

Lichens Diversity of Kabawetan District Kepahyang, Regency Bengkulu Province

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ABSTRACT

Organisms formed as a mutualism symbiotic between fungi as mycobiont and algae as photobiont, Lichens, recently has been world-wide explored due to its unique characteristics and its highly beneficial especially in using this creatures as herbal medicine, environmental bioindicator. About 100.000 Lichens species grown around the world. However, in Indonesia Lichens has not well known as well as well explored yet, it has not been known by most people even though it's grown all over the region. In Kabawetan District, Kepahyang Region; one of a highland region of Bengkulu Province, Lichens can be found everywhere; they have grown as an epiphyte at various substrates; trees barks, stones, fences, etc. The purpose of this research was to study the diversity of lichens and their substrates at Kabawetan District Kepahyang Regency Bengkulu Province. Lichens investigation has been conducted on May – November 2019. Samples were collected from the villages of Kabawetan District. Samples then were identified based on morphological characteristics at Plant Biosystematic Laboratory of Mathematics and Natural Science Faculty Bengkulu University. Photobionts were observed using a light microscope. Data were analyzed by qualitative descriptively. It was found 20 Genera of lichens, belonged to 10 families, 4 orders. All Lichens found are belonged to Class Lecanoramycetes of Ascomycota. It was also found 2 photobionts that formed Lichens found at Kabawetan villages, those are *Trentepohlia* and *Trebouxia*. At the sites, Lichens found grown epiphytically at stones, wall, fences surfaces, and barks of many species of trees such as Tea (*Camelia chinensis* L.), African wooden tree (*Maeopsis eminii* Engl.), Jackfruit (*Artocarpus integra* L.), Breadfruit (*Artocarpus altilis* L.), Petai cina (*Leucaena leucocephala*, L.), Aren (*Arenga pinnata* L.), Manggo (*Mangifera indica* L.), Cemara Norfolk (*Araucaria cunninghamii*), Coffea (*Coffea arabica* L.), Chocolate (*Theobroma cacao* L.), water apple (*Syzygium aquea* L.), Guava (*Psidium guajava* L.), and bamboo (*Bambusa*).

Keywords: Diversity, lichens, Kabawetan

1. INTRODUCTION

1.1 Lichen

Lichen is of an important creature that make up the ecosystem, pioneering organisms a combination of algae and fungi that are mutually symbiotic [2]. The body structure of lichen is in the form of a thallus which is vegetatively similar in shape to a fungus. Lichen, which can be found in humid places; epiphytes are often found on trunks, branches, and tree bark, weathered wood, on the ground, on rocks, and other surfaces such as glass, metal or plastic, from lowlands to highlands. The thallus of lichen is

generally gray or greenish-gray, but some species are yellow, orange, brown, or red with varied habitats [1].

1.2 Structure of lichen

The lichen thallus consists of the cortex, medulla, and layers of algae. The cortex is composed of highly dense, pigmented hyphae/mycelium, while the medulla is composed of looser hyphae. The algae layer is composed of algae that are under the cortex, sometimes bound to the fungal hyphae that make up the lichens [2]. The anatomical structure of lichens based on the thallus can be seen in Figure 1.

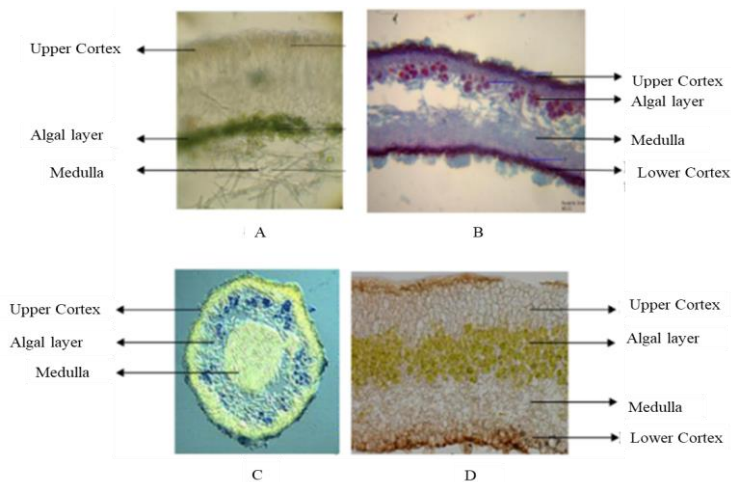


Figure 1. Anatomy structure of lichen based on their thallus. A. *Crustose* [11]; B. *Foliose* [18]; C. *Fructiose* [17]; D. *Squamulose*. [18]

1.3 Type of thallus

Lichens are divided into four types of thallus form; crustose (shaped like a crust, small, flat, thin, firmly attached to the substrate), as in *Graphis* and *Cryptothesia*. Foliose shape (thallus is flat, wide, many curves like a curled leaf rotating), as in *Parmelia* and *Peltigera*. Fruticose form (thallus shaped like a bush or hanging like a tuft or ribbon) as in *Ramalina* and *Usnea*, and squamulose form (thallus in the form of lobes like overlapping scales) as in *Cladonia* [3]. According to [2], height, type of substrate, and other abiotic factors such as air temperature, air humidity, substrate pH, light intensity affect the diversity of lichens in each place. Lichens species with its various types' thallus can be seen in Figure 2.

1.4 The benefits of lichen

Various roles and benefits are shown by lichens; including as environmental bioindicator; the abundance of lichens in a place indicates the cleanness of the environment in that place, on the contrary, fewer lichens in a place indicate high pollution in the atmosphere. Another role of lichen is its use in the health sector, both as an anti-bacterial [15], antifungal [16], anthelmintic [14], etc. Exploration and scientific studies on lichens have been carried out in many countries, while in Indonesia scientific information and data about lichens is still very limited, although some people have used this lichen for health. In Bengkulu City, a type of lichen, wind wood (*Usnea* sp) was found to be sold in a spice shop (personal observation).

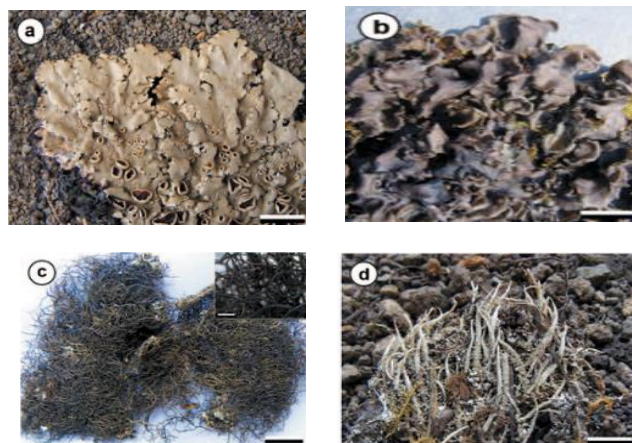


Figure 2. Examples of lichen species based on the thallus a. *Bulbothrix meizospora* (Nyl.) Hale (crustose), b. *Leptogium cyanescens* (Rabenh.) Körb., (foliose) c. *Bryoria asiatica* (Du Rietz) Brodo and D. Hawksw., (fruticose), d. *Cladonia awasthiana* (squamulose) [4].

Seeing the role of this lichen, further exploration and research is needed to obtain more complete data.

Scientific studies on lichens in the Department of Biology, Faculty of Mathematics and Natural Sciences, UNIB have been started in 2013 (through BOPTN funds). Starting with studying the diversity of lichen species Bengkulu City [5] followed by exploration/inventory of lichen species in several places in Rejang Lebong Regency [9], Scientific studies on phytochemical tests [13], and the effectiveness of lichen as anti-bacterial [15], anti-fungal [16] and anthelmintic [14], have also been carried out.

1.5 Distribution of lichen

The scientific data of lichens is still very small compared to the total number of lichens in the world which reaches $\pm 100,000$ species [6] and based on data from the Bogor Herbarium Bogoriensis, it has been found that around 40,000 species of lichens in Indonesia complete [7]. considering that there are still many areas in Bengkulu Province that store the diversity of lichens, but they have not been scientifically recorded, it is necessary to conduct research studies on lichens that are more representative, by conducting exploration in different

locations. Kabawetan District Kepahyang Regency, Bengkulu Province, one of Bengkulu highlands, with a tea plantation area and a fairly cool, slightly humid, and relatively clean environment, has a sufficiently supportive environment for lichen growth. Based on the results of observations, in Kabawetan Tea Plantation and its surroundings, there are many lichens such as *Graphis*, *Parmelia*, *Usnea*, *Cryptothecia*, *Ramalina*, and *Teloschistes*. But nothing has been scientifically documented. Therefore, scientific exploration and data collection of lichens was carried out in Kabawetan District, Kepahyang Regency has been done.

2. MATERIALS AND METHODS

This research was conducted in May-November 2019. Samples of lichen were taken in villages in Kabawetan District, Kepahyang Regency which had been determined based on the results of field exploration [8]. The samples is taken along with the substrates. Preparation of Herbarium and identification of lichen samples and their host plants were carried out at the Biosystematic Laboratory of the Department of Biology - Basic Sciece Building, FMIPA UNIB. Map of Kabawetan District, Kepahyang Regency, Bengkulu Province can be seen in Figure 3.

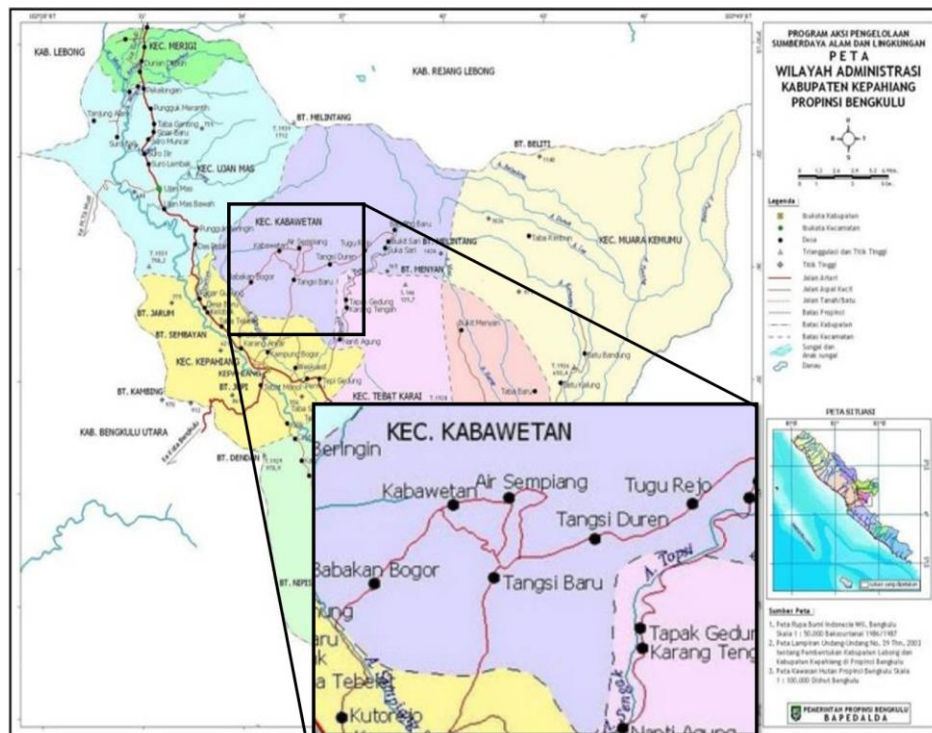


Figure 3. Map of Kabawetan District, Kepahyang Region, Bengkulu Province.

The tools and materials used in this research include field books and other stationery, GPS (Global Positioning System), cameras, label paper, brushes, cutters, chisels, machetes, plastic samples, large plastic bags, herbarium plastics, loops, label paper, sewing needles, thermo-hygrometer, and lux meter. The materials used are pH paper, 70% alcohol, Newsprint paper, cardboard, paper envelopes, thread, rubber bands,

3. RESULT AND DISCUSSION

The exploration of lichens in this study was carried out in Kabawetan Tea Plantation and Villages in Kabawetan District (Air Sempiang Village, Babakan Bogor Village, West Wetan Village, Kabawetan Village / Tangsi Baru Village,

Tangsi Duren Village, Bandung Baru Village, Bukit Sari Village, Pematang Donok Village, Sukasari Village, Tugurejo Village). More samples were found in Kabawetan Tea Plantation, while lichens found in these villages was relatively homogeneous and less. This is presumably the lack of a substrate where lichens grow; in the form of slightly wet tree bark or tree and weathered wood.

The result of the investigation (lichen exploration) in Kabawetan District, it was found that there were 3 types of lichen thallus; Crustose, (in the form of crusts), Foliose (in the form of strands/leaves) and Fruticose (in the form of bushes). The lichens found and have been identified are presented in Table 1.

Table 1. Classification and Types of Lichens Thallus in Kepahyang District

Division/Class/Ordo	Family	Genus	Species	Type of thallus
Ascomycota/Lecanoramycetes /Lecanorales	Parmeliaceae	<i>Parmotrema</i>	<i>P. perlatum</i>	<i>Foliose</i>
		<i>Parmelia</i>	<i>P. sulcata</i>	<i>Foliose</i>
			<i>P. tiliaceae</i>	<i>Foliose</i>
			<i>P. carporhizans</i>	<i>Foliose</i>
		<i>Xantoparmelia</i>	<i>Xantoparmelia</i> sp	<i>Foliose</i>
	<i>Hypogymnia</i>	<i>H. physodes</i>	<i>Foliose</i>	
	Usneaceae	<i>Usnea</i>	<i>U. hirta</i>	<i>Fruticose</i>
			<i>U. cornuta</i>	<i>Fruticose</i>
			<i>U. barbata</i>	<i>Fruticose</i>
			<i>U. articulata</i>	<i>Fruticose</i>
Ramalinaceae	<i>Ramalina</i>	<i>R. farinaceae</i>	<i>Fruticose</i>	
		<i>R. fastigiata</i>	<i>Fruticose</i>	
		<i>R. leptocarpha</i>	<i>Fruticose</i>	
Lecanoraceae	<i>Lecanora</i>	<i>L. helva</i>	<i>Crustose</i>	
		<i>L. pulicaris</i>	<i>Crustose</i>	
Stereocaulaceae	<i>Lepraria</i>	<i>Lepraria</i>	<i>Crustose</i>	
Ascomycota/Lecanoramycetes/O stropales	Graphidaceae	<i>Graphis</i>	<i>G. scripta</i>	<i>Crustose</i>
		<i>Phaeographis</i>	<i>Phaeographis</i> sp	<i>Crustose</i>
		<i>Diorygma</i>	<i>Diorygma</i> sp	<i>Crustose</i>
Ascomycota/Lecanoramycetes/ Teloschistales	Teloschistaceae	<i>Teloschistes</i>	<i>T. flavicans</i>	<i>Fruticose</i>
	Megalosporaceae Physciaceae	<i>Caloplaca</i>	<i>Caloplaca</i> sp	<i>Crustose</i>
		<i>Megalospora</i>	<i>Megalospora</i> sp	<i>Crustose</i>
		<i>Physcia</i>	<i>P. stellaris</i>	<i>Foliose</i>
		<i>Phaeophyscia</i>	<i>Phaeophyscia</i> sp	<i>Foliose</i>
		<i>Dirinaria</i>	<i>Dirinaria</i> sp	<i>Foliose</i>
<i>Heterodermia</i>	<i>Heterodermia</i> sp	<i>Foliose</i>		
Ascomycota/Lecanoramycetes/ Arthoniales	Arthoniaceae	<i>Arthonia</i>	<i>Arthonia</i> sp	<i>Crustose</i>
		<i>Cryptothecia</i>	<i>C. striata</i>	<i>Crustose</i>
			<i>C. scripta</i>	<i>Crustose</i>

From Table 1, it can be seen the lichens found in Kabawetan District. It was identified by matching the morphological characteristics of the lichens found in the research sites with the lichens in the reference books. 21 species types of lichen were identified in this study, all of which are members of the Divisi Ascomycota Division and Lecanoramycetes Class. These lichens are grouped into 4 orders; Lecanorales, Ostropales, Teloschistales, and Arthoniales. These lichens are also member of families Parmeliaceae, Usneaceae, Ramalinaceae, Lecanoraceae, Stereocaulaceae, Graphidaceae, Teloschistaceae, Megalosporaceae, Physciaceae, and Arthoniaceae. These lichens are also members of 20 genera: *Parmotrema*, *Parmelia*, *Xantoparmelia*, *Hypogymnia*, *Usnea*, *Ramalina*, *Lecanora*, *Lepraria*, *Graphis*, *Phaeographis*, *Diorygma*, *Teloschistes*, *Caloplaca*, *Megalospora*, *Physcia*, *Phaeophyscia*, and *Cryptecia Heterodermia*.

It can be seen in Table 1, of the 28 lichens found, some lichenes are not completed identified to species taxon. This is due to the uniqueness of the lichens themselves, where lichens are a combination between fungi and algae which may provide different morphological variations due to environmental factors. Another reason that causes the low diversity

of species identified, is that of the limited number of references to for identification.

In Table 1. It can also be seen, the types of thallus from lichens found in Kaba Wetan District; of the 4 types of Lichen thallus [3], there found three types of lichen thallus; *crustose* (thallus like crusts, tightly attached to the substrate), *fruticose* thallus (shrub-like shape) and *foliose* thallus (thallus shape like a leaf). Squamulose lichens were not found in this study, this is presumably because lichens of the talus squamulose type are usually found on a very moist substrate, such as inside weathered wood or close to the waters.

There are 11 species of lichens with the crustose type thallus, including *Lecanora helva* L., *L. pulicaris* L. *Lepraria* sp, *Graphis scripta* L., *Diorygma junghuhnii* L., *Caloplaca* sp., *Megalospora* sp., *Arthonia* sp., *Cryptothecia striata*, L., *Cryptothecia scripta* L., lichens with the foliose thallus type were found in 10 species, including *Parmotrema perlatum* L. *Parmelia sulcata* L., *Parmelia tiliaceae* L., *Parmelia carporhizans* L., *Xantoparmelia* sp, *Hypogymnia physodes* L., *Physcia stellaris* L., *Phaeophyscia* sp., *Dirinaria* sp., *Heterodermia* sp.



Figure 4. Type of lichen found in kabawetan

There are 7 species of lichens with the fruticose thallus type, including *Usnea hirta* L., *Usnea cornuta* L., *Usnea barbata* L., *Usnea articulata* L., *Ramalina farinacea* L., *Ramalina fastigiata* L., *Ramalina leptocarpa* L. The lichen species found can be seen in Figure 4.

From the data found, crustose talus was found to dominate, where 11 species (39.3%) were found, followed by *foliose* talus as many as 10 species (35.7%) and *fruticose* as many as 7 species (25%). The results of this study are in line with previous studies [9], The difference in the number of these species is thought to be related to the characteristics of the lichen thallus itself; where the crustose thallus has the structure of the upper cortex and medullary (does not have a lower cortex) [3]; mycobionts/fungi directly penetrate the substrate. It is very difficult to take crustose type lichen without taking the substrate. So *crustose* type lichen is not affected by wind speed, because it sticks tightly to the substrate. So that it dominates the presence of lichens in every places. *Foliose*-type lichens are composed of the upper cortex, medulla, and lower cortex which has rhizine for attaching to the substrates. It is shaped like a leaf sheet, not too tall [3]; the sheet shape still allows part of the body or all of it detached from the substrate when exposed to blowing wind is very strong. The least number of lichens found was the *fruticose* type (thallus in the form of a flat or cylindrical bush), the part of the thallus that was attached to the substrate was relatively small [3]; so it is very vulnerable to be released by a big wind.

Lichens in Kabawetan District are found epiphytes on rocks, walls, and on the bark of various plants or trees such as Tea tree (*Camelia chinensis* L.), African wood (*Maeopsis eminii* Engl.), Jackfruit (*Artocarpus integra* L.), Bread fruit (*Artocarpus altilis* L.), Chinese Petai (*Leucaena leucocephala*, L.), Aren (*Arenga pinnata* L.), Mango (*Mangifera indica* L.), Pine (*Araucaria cunninghamii*), Coffee (*Coffea arabica* L.), Chocolate (*Theobroma cacao* L.), Water guava (*Sizygium aquea* L.), Guava (*Psidium guajava* L.), and various types of bamboo plants (*Bambusa* spp.). lichens are found on the substrate according to the habitat for their symbionts; there are water and moisture (algae and fungi). This is consistent with [10] so that the amount is not the same for each substrate. Trees with easily weathered and rough bark retain water and are covered with lichen compared to trees with hard and slippery surfaces.

Abiotic factors such as air temperature, humidity, light intensity, pH are known to greatly influence the

diversity and number of lichens, in addition to wind speed factors [2]. Light is one of the critical factors for the success of photosynthesis. So lichens need light for their growth. At the research location, the lichen attached to the stems of the tea plant was greatly influenced by the thickening of the leaves of the plant; in plants that are less penetrated by sunlight, the numbers is very small, in contrast to tea plants some trees which are in a place that is penetrated by the sun, more lichens found grown. So light intensity greatly affects the number/diversity of lichens.

Kabawetan sub-district is located at an altitude of 600-1000 masl. With air temperatures ranging from 19°C - 29°C, humidity ranges from 70% - to 85.5%, light intensity ranges from 30% to 50%, pH ranges from 4.5 to 7.5, wind speed 6 km / hour. Lichens can grow from the lowlands to the highlands; however, many factors can influence their variety and number. The temperature required to grow and reproduce lichens properly is 18°C - 25°C [2], the humidity required for lichen growth according to [11] is in the range of 45% to 76%. For a good substrate pH for lichen growth ranges from 5.5 to 8 [12]. In general, abiotic factors in Kabawetan District support the growth and development of lichens.

4. CONCLUSION

From the results of an inventory of lichens in Kabawetan District, Kepahyang Regency, 28 species of lichens from Ascomycota Division, Lecanoramycetes Class, Lecanorales, Ostropales, Teloschistales, and Arthoniales Orders, Families of Parmeliaceae, Usneaceae, Ramalinaceae, Lecanoroschistes, Stereocaulaceae, Graphidaceae, Stereocaulaceae, Physciaceae, Arthoniaceae and Genus *Parmotrema*, *Parmelia*, *Xantoparmelia*, *Hypogymnia*, *Usnea*, *Ramalina*, *Lecanora*, *Lepraria*, *Graphis*, *Phaeographis*, *Diorygma*, *Teloschistes*, *Caloplaca*, *Megalospora*, *Physcia*, *Phaeophyscia*, *Dirinothecium*, *Heterodermia*, *Arthritis*, and *Cryptothecia*. The lichens found, live epiphytes on rocks, surfaces/walls, and on the bark of various plants or trees such as Tea (*Camelia chinensis* L.), African wood (*Maeopsis eminii* Engl.), Jackfruit (*Artocarpus integra* L.), Breadfruit (*Artocarpus altilis* L.), Chinese Petai (L.). Aren (*Arenga pinnata* L.), Mango (*Mangifera indica* L.), Pine (*Araucaria cunninghamii*), Coffee (*Coffea arabica* L.), Chocolate (*Theobroma cacao* L.), Water guava (*Sizygium aquea* L.), Guava (*Psidium guajava* L.), and various types of bamboo plants (*Bambusa* spp.).

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