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Proximate composition analysis of stingrays from local fish market in Kuching, Sarawak

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ABSTRACT

Stingrays are one of the marine fishes that inhabit the shallow part of the ocean. They are well known to the locals as cuisine and its parts as accessories for items such as handbags, belts, and decorations. Stingrays of species *Himantura undulata* and *Maculabatis gerrardi* are commonly caught by fishermen of Sarawak, but most of its nutritional and antinutritional factors both species are unknown. This study focused on the analysis of some proximate composition such as moisture, ash, and lipid content. Analysis of total organic matter was done as well. The stingrays were obtained from local fish market in Kuching, Sarawak. The method used for moisture (wet basis), ash, and total organic matter is of AOAC (method 930.15), while crude lipid content was based on the Chedoloh method of extraction. The study revealed that *H. undulata and M. gerrardi* are nutritious in terms of moisture, ash, and lipid content to be 78.44 and 80.74% (dry basis), 0.48 and 1.37%, 2.46 and 7.74% respectively.

Keywords: Stingrays, *Himantura undulata*, *Maculabatis gerrardi*, Proximate composition

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INTRODUCTION

Marine fish are sea creatures that inhabit the ocean, respirate through gills and use fins to maneuver underwater. The majority of Southeast Asian people depend heavily on these marine fishes as it is a significant source of protein and income, particularly in the fishery industry. Currently, more than a thousand species of marine fishes have been identified in Malaysia, and some of them are near extinction. Some species are more common than others, such as Indian mackerel, tuna, and sardines, which contribute a large amount of income to the local industry . The marine fish sector contributed about 0.2 % of the country's GDP in the year 2019 (Department of Statistics Malaysia, 2019).

The nutritional value of a fish product can be measured by its constituents, such as water, protein, lipid, and mineral content (Unlusayin et al., 2015). Several studies proved that fishes have a rather significant amount of nutritional value, which are dependent on their species and factors such as age, sex, environment, feeding habit, and habitat. It is commonly understood that fish yield large amounts of protein and lipid-containing essential fatty acids (FAs) such as alpha linoleic acid (ALA), eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). These essential FAs are extracted, refined, and sold as a supplement that provides many health benefits such as reducing harmful cholesterol levels, faster development of brain cells, and reducing cardiovascular diseases (Ahmad et al., 2016).

Stingrays can be described as a fish that has a large flat kite-shaped body with pectoral fins, which can be mistaken as wings and a thorny tail that can reach twice the length of its body (Unlusayin et al., 2015). Stingrays typically inhabit the shallow muddy or sandy oceanic floor and prey on small sea creatures. It is considered as one of the marine fishes commonly consumed by the locals due to it being primarily composed of meat. Most of the stingrays serving as cuisine are either smoked, steamed, and included as main ingredients in curries and stews.

Research published by Aziz et al. (2013) stated that 20 species of marine fish from the Malacca Straits have significant nutritional value, particularly protein and lipid. Another study on the nutritional content of marine fish from the West Coast of Malaysia presented similar results (Nurnadia et al., 2011). Both studies wanted to provide sufficient nutritional information about marine fish to raise awareness among the locals on choosing the best possible marine fish for consumption. Similarly, this study aimed to raise awareness on nutritional factors of marine fish especially stingrays in Sarawak. The objectives of this study was to determine some proximate

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composition such as moisture, ash, lipid, and total organic content of two species of local stingrays, *H. undulata* and *M. gerrardi*.

MATERIALS & METHODS

Sampling and sample preparation

The two species of stingrays used in this study were *Himantura undulata* and *Maculabatis gerrardi*. They were obtained from local wet markets located at Kubah Ria and Kampung Bako, Kuching, Sarawak. These species were chosen because of their high availability within the region (Booth et al., 2021). One sample (1 kg) of each species were bought, stored inside a cool box, and transported to the Faculty of Resource Science and Technology (FRST), UNIMAS. Prior to analysis, the fishes were cleaned thoroughly with water to remove dirt stains from the fishes. The internal organs were removed, and meat was filleted. Food processor was used to shred the fillets. The shredded fish meats were stored inside a zipper bag and kept inside a freezer at temperature under 0 ± 2°C.

Proximate analysis

A. Determination of moisture content

Moisture content (dry weight basis) was determined according to the method outlined by the Association of Official Analytical Chemists (AOAC, 2019; method 930.15). Initially, the empty crucible and lid were dried using a convection oven at 105°C for an hour and cooled down using a desiccator before analysis. The initial weight of crucible and lid were recorded after they have cooled to room temperature. About 5 g of filleted muscle tissue were placed and spread out uniformly inside the crucible to allow equal drying. The samples together with lid were placed inside an oven and heated up to 105 °C for 3 hours. After 3 hours of drying, the sample was cooled down via desiccator to room temperature. After cooling, the weight of the samples was recorded until constant weight. The equation provided below was used to calculate the moisture content in terms of percentage.

$$\% \text{ Moisture content (wet weight basis)} = [(W_{wet} - W_{dry})/W_{wet}] \times 100$$

W_{wet} : weight (g) of wet samples
W_{dry} : weight (g) of dry samples

B. Determination of ash content and total organic matter

The samples were charred at a temperature of 550 °C in a muffle furnace for 12 hours to ensure proper impurities removal. After 12 hours, the sample was cooled inside a desiccator. The samples were then weighed and oven-dried at a temperature of 105 °C until constant weight. The percentage of ash content and total organic matter were calculated from the two equations below:

$$\% \text{ Ash Content} = [W_s/W_c] \times 100$$

W_c : weight (g) charred samples.
W_s : weight (g) sample used

$$\% \text{ Total organic matter} = (W_d - W_c/W_d) \times 100$$

W_d : weight (g) dried samples.
W_c : weight (g) charred samples.

C. Extraction and determination of lipid content

Lipid content of the stingrays was extracted using Chedoloh et al. (2011) lipid extraction method. Thirty grammes of sample was used to extract more lipid. The samples were then mixed with 50 mL chloroform and 100 mL methanol until homogenized. Afterward, another 50 mL of chloroform is added and blended, and 50 mL ultra-pure water (Milipore) was added and blended for another 15 minutes to ensure total extraction. The homogenate solution was then filtered using suitable filter paper and vacuum pump for fast filtration. The filtrate was transferred to a round bottom flask and evaporated at 62 °C using a rotary evaporator to remove organic solvent from the lipid yielded. Further drying was done to remove the residual solvent in an oven at temperature 105 °C for an hour. The equation is used to calculate the percentage of lipid yield from this procedure.

$$\% \text{ Oil Yield} = (M_l/M_s) \times 100$$

M_l : weight of lipid extracted, g
M_s : weight of sample, g

Statistical analysis

All results shown were the mean of ten measurements of each method and analyzed statistically using SPSS (Statistical Package for the Social Sciences) version 26 and Microsoft Excel. Mann-Whitney U test was used to compare the mean of each data. All data were reported as percentages (%) of means and standard deviation of ten replicates. P-value of less than 0.05 was considered as statistically significant.

RESULTS & DISCUSSION

Proximate Analysis

The proximate composition of the muscle tissues of the stingrays were shown in Table 1. Comparison of proximate composition was done to prove that there are variations in the nutritional values of different species of fish. The average moisture content of both species is similar to other species of stingrays in prior studies such as *Telatrygon zugei* and *Himantura uarnacoides*, 76.31 ± 3.15% and 78.62 ± 4.19% respectively (Mukherjee, 2017). Baruah et al., 2007 also recorded the moisture content of the stingrays *Dasyatis pastinaca* (78.19 %) and *Dasyatis americana* (76.50 %). Akland et al. (2005) concluded that teleost and elasmobranchs usually show high variation of moisture content in the range of 79.9 % to 84.1 %. Previous literature suggested that these species contain high energy density but are low in crude lipid (Aberoumad & Pourshafi, 2010). In addition, the method of meat storage also affects the moisture content. Fish muscle tissue tend to absorb water when frozen and subsequently absorbed more when exposed to water during defrosting (James et al. 2006; Young & Smith, 2004). Fish containing high moisture content can degrade essential fatty acids and increases the risk of spoilage by microbes as well as reduction in quality when preserved for a longer period (Ayanda et al., 2019).

The ash content of both species was lower when compared to other species stingrays such as *Raja clavata* (1.38 %), *Dasyatis Americana* (9.43 %), *Dasyatis zugei* (6.71 %) (Baruah et al., 2007). But within a normal range of ash content of fish meat (1.2% and 1.5%). The variation of ash content of marine fishes can be ascribed to health requirements and accessibility of nutrition of fish in their feeding ecosystem (Shabir et al., 2018). The major contributing factors are also the age of the fish, feeding habits and rate of metabolism (Jafri & Khawaja, 1968). High ash content could indicate a high presence of bioavailable minerals present in the fish such as Fe, Ca, Se and Mg, which are essential minerals in hormone regulation, metabolism, and absorption of vitamins (Pal et al., 2018). However, further analysis is needed to identify these minerals as well as their abundancy.

Both species have higher crude lipid content when compared to other rays' species such as *D. pastinaca* (0.75 %), *Raja miraletus* (0.25 %), *R. clavata* (0.47 %), *Gymnura altavela* (0.77 %) (Unlusayin et al., 2015). Generally, fish can be categorized based on their fat or lipid content. Lean fish are fish with less than 2 % crude lipid, low fat between 2-4%, medium fat from 4 % to 8 %, and high fat with equal or more than 8 % crude lipid. Hence, *H. undulata* with crude lipid of 7.74 ± 0.16 % can be considered as a medium fat fish while *M. gerrardi* can be considered as a low-fat fish with 2.46 ± 0.15 % crude lipid. The distinction in crude lipid content between the species can be traced to their general feeding habits and their bodily metabolic processes (Mukherjee, 2017). High moisture content could indicate low crude lipid content as well due to their inverse relationship. Lipid content also decreased when feeding became intermittent (Boran & Karacam, 2011). The decrease in lipid content can also be attributed to the process of skinning and trimming the fish (Manthey-Karl et al., 2016). In conclusion, fish with high-fat content is more nutritious due to high composition of essential fatty acids such as EPA and DHA. However, further analysis is needed to confirm the presence of these essential fatty acids.

Table 1. Analysis of stingrays

Analysis (%)	***Himantura undulata***	***Maculabatis gerrardi***
Moisture content	80.74 ± 0.76^a	78.44 ± 1.73^b
Ash content	1.37 ± 0.27^a	0.48 ± 0.66^b
Total organic Matter	98.63 ± 0.27^a	99.52 ± 0.66^b
Crude lipid	7.74 ± 0.16^a	2.46 ± 0.15^b

Notes: Means ± standard deviation of ten replicates, means with different superscript in the same row are statistically significant ($p < 0.05$). All analysis done based on wet weight basis.

CONCLUSION

This study has reported some proximate composition of *H. undulata* and *M. gerrardi*. However, further nutritional analyses such as protein and fatty acid profile are recommended to discover more benefits that could be provided by these species.

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