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Literatur Review: Compound Content and Bioactivity of Red Algae Found in Indonesia

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ABSTRACT

Red algae are lowland plants that often grow attached to certain substrates such as coral, mud, sand, rocks and other hard objects. This study aims to determine the content of secondary metabolite compounds and bioactivity and types of red algae species in Indonesia by taking references from previous studies. The results obtained are that red algae contain secondary metabolite compounds of steroids and triterpenoids and contain bioactivity such as antibacterial, antiviral, anticancer, antioxidant, anticoagulant, anti-inflammatory, antidiabetic, antiallergic, and analgesic and there are 14 species of red algae in Indonesia including Bostrychia tenella, Bostrychia radicans, Bostrychia sp., Chondria sp., Laurencia sp., Polysiphonia sp. Caloglossa leprieurii, Caloglossa monostica, Gelidium crinale, Gelidium sp., Catenella caespitosa, Catenella nippae, Catenella sp. and Murrayella sp.

Keywords: Secondary Metabolites, Bioactivity and Red Algae Species

I. INTRODUCTION

Indonesia is a country rich in diverse resources biological and has the richest number of marine species, around 45% of the world's algae species quoted in the Siboga expedition report, there are around 782 species of algae in Indonesiaincluding 196 species of green algae, 134 species of brown algae, and 452 species of red algae (Anggarana and Wathoni, 2017). Indonesia's natural wealth of algae is spread throughout region, one of the marine population's riches that is utilized and cultivatedhumans are red algae (Eucheuma cottonii) (Dwi et al., 2020). This is because there are manycontains useful substances. Secondary metabolites found in red algaeare steroids and triterpenoids. (Fasya et al., 2018).Articles must be written between approximately 2500-5000 words including body text, tables, images and a list of references. Articles must be written in a word document (MS Word), 1 space (single space), and Times New Roman style. Paper must be prepared on A4 paper (21cm x 29.7cm) with inner margins of 2.54 cm, outer margins of 2.54 cm, and top and bottom margins of 2.54 cm.

Red algae (Eucheuma cottonii) is a lowland plant that often grow attached to certain substrates such as coral, mud, sand, rocksand other hard objects (Samman and Janib, 2023). Red algae have the ability to produce active metabolites to protect themselves from attacks

disease and predators (Mattulada et al., 2018). Red algae have an ecological role important in marine ecosystems, including as primary producers and habitat providers for other marine organisms (Graham et al., 2016). Red algae also have an effect antimicrobial, several secondary metabolites show activity, namely they can fight bacteria, viruses and pathogenic fungi (Manandhar, et al., 2019). Bioactive compounds in Red algae have many different biological activities, including antibacterial, antiviral, anticancer, antioxidant, anticoagulant, anti-inflammatory, antidiabetic, antiallergic, and analgesic (Sianipar, 2022).

Compared with green algae and brown algae, red algae is algae which contains the most primary and secondary metabolites. Red algae is an algae that has high economic potential, contains vitamins, minerals, fiber, sodium, potassium and biologically active compounds in the form of secondary metabolites (Yuniarti et al., 2020). Red algae contain the pigment phycoerythrin which provides colortypical red. In addition, they also have chlorophyll a and d, as well as carotenoids (Guiry, M.D. 2015). Red algae are known to produce phycocolloids such as agarose, agar, carrageenan and other important secondary metabolites (Anggarana and Wathoni, 2017). There are several types of red algae that can be found in Indonesian waters, namely; Bostrychia sp., Caloglossa sp., Catenella sp., Gelidium crinale (Ghazali et al., 2019), Acanthopora muscoides, Euchema cottonii, Galaxaura regosa, and Amphiroa fragilissima (Ira et al., 2018).

Red algae can carry out photosynthesis at deeper water depths compared to most other algae because of its phycoerythrin pigment absorb blue light (Gómez, I., et al. 2016). Red algae is considered as one the oldest group of eukaryotes, with fossils found dating back up to 1.6 billion year. (Yang, E.C., et al. 2016). Recent research shows that some Red algae species show resistance to increased temperatures and acidification sea (Cornwall, C.E., et al. 2020). This research aims to determine the content secondary metabolite compounds and bioactivity as well as types of red algae species in Indonesia.

II. METHODS

In preparing this review, the technique used is the literature study technique by searching for sources or literature in the form of primary data in the form of national journals and international journals for the last 10 years (2014-2024). Besides, in In making this review, a data search was also carried out using online media, such as: Google and journal sites (Scholar, PubMed, etc.).

III. RESULTS AND DISCUSSION*

Algae (algae) are thallus plants that live in fresh waters and sea and occupies damp or wet places. Algae is a group of plants consisting of one or many cells, solitary, filamentous or colony and capable of photosynthesis. Algae also live in the form of benthos, nekton and fish small (Abizar, 2020). Overall, these algae have similar morphology even though they are actually different, so they are grouped into groups Thallophyta (thallus plants) are plants that have a structure the body framework is unbranched, has stems and roots, all consisting of stems thallus (Kepel, 2018).

Algae or red algae have biological characteristics such as mass reproduction does not have a ciliated gametophyte stage, reproduces sexually sexual with carpogonia and sperm, development is uniaxial and multiaxial. Holdfast consists of single cells or many cells, with the pigment phycobilin including phycoerethrin (red) which is color adaptive (Subagio, 2019). Compound Bioactives in red algae have different biological activities, among others as antibacterial, antiviral, anticancer, antioxidant, anticoagulant, anti-inflammatory, antidiabetic,

antiallergic, and pain reliever (Sianipar, 2022).

Red algae (Rhodophyta) are found throughout the research station are epiphytic algae and ephylitic algae. Red algae can live in mangrove forests by attaching to roots or stems as a substrate. There are 14 species of algae red found in the mangrove ecosystem of Ekas Bay. Species discovered included in the orders Ceramiales, Gelidiales and Gigartinales. Order Ceramiales has 2 families with 9 species. The first family is the Rhodomelaceae includes 7 species: B. tenella, B. radicans, Bostrychia sp., Chondria sp., Laurencia sp., Polysiphonia sp., Murrayella sp. The second family is Dellesseriaceae with two species namely C. leprieurii and C. monastery. Members of the order Ceramiales can be found in most stations, especially in the genus Bostrychia. As explained by Gyi and Soe-Htun (2014), Bostrychia varieties are generally more resistant to fluctuations drought and salinity. Members of the genus Bostrychia are capable of producing sugar alcohols which corresponds to the solute. Besides Bostrychia, Caloglossa also has lines metabolism which may be a biochemical adaptation to the environment hard.

The type of red algae found in the mangrove ecosystem of Ekas village is Bostrychia tenella, Bostrychia radicans, Bostrychia sp., Chondria sp., Laurencia sp., Polysiphonia sp., Caloglossa leprieurii, Caloglossa, Gelidium monosticanale, Gelidium sp., Catenella caespitosa, Catenella nippae, Catenella sp., Murrayella sp. and Species a. The description of the red algae found in Ekas Bay is as follows: Bostrychia tenella

1. Bostrychia tenella

Bostrychia tenella is a member of the order Ceramiales which has Distinctive and unique thallus with lateral branches (alternatingly pinnate) resembling feathers chicken. Gradient colors range from dark brown to purple. This type of algae is the most frequently encountered compared to other species. Holdfast fibers are present on the primary talus. The tetraspore thallus has capsule-shaped sporangia (stichidia) and are located at the ends of the branches. Meanwhile, the thallus is in the gametophyte phase there is a cyst. The habitat of this algae is found attached to the roots of Soneratia mangrove trees alba, Avicennia sp. and Rizophora mucronata. Apart from attaching to roots or stems mangrove trees, also found on rocks and other objects (Ghazali et al., 2018).

2. Bostrychia radicans

Thallus cylindrical, unipolar branching. Primary thallus has 4 rows of cells regular pericardial. The secondary branch has 4 rows of pericardial cells pointed at the end. Gradient colors range from brown to red. Bostrychia radicans was found to have round and tapered capsules located in branch tip. Collections of spores are found in capsule-shaped sporangia (stichidia). This species is found attached to the roots and trunks of mangrove trees Soneratia alba at station IV with Murrayella sp (Marfaung et al., 2015).

3. Bostrychia sp.

The thallus is cylindrical, brittle and prone to breaking, with 4 to 5 rows of cells pericardial, brown to purple in color. In this research, many were found sporangia (stichidia) at the tip of the thallus, some are empty and some are still contains spores. In general, Stichidia have a special shape, swollen at the base, narrows in the middle, then swells again in the middle end. The protrusions at the tip are smaller and sharper than those at the base The tip of the stichidia contains spores. The central part of the stichidia is often narrowed separated. The head of the embankment is curved like a hook. This species was discovered attached to the roots of Soneratia alba at stations II, III and IV. (Idrus et al., 2017).

4. Chondria sp.

The thick, cylindrical thallus has a deep purple to red color. Pinnate branching, the connecting base between the lateral thallus and the main thallus looks narrower than the

tip. The shape of the cells cannot be seen because of the thallus thick. The tip of the thallus attaches more easily to the roots and stem of Soneratia alba di stations III and IV (Littay, 2014).

5. Laurencia sp.

The thick, irregular cylindrical thallus has a dark brown color red especially at the tip. The base of the connection between the branch and the main thallus looks narrower than the tip. The thicker and wider towards the tip, the shape cells cannot be seen because of the thick thallus. The tip of the talus swells. The swelling at the end of image b contains 4 protrusions containing spores. Attaches to the roots and stems of the mangrove Soneratia alba, Rizophora mucronata, Avicennia sp. at all stations, except station V (Kafrani et al., 2016).

6. Polysiphonia sp.

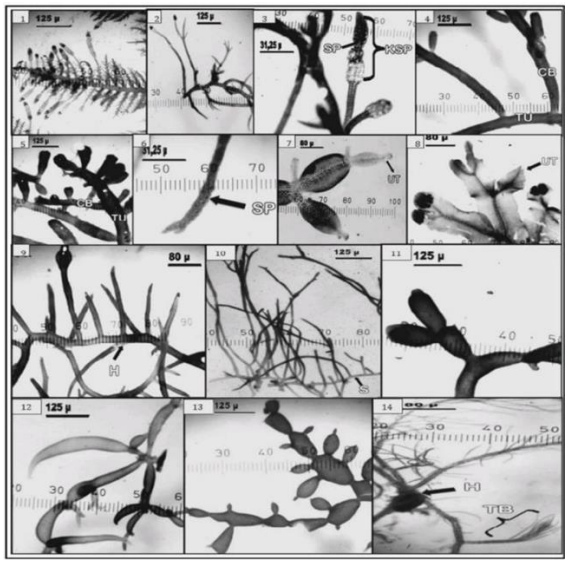
Colors range from brown, red to purple. The revetment is cylindrical in shape and looked stiff. New side embankments appeared with sharp tips like thorns. There are branches at the tip of the thallus. These scales have septa-like characteristics knots on sugar cane plants. Spores appear directly at the tip of the thallus and not swelling like a tumor. This species was found in association with Gelidium sp. on the roots of the Soneratia alba mangrove tree at station IV (Dang et al., 2017)

7. Caloglossa Leprieurii

The characteristics of the Caloglossa genus are that they have wide, oval blades and thin, composed of 3 rows of cells with a thick outer membrane like a midrib in the middle blade, the edge of the blade is like a parabola, and the tip of the blade is parabolic. cell on its side wide. The thread is held between one blade and the other blade. New slope appears around the tips of wedges and blades. Caloglossa leprieurii was found at station I, II, III and IV. Many species attach tightly to roots and rootstock Soneratia alba, Rizophora mucronata, Avicennia sp., and other objects such as stones. (Ito et al., 2018)

8. Caloglossa monosticha

The thallus resembles a very thin leaf or leaf blade with a pattern double branching. Holdfast grows between dichotomous branches so that This species is firmly attached to the substrate, has 3 rows of very pericardial cells similar to a midrib and extends to both sides. The tip is sharp and split in two. This division will form the next bifurcation branch. At the other end of the thallus looks round and has a dark side which is a collection of spores. The spores cooked will come out of the bag and the bag will be empty as shown in the picture d. This species was found attached to rocks at station III (Liu et al., 2015)



Picture 1. Types of red algae found in the mangrove forest of Ekas Hamlet 1.*Bostrychia tenella* 2. *Bostrychia radicans.* 3. *Bostrychia sp.,* 4. *Chondria sp.*, 5. *Laurencia sp.*, 6. *Polysiphonia sp.* 7. *Caloglossa leprieurii,* 8. *Caloglossa monostica,* 9. *Gelidium crinale,* 10. *Gelidium sp.* 11. *Catenella caespitosa,* 12. *Catenella nippae,* 13. *Catenella sp.,* 14. *Murrayella sp*

9. Gelidium Crinale

Gelidium crinale has a cylindrical thallus with a pointed thallus at the the end. The fibers are strong, the thallus color is dark purple, in this species it is found The stichidia are pointed at the ends like clubs. Gelidium crinale was found attached to roots of Soneratia alba, Avicenia sp. and Rizophora mucronata at stations I, II, III and IV (Diharmi et al., 2020).

10. Gelidium sp

Gelidium sp. has stone plates, fibrous supports, cylindrical thallus, dark purple, tip of thallus tapered. There are two branches. On This species has sporangia (stichidia) which have pointed ends and contain spores. Gelidium sp. found attached to the roots of Soneratia and Rizophora at the station III and IV (Indriatmoko et al., 2015)

11. Cetenella caespitosa

The stem is shaped like a small leaf, wide, thick, looks a bit wider than middle to end. Holdfast fibers are found at the Talus bifurcation. In the branches, the embankments appear to get smaller so that the median line is clearly visible connecting one embankment to another embankment. This deduction makes it less stiff. On the thallus branch there is a protrusion, the tip of the thallus has branches.The species Catenella caespitosa was found to have spores at the tip of the thallus. Spores visible perfectly aligned and partially protruding from the thallus. The color ranges from green until brown. This species was found at all stations except station V (Liu et al.,.2015)

12. Catenella nipae

The stem has small and thick leaves, rather wide from the middle to the top end. The fibers are strong and found between the branches of the embankment. In the branches, the embankments appear to get smaller so that the median line is clearly visible connecting one embankment to another embankment. This deduction makes it less stiff. Catenella nippae is found with spores at the tip of the thallus. Spores are visible like a ball inside the tip of the thallus. The tip of the thallus containing the spores becomes swollen. The thallus is green to brown. This species was found at all stations except station V. (Diharmi et al., 2020)

13. Catenella sp

Tallus looks like a cactus that continues to grow. The initial shape is oval and will become irregular along with the growth of other embankments around it like arms, sometimes even up to 6 arms. The slope is thick and wide. The tip of the thallus continues to grow like a scorpion's tail joined together. At the end of the embankment there is a small protrusion that resembles a thorn. This projection will be new embankment. The color of the slopes is brown, red to purple. Found attached to Soneratia type mangrove at station III (Nurjanah et al., 2017).

14. Murayella sp

The thallus is cylindrical, smooth, brittle, dark brown to red in color. New branches appear on the main branches and are very thin, especially the branches side. The cells of the thallus or main branches have light septa. Found attached to the roots of Bostrychia radicans. This type is not found as often others (Nurjanah et al., 2017)

IV. CONCLUSION

Indonesia is a country with a high concentration of marine species, with 782 species found in the country, including 196 marine species, 134 marine species, and 452 marine species. One of the most abundant and widely studied marine species is seaweed (Eucheuma cottonii), which is rich in essential nutrients and has many biological activities. It is considered a primary producer and habitat for other marine organisms, with antimicrobial properties and antibacterial effects, viruses, and pathogens. Several marine species, such as Bostrychia, Caloglossa, Catenella, Gelidium crinale, Acanthopora muscoides, Euchema cottonii, Galaxaura regosa, and Amphiroa fragilissima, can be found in Indonesia. Recent studies have shown that several marine species have significant effects on water quality and assimilation, with studies aimed at understanding the relationship between their essential nutrients and biological activities.

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