connected with the Arabian Sea through Manora Channel (Map). During high and low tides, the sea water enters the backwaters area and drains back periodically to the Arabian Sea through Manora channel which is also the main navigation channel of the Karachi port. It is estimated that an average volume of about 3.4 million m3 of seawater enters and leaves the backwater area during the tidal cycle (18). The backwater also receives discharge from the Lyari River, which is a seasonal River and discharges mostly industrial and domestic effluents throughout the year besides draining rainy water It has been estimated that the Lyari Riverbrings 120 million gallons per day of municipal and industrial wastewater with an organic load of 2000 tons of BOD per day (3). The climate is arid subtropical with temperatures remaining moderate throughout the year. The average annual rainfall is 125 mm and the mean annualtemperature is 32 $^{O}$C. The area has significant ecological and biodiversity value. Mangrove forest comprises of only one species *Avicennia marina* and provides good feeding, sheltering and breeding ground for many species of birds. The mangrove forest is of significant importance as it provides a representative wetland ecosystem close to the mega city.

**Sampling and taxonomic analysis**

The sampling of algae was collected on 18$^{th}$ July 2023. Physico-chemical parameters i.e. watertemperature (29.8$^{o}$C), air temperature (30$^{o}$C), salinity (42‰) and pH (7.1) were measured. The algal samples were placed in polythene bags and transported to the laboratory, washed with distilled water and remove foreign particles then 5% formaldehyde was used to preserve the samples, after that shifted in70% alcohol for further analysis. Measurements were taken and photography was performed under stereo-zoom microscope (Wild 181300, Switzerland) at (10x50 magnification). For detailed internal structure study and illustration were made by using upright microscope (Nikon LABOPHOT-2) at (10x4, 10x10 magnifications). Using the available literature, taxonomist studies of algal specimen were conducted up to the species level.

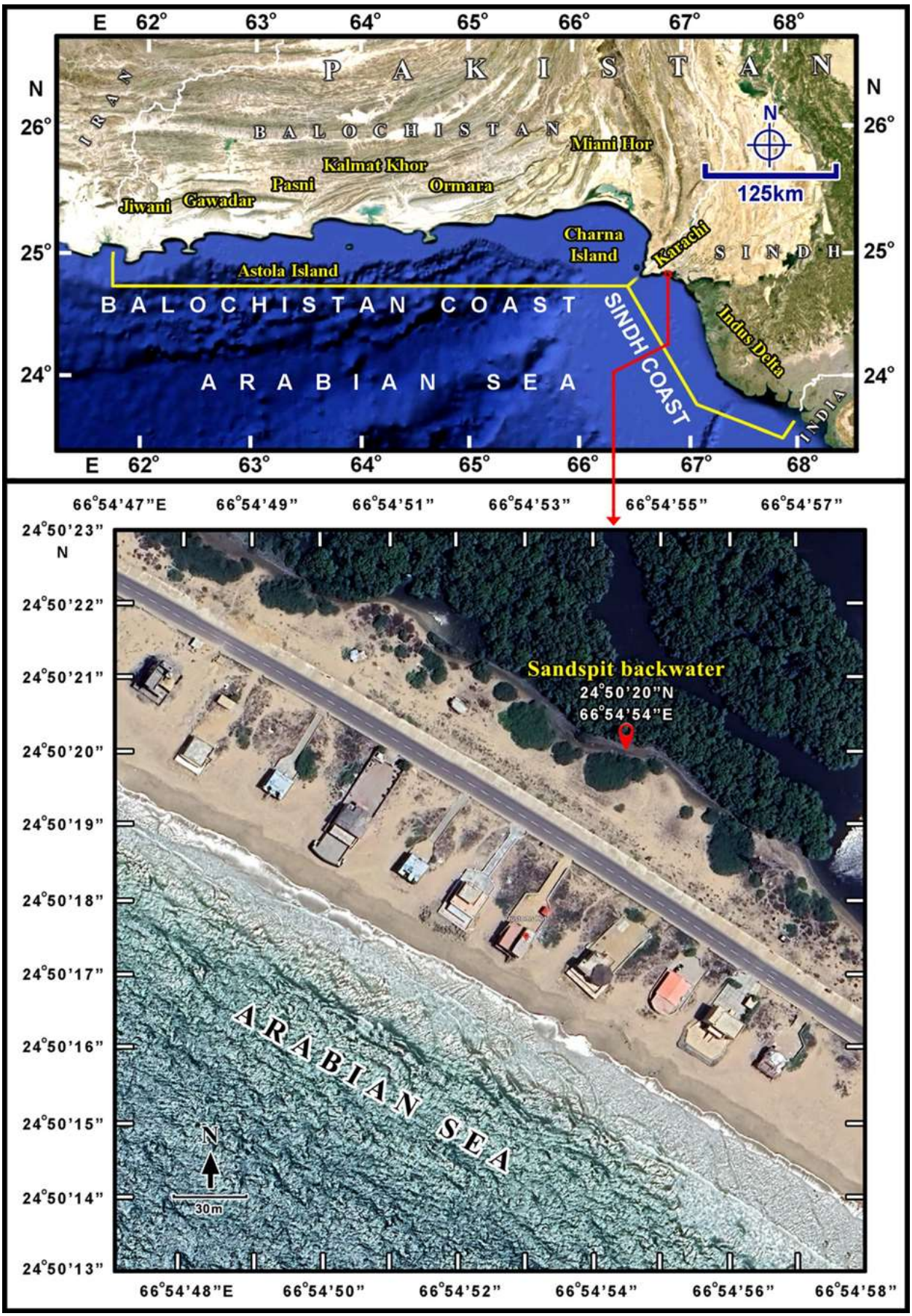


**Figure 1. Map showing study area of Sandspit backwater (24°50'20''N and 66°54'54''E) (Map developed by Abrar Ali, Marine Reference Collection and Resource Centre, University of Karachi).**

**Figure 2.Sandspit backwater (24°50’20’’N and 66°54’54’’E).**

## RESULTS AND DISCUSSION

In this research paper, we report and discuss the first record of *Chaetomorpha minima*. This macroalga is identified morphologically thorough assessment of the taxonomic aspects. Our research sheds light on the fine aspects of their surface and interior structures, as well as taxonomy, allowing for a better comprehension of their systematic study.

**Systematic:**

**Order**: Cladophorales

**Family**: Cladophoraceae wille, 1884

**Genus**:*Chaetomorpha* Kützing, 1845

**Species:** *Chaetomorpha minima*
Collins and Hervey, 1917.

**Material Examined***:* Sandspit back waters(24°50’20’’N and 66°54’54’’E), collectors,

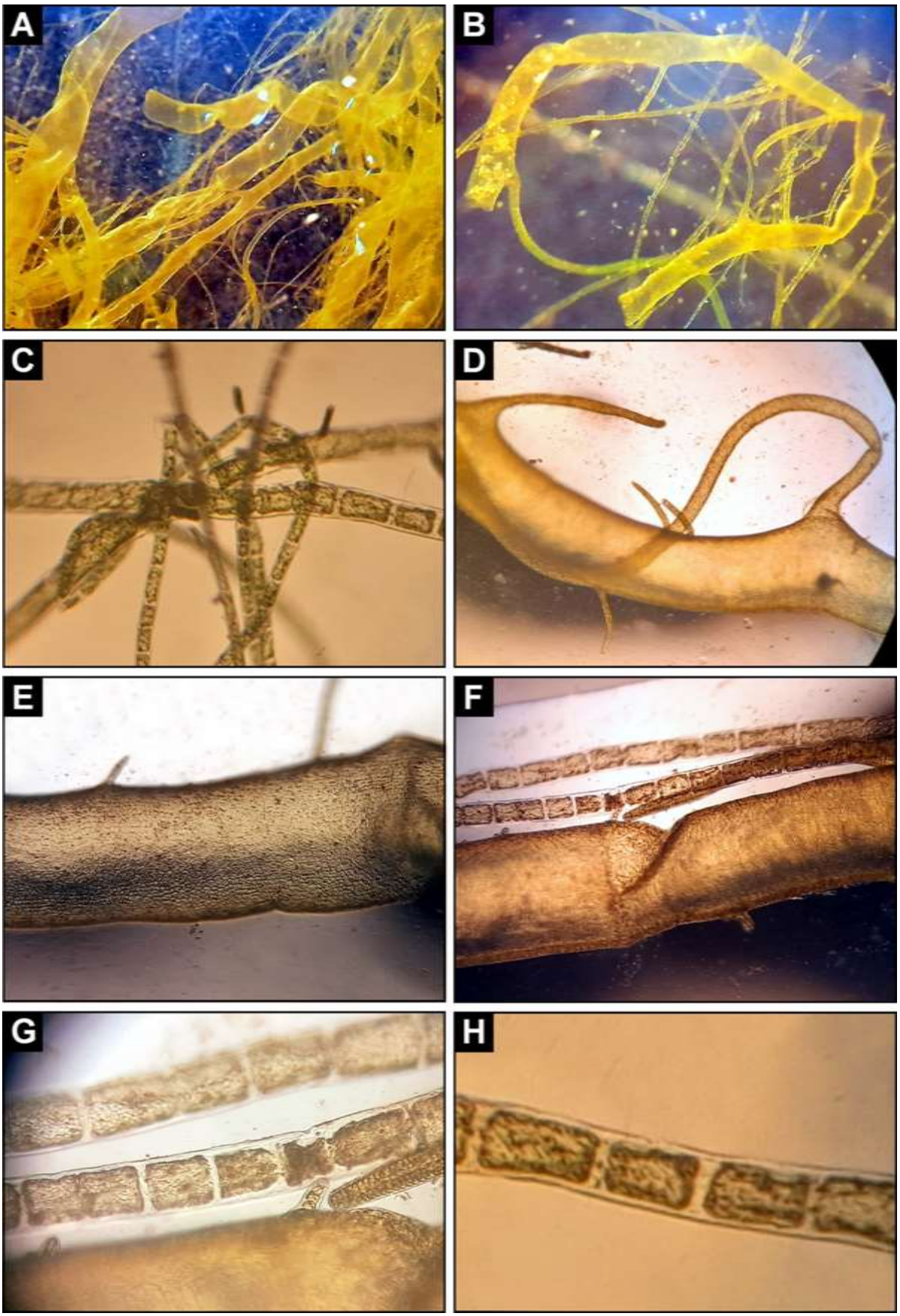


**Figure 3.*Chaetomorpha minima*: A-B. Stalk showing filaments; C. Detail of filaments; D-F. Basal cell showing attachment disk; G-H.Middle portion of the filament**

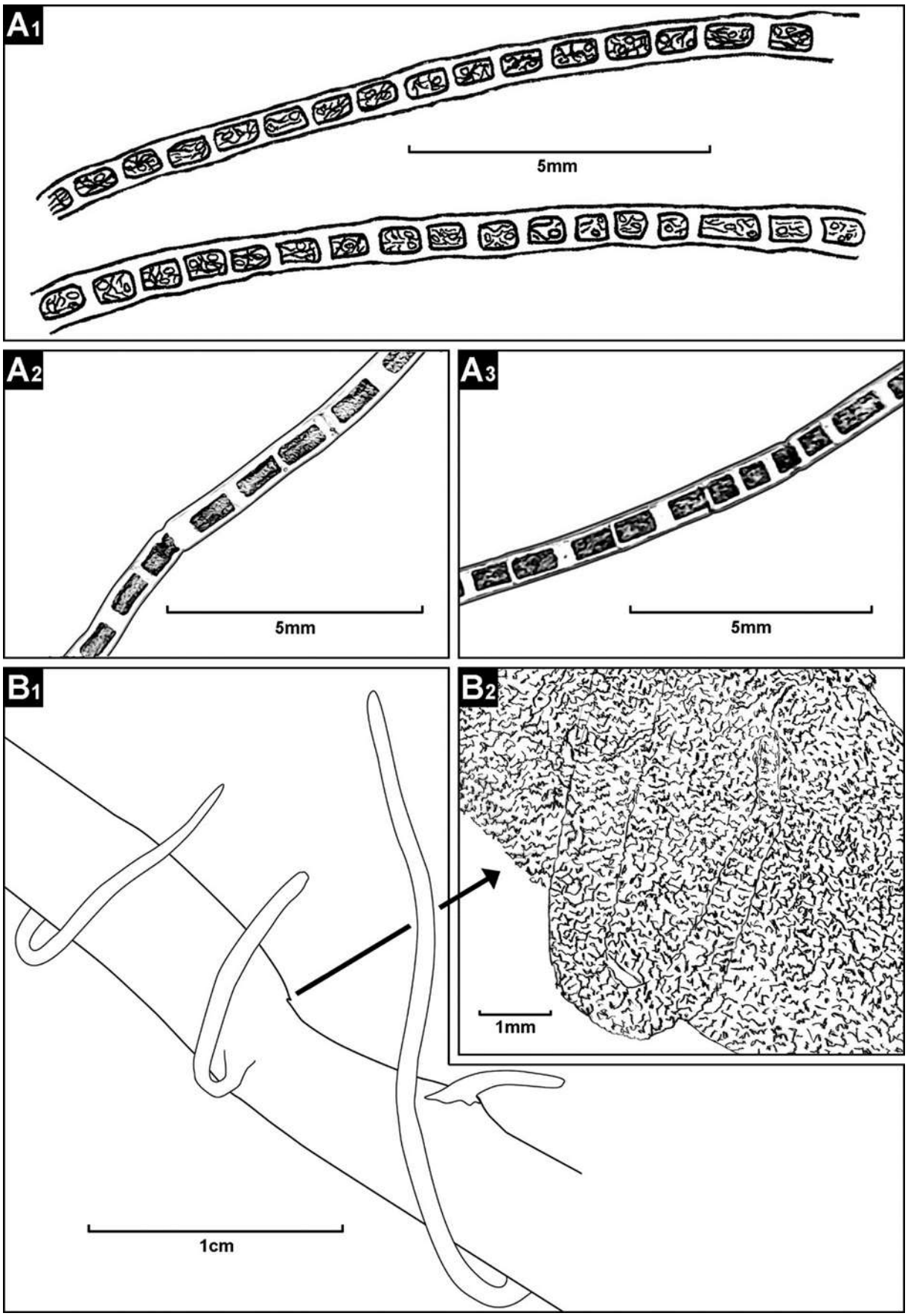


**Figure 4.Illustration showing the *Chaetomorpha minima*; A1- A3.Middle portion of the filament; B1-B2.Internal structure of basal cell**

Dr. Qadeer Mohammad Ali, Dr. Quratulan Ahmed, Ms. Shumaila Mubarak, on 18 July 2023 (CAT NO. MRCC-UOK-CHLO-01)

**Description**: The thallus filamentous is unbranched, uniseriate, epiphytic, yellowish-green to dark green, to 5(–10) mm in height,

cylindrical, occasionally slightly constricted at cell walls, (10–) 22.5–30(–40) µm in diameter. Cells (20–) 45–80 µm long (2–4 diameters long). Basal cell 12.5–15 µm in diameter, to 55 µm long, ends into small disc or lobed disc-like holdfast (Fig 3, 4). Often forms extensive mats of intertwined trichomes. Produces bi-flagellate gametes, some repeat gametophytic stage partheno-genically. Growing on hard substratum, or epiphytically on *Bostrychiatenella.*

**Distribution**: North, Central, and South America, Atlantic islands, Caribbean islands, western Atlantic, Africa, Indian Ocean islands (Maldives), Kenya, Pacific islands.

**Remarks:** This research contains on morphological and taxonomic description of *Chaetomorpha minima*, a new recorded species from Pakistan coast. Our research sheds light on the fine aspects of their surface and interior structures, as well as taxonomy, allowing for a better comprehension of their systematic study. *Chaetomorpha minima* was discovered in New England (4), Kenya by (5), and in Malaysia by (20). In west Bengal, India the genus *Chaetomorpha* was discovered with numerous species including *Chaetomorpha aerea, Chaetomorpha crassa, Chaetomorpha gracilis,* and *Chaetomorpha tortuosa* (46). As well as from Iran's southern coast, the Persian Gulf, and Oman (15, 39, 40). Taxonomic treatment of *Chaetomorpha* and *Rhizoclonium* species (*Cladophorales; Chlorophyta*) in New England were performed by (4), *Chaetomorpha minima* might be an attached form of a *Rhizoclonium* species, according (31) and (28) reported on the attached stages of the aforementioned species. When compared to our specimen, *Chaetomorpha minima* from New England has the following characteristics: basal cell with 10mm, cells cylindrical, 24 to 40 /urn diameter, 2 to 4 times as long as broad, and occasionally constricted at the end walls (9). *Chaetomorpha* is an economically important seaweed (13). Because of this, more study of this species is necessary, and additional research into the species will be needed to clarify any potential links.

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**REFERENCES**

1. Algal Web, 2023. Why Chaeto Algae is Essential for a Healthy Reef Tank. https://algalweb.net/chaeto-algae/#google_vignette

2. Anand, P. L., 1940. Marine Algae from Karachi .I. Chlorophyceae. Punjab University Botanical Publications, Lahore. P: 52

3. Beg, M.A.A., S. N. Mahmood, S. Naeem and A.H.K. Yousufzai. 1984. Land based pollution and the marine environment of Karachi coast. Pakistan Journal of Scientific and Industrial Research. 27: 199-205

4. Blair, S. M., 1983. Taxonomic Treatment of the *Chaetomorpha* and *Rhizoclonium* species (*Cladophorales*; *Chlorophyta*) in New England. Rhodora. Pp: 175-211

5. Bolton, J. J., H. A. Oyieke and P. Gwada, 2007. The seaweeds of Kenya: checklist, history of sea weed study, coastal environment, and analysis of sea weed diversity and biogeography. South African Journal of Botany. 73(1): 76-88

6. Bolton, J.J., D. V. Robertson-Andersson, D. Shuuluka and L. Kandjengo, 2009. Growing *Ulva* (Chlorophyta) in intergrated systems as a commercial crop for abalone feed in South Africa: a SWOT analysis. Journal of Applied Phycology. 21(5): 575-583. doi:10.1007/s10811-008- 9385-6

7. Brodie, J. and J. Lewis,2007. Unravelling the Algae: the Past, Present, and Future of Algal Systematics.CRC Press. pp. 412

8. Caffrey, J. M. and C. Monahan, 1999. Filamentous algal control using barley straw. Hydrobiologia. 415(3): 315-318. doi:10.1023/ A: 1003884211027

9. Collins, F. S. and A. B. Hervey., 1917. The algae of Bermuda. Proceedings of the American Academy of Arts and Sciences. American Academy of Arts & Sciences. 53(1): 3-183, 185-195. https://www.jstor.org/stable/ 20025740

10. Cruz-Sua´rez, L.E., A.Leo´n, A. Pen˜a-Rodrı´guez, G. Rodrı´guez-Pen˜a, B. Molland and D.Ricque-Marie, 2010. Shrimp/Ulva co-

culture: a sustainable alternative to diminish the need for artificial feed and improve shrimp quality. Aquaculture. 301(1-4): 64-68. doi:10. 1016/j.aquaculture.2010.01.021

11. de Paula Silva, P.H., S. McBride, R. de Nys and N.A. Paul, 2008. Integrating filamentous 'green tide' algae into tropical pond-based aquaculture. Aquaculture. 284(1-4):74-80. doi:10.1061/j.aquaculture.200807.035

12. Dring, M. J. and M. J. Dring,1992. The Biology of Marine Plants. Cambridge University Press. pp. 208

13. Francavilla, M., M. Franchi, M. Monteleone and C. Caroppo, 2013. The Red Seaweed *Gracilaria gracilis* as a multi products source. Marine Drugs. 11(10): 3754-3776

14. Gaillon, B., 1828. *Résumé méthodique des classifications des Thalassio phytes*. Dictionnaire des Sciences Naturelles, édition 2 F. Cuvier. 53: 350-406

15. Gharanjik, B. M., 2000. The marine algae of the Sistan and Baluchestan Province, Iran. Iranian Journal of Fisheries Sciences. 2(2): 57-70

16. Guiry, M. D., and G. M. Guiry, 2014. Algae Base.Worldwide electronic publication, National University of Ireland, Galway. http://www.algaebase.org

17. Guiry, M. D. and G. M.Guiry, 2017. AlgaeBase.Worldwideelectronicpublication,National University of Ireland, Galway. http://www.algaebase.org

18. Haq, S.M., 1976. Overview of pollution in the Coastal Environment of Pakistan and Its Possible Implication for the Marine Ecosystem. *In*: Proceedings of International Symposium on Marine Pollution Research. Center for Wetland Resources Louisiana State University, Baton Rouge.pp: 33-53

19. Hiraoka. M., M. Ohno, S. Kawaguchi and G. Yoshida, 2004. Crossing test among floating *Ulvathalli* forming 'green tide' in Japan. Hydrobiologia. 512: 239-245. doi:10.1023/B: HYDR.0000020332.12641.a2

20. Isa, H. M., A. H. M. Kamal, M. H. Idris, Z.Rosli and J. Ismail,2017. Biomass and habitat characteristics of epiphytic macroalgae in the Sibuti mangroves, Sarawak, Malaysia. TropicalLife Sciences Research,28 (1): 1-21

21. Lehvo, A. and S. Ba¨ck. 2001. Survey of macroalgal mats in the Gulf of Finland, Baltic Sea. Aquatic Conservation Marine and Freshwater Ecosystems. 11(1): 11-18

22. Leliaert, F. and C. Boedeker, 2007. Cladophorales. *In*: Brodie J, Maggs C A, John D M (eds). The green Seaweeds of Britain and Ireland. The British Phycological Society, London. Pp: 131-183

23. Liu, D., J. K. Keesing, Q., Xing and P. Shi, 2009. World's largest macroalgal bloom caused by expansion of seaweed aquaculture in China. Marine Pollution Bulletin. 58(6): 888-895

24. Liu, D., J. K. Keesing, P. He, Z. Wang, Y. Shi and Y. Wang, 2013. The world's largest macroalgal bloom in the Yellow Sea, China: formation and implications. Estuarine, Coastal and Shelf Science. 129: 2-10

25. Maceiras, R., M. Rodrı, A.Cancela, S.Urréjola and A. Sánchez, 2011. Macroalgae: raw material for biodiesel production. Applied Energy. 88(10): 3318-3323

26. McAvoy, K.M. and J.L. Klug, 2005. Positive and negative effects of riverine input on the estuarine green alga *Ulva intestinalis* (syn. *Enteromorpha intestinalis*) (Linnaeus). Hydrobiologia. 545: 1-9. doi:10.1007/s10750-005-1923-5

27. Morand, P. and M. Merceron, 2005. Macroalgal population and sustain-ability. Journal of Coastal Research. 21(5): 1009-1020

28. Nienhuis, P. H., 1975. Biosystematics and ecology of *Rhizoclonium riparium* (Roth) Harvey (Chlorophyceae: Cladophorales) in the Estuarine Area of the Rivers Rhine, Meuse and Scheldt. Rotter. Bronder Offset B. V. Pp: 240

29. Nizamuddin, M. and N. Begum,1973. Revision of the marine Cladophorales from Karachi. Botanica Marina. 16(1):1-18

30. Ohno, M., 1993. Cultivation of the green algae, Monostroma and Enteromorpha ''Aonori''. *In*: Ohno M, Critchley AT (eds) Seaweed Cultivation and Marine Ranching. Japan International Cooperation Agency (JICA), Kanagawa. Pp: 151

31. Perrot, Y., 1965. Sur le cycle de reproduction d'uneCladophoracee marine de la région de Roscoff: Lola implexa (Harvey). Comptes rendus hebdomadaires des séances de l'Académie des sciences, Paris. 261:503-506

32. Qari, R. and E. Khan, 2018. Diversity of

Green Sea weeds along the Coast of Karachi. International Journal of Marine Science. 8(22): 176-185

33. Saifullah, S. M., 1973. A preliminary survey of the standing crop of seaweeds from Karachi coast. Botanica Marina. 16(3): 139-144

34. Shameel, M., 1987. Apreliminary survey of seaweeds from the coast of Lasbela, Pakistan. Botanica Marina. 30(6): 511-515

35. Shameel, M. and S. Afaq-Husain,1987. Survey of algal flora from Lasbela coast. *In*:Modern Trends of Plant Science Research in Pakistan. Ilahi, I. And F. Hussain (eds.), Proceeding of National Conference of Plant Scientists, Peshawar. Pp: 292-299

36. Shameel, M. and J. Tanaka, 1992. A preliminary check-list of marine algae from the coast and inshore waters of Pakistan. *In*: (T. Nakaike and S. Malik, eds) Cryptogamic Flora of Pakistan. National Science Museum, Tokyo. 1: 1-64

37. Shameel, M., K. Aisha and S.H. Khan. 1996. A preliminary survey of seaweeds from the coast of Makran, Pakistan. Botanica Marina. 39(3): 223-230

38. Silva, P. C. 1950. Generic names of algae proposed for conservation. Hydrobiologia. 2(3): 252-280

39. Sohrabipour, J. and R. Rabii, 1999. A list of marine algae of sea shores of Persian Gulf and Oman Sea in the Hormozgan Province. Iranian Journal of Botany. 8(1): 131-162

40. Sohrabipour, J., R. Rabei, T. Nejadsatari and M. Assadi, 2004. The marine algae of the southern coast of Iran, Persian Gulf, Lengeh area. The Iranian Journal of Botany. 10(2): 83-93

41. Stafleu, F. A., 1978. International Code of Botanical Nomenclature. Regnum Vegetabile. 97: 1-457

42. Thompson, M. F. and N. M. Tirmizi, 1988. Marine Sciences of the Arabian Sea, American Institute of Biological Sciences,Washington D.C. pp.658

43. Tsutsui, I., Q. N.Huy`nh, H. D. Nguyeˆ ˜n, S. Arai and T. Yoshida, 2005. The common marine plants of Southern Vietnam. Japan Seaweed Association, Kochi. P. 250

44. Tsutsui, I., P. Kanjanaworakul, P. Srisapoome, D. Aue-umneoy and K. Hamano, 2010. Growth of giant tiger prawn, *Penaeus monodon* Fabricius, under co-culture with a discarded filamentous seaweed, *Chaetomorpha ligustica* (Ku¨tzing) Ku¨tzing, at an aquarium-scale. Aquaculture International. 18(4): 545-553. doi:10.1007/s10499-009-9274-2

45. Tsutsui, I., K. Hamano, D. Aue-umneoy, J. Songphatkaew, P. Srisapoome, S. Ruangsomboon, S. Klomkling, M. Ganmanee, P. Taveekijakarn and Y. Maeno, 2012. Common underwater plants in coastal areas of Thailand. JIRCAS International Agriculture Series 21. Japan International Research Center for Agricultural Sciences, Tsukuba. Pp: 172

46. Yadav, S. K., 2022. Diversity and distribution of seaweeds in the West Bengal Coast, India. International Journal of Bioresource Science.09(02): 129-138

47. Yamochi, S., 2013. Effect of desiccation and salinity on the outbreak of a green tide of *Ulva pertusa* in a created salt marsh along the coast of Osaka Bay, Japan. Estuarine, Coastaland Shelf Science. 116: 21-28. doi:10.1016/j.ecss.2012.07.002