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Diversity of Epiphytic Microalgae in Universitas Indonesia Campus, Depok

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Abstract. Epiphytic microalgae inhabit terrestrial ecosystem and can be found in trees. Research on epiphytic microalgae has been carried out in three locations at Campus Universitas Indonesia (UI), which were The Faculty of Mathematics and Natural Sciences, the main road near Universitas Indonesia Railway Station, and the North Ring Road (in front of the Engineering Faculty). This research aimed to analyse the diversity of epiphytic microalgae in the three locations based on their occurrence. Six individual trees were purposively selected from each location. Four plots (5x5cm) were placed on the bark tree, following the cardinal direction. Epiphytic microalgae were collected using scalpel and put into plastic sample before labelling. Observation was carried out under light microscope with 40x10 magnification. The identification result indicated that six species of trees, including *Delonix regia* (6), *Havea brasiliensis* (5), *Filicium decipiens* (3), *Adenathera pavonine* (2), *Dillenia indica* (1), and *Acacia auriculiformis* (1) were found to host microalgae among the 18 individual trees analyzed. There were eight taxa of epiphytic microalgae found: *Trentepohlia* sp., *Schroederia* sp., *Aphanothece* sp., *Lyngbya* sp., *Oscillatoria* sp., *Scytonema* sp., *Gloeocapsa* sp. and unidentified filamentous microalgae. *Threntepohlia* sp. (*Ulvophyceae*, *Chlorophyta*) was found in all locations, while *Schroederia* sp. (*Chlorococcaceae*, *Chlorophyta*) was the species with the least presence.

Keyword: biodiversity, bark tree, epiphytic microalgae, terrestrial, Universitas Indonesia

1. Introduction

Microalgae are autotrophic microorganisms, meaning they are capable of photosynthesis. Chlorophyll, carbon dioxide, nutrients, and light are incorporated in microalgae to perform this process [1]. The number of described microalgae species is estimated to be 50,589 species, which recorded to be the third large groups of organisms after flowering plants (ca. 382,000 species) and fungi (ca. 170,000 species, including lichens) [2]. Microalgae are highly diverse and account for half of the Earth's primary production. The biodiversity of microalgae plays a crucial role in shaping global natural ecosystem productivity. This is because microalgae are the most efficient microorganisms in capturing and utilizing solar energy and CO₂ for photosynthesis [3]. Their simpler structure compared to higher plants, along with their chlorophyll, allows them to produce



organic matter and oxygen in water, grow rapidly, and thrive in harsh conditions with simple unicellular or multicellular form.

Epiphytic microalgae inhabit in the parts of plants, such as root, trunk, and leaf. They can be found in terrestrial and aquatic ecosystem, in tropical and temperate regions, from lowland to highland [4][5][6]. Epiphytic microalgae exhibit a variety of shapes, including spherical, plate-like, ribbon-like forms, and some that aggregate to form colonies. In addition to the diverse shapes, they also display a range of colour, such as green, blue, red, yellow, orange, and even brown, depending on the pigments present in their cell [7]. Cyanobacteria, green algae (Chlorophyta), diatoms (Bacillariophyta) are common epiphytic microalgae, but other groups may also be found.

The Universitas Indonesia (UI) Campus covers 312 hectares and is divided into three areas. There are buildings, facilities and infrastructure area, green spaces, and aquatic ecosystems. The Campus is located on the border of DKI Jakarta and Depok Provinces. The green open spaces of UI Campus serve as “cities’ lung” because it plays role as urban dwellers spaces for breathing in polluted cities. Vegetation on the UI campus can be found in various locations, such as city forests (Hutan Kota), around faculty gardens, and main campus roads [8].

City forests and main road edges have various types of trees and different microclimates, which are believed to contribute to variations in species composition and epiphytic microalgae diversity within the Universitas Indonesia area. Research in 1997 reported 42 species of trees found in UI Campus, mostly in UI’s city forest [8]. The number of trees species got higher in 2009 (113 species), which were dominated by *Acacia falcataria* and *Albizia falcataria* [9], while *A. falcataria*, *Delonix regia*, and *Polyalthia longifolia* were frequently found at the side of main road [10]. Despite the high biodiversity of plants in UI Campus, diversity of epiphytic microalgae on the tree barks is less explored. The ability of microalgae to convert carbon dioxide to oxygen and absorb pollutants on air are some of the reasons to study these ecosystem’s components more extensively.

The purpose of this study was to explore and identify the diversity of epiphytic microalgae in several habitats of UI campus based on their morphological characteristics. The results of this study will fill the “empty space” of biodiversity at UI Campus which has been acknowledged for its flora and fauna. Moreover, information gained from this preliminary study will make better understanding about the role of UI’s green space on macro and microorganisms’ perspectives. Finally, the data of epiphytic microalgae can be used as learning materials for UI students to promote their awareness about biodiversity and conservation.

2. Method

2.1 Location

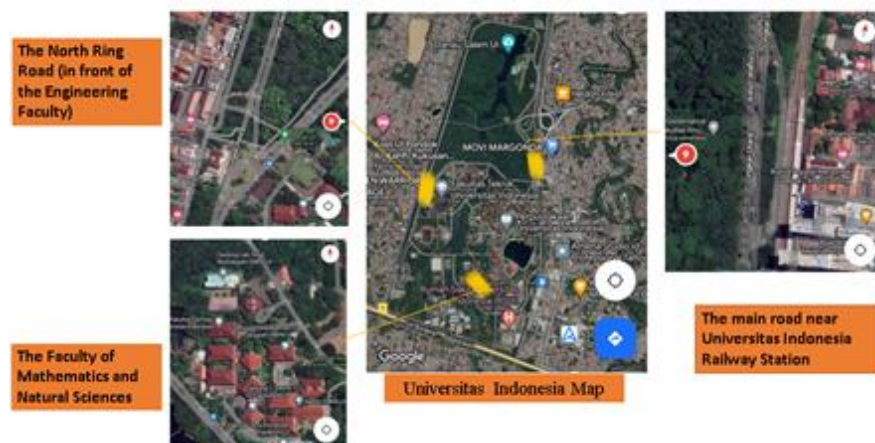


Figure 1. Sampling locations of epiphytic in the UI Campus area.

Sampling locations were determined at three sites using purposive sampling methods. The selected sites would represent the variety of habitats on the Universitas Indonesia Campus (Figure 1), which were 1) The entrance gate area of UI (from the main gate to UI station) (representing the busy area), 2) Faculty of Mathematics and Natural Sciences area (representing building and facility area), and 3) The northern ring road in front of the Faculty of Engineering (representing vegetation area). The selection of microalgae host tree samples was based on purposive sampling [11], which considered the present of microalgae on the barks and the safety conduction of sampling (for examples no ants or bees colony, or any animals that could harm the researcher). Epiphytic microalgae were collected at the end of rainy season, over periods of two months (February-March 2024). Samples were brought to the Department of Biology Faculty of Mathematics and Natural Sciences (FMNS). Identification and documentation of microalgae were carried out at Laboratory of Algal Preparation and Bioimaging, respectively.

2.2 Sampling of Epiphytic Microalgae

Sampling was conducted at each designated location. Six individual trees were selected at each location with several considerations mentioned before. For each sampled tree, a subplot of 5 x 5 cm was established around the tree in all four cardinal directions and at a height of 120-150 cm above the ground to assess the diversity of epiphytic microalgae. Epiphytic microalgae samples were collected using a sterile scalpel by scraping, then placed in sterile plastic bags and labelled. Sampling was performed around the tree trunk where epiphytic microalgae present.

2.3 Environmental Parameter Measurement

Environmental parameters were measured at each location and during sampling. These environmental parameters are also necessary to assess the impact of the presence of epiphytic microalgae at each site. In this study, the environmental parameters measured including temperature, humidity, light intensity, and tree bark's pH. The pH was measured after soaking 0.5 g cleaned surface bark into sterilized aquadest for an hour.

2.4 Observation and identification of Epiphytic Microalgae

Epiphytic microalgae were observed using a light microscope Leica DM 500 with magnifications of 10x10 and 10x40. Identification of epiphytic microalgae was carried out by examining the morphological characteristics such as thallus shape, colour, and other's specific features. The morphological characteristics of each microalga were then compared to the algal description from monographs and related journal's articles [12][13][14].

3. Results and Discussion

Among the 18 individual trees samples, six were identified as *Delonix regia*, five *Havea brasiliensis*, three *Filicium decipiens*, two *Adenathera pavonine*, one *Dillenia indica*, and one *Acacia auriculiformis*. Tree composition on each sampling locations was different. *Delonix regia* was the only tree species found at the location 1 (the sideroad near UI Railway Station), while *Hevea brasiliensis* and *Dillenia indica* were found in location 2 (FMNS). Diversity of trees species was higher in location 3 (the northern ring road in front of the Faculty of Engineering), which including *Filicium decipiens*, *Adenathera pavonine*, and *Acacia auriculiformis*.

Table 1. Epiphytic microalgae presence at the three sampling locations.

No	Taxa	The Faculty of Mathematics and Natural Science						The main road near Universitas Indonesia Railway Station						North Ring Road (in front of the Engineering Faculty)					
		1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
1	<i>Trentepohlia</i>	+	+	-	+	+	+	+	+	+	+	+	+	-	+	+	+	+	-
2	<i>Schroederia</i>	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	<i>Aphanothece</i>	+	+	+	-	-	+	-	+	-	+	+	+	+	-	-	+	+	-
4	<i>Lyngbya</i>	+	+	-	+	+	+	+	+	-	-	+	-	+	-	-	+	-	+
5	<i>Oscillatoria</i>	+	-	+	-	-	-	-	-	-	-	-	-	+	-	-	+	+	-
6	<i>Scytonema</i>	-	-	-	-	-	-	-	-	-	+	-	-	-	+	-	+	-	-
7	<i>Gloeocapsa</i>	-	-	+	-	-	-	-	-	-	-	-	-	+	+	-	-	-	+
8	Unidentified	-	-	+	-	+	-	-	+	+	-	+	-	+	-	-	+	+	+

Note: + = present; - = not present

Epiphytic microalgae were found on the cracks of tree barks. The cracked and grooved at the barks provide microhabitats and places for the accumulation of humus and water, thus maintaining moisture [15] which later support the growth of microalgae [16]. Seven taxa were found (Table 1 and Figure 2.) which belong to two Divisions of Cyanobacteria (*Aphanothece* sp., *Lyngbya* sp., *Oscillatoria* sp., *Scytonema* sp., and *Gloeocapsa* sp.) and Chlorophyta (*Trentepohlia* sp. and *Schroederia* sp.). One filamentous species was unidentified. Microalgal thallus diversity included unicellular (*Schroederia* sp.), non-filamentous colonial forms (*Aphanothece* sp., *Gloeocapsa* sp.), and filamentous colonial forms (*Lyngbya* sp., *Oscillatoria* sp., *Scytonema* sp., *Trentepohlia* sp.). The epiphytic Cyanobacteria was frequently found than Chlorophyta and this result was concordance with the study of epiphytic microalgae in Bangkok City [6]. *Trentepohlia* sp. (Ulvophyceae, Chlorophyta) was found on all tree barks, while *Schroederia* sp. (Chlorococcaceae, Chlorophyta) was observed only on the bark of *H. brasiliensis* at location 1 (FMNS). *Trentepohlia* has been known as epiphytic green algae dominated bark habitat at tropical ecosystem [17].

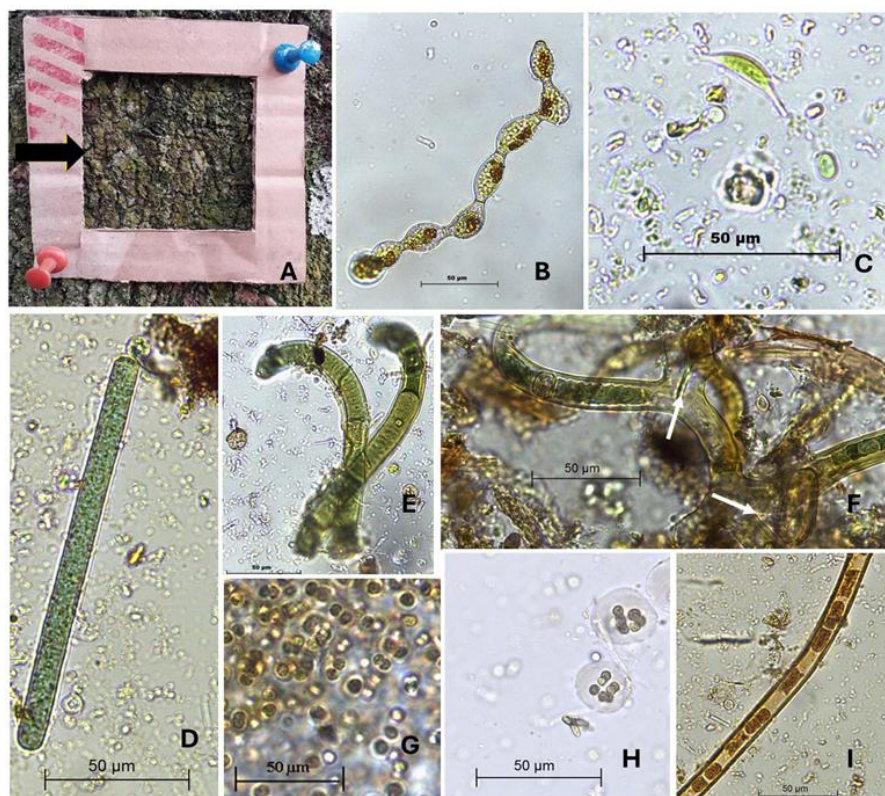


Figure 2. Microscopic photographs of epiphytic microalgae found on the tree barks at Universitas Indonesia Campus. A. The cracks on tree bark of *Hevea brasiliensis* (arrow), B. *Trentehpohlia* sp, C. *Schorederia* sp, D. *Oscillatoria* sp., E. *Lyngbya* sp., F. *Scytonema* sp., G. *Apanothece* sp., H. *Gloeocapsa* sp., and I. Unidentified filamentous microalgae.

Table 2. Abiotic Parameters

Sampling Locations	Humidity (%)	Light intensity (Lux)	Temperature (°)	Bark pH
1	70-80	2,000-10,000	33	5-5,5
2	75-80	3,000-10,000	24-31	5-5,5
3	60-70	2,000-9,000	30-33	5-6

Note:

1= The main road near Universitas Indonesia railways station

2= The Faculty of Mathematics and Natural Science

3= The North ring road (in front of the Faculty Engineering)

Abiotic parameters at each sampling location were varied due to vegetation's structure at each site (Table 2). However, the values of all environmental factors were on the range that supported the growth of epiphytic microalgae found at the habitats. Light intensity of approximately 5,000-10,000 lux is required for the process of photosynthesis, while temperature between 20°C and 30°C is optimum for the growth of microalgae [18]. The humidity value of Location 3 (the road in front of Faculty Engineering) was lower (60-70%) than the other two locations (near UI Railway Station and FMNS) which was 70-85% (Table 2).

The low humidity might be due to the landscape of this site where trees were planted in the middle of the roads and sunlight easily penetrated the empty space between the roadsides. Vegetation structure showed that four out of six individual tree samples had diameter <200 cm,

indicating the young stage of trees. Vegetation structure in Location 1 was dominated with *Delonix regia* with diameters up to 400 cm, creating large canopy. Structure vegetation at FMNS was dominated with *Hevea brasiliensis* which was planted long before the development of the faculty. Although the average diameter of trees samples <200 cm, trees coverage at the faculty green space increased the humidity of this area. The pH values of bark's trees at each location ranged from 5 to 6 which is rather low for Cyanobacteria that used to be found in alkaline habitat [19]. On the other hand, the green algae prefer acidic environment [20]. The epiphytic cyanobacteria were found almost in all sampling sites showing that many species within this group can develop a strategy to occupy the microhabitats provided by the tree barks. On the other side, the green algae of *Trentepohlia* showed specialized adaptation to live on many species of trees. Hence, the acidity of tree barks might be an advantage for the wide occupation of *Trentepohlia*.

4. Conclusion

Six species of trees were identified as the substrates for epiphytic microalgae on Universitas Indonesia Campus. Seven taxa of epiphytic microalgae were recorded: *Trentepohlia* sp., *Schoroederia* sp., *Aphanothece* sp., *Lyngbya* sp., *Oscillatoria* sp., *Scytonema* sp., and *Gloeocapsa* sp. *Trentepohlia* sp. (Ulvophyceae, Chlorophyta) was found in all sampling location, while *Schoroederia* sp. (Chlorococcaceae, Chlorophyta) was recorded only at the Faculty of Mathematics and Natural Sciences, specifically on the bark of *Hevea brasiliensis*.

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