Evaluation of the nutritional value and heavy metal content of the dried marine gastropod *Laevistrombus turturella*

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Abstract. *Laevistrombus turturella* is a species of marine gastropod that abundantly found in the Klabat bay waters, West Bangka, Indonesia and has become one of favorite seafood of the people in the area. This study aims to determine the proximate, mineral, vitamin and heavy metal content of the soft body of the dried marine gastropod *L. turturella* collected from Klabat bay water, West Bangka, Indonesia. Results showed that moisture (44.68%) and protein (44.66%) content were the major constituents of proximate composition. Phosphorus content (31,902.90 mg/100 g) was the major constituent of mineral followed by calcium, sodium, potassium, magnesium, and iron were 4,376.75 mg/100 g, 867.81 mg/100 g, 664.40 mg/100 g, 438.28 mg/100 g and 16.92 mg/100 g respectively. The content of vitamin B2 and vitamin E were 0.15 mg/100 g and 0.48 mg/100 g respectively. While vitamin A, vitamin B1 and vitamin B12 were not detected. All heavy metal concentrations tested were below the permitted limit of Food Agriculture Organization/World Health Organization and The National Standardization Agency of Indonesia. The nutritional content of marine gastropod *L. turturella* is appropriate for the human diet.
Key Words: *L. turturella*, human diet, Klabat Bay, proximate composition, minerals.

Introduction. Besides having an important role in ecology, marine molluscs also have importance in human diet since it is an important source of nutrients. Marine molluscs are commercially valuable species in the coastal region. Moreover, consumption of marine molluscs provides an inexpensive source of protein with high biological value, vitamins and essential minerals (Periyasamy et al 2014).

Laevistrombus turturella is a species of edible marine gastropod in the family of Strombidae. It is commonly known as "siput gonggong" by local people in Bangka Belitung islands, Bintan Island, Batam Island and also in the Johor strait, Malaysia (Cob et al 2009; Dody 2011). In addition to the *L. turturella*, there is one another species in the genus *Laevistrombus*, namely *L. canarium.* Morphologically, *L. turturella* closely resembles to *L. canarium* (Cob et al 2009).

Currently, *L. turturella* has been one of the most important fishery commodities and also has become people livelihood in Bangka Belitung islands. It used in various meals such as crispy chips, moreover the fresh meat also serves as a special menu in restaurants. However, the fulfillment of the need for *L. turturella* still relies on natural harvest until now, because it could not be cultivated yet. As a result, availability in nature also decreases due to excessive harvesting. In addition, the sea mining activities also affect the reduced population of *L. turturella* in nature (Dody 2011; Supratman & Syamsudin 2016).

Although there have been many studies on marine gastropod *L. turturella*, there are no scientific information about the nutritional value of *L. turturella* from Klabat bay waters, West Bangka, Indonesia. Different habitat may affect significantly the nutritional value. Therefore, this study aims to determine the proximate, mineral and heavy metal content in marine gastropod *L. turturella* from Klabat bay waters, West Bangka, Indonesia.

Material and Method

Sample collection and preparation. Marine gastropod *L. turturella* (Figure 1) was manually collected from Klabat bay waters, West Bangka, Indonesia (Figure 2) in May 2018. The samples were boiled in water for 25 minutes and the soft parts were removed from the shells and then kept in ice box and brought to the Marine Natural Product Laboratory, Research Center for Oceanography Jakarta for keeping at -20°C. Before used for analysis, samples were allowed to dry in an oven at 40°C for 5 hours.

Proximate analysis. The proximate analysis including moisture, ash, fat, protein and carbohydrate contents were determined according to the AOAC (1999) standard method. Determination of moisture content (%) was performed by drying 2 g marine gastropod *L. turturella* at 105°C for 3 hours. Immediately after being cooled in a desiccator, sample was reweighed (AOAC 1999). Determination of ash content (%) was done by heating 2 g marine gastropod *L. turturella* for 4 hours in a muffle furnace at 550°C. The sample was reweighted immediately after cooled in desiccator (AOAC 1999).

Figure 1. Marine gastropod *Laevistrombus turturella* (Dody 2011).

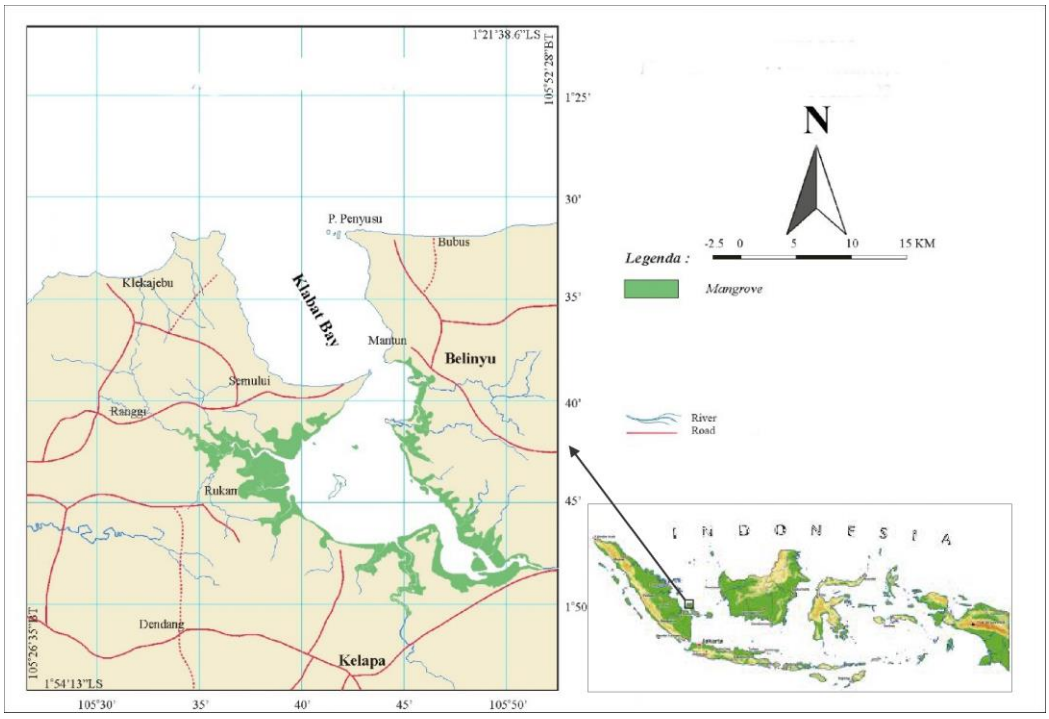

Figure 2. Map of the Klabat bay waters, West Bangka, Indonesia.

Determination of fat content (%) was performed by loosely wrapping 2 g marine gastropod *S. tuturella* with a filter paper and then placed into the thimble which was fitted to a clean round bottom flask. A 120 mL of petroleum ether was measured into a flask and allowed to reflux for 5 hours. The spent samples with the thimble kept and then reweighted (AOAC 1999). Determination of protein content (%) was done by elemental N determination using the nitrogen-protein conversion factor of 6.25 (AOAC 2000). While the carbohydrate content (%) was determined by difference: 100-(moisture + ash + protein + fat)%.

Mineral analysis. Determination of minerals (calcium, iron, phosphorus, potassium, sodium and magnesium) content was determined by using the Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES) method.

Vitamin analysis. Determination of vitamin A and vitamin E were performed by using High Performance Liquid Chromatography (HPLC) method. Vitamin B1 and vitamin B2 were determined by using Ultra Performance Liquid Chromatography (UPLC) method. While vitamin B12 were determined by Liquid Chromatography Mass Spectrometry (LC-MS/MS) method.

Heavy metal analysis. Determination of heavy metals (lead, cadmium and mercury) content was performed by using Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES) method.

Result and Discussion. The proximate composition of the dried marine gastropod *L. turturella* is presented in Table 1. Like other marine organisms, the moisture content is one of the most important constituents for knowing the quality of gastropods. Where very high moisture content will affect a product to be damaged quickly or easily overgrown with microorganism. In the present study, the moisture content of the dried marine gastropod *L. turturella* was 44.68%. This is almost similar when compared to the report of Kumar et al (1986) with 41.41-66.69% in the dried gastropod *Volegalea cochlidium.* In other dried gastropods, the moisture content found was *Babylonia zeylanica* 36.12% (Jayalakshmi 2016), *Phalium glaucum*, *Turbinella pyrum*, *B. spirata*, *B. zeylanica, Harpa articularis*, *V. cochlidium*, *Ficus ficus*, *Chicoreus ramosus* and *Tonna dolium* 83.70%, 81.20%, 80.00%, 78.10%, 72.00%, 71.30%, 67.10%, 65.40% and 60.15% respectively (Govindarajalu et al 2016), *B. zeylanica*, *Chicoreus virgineus*, *B. spirata* and *Trochus radiatus* 82.33%, 76.20%, 72.80% and 66.76% respectively (Margret et al 2013), and *Tympanotonos fuscatus* var *radula* 13.45% (Ogungbenle & Omowole 2012).

The ash content of the dried marine gastropod *L. turturella* analyzed in the present study was found to be 7.22%. This result was higher than in other marine gastropods reported in previous studies such as *B. zeylanica* ranging from 0.72 to 2.39% dry weight basis (Jayalakshmi 2016), *B. zeylanica*, *C. vigeineus, B. spirata* and *T. radiatus* 1.18%, 1.13%, 0.96% and 0.89% respectively (Margret et al 2013), *C. ramosus, B. zeylanica*, *V. cochlidium*, *P. glaucum*, *F. ficus*, *T. pyrum*, *B. spirata*, *T. dolium* and *Harpa artucularis* 1.20%, 1.19%, 1.1%, 0.98%, 0.93%, 0.88%, 0.85%, 0.82% and 0.81% respectively (Govindarajalu et al 2016). Ogungbenle & Omowole (2012) reported the highest ash content of 9.56% in *T. fuscatus* var *radula.*

Table 1

Proximate content of marine gastropod *Laevistrombus turturella*

Parameters	*Result (% dry weight)*
Moisture content	44.68
Ash content	7.22
Protein content	44.66
Fat content	2.20
Carbohydrate content	1.24

For hundreds of years, foods from the sea have become a source of high-quality protein. Seafood as a major source of protein belongs to the same category as eggs, meat, poultry, dried beans, and peas. As an essential for the sustenance of life, protein exists in the largest quality of all nutrients as component of the human body (Okuzumi & Fujii 2000). Table 1 showed that the protein and moisture content was the major constituent in the proximate analysis. The present study revealed that the protein content in marine gastropod *L. turturella* was 44.66% base on the dry weight. This result was almost similarly with the report of Jayalakshmi (2016) in marine gastropod *B. zeylanica* with a range of 40.33-42.05% on dry weight basis; *B. spirata* (41.1%) and *B. zeylanica* (40.8%) (Govindarajalu et al 2016), and *B. spirata* (48.2%) (Margret et al 2013). The protein content revealed by the present study was higher than in other marine gastropods such as *Purpura bufo* with 22.45% (Darwin et al 2017), *V. cochlidium, C. ramosus, T. pyrum, H. articularis, P. glaucum, T. dolium* and *F. ficus* with 38.9%, 37.3%, 37.2%, 35.2%, 35.1%, 33.6% and 32.2% respectively (Govindarajalu et al 2016), *Telescopium telescopium*, *Cerithideopsilla cingulata* and *Cerithidea obtusa* with 21.01%, 13.03% and 20.38% respectively (Chakravarty et al 2015), *C. virgineus, B. zeylanica* and *T. radiatus* with 39.80%, 36% and 28.55% respectively (Margret et al 2013). Kumar et al (1986) reported the protein content of the dried marine gastropod *V. cochlidium*at a range of 33-55.93%. Whereas Ogungbenle & Omowole (2012) reported the higher protein content in *T. fuscatus* var *radula* (74.74%) and Periyasmy et al (2011) in *B. spirata* (53.86%).

The results of the present study indicate that the protein and moisture content are constituents with the highest percentage of dried gastropod *S. turturella.* In addition, the results of this study also show that marine gastropod is a marine organism that is very rich in protein content similar to previous studies.

The present study revealed that the fat content of marine gastropod *L. turturella* was 2.20% basis on the dry weight. This result is almost similar with *F. ficus, C. ramosus*, *T. dolium* and *V. cochlidium* with 2.2%, 2% and 1.9% respectively (Govindarajulu et al et al 2016). Previous studies also reported that the fat content in gastropods such as *B. zeylanica* was ranging from 6.81% to 9.17% dry weight basis (Jayalakshmi 2016). In *P. bufo* 4.56% fat content was found (Darwin et al 2017), in *B. spirata* 9.3% (Periyasamy et al 2011), in *V. cochlidium* 13.90-23.67% (Kumar et al 1986), in *B. spirata*, *B. zeylanica*, *H. articularis*, *T. pyrum*, *P. glaucum* and *V. cochlidium*with 6.6%, 6.1%, 4.7%, 4.3%, 3.9%, and 1.1% respectively (Govindarajalu et al 2016), in *T. telescopium*, *C. cingulata* and *C. obtusa* with 18.9%, 16.57% and 19.5% respectively (Chakravarty et al 2015), in *T. fuscatus* var *radula* 1.32% (Ogungbenle & Omowole 2012), *B. zeylanica*, *C. virgineus*, *B. spirata* and *T. radiatus* with 6.2%, 4.7%, 1.45% and 1% respectively (Margret et al 2013).

Carbohydrate was the constituent with the smallest percentage obtained in the present study. This study revealed that the carbohydrate content of the marine gastropod *L. turturella* was 1.24% basis on the dry weight. This result was lower than in other marine gastropods reported in previous studies such *B. zaylanica* with a range of 16.02-18.15% dry weight basis; in *P. bufo* 20.3% (Darwin et al 2017), *B. spirata* 53.86% (Periyasamy et al 2011), *V. cochlidium* 3.26-12.13% (Kumar et al 1986), *B. zeylanica*, *C. virgineus*, *B. spirata* and *T. radiatus* 19.6%, 19.5%, 13.75% and 6.7% respectively (Margret et al 2013), *B. spirata*, *V. cochlidium*, *B. zeylanica*, *C. ramosus*, *T. pyrum*, *H. artucularis*, *P. glaucum*, *F. ficus* and *T. dolium* 17.5%, 16.9%, 16.6%, 15.2%, 14.5%, 14.3%, 14.2%, 13.5% and 12.3% respectively (Govindarajalu et al 2016), *T. telescopium*, *C. cingulata* and *C. obtusa* 18.9%, 16.57% and 19.5% respectively (Chakravarty et al 2015). Whereas Ogungbenle & Omowole (2012) reported the lower content of carbohydrate content in *T. fuscatus* var *radula* with 0.18%.

Vitamins are organic chemical compounds which are essential for reproduction, in promoting growth and maintenance of normal body health and function (Jayalakshmi 2106). Result analysis of the vitamin content of the marine gastropod *L. turturella* is shown in Table 2.

Table 2

Vitamin content of marine gastropod *Laevistrombus turturella*

Parameters	*Result (mg/100 g dry weight)*
Vitamin A	nd
Vitamin B1	nd
Vitamin B2	0.15
Vitamin E	0.48
Vitamin B12	nd

The content of vitamin A, vitamin B1 and vitamin B12 were not identified. Whereas, the content of vitamin B2 and vitamin E were 0.15 mg/100 g and 0.48 mg/100 g. In the other marine gastropod as *B. zeylanica*, the detected vitamin contents were: vitamin A (651 mg/100 g), vitamin B2 (412 mg/100 g), and vitamin E (220 mg/100 g), whereas vitamin B1 was not detected (Jayalakshmi 2016). Vitamin B12 was reported in *B. japonica* and *Turbo cornutus* at 0.47 mg/100 g and 0.17 mg/100 g respectively (Teng et al 2015).

Result analysis of the mineral content of the marine gastropod *S. turturella* is shown in Table 3. This study revealed that the major constituent of minerals content was the phosphorus (31,902.90 mg/100 g) basis on the dry weight. The second major constituent of minerals content was calcium (4,376.75 mg/100 g) followed by sodium, potassium, magnesium and iron with 867.81 mg/100 g, 664.40 mg/100 g, 438.28 mg/100 g and 16.92 mg/100 g respectively.

Table 3

Mineral content of marine gastropod *Laevistrombus turturella*

Parameters	*Result (mg/100 g dry weight)*
Sodium (Na)	867.81
Phosphorus (P)	31902.90
Calcium (Ca)	4376.75
Potassium (K)	664.40
Iron (Fe)	16.92
Magnesium (Mg)	438.28

The high content of phosphorus in marine gastropod *L. turturella* shows that consuming *L. turturella* will provide enormous benefits for human health. Phosphorus is an essential mineral that the body uses for growth and repair of body cells and tissues with 85% concentration in bones and teeth. It is further used to carry out many biochemical processes, include energy production and pH regulation. There are several benefits of phosphorus for human health, such as for bone growth, healthy digestion, helps eliminate toxins, reduce fatigue and weakness, prevent arthritis and osteoporosis, healthy brain function, protein metabolism, cell repairing mechanism, balanced hormones, weight loss and nutrient absorption (Marcene 2018).

The minerals content reported in other marine gastropod, such as *B. zeylanica* found calcium 509 mg/100 g and magnesium 104 mg/100 g. The magnesium content was the major constituent reported in *T. fuscatus* var *radula* (176.86 mg/100 g) followed by sodium, calcium, potassium and iron with 90 mg/100 g, 41.98 mg/100 g, 36 mg/100 g and 3 mg/ 100 g respectively (Ogungbenle & Omowole 2012).

The heavy metal analyzed in the present study concerned lead, cadmium, and mercury (Table 4). The result showed that the lead content was 0.61 mg/kg and the cadmium 0.23 mg/kg, while the mercury content was not detected. Our result is almost similar with a previous study on *L. canarium* reported by Sharif et al (2016) where cadmium content was 0.05 mg/kg and lead 0.54 mg/kg. Nasution (2011) also reported that cadmium content was 0.56 mg/kg in *L. canarium* collected from North Bintan island waters, Indonesia. Primost et al (2017) reported that cadmium and lead concentration detected in digestive gland and gonad complex of three marine gastropods from Nuevo

gulf, namely *Adelomelon ancilla*, *Buccinanops deformis* and *Trophon geversianus* was 8.02 mg/kg and 1.81 mg/kg, 38.86 mg/kg and 1.95 mg/kg, 104.24 mg/kg and 3.51 mg/kg respectively. Cadmium detected in foot of *A. ancilla*, *B. deformis* and *T. geversianus* was 0.06 mg/kg, 0.2 mg/kg and 1.23 mg/kg respectively. While lead was only detected in foot of *B. deformis* (1.02 mg/kg).

Gay & Maher (2003) reported cadmium concentration in the marine gastropod *Bembicium nanum* form Jervis Bay and Rosedais (New South Wales) 0.78-3.47 mg/kg. Cadmium and lead concentration reported in *Phorcus turbinatus* and *Patella caerulea* from Mediterranean Sea was 0.77-1.28 mg/kg and 0.62-1.78 mg/kg, 1.87-3.68 mg/kg and 0.17-2.41 mg/kg respectively (Conti et al 2006).

Table 4

Heavy metal content of marine gastropod *Laevistrombus turturella*

Parameters	*Result (mg/kg)*		
	Lead	*Cadmium*	*Mercury*
Laevistrombus turturella	0.61	0.23	nd
Permitted limit by FAO/WHO (1995)	1.5	2.0	0.5
Permitted limit by SNI (2009)	1.5	1.0	1.0

nd - not detected, SNI - The National Standardization Agency of Indonesia (2009).

All heavy metals content tested in the present study were below the permitted limit of FAO/WHO (1995) and SNI (2009). The results show that marine gastropod *L. turturella* from Klabat bay waters is still safe for consumption.

Habitat and anthropogenic activities near the habitat of marine gastropods are crucial in order to identify the accumulation basis of heavy metals in marine gastropods (Hajeb & Jinap 2009; Zhang et al 2007). Sharif et al (2016) reported that the weather changes or climate changes could be contributory factors to heavy metal concentration in gastropods (Sharif et al 2016). In addition, mining activities near the sampling area used in this study might affect the levels of heavy metals tested.

Conclusions. The results showed that the marine gastropod *L. turturella* is nutritionally rich in protein but low in fat. It is also rich in some minerals mainly phosphorus, calcium, potassium, sodium and magnesium. The heavy metal concentration tested were below the permitted limit FAO/WHO and The National Standardization Agency of Indonesia. The nutritional content of marine gastropod *L. turturella* is beneficial for human diet.

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