

# Copper in Water, Sediment and *Strombus Canarium* at South Western Coast of Peninsular Malaysia

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**Abstract**—Cu concentration was determined in water, sediment and soft tissue of deposit feeder *Strombus canarium* collected from two sites at western coast of Johor Straits, Malaysia. The sites are located at Tanjung Bin and the seagrass bed near Tanjung Kupang. The study found higher concentration in *Strombus canarium* from seagrass bed than those in Tanjung Bin which were 7.02 and 3.71 µg/g respectively. Smaller concentration in *Strombus canarium* from Tanjung Bin is due to less Cu accumulation from its surrounding. However, the concentrations were within the permissible limit of Malaysian Food Standard. The concentration of Cu in water at both sites exceeded the Malaysia Marine Water Quality Criteria and Standard for Class E, whereas sediment is classified as moderately polluted based on the proposed quality by Environmental Protection Agency.

**Index Terms**—Copper, sediment, *strombus canarium*, water.

## I. INTRODUCTION

Metal concentrations in the coastal area of Johor Straits have been increasing as a result of human activities [1]. The metals have capability to accumulate and transfer through food chain which could lead to greater environmental problem [2]-[3]. They tend to adsorb suspended matter within the water and later deposited in the sediment. Marine life such as deposit feeder could take up the metals from the contaminated water and sediment which then form significant pathway to metal contamination in their predators including human being. Copper (Cu) is one of the metals that is essential for organism's growth. However [4] suggested that deleterious effect to aquatic organism would frequently occur as consequence of high level of Cu in water and sediment.

The present study focused on *Strombus canarium* as one of the popular food source with high commercial value among local people at western coast of Peninsular Malaysia. *Strombus canarium* is among the largest and abundant mollusks in the area [5]. This bottom dwelling gastropod is also a part of marine life's diet such as volute snails, rays, dugong and fish [6]-[7]. The deposit feeder, *Strombus canarium* are exposed to Cu through water, ingested sediments and other food particles. Due to this exposure, accumulation of Cu is expected to be higher and thus have

potential to cause adverse effect to themselves and also their predators.

This study reports the concentration of Cu in *Strombus canarium*, water and sediment samples collected at two sites from western part of Johor Straits. Relationships of Cu concentration between these sites were also investigated. Water quality data were then compared to Malaysia Marine Water Quality Criteria and Standard and Cu concentrations in the soft tissues of *Strombus canarium* were referred to Malaysia Food Act 1985 [8]. The sediments at the study area were also classified based on the sediment criteria proposed by Environmental Protection Agency (EPA) [9].

## II. MATERIALS AND METHOD

### A. Study Area

Water, sediment and *Strombus canarium* were sampled from Tanjung Kupang seagrass bed (N 1° 19' 50.9" E 103° 35' 51.6") and Tanjung Bin (N 1° 19' 96.6" E 103° 32' 84.5"). Both sites are located at the western coast of Johor Straits (Fig. 1). Tanjung Bin located at the estuary of Pulau River is designated as an industrial area. Port of Tanjung Pelepas is located approximately 1 km at the opposite site. Currently, mangrove area near Tanjung Bin has been cleared for development of petrochemical industry. The Tanjung Kupang seagrass bed is located approximately 6 km to the east of Tanjung Bin outside the Pulau River estuary. It is the largest bed in Peninsular Malaysia with size of 38 hectares and only appears during spring low tides.

### B. Sample Preparation and Analysis

Surface water samples (0.5 m depth) collected using polyethylene bottles (1 liter). The water samples were then filtered and preserved with nitric acid. Sediments were collected at the surface of seabed (3-5 cm depth) and placed in a plastic bag. *Strombus* specimens were collected using quadrat transects method. All samples were obtained between 8.00 and 9.00 a.m. and then kept frozen prior to further analysis

Ten *Strombus* from each sampling site were selected and analyzed for Cu concentration. The sediments and soft tissues of *Strombus* were oven dried at 60°C. Homogenized samples (1g) were digested in 10 mL nitric acid (95%) using an open beaker digestion technique. The digested samples were then diluted with 100 mL deionized water. After filtration, all samples were determined for Cu using Perkin-Elmer model Elan 6100 Inductively Coupled Plasma Mass Spectroscopy (ICP-MS). The Cu concentration in the water was presented in milligram per liter (mg/L), whereas

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those in the sediment and soft tissues of *Strombus* specimens are reported as microgram per gram ( $\mu\text{g/g}$ ) dry weight. The dry weight converted to wet weight by using conversion factor (0.017) suggested by [10] for comparison purpose with

Malaysia Food Act. The significant differences of Cu concentration at each site was determined with a Student's t-test ( $\alpha = 0.05$ ).

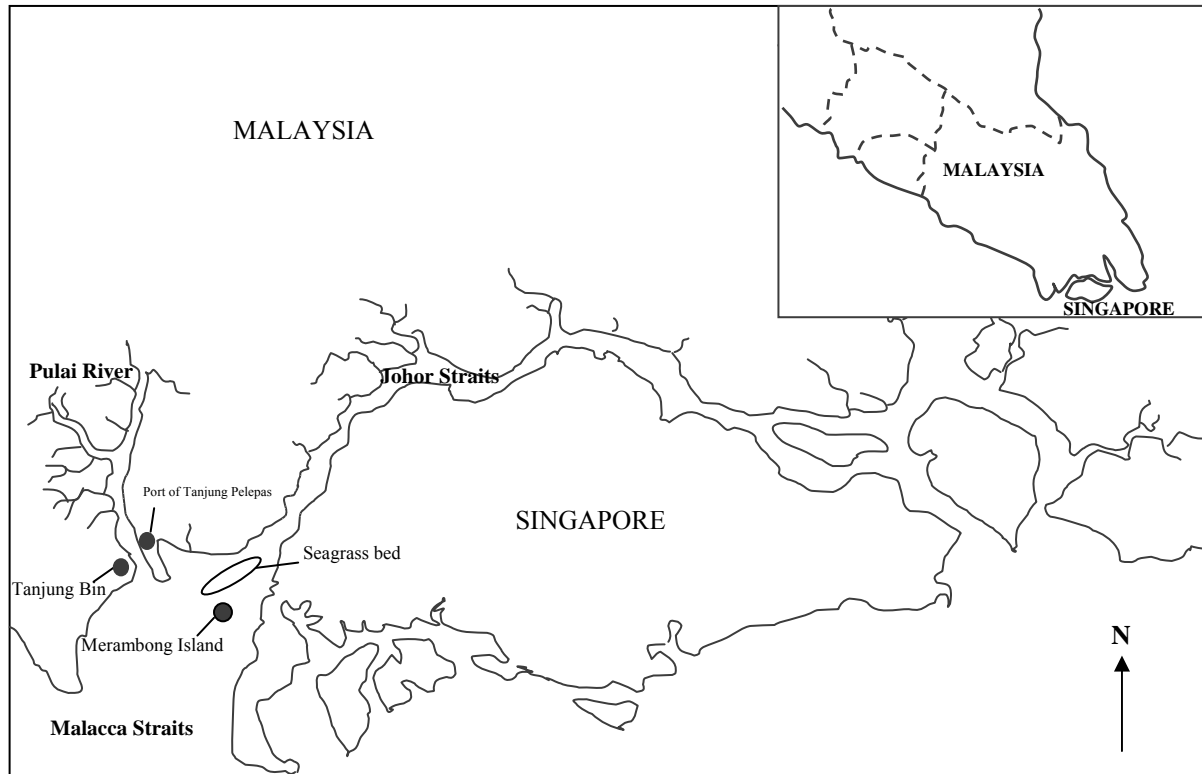


Fig. 1. Location of seagrass bed and Tanjung Bin

### III. RESULT AND DISCUSSION

#### A. Copper Concentration in *Strombus Canarium*

Cu concentration in soft tissue of *S. canarium* is shown in TABLE I. The concentration of Cu in the *S. canarium* at Tanjung Kupang seagrass bed was significantly higher ( $p < 0.05$ ) than concentration in the *S. canarium* from Tanjung Bin. However, the concentrations at both sampling stations were within permissible limit of Malaysia Food Act 1985 (30  $\mu\text{g/g}$  wet weight). As for *S. canarium* from Tanjung Kupang seagrass bed is larger (55 – 69 mm) than *S. canarium* from Tanjung Bin (35 -50 mm). It is possible that large *S. canarium* accumulate more metal than the smaller ones. [11] also found high levels of metal accumulated in the largest size of gastropod *Monodonta* sp. and *Patella* sp. from Mediterranean coastal area.

TABLE I: COPPER CONCENTRATION IN STROMBUS CANARIUM

Station	Copper Concentration			
	Mean		Range	
	$\mu\text{g/g}$ dry weight	$\mu\text{g/g}$ wet weight	$\mu\text{g/g}$ dry weight	$\mu\text{g/g}$ wet weight
Seagrass bed	7.02	1.19	4.49-9.63	0.76 – 1.64
Tanjung Bin	3.71	0.54	0.05 – 6.96	0.01 – 1.18

The results obtained in the present study are comparable to previous studies [12]-[13]-[14] reported on *Strombus* and other marine life (Table II). The concentrations were similar to *S. canarium* reported from Teluk Kelabat, Pulau Bangka [12]. The study also showed that the concentration of Cu in *S. canarium* was 1.5 to 8 times higher compared to fish. [13] found high concentration of Cu in *Strombus gigas* from Guacanayabo Gulf, Cuba which is above the recommended limits of Cuban regulations for public health. The concentration of Cu in *S. canarium* collected in this study was lower compared gastropod *Nerita lineate* [14].

TABLE II: COPPER CONCENTRATION IN STROMBUS AND OTHER MARINE LIFE

Species	Copper concentration		Reference
	$\mu\text{g/g}$ dry weight	$\mu\text{g/g}$ wet weight	
<i>Strombus canarium</i>	6.73	0.992	[12]
<i>Strombus gigas</i>		6.4 – 32.6	[13]
<i>Nerita lineate</i>	18.02		[14]
<i>Strombus canarium</i>	0.05 – 9.63	0.01 – 1.64	This study

#### B. Metal Concentration in Water and Sediment

Mean concentration of Cu in seawater samples at Tanjung Kupang seagrass bed and Tanjung Bin were 0.08 and 0.05

mg/L respectively. Cu concentration from both stations does not appear to be significantly different with  $p > 0.05$ . These values exceeded Malaysia Marine Water Quality Criteria and Standard for Class E (0.01 mg/L). The Class E standard is applicable for mangroves estuarine and river-mouth water. The results also exceeded the ASEAN's recommended criteria (0.0029 mg/L) for protection of marine aquatic life [15]. However, the results showed higher concentration of Cu compared with previous study reported by [16] in the water column at Johor Straits.

Mean Cu concentration in the sediment of seagrass bed and Tanjung Bin were 31.16 and 46.56  $\mu\text{g/g}$  dry weights respectively. There is no significant difference ( $p > 0.05$ ) of Cu detected in the sediment from both stations. The sediments can be classified as moderately polluted based on the EPA standards [9]. [1] reported higher concentration of Cu (57.84  $\mu\text{g/g}$  dry weight) in the sediment of Johor Straits. The results were also compared with sediment from West Port of Peninsular Malaysia of which [9] obtained low concentration of Cu ranging from 7.4 to 27.6  $\mu\text{g/g}$  dry weights.

The results showed that the study area is contaminated with Cu and it accumulates in the soft tissues of *S. canarium*. Entrapment of Cu is possible to occur since the coastal area is connected to the Straits of Malacca and also receives flow from adjacent rivers such as Pulai River and Pendas area. Moreover, the study area also located near busy shipping lane of Port of Tanjung Pelepas and Singapore. Similarly, [17] reported high concentration of Cu in marine water associated with port and boatyard activities. Furthermore [18] claimed that the high level of Cu at such area is expected since the use of Cu as biocide for protection of marine vessels has increased.

#### IV. CONCLUSION

The present study indicated that *S. canarium* (7.02  $\mu\text{g/g}$  dry weight) at Tanjung Kupang seagrass bed have higher concentration compared with *S. canarium* (3.71  $\mu\text{g/g}$  dry weight) collected from Tanjung Bin. However, the concentrations were within the recommended limit Malaysia Food and Standard. Copper concentration at both sites exceeded the Malaysia Marine Water Quality Criteria and Standard for Class E whereas sediment classified as moderately polluted. The mean concentration of copper in the study area decreased in the order of sediment  $>$  *S. canarium*  $>$  water. Since there is no previous study on *S. canarium* at Johor Straits, the present study has provided significant findings on Cu contamination in the area.

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