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TENTACLE COMPONENTS (NEMATOCYSTS AND ZOOXANTHELLA) OF *Montipora danae* in MARAK ISLAND, WEST SUMATERA

Lieng Lieng[1], Nevianty P Zamani[1*], Dietriech Geoffrey Bengen[1], Yuli Naulita[1]
[1]Department of Marine Science, Faculty of Fisheries and Marine Sciences,
IPB University, Bogor 16680 Indonesia
*neviaty@apps.ipb.ac.id

ABSTRACT

Coral animals have tentacles in which there are Nematocysts in the ectoderm layer and zooxanthella in the endoderm layer, and these two components have a role as a defense and food source; this study was conducted to identify the components of *Montipora danae* coral tentacles. The research was conducted in Marak Island, West Sumatra, with a purposive sampling method based on the presence of M.danae. The coral samples were decalcified to separate the tissue from the skeleton. The results of this study indicate that *M.danae* consists of Nematocysts type sH (small Holotrich), MpM-I (Microbasic p-Mastighopore I), and H (Holotrich). Holotrich has the highest relative abundance of 74-91%, MpM-I has 3,92-20,63% and sH has 3-24%. Holotrich has larger morphometrics than sH and MpM-I, namely 72,76-82,35 µm capsule length and 19,55-24 µm capsule width. The zooxanthella density of *M. danae* was lower than that of normal corals at 624 cells/cm^2.

Keywords: Coral, Nematocysts, Zooxanthella

1. INTRODUCTION

Coral reef ecosystems have high productivity and ecological benefits for the survival of marine biota, but they are also vulnerable to damage. Coral colonies are vulnerable to environmental changes, which can damage and kill corals. Two things are very important for corals' lives: nematocysts and zooxanthella.

Corals have nematocysts and zooxanthellae located on their tentacles[1]. Nematocysts, or stinging cells, function as a defense against predators and as a food source[2]. Nematocysts have various types and are different in each type of coral. The abundance and morphometrics of Nematocysts in a coral also determine the group of coral species[3].

Zooxanthellae are algae that are symbiotic with corals. The food source for corals is mostly obtained from zooxanthella, which is 90%. Zooxanthella also provides pigments to corals and helps the formation of coral reefs[4]. Corals with normal conditions have more than 0.10×106 cells/cm[2,5].

The role of nematocysts and zooxanthella is equally important for corals. Therefore, this study was conducted with the aim of identifying the tentacle components of the coral *Montipora danae*. Through this study, the type, relative abundance, and morphometrics of nematocysts can be known as characteristics of *M. danae*. The density of zooxanthella found in coral tentacles can provide information about the condition of coral colonies (*M. danae*) in Marak Island, West Sumatra.

2. RESEARCH METHOD

Time and Place

This research was conducted in October 2023 for coral sampling in the eastern part of Marak Island, West Sumatera. The analysis of coral samples and water samples for total suspended solids

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analysis was carried out at the Marine Chemistry Laboratory, Marine Science, Universitas Riau. The sampling locations are shown in Figure 1.

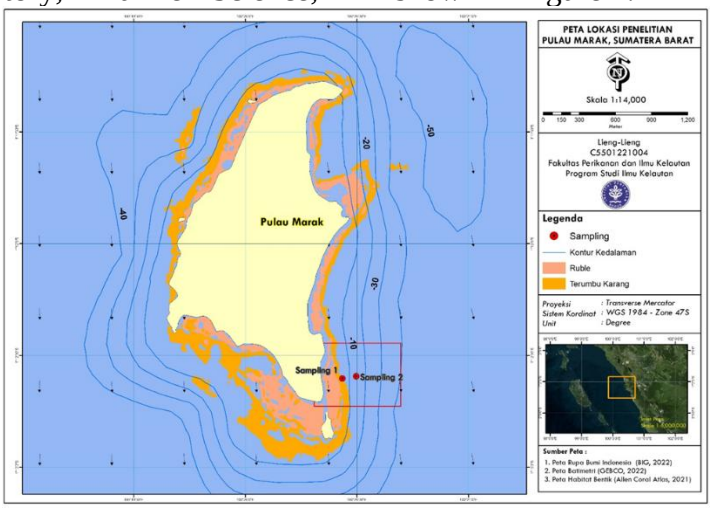

Figure 1. Research location of Marak Island, West Sumatera

Method

This study used purposive sampling method based on the presence of *M. danae* in Marak Island, West (Figure 1). *M. danae* coral was found on the east side of Marak Island.

Procedures

Coral samples were taken from as many as nine fragments from the *M. danae* coral colony, each fragment measuring 2 cm in size at a depth of 1-10 m. Furthermore, it was decalcified to separate the coral tissue from its skeleton using acetic acid (5%) and formalin (5%) in a ratio of 1:1 for ±4 days. After the coral tissue was separated from the skeleton, the tissue was pulverized and diluted using distilled water as much as 2 mL. Nematocysts and zooxanthella were observed using a microscope with a magnification of 10×40.

Identification of nematocysts type refers to Ryland & Lancaster[6]. The relative abundance of nematocysts was calculated using the formula[7]:

$$RA = \frac{NNT}{NTN} \times 100$$

Description:

RA : Relative Abundance
NNT : Total nematocysts type-i
NTN : Total all-over nematocysts

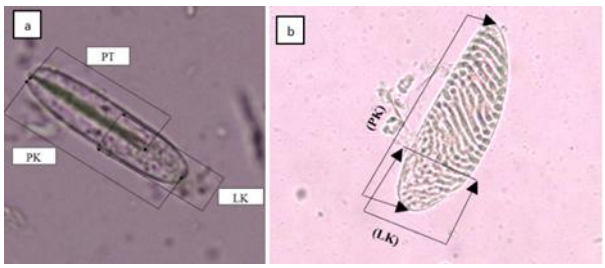

Figure 2. Morphometric measurement of nematocysts. (a). MpM-I (Microbasic p-Mastighopre). (b) sH (small Holotrich) and H (Holotrich).

Nematocysts measurements are based on Ballesteros[7]; the morphometrics measured are Capsule Length (CL), Capsule Width (CW), and Shaft Length (SL). Type MpM-I measured capsule length, capsule width, and shaft length. Types sH and H measured capsule length and capsule width; illustration can be seen in Figure 2. Morphometrics were measured using ImageJ software[7]. Zooxanthella density was calculated using the formula[8]:

$$N = \frac{n \times V}{L}$$

Description:

N : Density of *zooxanthellae* (cells/cm^2)
N : Number of cells/sub-sample volume (cells/mL)
V : Volume of sample bottle (mL)
L : Surface area (cm^2)

Environmental parameters measured were total suspended solids and temperature, salinity, and water brightness because these parameters are limiting factors for coral animal life. Measurement of environmental parameters is done in situ; temperature is measured using a water quality meter checker. Salinity was measured using a Hand Refractometer. Brightness was measured using a Secchi disk. Suspended solids were calculated according to the procedures of the Marine Chemistry Laboratory, Marine Science, UNRI, based on the Total Suspended Solid (TSS) test, Indonesian National Standard. The TSS calculation formula[9]:

$$\text{TSS (mg/L)} = \frac{(A-B)\times 1000}{Volume\ contoh\ uji\ (mL)}$$

Data Analysis

Data were tabulated in tables and graphs using Microsoft Excel software and described.

3. RESULT AND DISCUSSION

Environmental Conditions of Marak Island, West Sumatra

Temperature, pH, salinity, and brightness are good for coral reef growth. The average temperature of Marak Island is 27.67°C, which is relevant to the Ministry of Environment and Forestry No. 51 of 2004[10]. A temperature of 28-30°C is classified as a quality standard for coral animals. Corals are able to adapt to environments with temperatures of 25-32°C[5] (Table 1).

Environmental factors based on the quality standards, namely, pH for coral biota is 7-8.5, total suspended solids 20 mg/L, salinity 33-34‰ and visibility of water >5 m[10]. The visibility of Marak Island waters is in accordance with quality standards, but total suspended solids are greater than quality standards, causing inhibition of light entering the waters. The visibility of Marak Island waters is in accordance with quality standards, but total suspended solids are greater than quality standards, obstructing light entering the waters. Suspended solids are influenced by current movement[11].

Table 1. Environmental parameter measurements on Marak Island, West Sumatera

Environmental conditions	Average Value
Temperature (°C)	27.67±0.56
pH	7.86±0.03
Salinity (‰)	35±0.55
Visibility (m)	7±0.57
TSS (mg/L)	90.75±3.30

Relative Abundance and Morphometric Nematocysts of *M.danae*

Figure 3 shows Nematocysts and zooxanthellae coral tissue seen from a microscope. However, this study did not examine tentacles histologically. Nematocysts and zooxanthella are found on coral tentacles. Nematocysts are located in the ectoderm, and zooxanthellae are located in the ectoderm[12,13].

Montipora danae corals have three types of nematocysts: sH (small Holotrich) in Figure 4a, MpM-I (Microbasic p-Mastighopore I) in Figure 4b, and (H) Holotrich Morphologically in Figure 4c, all three types of nematocysts were undischarged. Types sH and H have an oval shape, wrapped by a capsule, and inside, there is a toxin thread. However, the MpM-I type is slightly different from the other types. It has an oval shape and is equipped with a shaft with a toxin thread connected to the end of the shaft.

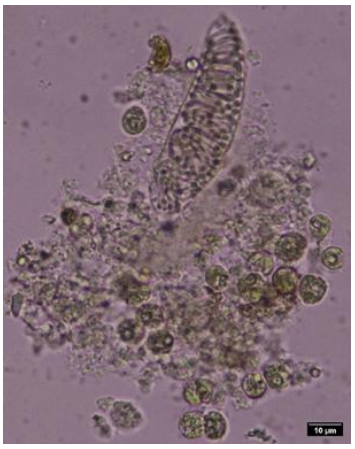

Figure 3. Visual of nematocysts and zooxanthella on coral tissue as seen through a microscope

Figure 4. Nematocysts types of *M. danae* are found on Marak Island, West Sumatera. (a). sH (small Holotrich). (b). MpM-I (Microbasic p-Mastighopore I. (c). H (Holotrich).

The graph in Figure 5 shows that the relative abundance of sH (small Holotrich) type nematocysts is lower than MpM-I (Microbasic p-Mastighopore I) and (H) Holotrich. The Holotrich type is the most dominant or has the highest abundance compared to the other two types in *M. danae*. Type H has a relative abundance of 74-91%, MpM-I has 3,92-20,63%, and sH is 3-24%.

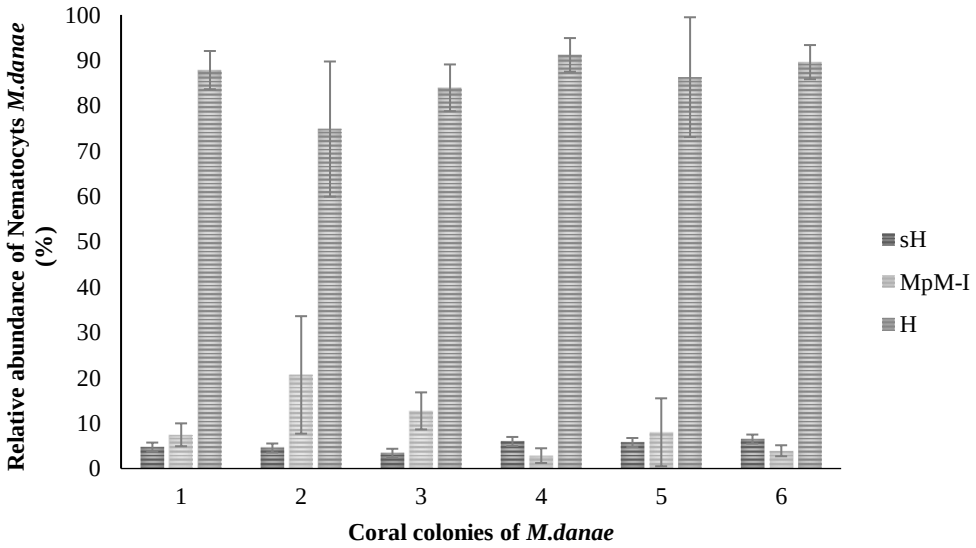

Figure 5. Relative abundance nematocyst of *M. danae* in Marak Island, West Sumatera

Montipora danae, found on the eastern side of Marak Island, is characterized by Holotrich and has large morphometrics, both in capsule length and capsule width. The capsule length ranges from 72,76-82,35 µm, and the capsule width ranges from 19,55-24 µm. sH has a capsule length of 18,92-24,90 µm and a capsule width size of 5,03-6,44 µm. MpM-I nematocytes have a capsule length size ranging from 21,85-27,33 µm, with a capsule width of 5,70-7,43 µm and a shaft length of 11,57-15,40 µm.

In contrast to previous research on the genus Montipora, the type of Montipora undata has MbM (Microbasic b-Mastighopore) type Nematocysts as its main type of Nematocysts, besides that there are also MpM (Microbasic p-Mastighopore) and, sHI (small Holotrichous isorhiza). This difference is because different coral species have specific main Nematocysts[3].

The morphology of nematocysts is closely related to the skeleton morphology of corals[14]. The sizes of nematocyst types are

most likely influenced by coral species[14]. MpM (microbasic p-mastigophore) nematocysts type is used by corals for aggression and lethality of prey or predators if disturbed by the surrounding aquatic environment. MpM is distributed from the planula phase, young polyps, to the adult polyp phase[14,15].

Zooxanthella Density in *M.Danae*

Information on zooxanthella density in corals on Marak Island has been conducted by Lieng et al.[16], showing that the density of zooxanthella on coral growth forms Acropora submassive, Branching, Foliose, and Heliopora is normal, in contrast to the results of the current study zooxanthella has a low density for normal corals. Zooxanthella found in *M.danae* are golden yellow in color and round in shape (Figure 6).

The density of zooxanthella in *M.danae* is 624 cells/cm^2; the number of densities illustrates that *M.danae* colonies that become corals are not in normal conditions because corals with normal conditions have a zooxanthella density of more than $0{,}10\times10^6$ cells/cm^2[5]. This condition can be caused by suspended solids in Marak Island, Sumatera Barat, which exceeds the quality standard threshold of 88.5 mg/L, while the well-suspended solids for coral biota are 20 mg/L based on the quality standard of the Ministry of Environment and Forestry No 51 of 2004[10]. Relevant to Thamrin et al.[12], high turbidity causes low zooxanthella density, as occurred in *Acropora aspera* corals on Poncan Island and Mursala Island, North Sumatra.

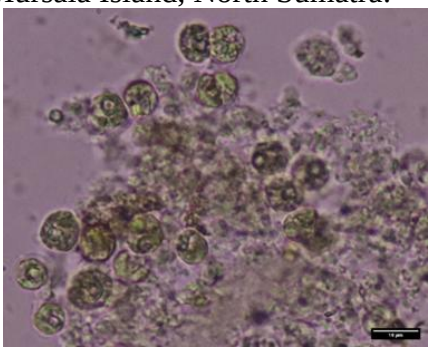

Figure 6. Zooxanthella in *M. danae* in Marak Island, West Sumatera

Total suspended solids will inhibit the penetration of light into the water. Besides that, suspended solids can also cover coral polyps and inhibit the absorption of light by zooxanthella. Relevant to Pangaribuan[17], coral polyps are a suitable habitat for zooxanthellae because they are the largest supplier of inorganic substances needed for zooxanthellae photosynthesis.

Differences in light intensity received by corals affect the density of zooxanthella[18]. Low light intensity still affects reducing the number of zooxanthellae in coral colonies[19]. Light is an important factor for coral growth because zooxanthella needs light for the photosynthesis process.

Light is needed by zooxanthellae for the photosynthesis process[5,13]. The results of photosynthesis are used as a food source for corals[5,20]. 90% of coral food sources come from zooxanthella[4]. Zooxanthella also helps the formation of calcium carbonates that form coral skeletons and give color to corals. An environment that is not suitable for zooxanthella will cause the release of zooxanthella from its host, bleaching events, and death in corals[5,13,20]. Coral morphology also affects zooxanthella density[1]. If the amount of sediment is high enough and exceeds the ability of coral polyps to adapt, there will be death and a decrease in coral reef closure[21].

4. CONCLUSION

Montipora danae has three types of Nematocysts, namely sH (small Holotrich), MpM-I (Microbasic p-Mastighopore I) and H (Holotrich). The Holotrich type has a higher relative abundance and has larger morphometrics compared to sH and MpM-I. The *zooxanthella* density of *M.danae* is lower than that of normal corals, which is 624 cells/cm^2. Future research is recommended to collect environmental data periodically to measure other environmental factors that were not measured in this study, such as chemical factors, to determine which factors are more influential on coral damage

and low zooxanthella density. Furthermore, healthy and abnormal corals, based on their zooxanthella density, should be considered to see differences in the relative abundance of nematocysts and morphometrics.

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