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# EPYPHITIC CYANOBACTERIA ON *Avicennia marina* PNEUMATOPHORE IN MANGROVE ECOSYSTEM OF CAGAR ALAM PULAU DUA (CAPD) SERANG, BANTEN

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**Abstract**

A Study aimed to explore cyanobacteria on pneumatophore *Avicennia marina* was conducted on September 2013 in mangrove ecosystem of Cagar Alam Pulau Dua (CAPD) Serang, Banten. Sampling was assessed a long a transect line at two stations. Physico-chemical parameters of both stations, including temperature, salinity, pH, nitrate, dan phosphate were measured. Epyphitic cyanobacteria sample were collected from nine pneumatophores of *Avicennia marina* at each station. The samples were scraped from cortex of pneumatophore and isolated on solid ASN-III medium incubated at 25 oC under light intensity of < 500 lux for 14 days. The result showed that a total of 9 genera of cyanobacteria; Choococcus, Aphanothece, Aphanocapsa, Myxosarcina, Oscillatoria, Microcoleus, Lyngbya, Phormodium, and Calothrix were observed. They are belonging to 4 order, Choococcales, Pleurocapsales, and Oscillatoriales which were non-heterocystous cyanobacteria order and one heterocystous order of Nostocales.

Key words: *Avicennia marina*, cyanobacteria, Cagar Alam Pulau Dua (CAPD), mangrove ecosystem, pneumatophore.

## INTRODUCTION

Mangrove is one of the very productive coastal ecosystem. Ecologically, mangrove provides a nutrient-rich habitat for many organisms (Kathiresan & Bingham, 2001). One of organism that play role as nutrient provider in mangrove ecosystem is cyanobacteria. Some of them can act as N2-fixation and provide nitrogen in mangrove ecosystem. Furthermore, cyanobacteria is photosynthetic bacteria, so they are play role in the carbon and oxygen cycle in mangrove ecosystem (Sahoo & Dhal, 2009).

Cyanobacteria in mangrove ecosystem has been fully explored. Cyanobacteria can be found as planktonic in waters (Joseph, 2005; Nedumaran et al., 2008), as a benthic in sediments (Kyaruzi et al., 2003; Silambarasan et al., 2012), and epyphitic in aerial roots of mangroves (Nedumaran et al., 2008; Pérez-Estrada et al., 2012; Toledo et al., 1995). Nedumaran et al. (2008) reported that cyanobacteria more found on pneumatophore Avicennia than other mangrove roots.

Cagar Alam Pulau Dua (CAPD) is the only protected mangrove area in Serang, Banten. So far, the existence of cyanobacteria in CAPD has been not explored yet, wheareas the exploration of cyanobacteria, such as their diversity and potensials is necessary. Therefore, in our study was aimed to explore cyanobacteria on pneumatophore Avicennia marina, which was dominant plant in mangrove ecosystem CAPD.

## RESEARCH METHOD

Sample site and Pneumatophore collection

Cyanobacteria samples were collected from submerged pneumatophores of Avicennia marina at two stations, station I (Lat. 6o1'6.6"- 6o00'63.81" S; Long. 106o11'42.41"-106o11'47.9" E) and station II (Lat. 6o1'00.11" - 6o00'57.99" S; Long. 106o11'30.77"-106o11'33.27" E) of CAPD (Fig. 1). At each sampling station, nine pneumatophores were collected randomly by cutting the root with cutter, 3 cm below the sediment (Toledo et al., 1995).

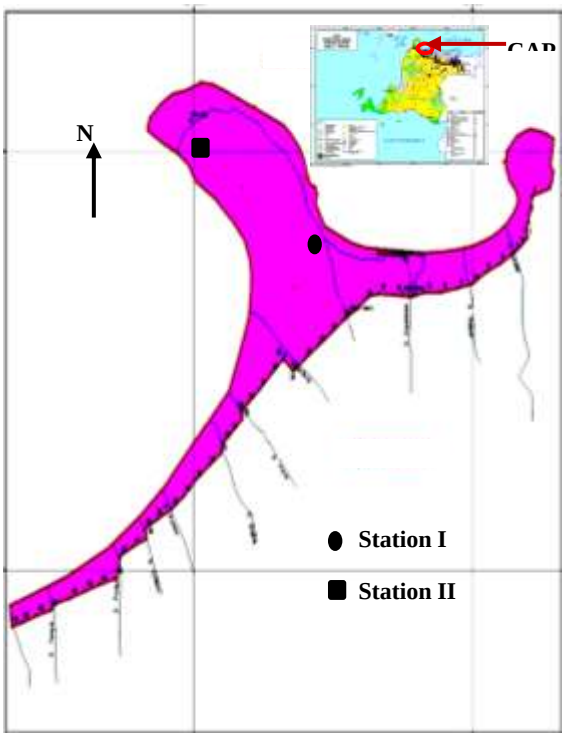


**Figure 1**. Map showing station I and station II in CAPD

Physico-chemical parameters

Physico-chemical, such as temperature (air and surface water) and salinity were measured in situ wheares pH, nitrate, and phospate were measured ex situ. The collected surface water sample for measurement of pH, nitrate, and phospate tranferred to the laboratory use bottle from high-density polyethylene (HDPE) and keep at 0-4oC in ice box. Air temperature was measured by higrometer, wheares temperature of the surface water was measured by thermometer. The salinity was measured by refractometer (Boeco). The pH, nitrate, and phospate were measured by Hanna Hanna Instrument (HI 83203 Multiparameter Bench Photometer for Aquaculture).

Isolation and identification cyanobacteria

Pneumatophore was divided into three segments, the lowest part was up to 3 cm from the sediment surface, the middle part was up to 10 cm, and the highest part was up rest (Toledo et al., 1995), expected there are difference in each section. Each section of pneumatophore were scrapped with a cutter and diluted in sterile aquades. 0,5 mL of the diluent was inoculated on solid ASN-III medium. The medium composition was 25 g NaCl L-1; 2 g MgCl2.6H2O L-1; 0,75 g NaNO3 L-1; 0,02 g K2HPO4.3H2O L-1; 3,5 g MgSO4.7H2O L-1; 0,5 g CaCl2.2H2O L-1; 0,0003 g citric acid L-1; 0,003 g ferric ammonium citrate L-1; 0,0005 g EDTA (disodium magnesium salt) L-1; 0,02 g Na2CO3 L-1; trace metal mix A5+Co (2,86 g H3BO3 L-1; 1,81 g MnCl2.4H2O L-1; 0,222 g ZnSO4.7H2O L-1; 0,390 g Na2MoO4.2H2O L-1; 0,079 g CuSO4. 5H2O L-1; 0,0494 g Co(NO3)2.6H2O L-1) mL-1; 1000 mL deionized water dengan pH 7,5

(Rippka et al. 1979). To isolation cyanobacteria used speading plate method. The culture was incubated at 25 oC under continue illumination < 500 lux for 14 days. Identification of cyanobacteria was done using taxonomic according Prescott (1951) and Rippka et al. (1979).

## RESULT AND DISCUSSION

The detailed of the physico-chemical parameters in CAPD can be seen in Table 1. The air temperature ranged between 31-35 oC in CAPD, wheares temperature of surface water ranged between 27-33 oC. CAPD is hypersaline environment with salinity levels 39-53o/oo. CAPD environment have pH acid to slightly alkaline (6,5-7,2). The concentration of nitrate and phospate were 30,8-69,3 mg/L and 4,5-7,7 mg/L.

**Tabel 1**. Physico-chemical parameters of mangrove ecosystem CAPD

| Parameters | Station | |
|---|---|---|
| | I | II |
| Air temperature (oC) | 31-32 | 32-35 |
| Surface water temperature (oC) | 27-28 | 28-33 |
| Salinity (o/oo) | 39-40 | 49-53 |
| pH | 6,5-6,9 | 6,5-7,2 |
| Nitrate (mg/L) | 30,8-41,8 | 62,8-69,3 |
| Phospate (mg/L) | 4,5-4,6 | 6,4-7,7 |

Totally 9 genera epiphytic were recorded from both stations (Table 2), namely Chroococcus, Aphanothece, Aphanocapsa, Myxosarcina, Oscillatoria, Microcoleus, Lyngbya, Phormidium, and Calothrix. They were belongs to 4 order, namely Chroococcales, Pleurocapsales, Oscillatoriales, and Nostocales. Chroococcales and Pleurocapsales were colonial, wheares Oscillatoriales and Nostocales were filamentous cyanobacteria. Oscillatoriales were the most widely found in CAPD. Genera which includ the order such as Oscillatoria, Microcoleus, Lyngbya, and Phormidium.Similar results were also found in same of the mangrove ecosystem in India (Nedumaran et al., 2008; Silambarasan et al., 2012; Sakthivel & Kathiresan, 2013).

**Table 2**. List of cyanobacteria were recorded from pneumatophore A. marina at CAPD

| Order | Genera | Station | | | | | |
|---|---|---|---|---|---|---|---|
| | | I | | | II | | |
| | | A | T | B | A | T | B |
| Chroococcales | Chroococcus | ✔ | - | - | - | - | ✔ |
| | Aphanothece | ✔ | ✔ | ✔ | - | - | - |
| | Aphanocapsa | - | - | - | - | - | ✔ |
| Pleurocapsales | Myxosarcina | ✔ | ✔ | - | - | ✔ | ✔ |
| Oscillatoriales | Oscillatoria | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| | Microcoleus | - | ✔ | - | - | - | - |
| | Lyngbya | ✔ | ✔ | - | - | ✔ | ✔ |
| | Phormidium | ✔ | ✔ | - | - | - | - |
| Nostocales | Calothrix | - | - | - | ✔ | ✔ | ✔ |

*Divided of pneumatophores (A = top part, T =middle part, B =bottom part)

The composition of the sianobakteria at the station I and II are relatively same. It can be caused by appropriate environment in CAPD which supported the growth of cyanobacteria. The optimum growth of canobacteria occured at 25-35 oC (Reynolds, 2006). In general, cyanobacteria were found abundantly in environments with the pH 6,5-8,5 (Joseph, 2005). Cyanobacteria were widespread in fresh waters until hypersaline. In this present study, only one heterocytous genera was found, viz. Calothrix (Table 2). The results also reported by Sugumar et al. (2011) that explore cyanobacteria in hypersaline environment, Tamilnadu, India. Hypersaline environment has a high sulphide content (Sakthievel dan Kathiresan, 2013), and its can inhibit the enzyme nitrogenase activity in heterocystous.

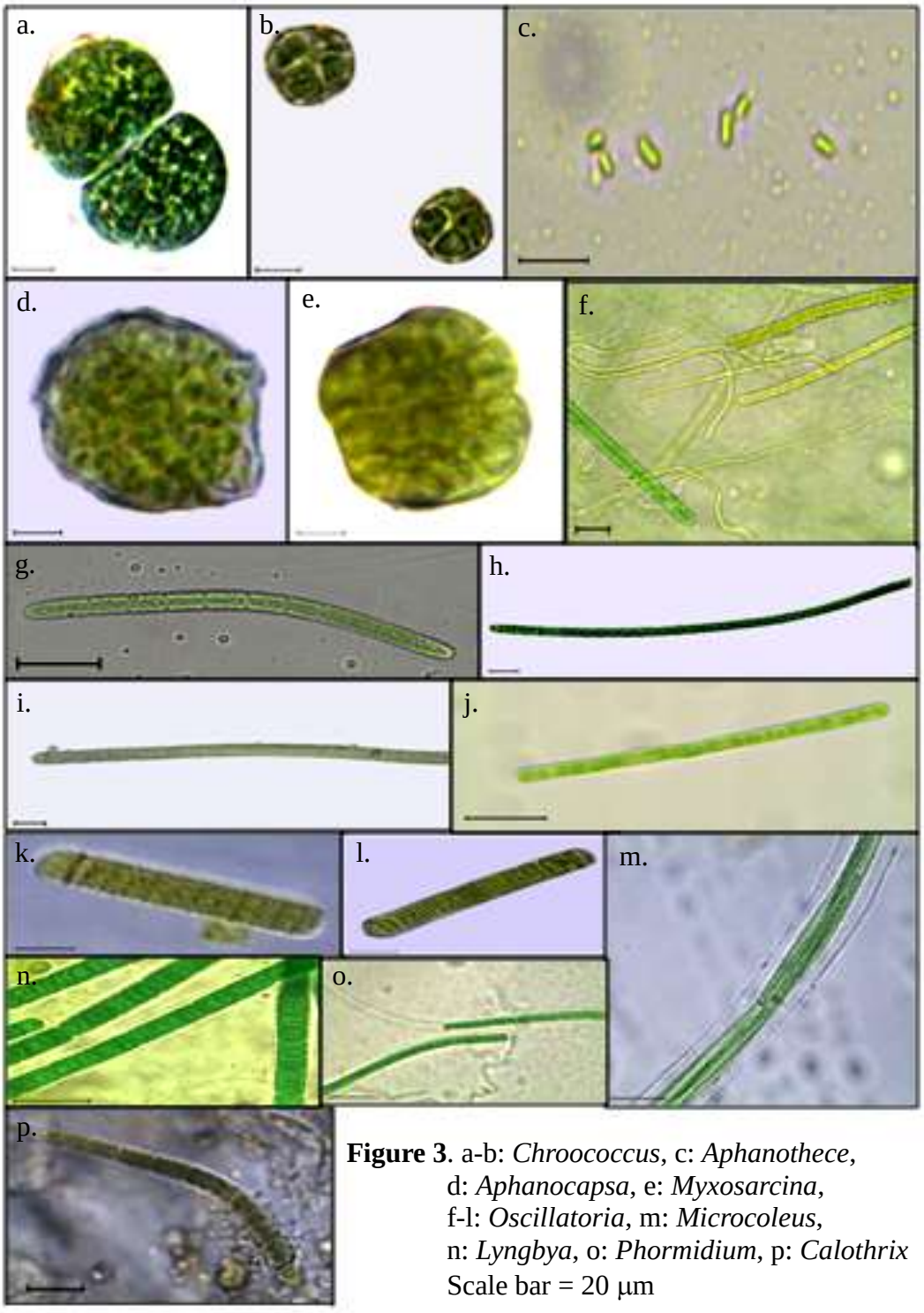


**Figure 3**. a-b: *Chroococcus*, c: *Aphanothece*, d: *Aphanocapsa*, e: *Myxosarcina*, f-l: *Oscillatoria*, m: *Microcoleus*, n: *Lyngbya*, o: *Phormidium*, p: *Calothrix* Scale bar = 20 μm

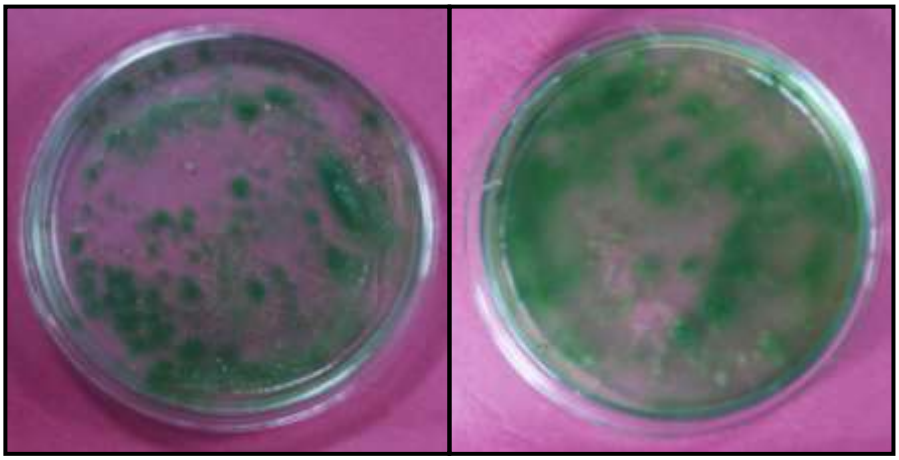

**Figure 2.** Culture cyanobacteria on solid ASN-III medium

In this study, each section of pneumatophore was not dominated by spesific cyanobacteria. Toledo et al. (1995) used the same methode and reported that existence of a difference cyanobacteria which dominate in each section of pneumatophore. The upper part was colonized by Aphanothece sp., the central part was colonized by Microcoleus sp., and the bottom part was colonized by Lyngbya sp. and Oscillatoria sp. The difference is probably caused by environmental condition and vegetation of mangrove which used as a sample. In this study using pneumatophore of A. marina, wheares Toledo et al. (1995) using pneumatophore of A. germinans. Zonation of microorganism on pneumatophore is a response to different microenvironmental (Toledo et al., 1995).

## CONCLUSION AND SUGGESTION

A totally 9 genera epypithic cyanobacteria have been founded on pneumatophore of Avicennia marina in CAPD, namely Chroococcus, Aphanothece, Aphanocapsa, Myxosarcina, Oscillatoria, Microcoleus, Lyngbya, Phormidium, and Calothrix. Growth of their influenced by phyco-chemical factors such us temperature, salinity, pH, nitrate, and phosphate at these habitat. In the present study, identification is only morphologically. For further research, the identification required by ultrastructur, biochemistry, and molecular. In adittion, identification should be done to species.

## REFERENCES

Joseph, S. 2005. Ecological and biochemical studies on cyanobacteria of cochin estuary and their application as source of antioxidants. Thesis. Department of Marine Biology, Microbiology and Biochemistry, Cochin University of Science and Technology, Kochi-India.

Kathiresan, K. & B. L. Bingham. 2001. Biology of mangroves and mangrove ecosystems. Advances in marine biology. 40: 81--251.

Kyaruzi, J. J., M.S. Kyewalyanga & M.H.S. Muruke. 2003. Cyanobacteria composition and impact of seasonality on their in situ nitrogen fixation rate in a mangrove ecosystem adjacent to Zanzibar Town. Western Indian ocean J. Mar. Sci. 2(1): 35--44.

Nedumaran. 2008. Mangrove associated cyanobacteria at Pichavaram, Tamilnadu. Seaweed res.

Utiln. 30(Special Issue): 77--85.

Pérez-Estrada, C. J., H. León-Tejera & E. Serviere-Zaragoza. 2012. Cyanobacteria and macroalgae from an arid environment mangrove on the East Coast of the Baja California Peninsula. Botanica marina. 55: 187--196.

Prescott, G. W. 1951. Algae of the western great lakes area. WM. C. Brown Company Publishers Dubuquedowa, United States of America: xiii + 977 pp.

Reynolds, C. S. 2006. The ecology of phytoplankton. Cambridge University Press, New York: xiv + 535 pp.

Rippka, R., J. Deruelles, J. B. Waterbury, M. Herdman & R. Y. Stainer. 1979. Generic assigment, strain histories and properties of pure cultures of cyanobacteria. Journal of general microbiology. 110(2): 1--61.

Rogers, J. 1996. Nutrient dynamics and productivity in mangrove ecosystems. Literature Review–Submitted in partial fulfilment of assessment for the Degree of Bachelor of Science: 71 pp.

Sahoo, K & N. K. Dhal. 2009. Potential microbial diversity in mangrove ecosystems: A Review. Indian journal of marine sciences. 38(2): 249--256.

Sakthivel, K & K. Kathiresan. 2013. Cyanobacterial diversity from mangrove sediment of South East Coast of India. Asian journal of biodiversity. 4: 190--203.

Silambarasan, G., T. Ramanathan & K. Kathiresan. 2012. Diversity of marine cyanobacteria from three mangrove environment in Tamil Nadu Coast, South East Coast of India. Current research journal of biological sciences. 4(3): 235-238.

Stal, L. J. 2002. Cyanobacterial mats and stromatolites. Dalam: Potts, M & B. A. (ed.). 2002. The ecology of cyanobacteria: Their diversity in time and space. Penerbit Kluwer Academic, New York: 61--120.

Sugumar, R., G. Ramanathan. K. Rajarathinam, A. Jeevarathinam, D. Abirami & M. Bhoothapandi. 2011. Diversity of saltpan marine cyanobacteria from Cape Comorin Coast of Tamilnadu. Journal of phytology. 3(9): 01--04.

Sundararaman, M., T. Boopathi & S. Gopinath. 2007. Status of mangrove ecosystem: Exploring the potential role of cyanobacteria in restoration and afforestation. Dalam: Seckbach, J. (ed.). 2007. Cellular origin, life in extreme habitats and astrobiology: Algae and cyanobacteria in extreme environments. Penerbit Springer, Netherlands: 211--221.

Toledo, G., Y. Bashan & A. Soeldner. 1995. Cyanobacteria and black mangroves in Northwestern Mexico: Colonization, and diurnal and seasonal nitrogen fixation on aerial roots: Can. J. Microbiol. 41: 999--1011.