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The Nutritional Content Found in Rhizophora Mangrove Fruits in Sondaken Village, Tatapaan District, South Minahasa

Priskila I. T. Mongdong[1](*), Yermia S. Mokosuli[2], Nova L.I.M Ogi[3]

[1] Department of Biology, Faculty of Mathematics, Natural, and Earth Sciences Universitas Negeri Manado
[2] Laboratory of Bioactivity and Molecular Biology, Faculty of Mathematics, Natural, and Earth sciences, Universitas Negeri Manado
[3] Laboratory of Microbiology, Faculty of Mathematics, Natural, and Earth Sciences Universitas Negeri Manado
Jl. Kampus Unima, Tonsaru, Kec. Tondano Selatan, Kabupaten Minahasa, Sulawesi Utara 95618, Indonesia

***Corresponding author**: *priskilaitmongdong@gmail.com*

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Abstract

Mangroves are fertile plants that dominate the coastal areas. The fruit of the Rhizophora mangrove can be used as food and beverage ingredients, containing numerous nutrients for the human body. The mangrove fruit contains carbohydrates, water, protein, fat, as well as secondary metabolites such as flavonoids, triterpenoids, tannins, and saponins. The aim of this research is to determine the nutritional content of the Rhizophora apiculata, Rhizophora mucronata, and Rhizophora stylosa mangrove fruits in Sondaken Village, Tatapaan District, South Minahasa. This study employs a descriptive research method, where laboratory experiments were conducted using the SNI 01-2891-1992 method at the Baristand Manado laboratory. The nutritional analysis results for Rhizophora apiculata showed a water content of 62.17%, ash content of 1.09%, protein content of 0.59%, fat content of 0.79%, crude fiber content of 5.45%, and carbohydrate content of 35.36%. For Rhizophora mucronata, the analysis revealed a water content of 65.54%, ash content of 3.07%, protein content of 1.27%, fat content of 0.74%, crude fiber content of 7.52%, and carbohydrate content of 29.38%. Lastly, Rhizophora stylosa had a water content of 64.77%, ash content of 3.547%, protein content of 1.30%, fat content of 1.63%, crude fiber content of 7.14%, and carbohydrate content of 28.76%. These results indicate that mangrove fruits have numerous benefits and contain valuable nutrients and good nutritional value for the body. By preserving the mangrove ecosystem and utilizing the nutrients found in the fruits and leaves, there is an opportunity to explore their potential as alternative natural remedies

Keywords: *Mangrove fruit, nutrition, Rhizophora apiculata, Rhizophora mucronata, Rhizophora stylosa*

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INTRODUCTION

South Minahasa Regency is one of the regencies in the North Sulawesi Province, resulting from the division of Minahasa Regency, with its capital in Amurang. Based on the administrative division, the local government is divided into 17 districts, 167 villages, and 10 Subdistrik. One of the districts in South Minahasa Regency is Tatapaan District, which consists of several villages, including Sondaken Village. Sondaken Village has a fairly extensive coastal area, including a mangrove coastline. According to (Podungge et al., 2015), Mangrove is a fertile plant that dominate the coastal area. Mangrove forest is also known as Mangrove Swamp. Mangrove forests are a renewable resource that has biodiversity. Wibowo (2009) *Rhizophora* is a mangrove plant that has important ecological and economic benefits, particularly its fruit. *Rhizophor*a apiculata is a species of mangrove found in Sondaken Village. *Rhizophora apiculata* is a mangrove plant with an average adult tree height reaching 15 meters (Hadi & Irawati, 2016). Apart from that, there is also the Ceriops decandra Species which has a tree height of around 1-5 meters and grows in waterlogged areas. This plant has supporting roots (*Radix Primaria*) and respiratory roots (Pneumatophores), which grow from the bottom of the stem. This pneumatophore is dark brown in color, and its tip has a dark brown texture (Novitasari et al., 2018).

The mangrove is a plant that can grow in mud flats and shallow water coastal areas where the water is generally brackish (Mahmiah et al., 2017). Mangrove is a special plant cause they grow in coastal areas or coastal and has many benefits. Churun et al., (2018), Mangrove Forest is a type of forest which is typical along the coast or river estuaries that are influenced by tide. Nurhayati et al., (2015) Apart from that, there are mangrove forests role in the ecosystem that functions as a protector against crashing waves and currents. Akbar et al., (2018) Ecological function as provider of nutrients for aquatic biota, spawning and nursery grounds for various kinds of biota, preventing abrasion, raging hurricanes, and tsunami, absorbing waste, preventing sea water intrusion and others etc (Halidah et al., 2014), One of the natural resources plays an important role in coastal areas mangrove forests, good to maintain productivity of coastal and internal waters support people's lives in surroundings (Handayani et al., 2018).

The majority of coastal society have a limited knowledge about the potential of antioxidants contained in mangrove fruit. Previous research conducted by (Priyanto, 2012) has provided evidence of the robust antioxidant activity present in mangrove fruit. Mangroves fruit is abundant and easily accessible along the Indonesian coastline, but its optimal utilization has not been realized. However, based on the author's observations in Sondaken Village, it apears that the mangrove plants in this village has experienced significant damage, due to the lack of awareness among coastal society about the significant benefits of mangrove forests for their livelihoods.

The locals who lived in the local area lacks of awareness about the nutritional content that contained in mangrove fruit, especially *Rhizophora Apiculata*, *Rhizophora Mucronata*, and *Rhizophora Stylosa*. Even though these fruits are easily accesible in the village, they fails to fully harness their potential and get used to it. The main reason for their limited utilization is the lack of information. According to Sabana's research (Saban et al., 2014), *Rhizophora A*piculata, a type of mangrove plant commonly found in coastal areas, is primarily used for rehabilitation purposes. Despite the abundance of its fruit, they

fails to harness its potential as a valuable source of nutrients for supplementary food. Another essential issue is the lack of knowledge regarding the specific nutritional content of the mangrove fruits *Rhizophora Apiculata, Rhizophora Mucronata, and Rhizophora Stylosa* in Sondaken Village, Tatapaan District, South Minahasa Regency. Proximate analysis is one of the methods used to determine macronutrient content (Ardiansyah et al., 2020). Proximate analysis has several advantages, including being a commonly used method to determine the chemical composition of a food substance, not requiring sophisticated technology for testing, providing a general overview of the analysis results, being able to calculate the total digestible nutrient (TDN) value, and providing a general assessment of the utilization of a food substance (Suparjo et al., 2010).

Considering the issues has mentioned above, the researchers are interested in conducting a study entitled "Nutritional Content of Mangrove Fruits *Rhizophora Apiculata*, *Rhizophora Mucronata, Rhizophora Stylosa* in Sondaken Village, Tatapaan District, South Minahasa."

METHOD

The research utilized various equipment, including an oven, crucible, desiccator, analytical balance, distillation flask (250 ml), measuring cylinders (25 ml, 50 ml), distillation apparatus, 5 ml volumetric pipette, 25 ml burette, Kjeldahl flask, Soxhlet apparatus, special flask for fats, analytical balance, and clamps. The specimens used in the study were mangrove fruits of the *Rhizophora stylosa, Rhizophora mucronata* L., and *Rhizophora apiculata*. The research also involved the use of 96% ethanol solvent, H2SO4, NaOH, phenolphthalein, potassium oxalate, distilled water, and formaldehyde.

The study followed the stages of research outlined in the SNI 01-2891-1992 method, this method is the Indonesian National Standard. Namely, a standard established by the National Standardization Agency as a method used to measure and test food and drinks. employing a descriptive research approach and conducting laboratory experiments to collect data.

Sampling

Samples of *Rhizophora sp*. fruits were obtained from the Mangrove Forest in Sondaken Village, Tatapaan District, South Minahasa Regency. The Mangrove Forest in Sondaken Village is part of the Bunaken National Park. Fresh samples were collected from the Mangrove Forest and preserved in labeled plastic bags. A total of three species of fruits*, Rhizophora Apiculata, Rhizophora Mucronata, and Rhizophora Stylosa,* were collected, with a total weight of 2 grams. The fruit samples are greenish-brown in color, elongated in shape, with a diameter ranging from 1.3 to 1.7 cm, and a hypocotyl length of 20-52 cm.

Research Procedure
Water Content

Water content is determined using the oven method, which involves evaporating the water in the food material through heating. The procedure begins by drying an empty crucible in an oven at 105°C for 10 minutes. Then, approximately 2-3 grams of the sample are weighed and placed into the dried crucible. The sample is further dried in the oven at 105°C for 5 hours. After drying, the sample is cooled in a desiccator for 15 minutes and weighed to obtain its final weight. This process is repeated until a constant weight is obtained, indicating that the water content has been determined.

Ash Content

The determination of ash content, or mineral content, in a material is done using the combustion method. A porcelain crucible is dried in an oven at 105°C, then cooled in a desiccator and weighed. Approximately 3-5 grams of the sample are weighed and placed into the porcelain crucible. Before combustion, the sample is heated on a destruction burner until it forms charcoal and no longer emits smoke. Then, the sample is combusted in an electric furnace at a temperature of 600°C until it turns into gray ash. The sample is then cooled in a desiccator. The final weight is measured and the process is repeated until a constant final weight is obtained.

Fat Content

Determination of fat content in a sample using the Soxhlet method. Filter paper, shaped like a tube, is dried at 105°C for 1 hour. The dried sample (after moisture content determination) is placed inside the filter paper, covered, and dried again in an oven. It is then cooled in a desiccator and weighed. The sample with a known final weight is placed in the Soxhlet apparatus, and extraction is performed using an appropriate solvent such as hexane or petroleum ether. The process continues with reflux for approximately 6 hours until the solvent drips back into the fat flask and the fat solution becomes clear. After extraction, the sample is removed from the Soxhlet apparatus and air-dried. Once the solvent had evaporated completely, the sample were dried in an oven at a temperature of 105°C until it reach constants weight. Once the drying process is complete and a constant weight is achieved, the sample is cooled down in a desiccator.

Protein Content

The protein content of the dried brown algae sample, which was subjected to water extraction, was determined using the formol titration method. To initiate the process, 2 grams of the sample were placed into an Erlenmeyer flask. A small amount of 1% phenolphthalein indicator was added, followed by the introduction of saturated potassium oxalate solution (0.4 ml). Next, Titrations were performed using a 0.1 N NaOH solution until a light red color was observed. The volume of 0.1 N NaOH used, denoted as "p" milliliters, was recorded for analysis. For the preparation of a blank titration, 10 ml of distilled water was mixed with 0.4 ml of saturated potassium oxalate solution, 1 ml of

40% formaldehyde (or formalin), and a few drops of 1% phenolphthalein. The resulting solution was titrated with 0.1 N NaOH until a light pink color appeared, and the volume of NaOH used was recorded.

Crude Fiber Content

The measurement of fiber content is used to determine the amount of fiber in a substance. The principle of fiber content analysis involves dissolving the fiber present in a substance using a 1.25% H2SO4 solution and NaOH. The procedure for analyzing fiber content begins with the preparation of a 5 ml NaOH solution with a normality of 0.313 N and a 5 ml H2SO4 solution with a concentration of 1.25%. Then, filter paper is dried in an oven at 105°C for one hour and left in a desiccator for 15 minutes. Next, 2 grams of the finely ground sample, which has been dried and passed through water, is weighed and placed in a 100 ml beaker. Then, 10 ml of the H2SO4 solution is added (enough to submerge the sample) and heated on a hot plate at approximately 6 hours.

Total Carbohydrate Content

The "by difference" method requires the calculation of the cumulative value of all remaining contents and then subtracting it from 100%.

Data Analysis

In this research, proximate analysis was employed to examine various aspects such as moisture content, protein content, fat content, and carbohydrate content.

RESULTS

The analysis of physicochemical characteristics using drying and ashing methods revealed variations in moisture content and ash content among the three species of *Rhizophora*. *Rhizophora Mucronata* exhibited the highest moisture content at 65.54%, whereas *Rhizophora Apiculata* showed the lowest moisture content at 62.17%. In terms of ash content, *Rhizophora Stylosa* had the highest value at 3.54%, while *Rhizophora Apiculata* exhibited the lowest ash content at 1.09%, as indicated in Table 1.

Table 1. Physical and Chemical Characterization

No	**Species Name**	**Physicochemical characteristics**		
		Water Content	**Ash Content**	**Fruit weight**
1	*Rhizophora Apiculata*	62.17%	1.09%	200 gr
2	*Rhizophora Mucronata*	65.54%	3.07%	200 gr
3	*Rhizophora Stylosa*	64.77%	3.54%	200 gr

In the proximate analysis, it is shown that there are differences in the proximate content among the three *Rhizophora* species. *Rhizophora Stylosa* exhibits the highest protein content at 1.30%, whereas *Rhizophora Apiculata* demonstrates the lowest protein content

at 0.59%. In terms of fat content, *Rhizophora Stylosa* displays the highest value at 1.63%, while *Rhizophora Apiculata* shows the lowest fat content at 0.79%. Additionally, *Rhizophora Mucronata* has the highest crude fiber content at 7.52%, whereas *Rhizophora Apiculata* has the lowest crude fiber content at 5.46%. Lastly, *Rhizophora Apiculata* displays the highest carbohydrate content at 35.36%, and *Rhizophora Stylosa* exhibits the lowest carbohydrate content at 28.76%, as depicted in Table 2.

Table 2. Proximate Analysis

No	Species Name	Proximate Analysis			
		Protein	**Fat**	**Crude Fiber**	**Carbohydrate**
1	*Rhizophora Apiculata*	0.59%	0.79%	5.46%	35.36%
2	*Rhizophora Mucronata*	1.27%	0,74%	7.52%	29.38%
3	*Rhizophora Stylosa*	1.30%	1.63%	7.14%	28.76%

Discussion

The mangrove fruit has numerous benefits and contains a variety of nutrients and good nutritional value for the body. The nutritional content of the *Rhizophora Apiculata, Rhizophora Mucronata,* and *Rhizophora Stylosa* fruits found in Sondaken Village, Tatapaan Subdistrict, South Minahasa. Among the three species of *Rhizophora*, the highest water content is found in *Rhizophora Mucronata* with a content of 65.54%. The high water content in *Rhizophora Mucronata* is attributed to its ability to dissolve substances such as salts, water-soluble vitamins, minerals, and flavor compounds (Ardiansyah et al., 2020). The highest ash content among the three species is found in *Rhizophora Stylosa* with a content of 3.54%. Ash content refers to the inorganic or mineral components present in a food material. Food materials consist of 96% inorganic matter and water, while the remaining portion comprises minerals. Organic minerals are known as ash content. Determining the total ash content serves various purposes, including assessing the quality of processing, identifying the type of ingredients used, and determining the nutritional value of a food material. The moisture content in food materials is a factor that affects the speed and activity of enzymes, microorganisms, and chemical reactions, leading to rancidity, non-enzymatic reactions, and changes in sensory properties, appearance, texture, and nutritional taste. The highest protein content among the three species is found in *Rhizophora Stylosa* with a content of 1.30%.

Protein is a compound required by the human body for growth and development. It serves as a source of energy and a regulator of body tissues. Proteins also function as biocatalysts in chemical processes. Proteins are usually obtained from the food we consume, whether from animals or plants. Protein is an essential nutrient for the body as it not only serves as a source of energy but also plays a crucial role in growth and development (Prayitno et al., 2017). Protein content is typically derived from both animal and plant-based foods. It is an important nutrient for the body, serving as a building block and regulator (Yuniarti et al., 2018) the protein content in *Rhizophora Apiculata* fruit is 0.59%. According to Gultom et al., (2015) fruits suitable for food products should have protein content greater than 1%. Therefore, the protein content in *Rhizophora Apiculata* fruit does not meet the requirement. However, the protein content in *Rhizophora*

Mucronata and Rhizophora Stylosa fruits meets the requirement as their protein content exceeds 1%. Protein analysis can be conducted by determining the empirical amount of protein. The most common method is to determine the amount of nitrogen (N) present in a substance. Determining protein based on nitrogen content indicates the presence of crude protein, as it may also include other nitrogenous compounds.

The highest crude fiber content among the three species of *Rhizophora* is found in *Rhizophora Mucronata* with a content of 7.52%. Crude fiber derived from vegetables and fruits is known as a non-nutritive substance but is necessary for the body to facilitate the elimination of feces (Ardiansyah et al., 2020). The highest carbohydrate content among the three Rhizophora species is found in *Rhizophora apiculata* with a carbohydrate content of 35.36%. According to Gultom et al., (2015), carbohydrates can be classified into two types: simple carbohydrates and complex carbohydrates. Simple carbohydrates can be found in food products such as honey, fruits, and milk. Complex carbohydrates can be found in food products such as rice, potatoes, corn, bread, and others. Complex carbohydrates include starch, glycogen, cellulose, and fiber (Yuniarti et al., 2018). Carbohydrates are the main source of calories for almost the entire global population, especially in developing countries. Carbohydrates play a vital role in defining the properties of food substances, including taste, color, texture, and other characteristics. Moreover, within the body, carbohydrates are crucial for preventing ketosis, excessive protein breakdown, mineral loss, and aiding in the metabolism of fats and proteins.

CONCLUSION

Mangrove fruits have numerous benefits and contain a wide range of nutrients and good nutritional value for the body. The nutritional content of *Rhizophora apiculata, Rhizophora Mucronata, and Rhizophora Stylosa* mangrove fruits in Sondaken Village, Tatapaan Subdistrict, South Minahasa, is significant. The physicochemical characteristics were analyzed using the SNI 01-2891-1992 method, indicating differences in water content and ash content among the three *Rhizophora* species. Proximate analysis using the SNI 01-2891-1992 method revealed variations in proximate content among the three *Rhizophora* species.

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