

Concentration of Heavy Metal and Nutrients Fact of Pontian Johor Cerithidea Obtusa

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ABSTRACT

Sea snails are marine gastropods with shells and usually live in saltwater. There are species of sea snails which are edible and used as food sources by humans. The cerithideaobtusa is a species of sea snail, a marine gastropod mollusk in the family Potamididae and found in the coastal mud areas. The cerithideaobtusa or the Malay name 'Siput Sedut' cultivated in Kampung Sungai Durian Jetty at coordinate 1.3197580, 103.4544940 in 2 hectares fenced mud land areas with an objective to help boost the fisherman's monthly income. This research aims to ensure reared cerithidea obtusa cultivated from Sungai Perpat Punggor, Kampung Sungai Durian, Johor Malaysia is free from heavy metal and also to analyze the nutrients content of cerithideaobtusa flesh. The big size of Cerithidea obtusa (3 to 4 cm) collected in August 2017. The soft muscle tissues analyzed and the nutrient facts found to be high in protein with 11.2 g, total fat 1.8 g, carbohydrate 1.5 g and energy 287 kJ or 67 kcal per 100 g serving. As the jetty is far from industrial and human activity, heavy metal content analyzed using Atomic Absorption Spectrophotometric (AAS) depict the safe value to serve as food. The Arsenic (As) and Cadmium (Cd) is not detected (<0.1mg/kg), Chromium (Cr) is 0.9 mg/kg, Nickel (Ni) is 1.2 mg/kg and Lead (Pb) is 0.9 mg/kg. As from the data analyzed, the cultivated cerithideaobtusa is considered to be safe and ready to be commercialized as food in the market.

KEYWORDS: Mollusk, Soft Muscle Tissues, Edible Gastropods, CerithideaObtusa, Kampung Sungai Durian.

INTRODUCTION

Mollusks are those sea animals which has a soft body which may or may not be protected by an outer shell. It is divided into Gastropods or Univalves, Bivalves and Cephalopods which has a single protective shell. The species found held to a side of the rock which appeared as a rock. The meat is very chewy and salty in flavor. The edible mollusk harvested from freshwater, saltwater or the land. There are different types of the classes such as Gastropoda (snails), Bivalvia (oysters, clams, scallops etc.), Polyplacophora (chitons) and Cephalopoda (octopus and squid). Marine gastropods are one of the marine organisms of the phylum Mollusca which is extensively expanded. These microorganisms can adapt well to transition in environmental factors created by the temperature, ocean tides and salinity [1]. In this community research project, a cultivated gastropods (snails) with scientific named cerithideaobtusa species were grown in coastal mud areas at mangrove ecosystem of Sungai Perpat Punggor near to fishermen jetty of Kampung Sungai Durian, Johor, Malaysia. The cerithidea obtusa are gastropod mollusks which harvested for food consumption. There is not enough information relating to the nutritional fact of these snails, mainly from Malaysian waters.

Kukup is a well-known seafood paradise for local people which under the administration of Tanjung Piai Parliamentary constituency in Pontian District, Johor, Malaysia. In March 2017, an allocation of RM850 million was channelled by the federal and state governments, to implement various development projects in Tanjung Piai Parliamentary constituency [2]. Later, the cerithideaobtusa or in Malay it is called siputsedut cultivated in mangrove ecosystem near to fishermen jetty at Kampung Sungai Durian Jetty as community project under Duta Jauhar 4.0 UiTM Kampus Pasir Gudang. The exact location is at the coordinate of 1.3197580, 103.4544940 where the 2.5 hectares mangroves are as developed to help increase the fishermen income. The selling price of Cerithidea obtusa can go up to Ringgit Malaysia 18 in Johor Bahru market. The location is at the river estuary where the wave is not so high and it eases the fishermen to collect and cultivate the cerithidea obtusa. The

community project aims to help the villagers turning the area to be the breeding center of cerithidea obtusa and help them to commercialize the area for eco-tourism which in return will help generates sustainable income for them.

The sea snail (*Cerithidea obtusa*) and freshwater snail (*Pomacea canaliculata*) were used in Indonesia as traditional medicines as fever, wounds and itching treatment [3]. In Malaysian, it is commonly sold as seafood has high market demand and widely used for the preparation of local delicacies such as 'masak lemak cili padi' and 'sambal berlada'. They also have high nutritional value. They are suitable to be used as a source of food [4]. This type of fresh snails can be found in many seafood markets, as fresh, cans or packages and sold by the size. It is necessary to inquire about the nutritional fact, the heavy metal content, the arrival date and whether they have liquidated. Because of health conscious, people are more interested in taking more seafood given its relatively higher nutrition. The nutritional values of *Cerithidea obtusa* received less attention in Malaysia and were not well studied. Having this kind of study on nutrient content and showed the significant result to be used in both agro-industry and human consumption, may help increase the awareness and fact on this species. This research examines the critical nutrient fact such as energy, protein, carbohydrate and fat of *Cerithidea obtusa* mainly from Kukup, Pontian, Johor, Malaysia.

The nutritional facts required for healthy food selections. Standardized serving sizes are needed to create a nutrition comparisons. Information on the amount per serving of nutrients such as saturated fat, cholesterol, sodium, sugar and fiber is essential for people with different health concerns. According to the Food Act and Regulations in Malaysia, the seller must provide useful information to consumers so that they, in turn, can make an informed food choices. Local food manufacturers and distributors abide by the Food Regulations 1985 and Malaysian Food Act 1983. The act protects the public against health hazards and fraud during food preparation, when it on sale and the use of food. The example of nutrients contains declared on a nutrition label are energy, protein, carbohydrate and fat. Meat is foods that require mandatory nutrition labelling under regulations number 149, 151, 161 and 220 [4].



Figure 1: Study area and satellite map at coordinate 1.3197580, 103.4544940

The gastropods are nutritious given its protein and mineral contents. However, gastropods may contain heavy metals which can be harmful to human health [5]. Heavy metal pollution in the aquatic ecosystem recognized as a serious environmental issue. The rapid industrialization in Malaysia has led to an alarming level of heavy metal pollution and lately, more attention increase due to the extensive existence of metal pollution in the aquatic system. In various cases, the heavy metals occur in natural water bodies at levels below their toxic thresholds. Despite due to the nondegradable environment, the low concentrations may pose a risk of damage through uptake and subsequent bioaccumulation by organisms. It cannot metabolize and these absorbed metals are extracted [6]. A few scientific researchers have shown that heavy metals are bioaccumulated or bioconcentrated in a few compartments across food webs. When humans consume the accumulators, the metal bioaccumulated must be stress out in mind to give consciousness to the point of health view.

As shown in a review by [7], several research studies were about metal pollution wherein plants, mammals, invertebrates and fish were the dominant used bioindicator species. Each bioindicator represents the different merits for the biomonitoring of metal pollution in an aquatic ecosystem when compared to the others. Gastropods are more susceptible to heavy metal accumulation through food intake and absorption from the

environment and sometimes impose health hazard to consumers. Thus, this study was done to investigate the concentration of cadmium (Cd), Lead (Pb), Arsenic (Cu), Nickel (Ni) and Chromium (Cr) in cultivated *Cerithidea obtusa* at Sungai Perpat Punggor, Kampung Sungai Durian, Kukup Johor, Malaysia. The project hopefully can boost the side income for fishermen hence enhance Pontian district to be well developed for future generations.

METHODOLOGY

The big size of *Cerithidea obtusa* (3 to 4 cm) collected in August 2017 at the cultivated area, Sungai Perpat Punggor, Kampung Sungai Durian, Johor Malaysia and were tested as received.



Figure 2: The cultivated *Cerithidea obtusa* surrounded by a 1-meter high fence in the 2.5-hectare collection area

Fat Content

Fat content determined by using Soxhlet method (Soxhlet extraction mantle 250 ml, brand ross-India). First of all, the round bottle flask will be placed in an oven at 105°C overnight to ensure the weight of flask is stable. Then, 3-5 g of the sample will be weighed to filter paper and wrap. After that, the sample will be taken into extraction thimble and then transferred into Soxhlet. About 250 mL of petroleum ether will be added in round bottle flask and take it on the heating mantle. The Soxhlet apparatus will be connected and turned on the water to cool them. Then, the heating mantle will be switched on. The sample will be heated and then the petroleum ether will be evaporated on boiling water bath. After that, the flask will dry in the oven for 1 hour at 105°C until the solvent completely evaporated and the flask is completely dry. After drying, the flask will be transferred with a partially covered lid to the desiccator to the cooling process and the weight will take again (Official Method 960.39, AOAC 2000). The amounts of fat content determined by different weightings:

$$\% \text{ Fat} = \frac{(\text{Weight of flask} + \text{fat}) - (\text{Weight of flask})}{\text{Weight of dried sample}} \times 100\%$$

Protein Content

Protein analysis determined using the Kjeldahl method (Official method 955.04, AOAC 2000). First of all, about 0.5-1.0 g of the sample will be weighted and transferred into digestion flask. Then, 200 mL of concentrated sulphuric acid added and two tablets of Kjeldahl catalysts added too. The digestion process is for 1 to 2 hours until the solution becomes transparent or clear. The digestion flask will be allowed to cool and proceed with titration. 60 mL of distilled water and 50 mL of 40% NaOH solution will be added to the solution in digestion tube, resulting in the formation of ammonia. The ammonia obtained will be collected in 60 mL of 2% boric acid containing an indicator, methyl red. The content in the receiving flask titrated with 0.1 M HCl until solution turn to light pink. The volume titrated will be recorded and protein content will be calculated using given formula:

$$\% \text{ Protein} = \frac{(A - B) \times N \times 1.4007 \times 6.25}{W (g)}$$

Where A = Volume (mL) of 0.1 M HCl used sample titration, B = Volume (mL) of 0.1 M HCl used in blank titration, N = Normality of HCl, W = Weight (g) of sample, 14.007 = Atomic weight of nitrogen and 6.25 = the protein-nitrogen conversation factor.

Carbohydrates and Calories

The term other carbohydrate defined as the difference between the total carbohydrate and the sum of dietary fiber, sugars and sugar alcohol. The total carbohydrates content calculated by subtracting the summation of the crude protein, total fat, moisture and dust from the total weight of the food. The calorie value for nutrition labeling determined by the calculation. The formula is subtracting the insoluble dietary fiber (IDF) using protein $\times 4$, (carbohydrates-IDF) $\times 4$ and fat $\times 9$.

Heavy Metal

The heavy metal determined by atomic absorption spectroscopy (AAS). The samples sent to a private lab which certified by the Ministry of Health Malaysia (KKM). The test method referred to the various official methods used for different parameters. The first parameter tested was arsenic using the Official Methods of Analysis of AOAC International (AOAC 986.15). The second parameter tested was lead using the Official Methods of Analysis of AOAC International (AOAC 972.25). The third parameter tested was copper using the Official Methods of Analysis of AOAC International (AOAC 971.20). The fourth parameter tested was chromium using the Official Methods of Analysis of AOAC International (AOAC 968.08). The last parameter tested was cadmium using the Official Methods of Analysis of AOAC International (AOAC 968.08).

RESULTS AND DISCUSSION

Cerithidea obtusa from Malaysian waters are gastropod mollusk harvested for human food consumption but unfortunately the nutritional facts not made known to the public. The cultivated *Cerithidea obtusa* has approximately 90% yield. The mangrove tree coupled with the existing mud areas reduce the speed of wave contribute to its high return and make it suitable for collection area. So far, the nutritional value of *Cerithidea obtusa* is not the focus of attention, thus consumption of these nutrient-rich mollusks has not mainly studied. Biochemical studies are significant from the nutritional point of view. The biochemical constituents in animals are known to vary with size of the animal, season, temperature, stage of maturity and availability of food, etc. To commercialize the *Cerithidea obtusa* in Malaysia, information on nutrients values which are compulsory is fat, protein, carbohydrates and calories value. Information on energy value is to be expressed as kcal (kilocalories) per 100 g or per 100 ml of the food or package if the package contains only a single portion. Also, the energy value should also be given for each serving of the food as quantified on the label. Besides kcal, energy value expressed as kilojoule (kJ). The amount of protein, carbohydrate and fat were expressed as g per 100 g of the *Cerithidea obtusa*.

Table 1: Result of energy, fat, carbohydrate and protein for 100gram serving of *C. Obtusa*

	Per 100g
Energy	283kJ or 67 kcal
Total Fat	1.8 g
Carbohydrate	1.5 g
Protein	11.2 g

The nutritional fact showed that these seafood has low saturated fat. It has a good source of protein and potassium. *Cerithidea obtusa* has an excellent source of Vitamin E (Alpha Tocopherol), iron, magnesium, phosphorus, copper and selenium. However, the content of cholesterol is high which is not suitable for those who had diabetes. The results showed that *Cerithidea obtusa* obtains unusually low in fat; 100g of *Cerithidea obtusa* contain only 1.8 grams of fat with slightly more unsaturated than saturated fat. Whereas for calories, a 100-gram serving of *Cerithidea obtusa* provides 67 calories and maximum calories in a dish of snails came from protein.

Protein is vital for life nutrition. The protein occurs in considerable quantity of all nutrients to form the components of the human body [8]. Some proteins in the flesh of four snails species recorded by [10] ranged from 18.66% to 20.56%. In another study by [9], the amount of protein is 6.464 % to 12.927%. While, in this study showed that the protein content is 11.2% or 11.2 g in 100g of meals. In term of carbohydrates, we have found only 1.5% or 1.5 g in 100 g of serving. In [9] found 2.902% to 7.566% carbohydrates, while in [10] recorded only 0.007% of 0.42%. The most significant difference between these three studies and a possible explanation for the difference in protein and carbohydrate content may be due to differences in species, region, diet and environment [10].

In [9] study area, Chanda Beel at Southeast India is unique for its dense and diversified aquatic vegetation which may have affected the protein value of the studied samples. Whereas, in [10] study area is from Ekiti State, southern Nigeria. Snails constitute a significant source of animal protein for many coastal communities in Nigeria [10]. The popularization of mollusks as human food can also supplement the protein requirement of the poor inhabitants of that locality. The seafood is one of the most nutritionally balanced foods. The seafood diet

helps to control weight and goes a long way towards preventing heart diseases. Comparing with fish, the average protein content of fish approximately ranges from 8 g to 23 g per 100 grams of wet edible protein.

Table 2: Test result for heavy metal content for several species of shellfish

Parameters	Pontian, Johor Malaysia	Bhavanapadu, Sriakulam, India [4]			Kota Kinabalu, Sabah, Malaysia[11]		
	Cerithidea Obtusa	Cerithidea Obtusa	Cerithidea Teles- copium	Cerithidea Cingulata	Metretrix spp (clam)	Amusium Pleuro- nectes (scallop)	Strombus Canarium (conch)
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Lead (as Pb), mg/kg	0.90	0.89	10.00	0.94	0.18-0.37	0.59-0.88	0.45-0.64
Arsenic (as As), mg/kg	Not detected (<0.01)	-	-	-	0.95-2.89	12.81-22.10	1.98-3.07
Cadmium (as Cd), mg/kg	Not detected (<0.1)	0.001	1.79	1.43	0.04-0.13	2.84-5.45	0.04-0.05
Nickel (as Ni), mg/kg	1.20	Not detected	4.77	1.79	0.81-2.15	0.9-2.23	0.37-0.55
Chromium (as Cr), mg/kg	0.90	-	-	-	0.47-1.69	2.20-3.39	1.19-1.94

Metal bioavailability to organisms depends on distinctive aspect including biological and geochemical processes. The relevance of metal concentration study in an organism provides information on the bioavailable fraction of metal. However, the measurement of metal in tissues does not give data about the process controlling metal intake. The more tolerant species responded to specific metal will accumulate more metal. In contrast, the less tolerant species accumulate less metal or may not survive. The aquatic mollusks commonly possess very diverse strategies in the handling and storage of accumulated metals [11].

As from the result Table 2, the arsenic and cadmium content are below the detection limit. The lead concentration in shellfish is higher during the rainy season compared to the drought period [12]. This study showed that the concentration of Pb was at the middle 0.9 mg/kg and did not exceed the permissible limits as recommended by Malaysia Food Act 1983 (Act 281) which is 2.0 mg/ kg. The reason may be due to the sample collected in August which is not fall under the raining season. In Malaysia, the maximum rainfall commonly occurs from October to November. It is equal value to the Cerithidea obtusa from India water where the leads value is less than 0.1 and amount of Pb is 0.9 mg/kg.

Unfortunately, the value of Nickel for Malaysian Cerithidea obtusa is quite high compared to Indian with the value of 1.2 mg/kg. As compared to other mollusk species such as clam, scallop and conch from Sabah, Malaysia. The result showed the high value of heavy metal like nickel, chromium, arsenic, cadmium except for lead content which is higher for Cerithidea obtusa (snail species). The result for Cerithidea obtusa at this area is below the limit of Malaysian food regulations and consider to be safe to eat as seafood.

CONCLUSION

The concentrations of metal in these species was concluded to have following order Ni>Cr>Pb>Cd>As. The heavy metals do exist in the environment, but the naturally occurring heavy metals are low in concentration for the Cerithidea obtusa. Whereas for nutrition fact, the Cerithidea obtusa obtained is suitable for low carbohydrate diet and the protein content more or less equal to protein from a fish source. Hopefully, this paper provides useful information regarding the nutrient content present in nutritionally essential gastropods at mangrove ecosystem near to fishermen jetty of Sungai Perpat Punggor, Kampung Sungai Durian, Pontian, Johor. The study may create awareness on the nutritional, health benefits, heavy metal content and thus enhance the marketability of this species in future.

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