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EXPLORATION OF *RHIZOPORA* MANGROVE PLANTS AS FUNCTIONAL FOOD COMPOUNDS FROM THE CUKU NYINYI ECOTOURISM AREA, SIDODADI VILLAGE PESAWARAN REGENCY, LAMPUNG PROVINCE

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ABSTRACT
This activity was empowerment community programme assisted by CSR PT. Bukit Asam Tbk Pelabuhan Tarahan Lampung. This research is a series of activities in an effort to preserve Mangrove plantation forests in Pesawaran Regency, Lampung province in collaboration with CSR PT. Bukit Asam, Tarahan Pelabuhan Panjang. The specific aim is to explore and screen Mangrove plants that have the potential to be used as food. There were 2 (two) types of Mangrove plants studied, namely the Mangrove species *Rhizopora apiculata* and *Rhizophora mucronata*. The first step of the research was to carry out phytochemical screening to identify chemical content and bioactive compounds using qualitative methods, and the bioactive compounds identified were flavonoids, saponins, tannins, tripertenoids and steroids as well as phenolic compounds. The third step is to test the main components of chemical compounds using proximate analysis which include tests for water content, ash content, total fat, protein and carbohydrates as well as crude fiber components. Chemical content test results of proximate analysis of mangrove fruit *Rhizopora apiculata* and *Rhizophora mucronata* for water content; ash content; total fat content; protein content; and carbohydrates each one were 64,99; 3,61;8,11; 0,31; 12,49; 22,95 (%) and 64,25; 3,25; 10,67; 0,74; 1,74, 21,10 (%).The aim of the phytochemical test is to determine the presence of secondary metabolite compounds distributed in plant parts. The research continued with trials of making Rhizopora fruit into food products such as sticks and crackers. The overall sensory test results showed a good level of panelist acceptance of snack food substituted with mangrove flour

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1. INTRODUCTION

The spesies of mangrove that found in Indonesia is Rhizophora or what is usually called mangrove or bakau plant. Rhizophora itself consists of 3 species, including *Rhizophora mucronata, Rhizophora apiculata and Rhizophora stylosa* (Kamal, 2011; Friess, 2017). Mangrove plants are plant communities that grow in tidal areas in coastal areas. *Rhizophora apiculata* is a type of mangrove plant that grows in coastal areas in Lampung. *Rhizophora apiculata* was found growing in flooded, sandy and muddy soil (Noor *et al.*, 2006; Rahmawati, 2006; Setiawan, 2008). It was one type of plant that is most commonly found in coastal areas. *Rhizophora apiculata* has a tree height that can reach 30

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m with a tree diameter of up to 50 cm. In the other side, *Rhizophora mucronata* is a species of the genus Rhizophora. Sofiyan (2023) described it type of mangrove were quite often found in the Cuku Nyinyi area, Sidodadi Village, Pesawaran Regency, Lampung Province (https://www.tvonenews.com/berita/226110-mangrove-ranger-cuku-nyinyi-usaha-grup-mind-id-jaga-kelestarian-pesisir).

Mangrove extracts have the potential to be antimicrobial, antiviral, anticancer and antidiabetic. From previous research, mangrove plants consist of several secondary metabolites such as alkaloids, saponins, tannins and flavonoids (Wang e*t al*., 2018; Chew *et al*., 2016). The high content of anti-nutritional components in mangrove fruit causes a lack of interest in further development of mangrove fruit into processed food products. The nutritional content in mangrove fruit can be used as a source of processed food. However, there is a problem faced by people in this area, namely limited knowledge regarding the use of mangrove fruit to make processed food products that can improve the community's economy.

The *R. apiculata* type was still rarely made into processed products because many people think that the antinutritional substances such as tannin found in the fruit will affect people's health, so the use of the fruit is carried out. mangroves by processing based on substitution to processed products. Mangrove fruit can be process to flour because its carbohydrate content is quite high (Dotulong *et al*.,2018). Mangrove fruit flour can also be used as a substitute for wheat flour which is currently increasingly rare and expensive. Mangrove fruit flour can be processed into various products such as wet noodles, crackers, cakes, cendol and cookies. Apart from making flour, mangrove fruit can also be processed into syrup, sweets and jam. Snack products generally have quite low fiber content. To increase the functional value of the product, it can be substituted with mangrove fruit flour. Substitution of mangrove fruit flour into snack products is expected to provide functional value to the product because the fiber content of mangrove fruit is quite high.

In this research, mangrove fruit of *Rhizopora* was used from the Cuku Nyinyi Mangrove Forest Ecotourism in Sidodadi Village, Teluk Pandan District, Pesawaran, Lampung (Figure 1). The high content of antinutritional components in mangrove fruit causes a lack of interest in further development of mangrove fruit into processed food products. Efforts need to be made so that mangroves can be used as a food source by processing them into processed products such as onion sticks, steamed brownies and jelly candy. Onion sticks and steamed brownies are processed food products using mangrove fruit which is processed into flour and then used as a mixture of these products. Onion sticks have a high fat and carbohydrate content. *Rhizopora apiculata* mangrove fruit has not been widely used in Indonesia. So it is necessary to make processed food products that taste delicious and are nutritious and have added value for families around mangrove forests.

Figure 1. Mangrove type Rhizopora (Sofiyan, 2023)

2. METHODS

The equipment used in this research is a pH meter, analytical balance, oven, mesh filter, grinder, glassware for analysis such as beakers and volume pipettes. The materials used are mangrove fruit and other parts such as leaves and stems taken in the Ciku Nyinyi Mangrove forest, Sidodadi Village, Pesawaran Regency, Lampung Province (https://jadesta.kemenparekraf.go.id/desa/ekowisata_mangrove_cuku_nyinyi_1).

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The chemicals for analysis are HNO_3 p.a. (Merck), distilled water, chemicals for proximate testing and phytochemical testing. Whatman 42 filter paper and DPPH for antioxidant testing and chemicals for phytochemical testing were carried out at the Sumatra Biota Laboratory, Andalas University, West Sumatra.

This research was carried out in 3 (three) research steps, namely phytochemical testing, determining nutritional components using proximate tests and then testing for the manufacture of food products. The test was carried out by identifying compound components using qualitative tests to obtain information on what components are contained in the mangrove plant simplicia. Phytochemical analysis such as Alkaloids, Flavonoids, Phenolics, Tannins, Saponins, Steroids and Triterpenoids (Kasitowati *et al*., 2017). Analysis of components in food ingredients is carried out using chemical tests which include water content, ash content, fat content, protein content and is carried out according to AOAC (2015).

Material preparation includes for making mangrove flour were, first drying mangrove fruit material and other components such as leaves, fruit stems and wood will be dried with the aim of eliminating the wind so that the simplicia becomes dry. Then dried mangrove and simplicia fruit, each of which is then ground using a grinder machine. The last was sifting flour material is then filtered using an 80 mesh sieve.

3. RESULT AND DISCUSSION

Determination of the components of macro compounds in mangrove plants was carried out on 2 (two) types of mangroves that grow more frequently in the Cuku Nyinyi Ecotourism area, Sidodadi Village, Pesawaran Regency, Lampung Province. The types of mangroves are *Rhizophora apiculata* and *Rhizophora mucronata*. The results of this component testing are called proximate analysis which consists of determining the water content, ash content, protein content, fat content and crude fiber in food samples. Carbohydrate content is calculated differently from 100% of the total compound components. Data on Proximate analysis results of mangrove *Rhizophora mucronata* and *Rhizophora apiculata* fruits were in Table 1 and Table 2.

Table 1. Proximate analysis results of mangrove *Rhizophora mucronata* fruit

Samples	Water	Ash	Lipid	Protein	Fiber	Carbohydrat
			(%)			
Leave	69,24	3,96	0,45	9,97	6,44	16,39
Fruit bark	39,93	1,32	0,29	7,78	28,20	50,69
Filler fruit	64,99	3,61	0,31	8,11	12,49	22,95
Rind	69,41	3,43	0,84	8,17	6,10	18,15
Fruit stem	33,00	1,16	0,64	7,94	15,11	57,26

Table 2. Proximate analysis results of mangrove *Rhizophora apiculata* fruit

Samples	Water	Ash	Lipid	Protein	Fiber	Carbohydrat
			(%)			
Leave	68,56	3,75	0,91	9,13	5,11	17,65
Fruit bark	40,12	1,38	0,89	8,92	15,20	48,69
Filler fruit	64,25	3,25	0,74	10,67	1,74	21,10
Rind	66,84	2,76	1,56	8,51	7,27	20,33
Fruit stem	36,94	1,28	0,21	8,75	10,05	52,82

One alternative that can be used to utilize mangrove fruit is to process it into flour because its carbohydrate content is quite high. Apart from that, mangrove fruit flour can also be used as a substitute for wheat flour which is currently increasingly rare and expensive. Mangrove fruit flour can be processed into various products such as wet noodles, crackers, cakes, cendol and cookies. Cracker products generally have quite low fiber content. To increase the functional value of the product, it can be substituted with mangrove fruit flour. The substitution of mangrove fruit flour for cracker products is expected to provide functional value to the product because the fiber content of mangrove fruit is quite high.

Rhizophora mucronata is a species of the genus Rhizophora. This type of mangrove is quite often found in the Cuku Nyinyi area, Sidodadi Village, Pesawaran Regency, Lampung Province. The results of chemical testing of the contents of the R. Mucronata type mangrove fruit that have been carried out are water content 65%, ash content 3.64%, fat content 0.31%, protein content 8.11%, carbohydrate 22.95% and fiber content 12. 49 %. The nutritional content contained in this fruit can be used as a source of processed food. However, there is a problem faced by people in this area, namely limited knowledge regarding the use of mangrove fruit to make processed food products that can improve the community's economy.

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Phytochemical tests on parts of mangrove *Rhizophora mucronata* and *Rhizophora apiculata* fruits were in Table 3.

Table 3. Phytochemical tests on parts of mangrove

Samples	Alkaloid	Flavonoid	Fenolic	Saponin	Terpenoid	Steroid
Rhizophora mucronata						
Leave	-	+	+	+	+	+
Fruit bark	-	+	+	+	+	+
Filler fruit	-	+	+	+	+	+
Rind	-	+	+	+	+	+
Fruit stem	-	+	+	+	+	-
Rhizophora apiculata						
Leave	-	+	+	+	+	+
Fruit bark	-	+	+	-	+	+
Filler fruit	-	+	+	-	+	+
Rind	-	+	+	-	+	+
Fruit stem	-	+	+	+	+	+

Phytochemical tests for flavonoid compounds were tested for their presence using concentrated Mg and HCl. The addition of Mg and HCl was carried out on the powder, extract and each fraction of the stem, fruit, skin and contents of the mangrove plant, and a red color was formed, this shows that the sample contains flavonoids. According to Simes (1995) flavonoid compounds will be reduced with Mg and HCl to produce red, yellow or orange colors.

Phytochemical screening of the parts of the Mangrove plant types *Rhizophora mucronata* and *Rhizophora apiculata* in Table 3 provides information that almost all parts of the plant contain phytochemicals such as flavonoids, phenolics, saponins, terpenoids and steroids. The aim of the phytochemical test is to determine the presence of secondary metabolite compounds distributed in plant parts. This test succeeded in providing a description that mangrove plants have the potential to utilize their phytochemical compounds for certain purposes such as modification or substitution in food so that they have a function as functional food.

The alkaloid test showed negative results for both samples but did not give a reaction. It was concluded that the *Rhizophora mucronata* and *Rhizophora apiculata* samples did not contain alkaloid secondary metabolite compounds. Based on the alkaloid test carried out, mangrove plants were added with 2N H_2SO_4 and then heated in boiling water for 30 minutes. The addition of H_2SO_4 functions to form alkaloid salts, because alkaloids which are basic can dissolve in acidic solvents (Culvenor and Fitzgerald, 1963). The heating in the alkaloid test is quite long, namely 30 minutes, which aims to form a stable alkaloid salt. The filtrate obtained was then tested with Dragendroff, Mayer and Wagner reagents.

Saponin is a surface active compound that is easily detected through its ability to form foam. The glycosidic bond component contained in saponin causes this compound to tend to be polar (Simes, 1995). The presence of saponin was positive because the samples tested formed foam 1-10 cm high with an interval of ± 10 minutes. Saponin testing produces stable foam. The addition of HCl can make the foam more stable and stable. Saponin functions as a biological antioxidant that is beneficial for health. Saponin has the effect of showing leukemia, paralysis, asthma, rheumatism and anti-inflammatory activity (Bialangi, 2018). Saponin is a colloid that dissolves in water and foams after shaking, has a bitter taste. Saponin can destroy red blood cells (Banerjee and Mukherjee, 2008)

Based on Table 3, the saponin phytochemical test shows that the powder, extract from all samples 1, namely with sample *R mucronata* fruit contents, fruit shells, fruit sprout contents, fruit sprout shells, and leaves were containing saponin, its were indicated by the presence of a lot of foam so that it is saponin. Next, sample *R apiculata*, namely fruit contents, contains saponin with the formation of a lot of foam, while samples fruit shell, sprouts skin, sprouts do not foam so they do not contain saponins and fruit leaves foam so that saponin. The cookies product formulation experiment used wheat flour as the main ingredient of the product and was substituted by mangrove fruit flour.

Mangroves are typical plants that grow in coastal or coastal areas. Mangrove plants have quite high nutritional content, especially carbohydrate and fiber content in the fruit. The results of tests carried out on Rhizophora mucronata mangrove fruit obtained a fiber content of 12.49% and carbohydrate content of 22.94%. The utilization of mangrove fruit in the Cuku Nyinyi area, Sidodadi Village, Pesawaran Regency, Lampung Province as a processed product has not been carried out optimally. One alternative that can be used to utilize mangrove fruit is to process mangrove fruit into cracker products.

The addition of 10% mangrove flour to the mangrove stick formulation can affect the color and texture sensory attributes of mangrove stick products, but has no effect on the taste sensory attributes. In the mangrove stick

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product with the addition of 10% mangrove flour, the water content was 3.71%, the ash content was 2.36%, the protein content was 8.09%, the fat content was 25.97%, and the crude fiber were 2.93% and carbohydrates by 60.71%. There are several types of dry cakes that can be tested with the addition of mangrove flour. Based on the characteristics of mangrove flour, it can be concluded that there are 4 (four) types of dry cakes that can produce product quality that meets standards, namely pineapple dry cakes, peanut cakes and cheese rings (Figure 2).

Figure 2. Cookies from mangrove flour

4. CONCLUSION

Chemical content test results of proximate analysis of mangrove fruit *Rhizopora apiculata* and *Rhizophora mucronata* for water content; ash content; total fat content; protein content; and carbohydrates each one were 64,99; 3,61;8,11; 0,31; 12,49; 22,95 (%) and 64,25; 3,25; 10,67; 0,74; 1,74, 21,10 (%). The aim of the phytochemical test is to determine the presence of secondary metabolite compounds distributed in plant parts. The results of phytochemical testing and proximate analysis mean exploring the potential of Mangrove fruit as a raw material for food products. Rhizopora mangrove fruit can be processed into flour and used as a substitute for dry cake products such as cookies and crackers and sticks. Mangrove fruit flour of the Rhizopora type has good nutritional content so it is recommended as a food ingredient.

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