Journal

Original Research Article

https://doi.org/10.62142/t1hm0x58

Ethnobotanical Analysis of Mangroves as Food Resources in East Lampung

Received: 05 May 2024
Accepted: 27 June 2024
Published: 30 June 2024

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The world is experiencing a food crisis due to climate change, and mangroves as a blue ecosystem have a significant potential to mitigate this crisis. This research seeks to record the ethnobotanical practices of utilising mangroves, as a food source in East Lampung. We employed the snowball sampling method in Margasari village, Purwerejo village, and Karya Makmur village. In addition, we gathered data on mangrove species, parts of used, processing methods, products, and their properties, through interviews and observations. Also, we analysed the data using descriptive analysis to provide a comprehensive overview of the varieties of mangroves, their processing, and the resulting products. This research revealed that the communities employs five distinct varieties of mangroves as sustenance sources. Mangroves produce various food products from their four components: fruit, juvenile leaves, old leaves, and propagules. Notably, processed products, including pidada fruit (*Sonneratia caseolaris*), are anti-hypertensive, canker sores, and heartburn treatments. Jeruju leaves (*Acanthus ilicifolius*) are known to improve stamina, and seeds without the root of *Rhizophora mucronata propagules* act as anti-gastritis agents, improve blood circulation, and prevent anaemia. Although there are ten processed mangrove products, they are still considered traditional and are not as popular among the newer generation.

Keywords: Food crisis, Climate Change, Ethonobotany, Mangrove, Traditional food, Blue Ecosystem

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1. Introduction

The world is currently experiencing a food crisis that has raised concerns for many parties (Sibuea et al., 2022). A food crisis is a condition where a country is unable to meet the food needs of its population (Venny, 2023). The food crisis occurs due to changes in climate behavior patterns over a long period of time, in addition, the triggering factors for the food crisis are population size, conversion of agricultural land functions, and difficulty in food distribution (Mudrieq, 2014; Yudhistira et al., 2024). One of the great potentials to overcome the food crisis is to utilize the potential of the blue ecosystem. The impact of climate change is closely related to the food system and food security (Lasminingrat and Efriza, 2020). These impacts can cause a potential decline in agricultural production to crop failure, crop failure, and reduced agricultural land area (Ruminta and Nurmala, 2018). Population growth can cause a food crisis due to the increasing demand for food (Mudrieq, 2014). Related to population growth, conversion of agricultural land can also cause a food crisis due to increased demand for food supplies (Prihati, 2015). Yudhistira et al. (2024) reported the impact of the difficulty of food distribution in a country due to high food export prices can cause a national food crisis. One effort to overcome the food crisis due to climate change is to optimize the blue ecosystem. This idea makes the sea and coastal areas the center for developing sustainable economic activities and ecosystems (Banu, 2020).

Blue ecosystem is an ecosystem that includes water areas of lakes, swamps, seas, coasts, and their habitats. Blue ecosystem has high potential to be

used as a food source, both from marine fisheries resources and mangrove forests (Turisno et al., 2018). Sabet and Ari, (2022) stated that blue ecosystem can provide high economic value ecosystem services that can be a source of food, one of which is from coastal mangrove forests. Mangrove forests can be a potential food source, where parts of the mangrove plant can be processed into food (Lestariningsih et al., 2021).

Mangroves have great potential to be used as a food source (Naibaho et al., 2023). Research conducted by the Directorate of Coastal and Small Island Utilization stated that the area of mangroves in Indonesia reaches 3,490,000 Ha or 21% of the total mangroves in the world (Damsir et al., 2023). Studies related to the use of mangroves as food have been widely reported in Indonesia. Diana et al. (2022) reported that people in Kutai Kartanegara Regency *use Bruguiera gymnorhiza* fruit as sweets, *putri salju* cakes, and mangrove sticks. Another study explained that people in Karangan Regency use mangrove fruit to be processed into coffee, dodol, syrup, chips, and soap (Sam'un et al., 2023). However, the use of mangroves as food in East Lampung Regency is still very limited. Herwanti, (2016) reported that people in East Lampung Regency develop pidada fruit as syrup to improve the economy. However, the utilization of mangroves as *ethnobotany* for food has not been carried out. Therefore, it is necessary to conduct research on the use of mangroves as food ingredients, specifically in Margasari Village, Purwerejo Village and Karya Makmur Village. Research on the use of mangroves as a food source is important. The use of mangroves as a food source in Indonesia is relevant to developing countries and maritime countries. Coastal communities are still included in the low economic group (Minsas et al., 2023; Indriyani et al., 2024). This is because the economy of coastal communities is mostly dependent on marine products such as fishing, shrimp and other marine biota (Siregar et al., 2024). Coastal communities have the advantage of utilizing mangroves as a food source to support national food security (Wibowo and Untari, 2023). Promoting mangroves as a food source has a very strategic value in blue ecosystem conservation. With the use of mangroves as food ingredients, it can encourage people to participate in mangrove conservation activities (Lestariningsih et al., 2021). This study aims to document *ethnobotanical* practices of mangrove utilization as a food source in East Lampung.

2. Method

1) Research Area

The study was conducted in March-June 2024 in Margasari Village, Labuhan Maringgai District, Purworejo Village and Karya Makmur Village, Pasir Sakti District, East Lampung Regency. The geographical position of the study location is at 5°15'60.0"S - 5°32'20.21"S and 105°50'42.8"E - 105°48'35.1324" E.

2) Sampling Method

Sampling was done using the snowball sampling method. This method was chosen because based on initial observations it was indicated that the use of mangroves as food had been largely abandoned by the community and was only used by certain groups. Therefore, to obtain all the knowledge that exists in the community, the snowball sampling technique is the most appropriate technique. The use of the snowball sampling technique was chosen because the use of probability sampling techniques cannot capture all the rare information known by the community. Therefore, to find out overall information related to the use of mangroves as food ethnobotanically by the community, the snowball sampling technique can be used.

3) Data Collecting

The data collected are the types of mangrove plants, the parts of the plant used, how to process them, the products produced and the benefits obtained. Data collection was carried out using interview, and observation techniques. The data collection was carried out through direct interview techniques with the community using or practicing the use of mangroves as medicinal plants directly using open questions, but still focusing on information on the use of mangroves as a food source. Then we observe how the community uses mangrove plants as a food source, then the processes carried out by the community in utilising, and using mangroves as a food source were documented in the form of a descriptive manuscript on the use of mangroves as food in East Lampung Regency.

4) Data Analysis

The research data were analyzed using descriptive analytical methods to describe the types of mangroves, processes and products of mangrove processing as a food source ethnobotanically.

3. Result and Discussion

Based on the research results, 5 types of mangroves were obtained that can be used as food sources in East Lampung, namely Pidada (*Sonneratia caseolaris*), White api-api (*Avicennia marina*), Jeruju (*Acanthus ilicifolius*), *Rhizophora mucronata*, and *Bruguiera gymnorrhiza*. Types of mangroves, parts of mangrove plants, processing methods, food product results, and food properties from mangrove plants are completely presented in Table 1.

Ethnobotanically, the use of mangroves as a food source has been practiced by the people in East Lampung Regency. This indicates that culturally, the community has known and used mangroves as a food source for generations. This practice illustrates local knowledge that has been passed down from generation to generation by the people in East Lampung Regency.

Table 1. Types of mangroves, parts of mangrove plants, processing methods, food products, and food properties from mangrove plants.

No.	Plants	Part of Plant	How to process	Product	Benefit
1.	Pidada *(Sonneratia caseolaris)*	Fruit	Ripe pidada fruit is washed until clean. Then, the fruit is crushed to get the juice. The juice is filtered and cooked until boiling. Water, rosella flower juice, and sugar are added. The ingredients are cooked until cooked.	Syrup	Canker sores, feverish, and antihypertension
		Fruit	Ripe pidada fruit is washed until clean. Then, the pidada fruit is crushed to get the juice. Granulated sugar, glutinous rice flour, coconut, pidada fruit flesh that has been separated from the seeds and water and butter are added. The mixed ingredients are cooked until they become jenang/dodol.	Jenang/ dodol	
		Fruit	Ripe pidada fruit is washed until clean. Then, the fruit is crushed to get the juice. The juice and sugar are mixed and cooked until they become jam.	Jam	
2.	Api-api putih *(Avicennia marina)*	Juvenile leaves	Juvenile api-api leaves are washed until clean. Api-api leaves can be eaten directly. In addition to being eaten directly, api-api leaves are boiled and then used as boiled vegetables. Api-api fruit is washed until clean. Api-api fruit is soaked until the skin opens/peels off. Api-api fruit is soaked again until it produces foam, then the fruit is washed until clean and steamed. After that, the fruit is dried in the sun until dry and then washed and fermented using yeast. To produce tempeh, the fermentation process is waited for 2-3 days until it becomes tempeh.	Fresh vegetable side dishes	
		Fruit	Young api-api leaves are washed until clean. Api-api leaves can be eaten directly. In addition to being eaten directly, api-api leaves are boiled and then used as boiled vegetables. Api-api fruit is washed until clean. Api-api fruit is soaked until the skin opens/peels off. Api-api fruit is soaked again until it produces foam, then the fruit is washed until clean and steamed. After that, the fruit is dried in the sun until dry and then washed and fermented using yeast. To produce tempeh, the fermentation process is waited for 2-3 days until it becomes tempeh.	Tempeh	
3.	Jeruju *(Acanthus ilicifolius)*	Leaf	Jeruju leaves are washed until clean, then blended. Then flour, shallots, garlic, pepper, salt, peanuts/rebon and sufficient water are added. All ingredients are mixed with the blended jeruju leaves. The mixture of ingredients is fried until cooked.	Indonesian crispy peanut crackers	

No.	Plants	Part of Plant	How to process	Product	Benefit
		Leaf	Jeruju leaves are washed until clean, then cut into small pieces. The cut leaves are dried in the sun until dry, and the tea is ready to be brewed.	Tea	Energy booster
		Leaf	Jeruju leaves are washed until clean. Then flour, salt, pepper, garlic, shallots and water are mixed until evenly distributed. The mixed dough is fried until cooked.	Fried Jeruju	
4.	*Rhizohpora mucronata*	Propagules without roots	The propagules are washed until clean, then cut into small pieces. The material is dried in the sun until dry, then the propagules are roasted. After roasting, the propagules are ground until smooth. The coffee powder is ready to be brewed	Propagul coffee	Anti-gastritis, improves blood circulation, and prevents anemia.
5.	*Bruguiera gymnorrhiza*	Propagul	The propagules are washed until clean, then the thick skin of the propagules is opened. The propagules are cut into pieces and washed again. The propagules are steamed until cooked.	Steamed Propagul	

Mangroves are not only used as coastal abrasion prevention plants, but can also be used as a food source by the people of East Lampung. Based on Table 1, it is known that there are 5 mangrove species used as a food source by the people in East Lampung which are spread across three villages, namely Margasari Village, Purworejo Village, and Karya Makmur Village. The use of mangroves in East Lampung is still very small because based on the report of Rodiani et al. (2023) there are 23 types of mangroves found in East Lampung Regency. The use of mangrove species as food in East Lampung is also lower than the report of Diana et al. (2022) which states that the community in Kutai Kertanegara utilizes 6 types of mangroves, namely *Avicennia alba, Rhizophora mucronata, Rhizophora mucronata, Bruguiera gymnorrhiza, Sonneratia alba, and Sonneratia ovata* as food ingredients. Likewise, the community in Siduarjo Regency has utilized 8 types of mangroves, namely *Avicennia officinalis, Avicennia marina, Bruguiera gymnorrhiza, Rhizophora stylosa Griff, Nypa fruticans, Sonneratia alba, Sonneratia caseolaris, and Sonneratia ovata* as food ingredients (Handayani, 2019). The low number of types of mangroves used as food sources in East Lampung Regency is thought to be related to the low level of education of the people in the area. In line with Lilis' report, (2020) that the level of adoption of farmer innovations can be influenced by the level of education. Likewise, Rosyida et al. (2021) reported that low education levels will be seen significantly with the level of innovation adoption, meaning that the lower a person's education level, the more difficult it is to carry out the innovation adoption process. Based on data from the Ministry of Education, it is known that most of the population of East Lampung is still studying at the elementary school level, which is 64.17%. So the innovation of the East Lampung community is thought to be low because most of the community is still in elementary school. In addition, the low utilization of mangroves as medicine is also influenced by ethnicity. Based on research conducted by Lestari et al. (2021), Javanese people often use herbal plants as herbal medicine compared to the Balinese and Mongondow tribes.

The results of this study showed that the people of East Lampung utilize 4 parts of mangroves as food ingredients, namely fruit, young leaves, old leaves, and propagules, all four parts of the mangrove are used by the people of the three research villages. This finding shows that the use of plant parts in the East Lampung region is still relatively small, because in fact there are other parts that have the potential to be used as food sources. Based on the report of Ridlo et al. (2017) the people of Tugurejo, Semarang utilize 5 parts of the mangrove, namely leaves, stems, bark, fruit and roots as food ingredients. However, the utilization of mangrove plant parts by the people of East Lampung is higher than that of the people in Siduarjo Regency who only utilize 2 parts of the plant, namely fruit and leaves (Handayani, 2019). This shows that the utilization of mangroves as a food source by the people of East Lampung is not as good as in Tugurejo Regency, but this utilization is quite good because in some areas the utilization of mangroves as a food source is still lower. The results of the study showed that in addition to being used as a source of nutrition, mangrove plants also have health benefits that are believed by the community or known as functional food. Functional food is food that naturally and has undergone a processing process has physiological compounds that are beneficial to health (Herlina and Nuraeni, 2014; Yulia, 2022). In the three research locations, namely Margasari Village, Purworejo

Village, and Karya Makmur Village, 3 types of mangroves were found that act as functional foods, namely pidada fruit (*Sonneratia caseolaris*) as a medicine for mouth ulcers, internal heat, and antihypertension, jeruju leaves (*Acanthus ilicifolius*) as a stamina enhancer, and seeds without *Rhizophora mucronata* propagules as antigastritis, blood circulation enhancer, and anemia. The use of pidada fruit (*Sonneratia caseolaris*) as a functional food that is effective as an antihypertension has great potential to be developed in the future. This is because hypertension is currently the number one deadly disease in the world that can attack anyone (Setyaningrum and Suib, 2019). In addition, *Rhizophora mucronata* rootless seeds processed into tea are efficacious as anti-gastritis which can reduce digestive tract disorders (Adini and Rahman, 2022). Referring to the various benefits obtained from mangroves, the development of mangrove processing as a source of functional food has good opportunities in the future. The results of the study showed that there were 10 types of processed foods sourced from mangrove plants, this indicates that processed mangrove products in East Lampung are quite diverse. However, the types of processed products produced are still classified as traditional processed foods and are less popular among the younger generation. In fact, processed mangroves can be created into modern food products, as reported by Utami et al. (2021) that in Pasuruan Regency, West Java, *Rhizophora mucronata* fruit can be processed into flour which is used as a raw material for making ice cream. Meanwhile, people in North Minahasa Regency utilize *Bruguiera gymorhizza* fruit to be processed into flour which is used as an ingredient for making mangrove sticks (Massie et al., 2020). The development of modern processed mangrove products can increase promotion among the younger generation. This can increase the popularity of processed mangrove products and increase demand, thereby providing economic benefits to the community. Increasing the economy that comes from mangrove plants can encourage people to participate in mangrove conservation efforts.

4. Conclusion

There are 5 types of mangroves that are used as a food source by the people of East Lampung, namely Pidada (*Soneratia caseolaris*), White api-api (*Avicennia marina*), Jeruju (*Acanthus ilicifoliu*), *Rhozohpora mucronata,* and *Bruguiera gymnorrhiza,* which three types of mangroves were found spread across the three research villages. There are 4 parts of the mangrove that are used as a food source, namely fruit, young leaves, old leaves, and propagules. From various products produced from processed mangroves, 3 types of mangroves were found to have health benefits or can be called functional foods, namely pidada fruit (*Soneratia caseolaris*) as a medicine for mouth ulcers, internal heat, and antihypertension, jeruju leaves (*Acanthus ilicifolius*) as a stamina enhancer, and seeds without *Rhizophora mucronata* propagules as antigastric, blood circulation stimulants, and minimizes symptoms of anemia, the three types of mangroves used as functional foods are used by the community in the research village. There are 10 types of processed foods sourced from mangrove plants, but the processed products produced are still classified as traditional processed foods that are less popular among the younger generation. Furthermore, to find out whether mangroves have health benefits or as functional foods, profiling of bioactive compounds contained in mangrove plants is needed. Therefore, for further research, it is necessary to conduct a profiling test of bioactive compounds contained in processed mangrove plant foods. However, this research is only limited to knowing the function of mangroves as food through interviews and literature studies. To find out whether mangroves have health benefits or as functional food, profiling of bioactive compounds contained in mangrove plants is needed. Therefore, for further research, it is necessary to conduct a profiling test of bioactive compounds contained in processed mangrove plant foods.

5. Author Contributions

The first author's contribution was as a compiler and analysis of scientific data based on research data in the field, collecting data in the field and collecting secondary data. The second author contributed to helping formulate the problem and research methodology. The third author's contribution helped in checking the writing and collecting secondary data

6. Completing Interests

The writing of this scientific article was prepared based on the results of joint research, where all authors were involved together and there was no conflict of interest because this research was jointly responsible.

7. Acknowledgements

The author would like to thank Duryat, S.Hut., M.Si. for his assistance in guiding, improving, and compiling this article, the author would like to thank Dr. Melya Riniarti, S.P., M.Si. who helped check the writing, and the author would like to thank Melviani, Syari Mela Simanjuntak, and Daffa Naufal who helped in collecting data for this article.

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How to cite this article:

Mustika Wati, D., Duryat, D., & Riniarti, M. (2024). Ethnobotanical Analysis of Mangroves as Food Resources in East Lampung. *Jurnal Wasian*, *11*(1), 20-26. https://doi.org/10.62142/t1hm0x58

Endnote/Zotero/Mandeley(RIS) BibTex