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Research Article

Macroalgae as a source of food and health for coastal communities in Maluku Province

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ABSTRACT

Macroalgae have an important role in the lives of coastal communities as nutritious food and have ecological and biological functions in maintaining the stability of the marine ecosystem and as place to live and protect other marine creatures. To find out macroalgae as a source of food and health, study was carried out using a survey and experimental research in the laboratory of the Faculty of Mathematics, Natural Sciences Pattimura University. Survey of people who consume macroalgae in several districts of Maluku Province. The rsults show that the types of macroalgae consumed by the community's, namely *E conttonii, G salicornia, C lentillifera, K alvarezii,* and *G arcuate*. The highest carbohydrate content founded in *G arcuata* (2.1370%), the highest proteins content in *E conttonii* (0.9161%), the highest fat content in *Kalvarezii* type at 0.4053%, the highest ash content in *E conttonii* (5.8155%). The highest water content contained in *C lentillifera* (93.5485%). There is a linear correlation between the knowledge of coastal communities in several districts of Maluku Province who consume macroalgae as a source of food and health, and the attitude of coastal communities towards cooking menus made from macroalgae.

INTRODUCTION

Sustainable development in Maluku Province cannot be separated from empowering natural resources in coastal and marine waters for the welfare of the community. Rudiyanto (2020) explains that the potential of aquatic resources has not been fully utilized for sustainable development, and has not fully paid attention to aspects of community welfare, which can result in inequality in understanding the management of coastal and marine water resources properly. One of the potential natural resources of coastal waters in Maluku Province is macroalgae. Pakidi and Suwoyo (2017) stated that Maluku Province has approximately 555 types of 8,642 species of macroalgae or seaweed which are found as germplasm resources, and the total macroalgae biodiversity is 6.42% in the coastal waters of Maluku Province. There are various types of macroalgae found in coastal waters in several

districts of Maluku Province. Rugebregt et al. (2021) explained the red macroalgae (Rhodophyceae) occupy the highest order in coastal water with around 452 spesies, green macroalgae (Chlorophyceae) around 196 types or species and brown macroalgae (Phaeophyceae) has about 134 species. These various types of macroalgae have an ecological and biological role in maintaining the stability of marine ecosystems and as a place to live and protect other biota. This group of macroalgae has economic potential, namely as food, raw materials in industry and health.

Several species of macroalgae have an important role in the lives of coastal communities, either as a source of food for families, as a source of health, as raw materials for the medicine industry or pharmaceutical industry. Lokolo (2019) explained that the number of macroalgae species in several locations in Moluccas, especially on Ambon Island. Approximately 40% of the total species of macroalgae were found, where people in this area have understood that macroalgae is not only used as food, but can be used to increase people's income through macroalgae cultivation activities. According to Kuswandono (2020) that macroalgae is a potential natural resource in coastal waters with high diversity, can provide benefits for humans by 70% as a food ingredient and raw material for medicines as well as providing a source of food and health for communities in coastal areas, they are aware that the nutritional content contained in macroalgae has properties for the health of the human body.

The use of macroalgae as a source of nutritious and healthy food has long been carried out by people in various districts of Maluku Province, because they have acquired knowledge about macroalgae from generation to generation from their families, for example as vegetables, as well as making jelly cakes and other macroalgae food menus. Domu and Meiyasa (2023) that exploration of various types of macrolagae regarding the composition of chemical compounds as a food source has been carried out for a long time, but is still limited to one family as healthy food. Harwindito et al. (2021), that healthy food is food that is free from dangerous ingredients and contains nutrients and is beneficial for human health. Healthy food is dominated by organic ingredients, such as carbohydrates, proteins, fat, vitamins. There is a desire of coastal communities to consume macroalgae in order to obtain nutritional content for each family. The existence of awareness of consuming macroalgae is thought to be the knowledge and attitude of the community regarding the importance of health for every family that needs to be maintained.

The results of various studies on the potential of coastal waters, especially macrolagae, provide an illustration of the existence of various chemical compounds that are very good for consumption for health. Setyorini and Puspitasari (2021) explained that the main components in mocroalgae are carbohydrate and protein which has and important role for human health. As explained by Rosemary et al. (2019) that proteins derived from macroalgae have antibacterial, antioxidant, immunostimulating, anti-thrombotic and anti-inflammatory activities. According to Yudiati et al. (2020), that macroalgae of the Chllorophyceae and Rhodophycea classes contain substances that can be added to fresh food to control blood glucose levels for diabetes sufferers and macroalgae are also known to have potential in the blood clotting sistem antioxidant, anticancer, immunomodulatory and antilipidemic activity. A persons health is of course related to what they eat, so as people become more aware of consuming health food and avoiding eating patterns that cause problems with their bodies, people must choose a menu of dishes that are health and easy to obtainin its environment.

Irawan et al. (2022) argued that to fulfill life's need for food, eat healthy food, because consuming food not only fulfills hunger, but also fulfills the need for substances that our body needs. This requires knowledge and understanding about health for the body. In this way, macroalgae as a source of food and health can be easily obtained by coastal communities to meet their food needs because various types of macroalgae can be found in every coastal water environment.

Consuming makroalgae as healthy food not only improves physical health but can also influence mood, because healthy food can increase the bodys endurance due to the presence of nutrients in macroalgae that the body need. Damongilala (2021), knowledge about food related to nutrition derived from marine products is closely related to health, so it is necessary for every person who consumes it to understand the importance of the substance contained in a food ingredient. An ingredient can be called a food ingredient if it meets special requirements, including: high nutritional value, meets consumer tastes, is safe and healthy for consumption. Thus, a study of the nutritional content through proximate tests, especially carbohydrate content, protein content, fat content, water content and ash content in various of macroalgae as a source of food and health, is very necessary, so that all levels of society in this region can understand food sources. Nutritious food that comes from natural resources in coastal waters, apart from that, information is needed that is truly appropriate to the lives of coastal communities, especially the knowledge and attitudes of coastal communities regarding the use of macroalgae as a source of food and health. Apart from that, a study of the relationship or influence between people's knowledge and attitudes towards macroalgae as a source of food and health as well as people's attitudes towards food menus made from macroalgae is very necessary in developing diversification of food types from natural aquatic resources for people in this area.

METHODS

This research is a combination of descriptive. The survey was carried out on community who consume macroalgae from Central Maluku Regence, Southeast Maluku Regence, East Seram Regency Maluku Province,as well as testing the nutritional content of macroalgae through proximate analysis in the Laboratory of the Faculty of Mathematics Natural Sciences Pattimura University.

People who consume macroalgae as well as a laboratory analysis of the types of macroalgae consumed by community in several districts of Maluku Province. To obtain accurate data, a procedur is needed, namely:

1. Making a map of macroalgae sampling locations and distributing questionarires to community in the Maluku Province area.
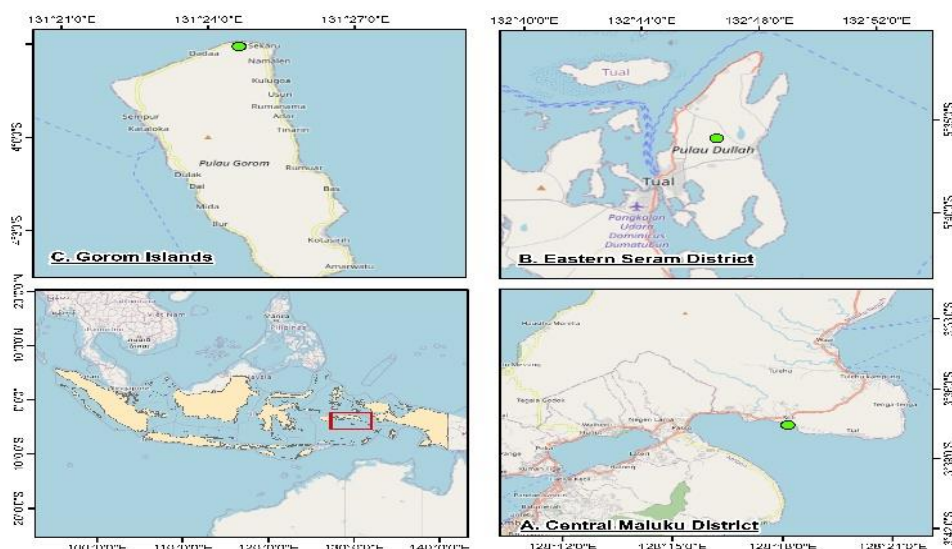

Figure 1. Map of macroalgae sampling locations and distribution of questionnaires to the community in the Districts of Maluku Province. A. Ambon Island, Central Maluku Regency; B. Dulla Island, Southeast Maluku Regency; C Gorom Island, East Seram Regency

2. Administring questionnaires to 45 people as respondents in Maluku Province who came from the district, namely Dulla Vilage, Dulla Island, Southeast Maluku Regency; Suli Village, Ambon Island Central Maluku Regence; Sekura Village Gorom Island East Seram Regency.
3. Taking macroalgae for testing for nutritional content in the Laboratory of the Faculty of Mathematic and Natural Science Pattimura University though a proximate test in accordance with *Association of Official Analytical Chemist* [AOAC](2005) on carbohydrate content, protein content, fat content, ash content, water content.
4. The questionnaire contains 10 questions consisting of 5 questions about community knowledge about macroalgae as a source of food and health and 5 questions about community attitudes towards types of macroalgae as a cooking menu. Knowledge and attitude questions can be described in Table 1.

Table 1. Of knowledge questions and attitude questions and respondent answers

Knowledge Questions	Respondents Answer		Attitude Questions	Respondents Answer	
	Right	Wrong		Yes	No
Is your knowledge about macroalgae as a source of food and health acquired through your family from generation to generation?	Right	Wrong	I really like the menu made from macroalgae that my family serves in the form of vegetables or raw vegetables	Yes	No
Can macrolaga be used as food in the form of vegetables and can also be processed into various nutritious food menus?	Right	Wrong	My family takes macroalgae to consume when the sea water recedes, without being asked I will help take the macroalgae	Yes	No
Can damage to macroalgae habitation can occur due to the removal of rock and sand material from coastal waters?	Right	Wrong	People who destroy macroalaga habitation will reprimand and scold them	Yes	No

| Various research results have proven that macrolaga is very good for health and is used as medicine | Right | Wrong | The macroalgae dish has a distinctive aroma and I still like it | Yes | No |
| Why do you get food sources of nutrition (carbohydrates, fats, proteins) minerals and water can be obtained through food derived from macroalgae | Right | Wrong | The places where macroalgae live in the coastal waters in my village need to be protected by village regulations | Yes | No |

5. After all the data was obtained, an analysis was carried out according to the problems raised, the data from the proximate macroalge test results were analyzed using descriptive statistics, and questionnaire in the form of knowledge and attitudes were assessed according to the scores obtained by each respondent and analyzed inferential statistics to determine the relationship using linear regression and influence using anova using the SPSS 20 programme.

RESULTS AND DISCUSSION
Results

Based on the results of a survey of 5 types macroalga consumed by community ini several districs of Maluku Province, namely *Eucheuma conttonii*, *Caulerpa lentillifera, Kappaphycus alvarezii, Gracilaria salicornia,* dan *Gracilaria arcuate*, as seen in Figure 2.

Eucheuma conttonii   *Gracilaria salicornia*   *Caulerpa lentillifera*

Kappaphycus alvarezii   *Gracilaria arcuate*

Figure 2. Macroalgae consumed by community of Maluku Province

Macroalgae *E conttonii*, *C lentillifera, K alvarezii* found in the coastal waters of the Sekura Village, East Seram Regency and type of macroalga *G salicornia* an *G arcuate* found in the coastal waters of Suli Village Central Maluku Regency, as well as macroalgae *C lentillifera, K alvarezii* found in the coastal waters of Dulla village Southeast Maluku Regency. From the results of observations, it turns out the there are similar types of macroalgae found in East Seram Regency and Southeast Maluku Regency, namely the type of maroalgae *C lentillifera* and *K alvarezii*

Coastal community consume the same types of macroalgae in Central Maluku Regency as the macroalgae consumed by community in East Seram Regency, especially the types *E conttonii, C lentillifera, and K alvarezii*, while community in Central Maluku Regency, especially in Suli Village, consume macroalgae types *G salicornia* and *G arcuate*. There are similarities and differences between people consuming types of macroalgae due to the presence of macroalgae types in coastal waters. Types of macroalgae found in the coastal waters of Central Maluku Regency, Ambon Island, especially Harie Hamlet in Suli Village, in every coastal water substrate, the macroalgae *G salicornia and G arcuate* were found. Meanwhile, in the coastal waters of Central Maluku Regency and East Seram Regency, macroalgae species *C lentillifera* and *K alvarezii* have been found which have been cultivated by the community, not only for consumption but also for sale to increase family income.

Based on the result of the identification of macroalgae consumed by the community as a source of food and health, it turns out that their taxonomi position is described in Table 2.

Table 2. Types of macroalgae the people conseme as a source of food and health

Class	Order	Family	Genus	Species
Rhodophycea	*Gigartinales*	*Solieriaceae*	*Eucheuma*	*Eucheuma conttonii*
Rhodophyceae	*Gracilariales*	*Gracilariaceae*	*Gracilaria*	*Gracilaria salicornia*
Chrorophyiceae	*Caulepales*	*Caulerpaceae*	*Caulerpa*	*Caulerpa lentillifera*
Rhodophyceae	*Gigartinales*	*Solieracea*	*Kappaphycus*	*Kappaphycus alvarezii*
Rhodophyceae	*Gracilariales*	*Gracilariaceae*	*Gracilaria*	*Gracilaria arcuata*

Based on Table 2, it can be explained that there are 2 class of macroalgae namely Rhodophyveae and Chlorophyceae, there are also 3 orders namely *Gigartinales, Gracilariales, Caulepales*, there are 3 families namely Solieriaceae, Gracilariaceae, Caulerpaceae, there are also 4 genera namely *Eucheuma, Gracilaria, Caulerpa, Kappaphycus*, and there are 5 species, namely *E conttonii, C lentillifera, K alvarezii, G salicornia,* dan *G arcuate*.

The results of proximate content is performed in Table 3. The highest carbohydrate content was in the macroalgae *G. salicornia* at 2.137% and the lowest is *K. alvarezii* at 0.406%. Next, the highest proteins content in the macroalgae *E. conttonii* is 0.916%, followed by the respective macroalgae *C. lentillifera* proteins content of 0.837%, *K .alvarezii* proteins content of 0.705%, *G arcuate* of 0.686% and proteins content the lowest was the macroalga *G. salicornia* 0.608%. The highest fat content is *K. alvarezii* type at 0.405%, followed by the macroalgae *E. conttonii* at 0.352%, *G. arcuate* at 0.218%, and *G. salicornia* at 0.209%, and the highest water content contained in various types of macrolagae is *C. lentillifera* at 93.548%, then *E. conttonii* at 92.331%, *G. salicornia* at 91.2438%, *G. arcuate* at 90.706% and the lowest water content is *K. alvarezii* at 90.621%. The highest ash content in macroalgae was *E. conttonii* at 5.815%, *G. salicornia* at 5.534%, *G. arcuate* at 5.517%, *K. alvarezii* at 5.472%, and the lowest ash content at *C. lentillifera* at 4.646%.

Table 3. Results of proximate analysis of the macrolagae consumed by community in Maluku Province

No	Macroalgae species name	Proximate Analysis				
		Carbohydrate (%)	Protein (%)	Fat (%)	Ash (%)	Water (%)
1	*Caulerpa lentillifera*	0,678	0.837	0.161	4,646	93.548
2	*Gracilaria arcuata*	1.856	0,686	0.218	5.517	90.706
3	*Eucheuma conttonii*	0.532	0,916	0.352	5,815	92.331
4	*Gracilaria salicornia*	2.137	0,608	0.209	5.534	91.243
5	*Kappaphycus alvarezii*	0.406	0,705	0.405	5.472	90.621

The macroalgae *C. lentillifera*, has thalus with round, creeping branches and grape-like branches, visible on all parts of the branches which are tightly closed, the blade shape is round, the number of ramuli is 15-30, with a diameter ranging from 0.90 to 1.27 mm, a dark green color. Its habitat is between the intertidal and subtidal zones, especially in areas that are not undulating, this can be seen in the cultivation of *C. lentillifera* by people in Dulla Village, Central Maluku Regency and East Seram Regency, Sekura Village, Gorom Island. The macroalgae *C. lentillifera* grows on sandy, gravel substrates such as coral rubble in the intertidal and subtidal zones. The results of research by Ines Septiyaningrum et al. (2020) show that the macroalgae *C. lentillifera* has thalus with round, creeping branches and grape-like branches, the branches close tightly and the thalus is thick, the blade shape is round, the number of ramuli is 17-31, with a diameter of 1.26 mm.

Communities in the coastal areas of Central Maluku Regency and Communities in Eastern Seram Regency have used the macroalgae *C. lentillifera* as a food ingredient by cooking it or eating it raw as fresh vegetables, anointing or as a vegetable. Septiyaningrum et al. (2020) explained that the macroalgae *C. lentillifera* or sea grape is an edible green macroalgae and has bioactive substances such as anti-bacterial, anti-fungal, anti-tumor and can used to treat high blood pressure and goiter. Ulfa et al. (2024) explained that *C. lentillifera* has quite high nutritional content as a source of vegetable protein, minerals and vitamins that are different from land plants. This is in accordance with the results of proximate analysis on the macrolagae *C. lentillifera* showing carbohydrate content, carbohydrate content of 0.678% of the sample weight of 1.1493 g, proteins content of 0.837% of the sample weight of 1.2017 g, fat content of 0.161% of sample weight 17.4129 g, water content 93.548% from sample weight 6.3079 g, ash content 4.646% from sample weight 3.41 g. This is not much different from the research results of Santika et al. (2021) that *C. lentillifera* has a carbohydrate content of 0.16% with a sample weight of 2.63 g, a protein content of 0.02% with a west of 1.04 g, a fat content of 0.01% with a sample weight of 0.54 g, water content 92.38% from a sample weight of 5.8402 g, ash content 0.009 from 3.41 g.

The macrologae *G. salicornia* found in the coastal waters of Suli Village, Ambon Island, Central Maluku Regency has morphological characteristics, namely a cylindrical or flattened thallus shape with branches ranging

from simple to the most complex and lush, above the branches the thallus shape is generally somewhat smaller, the surface is smooth or nodules. Thallus diameter ranges from 0.45-1.80 mm, length can reach 10-20 cm or more, grows in the intertidal zone of dead coral or coral gravel substrates. Macrolagae *G. salicornia* can be eaten by communities in Central Maluku Regency in the form of vegetables or fresh vegetables. Chairudin et al. (2023) that based on the characteristics of *G. salicornia*, it is a red macroalgae (Rhodophyta) with branching and dense thalus, this macroalgae is used as a source for making agar in the food industry. The results of proximate analysis on the macroalgae *G. salicornia* showed that carbohydrate content was 0.608% of the sample weight of 1.2843 g, protein content was 0.608% of the sample weight of 1.2843 g, fat content was 0.209% of the sample weight of 15.4819 g, water content was 91.243% from a sample weight of 3.4296 g, ash content was 5.534% of a sample weight of 3.4296 g. The nutritional content of this macroalgae is in accordance with the explanation of Yudiati et al. (2020), that *G. salicornia* has carbohydrate levels close to the same as other Gracilaria Genus, where the carbohydrate content is 0.63%, proteins content is 0.27%, fat content is 0.19% , water content 31.4% and ash content 0.39%. The slight differences in nutritional content of these foods are caused by differences in aquatic environmental factors and also the substrate where macroalgae grow.

The macroalga *G. arcuata* has a thallus that is shaped like irregular branches, very dense; dense and thick thallus reaches 8 - 10 cm in height, brownish green; lives on dead coral and slightly gravelly substrates in intertidal areas. The commuities in Suli Village, Central Maluku Regency and Sekura Village, Eastern Seram Regency, use the macroalgae *G. arcuata* as a food ingredient in the form of vegetables or eaten raw. The results of the proximate analysis of the nutritional content of the *G. arcuata* macrolagae showed that the carbohydrate content was 1.856% of the sample weight of 1.4005 g, proteins content was 0.686% of the sample weight of 1.2753 g, fat content was 0.218% of the sample weight of 158752 g, water content was 90.706% of the sample weight 3.8435 g, ash content 5.5174% of sample weight 3.8435 g. The nutritional content of macroalgae is in accordance with the study. Arulkumar (2019) that the marine macroalgae *G. salicornia* and *G. arcuata* used as dietary raw materials have been known for a long time in the region, because these materials are nutritious and are an excellent source of vitamins, dietary fiber, minerals and protein as raw materials for medicines. Kepel and Mantiri, (2018); Rugebregt et al. (2021), mention that macroalgae *G. arcuata, G. acerosa, G. salicornia*, contains various chemical compounds which are very good for the health of the human body, especially protein, fat and vitamins C as well as minerals calcium, magnesium.

The macroalgae *E. cottonii* is a macrolagae found in the intertidal zone on rocky coral substrates, and slightly sandy coral fragments that have thalus that appear morphologically with cylindrical or flat branches, the branches are irregular and rough. The tip is pointed or blunt, purple brown or yellow green. It has irregular spines covering the thallus and branches. The surface of this macroalgae seems slippery, and the appearance of the thallus varies from simple to complex shapes. Communities in Central Maluku Regency, Suli Village, Herie Hamlet, Ambon Island use the macroalgae *E. cottonii* as a food source in the form of vegetables and also as raw vegetables. This is in accordance with the results of research found by Jumiati (2023) that Red Algae (Rhodophyta), namely *E. spinosum* and *E. cottonii,* are used by local residents as vegetables, also used as ingredients for crackers, snacks, and also used as a source of food. *E. conttonii* macroalgae is very good for consumption as a source of food and health, because it is contains various chemical compounds which are very good for health. According to Ulfa et al. (2023), the results of a survey of various types of medicines turned out that the raw material comes from the macroalgae *E. conttonii* which is a macroalgae (Rhodophyta) which contains health supplements used for skin treatment because it contains vitamins E, containing a chemical compound known as dl-alpha-tocopheryl acetate is very good for the body, because it functions as an antioxidant or helps protect body cells from damage caused by free radicals.

The results of the analysis of the nutritional content of *E. conttonii* showed that carbohydrate content was 0.532%, proteins content was 0.916%, fat content was 0.352%, water content was 92.331%, ash content was 5.815%. The results of the analysis of nutritional content through proximate tests carried out at the Laboratory of the Faculty of Mathematics and Natural Sciences, Pattimura University are different from those carried out by the Marine Science Laboratory, and laboratory Faculty of Mathematics and Natural Sciences Tanjungpura University, Pontianak, West Kalimantan. According to Fatriyanti et al. (2022), the results of proximate analysis are to determine the macro nutrient composition of the *E. conttonii* found a carbohydrate content of 5.29%, proteins content of 1.90%, fat content of 0.91%, water content of 38.86% and an ash content of 3.04%. The difference in the results of this proximate analysis is thought to be due to differences in sample weight and freshness of *E. conttonii* macrolagae samples and differences in aquatic environmental factors and differences in substrates where *E. conttonii* macrolagae are found. According to Gusman et al. (2021), the composition of the nutritional content contained in marine *E. conttonii* can be influenced by water factors and the substrate where this macroalgae grows or influenced by seasonal variations and geographical location.

The macrolalgae *K. alvarezii* has a morphological characteristic, namely a branched thallus with smooth, flat branches with long and smooth branches that looks irregular due to the presence of nodules in the thalus. The

surface of *K. alvarezii* is smooth and slippery when touched. It has been cultivated by community in Central Maluku Regency, but according to the community's explanation, this macroalgae habitat is actually in the waters of the intertidal zone on hard substrates such as dead coral and gravel coral fragments. Even though it is classified as red algae, this type of seaweed is not always found in red, but *K. alvarezii* species appears reddish green in color, and there are yellow green and even brownish grey. According to Khotijah et al. (2020), Ashar (2021) that the color variations in the *K. alvarezii* are due to pigmentation and depend on the environmental conditions of its habitat. *K. alvarezii* is consumed, because it contains various chemical compounds for the health of the human body.

The communities in Southeast Maluku Regency, Dullah Village and in East Seram Regency, Sekura Village, have long consumed the red macroalgae *K. alvarezii* as a source of nutritious food and is good for health. The results of the proximate analysis of the *K. alvarezii* showed carbohydrate content of 0.406%, protein content of 0.705%, fat content of 0.453%, water content of 90.621%, and ash content of 5.472%. Not much different from what Khotijah et al. (2020), that *K. alvarezii* seaweed has nutritional composition values such as carbohydrate content of 0.587%, protein content of 0.938%, fat content of 0.56%, content of 3.44%. This is in accordance with the explanation of Ulfa et al. (2023), that rhodophyta macroalgae contains secondary metabolites such as polyphenols, polysaccharides, flavonoids, steroids, terpenoids, saponins, tannins, pigments, vitamins and minerals which are linearly correlated with their antioxidant activity, especially macroalgae *K. alvarezii* and *E. cottonii.*

Analysis quistionares

The results of the analysis of 45 respondents' answers to each question regarding knowledge and attitudes regarding macroalgae as a source of food and health as well as community attitudes towards food menus made by coastal communities from macroalgae, obtained results as shown in Table 4.

Table 4. Frequency (f) and percentage (%) of knowledge of macroalgae as a source of food and health and community attitudes towards cooking menus from macroalgae

Ques tion Num ber	Knowledge				Attitude			
	Right		Wrong		Yes		No	
	Freque ncy	Percenta ge (%)	Freque ncy	Percenta ge (%)	Freque ncy	Percenta ge (%)	Freque ncy	Percenta ge (%)
1	40	88.8	5	11,1	42	93.3	3	6.7
2	34	75.5	11	24,5	35	77,7	10	22,3
3	37	82.2	8	17,7	38	84.4	7	15.6
4	35	77.7	10	22,3	37	82.2	8	17.7
5	39	86.7	6	13.3	41	91.1	4	8.89
∑	187	83.1	38	16.9	193	85.8	32	14,2

The results of the analysis in Table 4 show that answers of 45 respondents in answering each knowledge question and attitude question. 88.8% of the knowledge about macroalgae as a source of food and health is obtained through the family from generation to generation, and only 11.1% of the community has knowledge that does not come from the family from generation to generation. Furthermore, 75.5% of the community's knowledge is that macroalgae can be used as vegetables, can be made into various dishes and only 24.5% did not understand that macroalgae can be used as vegetables or other dishes. Besides that, 82.2% of the community's knowledge is that taking stone and sand material from coastal waters can damage macroalgae habitat and only 17.8% didn't understand the habitat damage caused by taking stone and sand material from coastal waters. 77.7% knowledge about scientific evidence from research on macroalgae as a source of food and health, while 86.7% of the public has knowledge about macroalgae containing carbohydrates, fat proteins, minerals and water and only 13.3% do not understand that macroalgae contain carbohydrates, proteins, fat, water and minerals.

For the community attitudes regarding the macroalgae menu was described that the community's shows a very favorable attitude towards macroalgae dishes of 93.3% in the form of vegetables and other dishes and only 6.7% dislikes various dishes made from macroalgae. Next, 77.7% of the public showed a very favorable attitude towards helping their families pick up macrolaga to eat, and only 22.3% showed a less favorable attitude. And then if there are people who damage the macroalgae habitat, 84.4% of the people will reprimand and scold them and only 5.6% show an accommodating attitude towards damage to the macroalgae habitation. The menu made from macroalgae has a distinctive smell but 82.2% of people still like it and only 17.8% don't like the aroma of the macroalgae menu. The community's attitude towards protecting macroalgae living areas through village regulations is liked by 91.1% of the community and only 8.89% do not like the existence of village regulations regarding protecting macroalgae living areas.

The results of the regression analysis between people's knowledge and attitudes towards nutritious and healthy food sources originating from macroalgae which are obtained from coastal waters in various districts of Maluku Province. The results of the analysis are explained in Table 5.

Table 5. Linear regression analysis of the community knowledge and attitudes towards macroalgae as a source of food and health

Model Summary			
R	R Square	Adjusted R Square	Std. Error of the Estimate
.883	.779	.774	8.107

a. Predictors: (Constant) is knowledge
b. The independent variable is attitude

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Regression	10720.588	1	10720.588	221.690	.000
Residual	2079.412	43	48.358		
Total	12800.000	44			

a. Predictors: (Constant) is knowledge
b. The independent variable is attitude

Table 5 shows a significant correlation between community's knowledge about macroalgae as a food source and health towards attitudes regarding the macroalgae dishes consumed by community in several districts of Maluku Province. This correlation can be explained based on the value of R 2 = 0.779, which means there is a significant correlation between community's knowledge and attitudes about macroalgae as a source of food and health. The existence of this significant relationship is due to the influence of knowledge of 77.9% on the attitudes of people who consume macroalgae, and only 22.1% is influenced by other factors. Table 5 also shows that there is an influence, this is because something that has an influence definitely has a relationship, this can be proven based on the results of the analysis which shows that there is an influence with a value with a value of df = 44-43 = 1 with a value of F = 221,690 with a significant level 000, < p 0.05, this means that there is a significant influence between community knowledge and community attitudes.

The results of the regression analysis also show that the regression coefficient value is very significant between people's knowledge about macroalgae as a source of food and health and the attitude of people who consume various cooking products made from macroalgae as a healthy source and good for health as shown in Table 6.

Table 6. Regression coefficient between knowledge about macroalgae as a source of food and health and the attitude of the community Maluku Province towards the food menu from macroalgae

Coefficients					
	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
independent / ettitude	-5028.956	408.212	-.883	-12.319	.000
(Constant) knowledge	143.514	5.295		27.102	.000

Based on the Table 6, it shows that there is a coefficient value which can explain the existence of a linear correlation based on the formula y = a + bx = -5028,956 + 143,514 between community knowledge about macroalgae as a food source and health and attitudes about the macroalgae menu that people consume as sources of nutritious and healthy food, as seen in Figure 3. In the figure shows that there is a very significant correlation between public knowledge and public attitudes about macroalgae as a source of food and health for coastal communities in several districts of Moluccas Province. This can be seen from the linear correlation line which shows the existence of observation points and the inverse line. is close to the linear correlation line which indicates a very significant correlation between knowledge and attitudes of the people in Maluku Province.
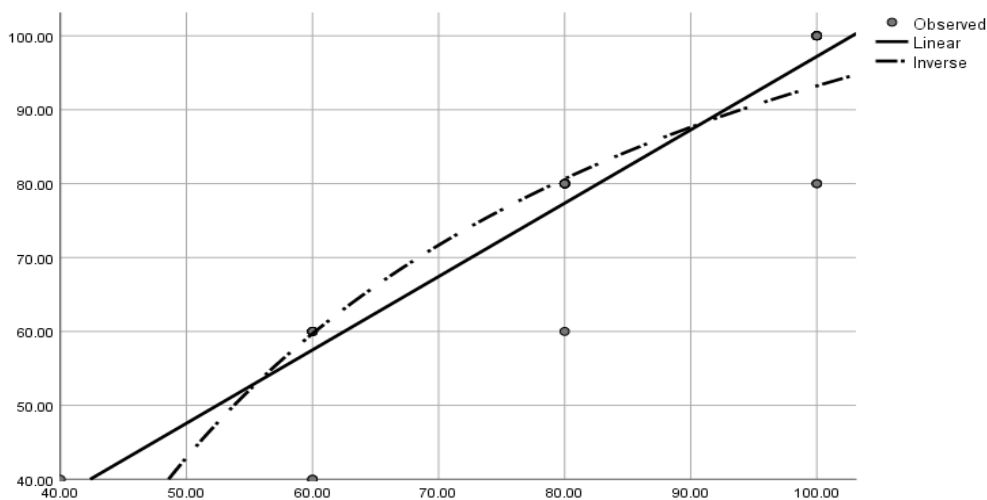
Figure 3. Graphic of the correlation between community knowledge and attitudes about macroalgae as a food source and health

The results analysis of the communities knowledge and atitudes about macroalgae as a source of food and health towards cooking menus made from macroalgae from 45 respondents, obtained a knowledge about macroalgae as a source of food and health, 88.8% gave the answer that the knowledge they had was obtained from their ancestors from generation to generation, so that the knowledge possessed by the community has been recorded in long-term memory, which ultimately results in a strong desire to continue consuming macroalgae as food to fulfill their daily needs. Nurdaya (2023), explains that the use of macroalgae, whether in medicine or food and drink, is community knowledge that has been acquired for generations, but some communities can obtain knowledge about macroalgae as a source of nutritious food obtained through training and counseling through. The community is like to follow suit and really enjoy consuming macroalgae, because it provides many sources of nutrients such as protein, carbohydrates and fats and chemical compounds as medicines that the human body needs. Prinata (2024) explained that people who like to consume macroalgae or who want to try out a food menu made from macroalgae must have the knowledge to be able to recognize and differentiate between types of seaweed that can be eaten and those that cannot be eaten.

Communities knowledge regarding damage to macroalgae habitat due to the extraction of stone and sand material from coastal waters is 82.2% known to the public. Kasman (2019), explained that coastal communities in utilizing natural aquatic resources must have an understanding and attitude to continue to protect the aquatic environment, without needing to destroy nature in accordance with their ancestral teachings regarding nature conservation so that balance between nature and humans is maintained, according to the potential of local wisdom. Existing in coastal communities, so that it is hoped that there will be an increase in a better standard of living. Meanwhile, 75.5% of knowledge about macroalgae being edible in the form of food vegetables has been known for a long time. According to Sanger et al. (2018), the existence of public awareness to utilize macroalgae as a functional food source is the best hope for overcoming life's needs for food and health sources. 86.7% of the communitie's knowledge regarding the carbohydrate, protein, nutrient, mineral and water content of macroalgae is obtained by the community, apart from the family, and also through printed information media such as books, tape, journals and electronic media. According to Ramdan and Nuraeni (2021), that macroalgae have long been utilized by coastal residents as food and medicine, public knowledge generally relates to food products such as vegetables or raw fresh vegetables. However, people who have cultivated seaweed or macroalgae try to increase their knowledge through various print and electronic media.

Coastal communities in Maluku Province have 77.7% of the knowledge obtained from training and coastal community empowerment activities, they understand the research results that macroalgae have nutritional content and are good for consumption for public health. According to Suparmin et al. (2022), to increase the utilization of the potential of macroalgae or seaweed, a real commitment is needed to participate in training and counseling so that coastal communities increase their knowledge in managing seaweed cultivation, the results of which are not only consumed but also increase family income.

The survey results show that there is knowledge of coastal communities in various districts of Maluku Province in managing the types of macroalgae *C. lentillifera, G. salicornia* and *G. arcuate, E. cottonii, K. alvarezii* as a food source to meet life needs as well as for health. Antara News Agency (2023) explains that many mothers in coastal areas use macroalgae as a food source in various processed products, because macroalgae contains elements

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that the body needs. Through nutritional absorption by the body by consuming macroalgae. Basir et al. (2023) that the use of coastal and marine resources both individually and in groups requires various abilities, knowledge according to people's work, the knowledge they have really helps them in improving their standard of living through the use of macroalgae or seaweed.

An assessment of the attitudes of coastal communities in Southeast Maluku Regency, Central Moluccas and Eastern Seram Regency, towards macroalgae food menus turned out to be that coastal communities really like macroalgae food menus, whether cooked in the form of vegetables or served in the form of raw vegetables. This shows that the frequency answers is 93.3%, they really liked the macrolagae food menu. This is in line with Faaizah (2023) explanation that the results of the study found alternative food resources that contribute to health, there is a high level of European people's preference for alternative food sources from various types of macronutrients.

Protection of the natural resource environment of coastal and marine waters by coastal communities in Maluku Province shows a very positive attitude of 84.4% in protecting macroalgae habitat by prohibiting people in general from taking rocks and sand in coastal waters. The attitude of coastal communities like this is very good in preserving the potential of macroalgae resources as a source of food and health which is really needed by the community. Husain et al. (2023) explain the attitude, coastal communities who are involved are directly involved in preserving natural resources to ensure the continuity of the use of natural resources as an effort to fulfill the living needs of coastal communities.

The behavior of coastal communities in Maluku Province in helping their families take macroalgae for consumption turns out to be 77.7% of them who are very happy to help their families. This kind of behavior is a community culture that has been embedded in the souls of every individual coastal community in Maluku Province. Apart from that, the attitude of coastal communities to maintaining and preserving the macroalgae habitat is 84.4% very good, this can be seen by the behavior of reprimanding or preventing damage to or taking sand or rocks in coastal waters. Nasution et al. (2024), that the destruction of the coastal and marine environment is the factor that has the most influence on coastal damage, due to poor community activities in coastal areas which can have an impact on life for organisms and also for humans themselves. The use of macroalgae as a source of food and health by coastal communities is 91.1% who really like a diet made from macroalgae and always consume macroalgae. Harwindito et al. (2021), that healthy food is food that is free from dangerous ingredients and contains nutrients that are beneficial for our bodies. Healthy food dominated by organic ingredients. The concept of health is important to help provide awareness to the public about the importance of comprehensive health, awareness. Health is a concern and concern for being good and motivated in improving, maintaining, maintaining health and quality of life by implementing a healthy lifestyle.

Support is needed from various natural environmental lovers, especially coastal and marine waters as a place to provide macroalgae as a source of food and health, so that in the end people can always consume food from natural sources in coastal and marine waters, such as food menus originating from macroalgae in the Maluku Province. According to Ridhani and Rukmana (2023), providing understanding to local communities and the general public in a region to always utilize the potential of resources in coastal areas is not only carried out through technical approaches, but also through socio-cultural approaches that can trigger changes in behavior, attitudes and patterns. Work, especially in utilizing macroalgae as a source of nutritious and healthy food. Prinata (2024) that the various types of macroalgae that can be eaten really depend on the knowledge and habits of coastal communities. Thus, by empowering coastal communities in the form of macroalgae cultivation activities as a source of community food security, a better life for coastal communities in this region can be realized.

The communities in the Maluku Province who live in various islands spread across several districts, and the people who live on the coast, so it is time for the people to be empowered in the form of utilizing the natural potential of coastal waters in the intertidal zone, especially macroalgae as a source of food and health. According to Cahyadinata (2019), the concept of coastal community resilience is reflected by the ability to gain access to sufficient food for a healthy and productive life and lasts from time to time. The food security of coastal community households can be seen from three aspects, namely: food availability, food access and food utilization. Furthermore, there are at least four indicators that are often used to measure household food security, namely dietary diversity (food diversification), individual dietary intake (consumption level), caloric acquisition (food availability) and indices of household coping strategy.

Community knowledge about macroalgae as a food source and people's attitudes towards various types of macroalgae cooking menus apparently show a significant correlation, based on a correlation coefficient value of R 2 = 0.779, which means there is a significant correlation between people's knowledge and attitudes about macroalgae as a source of food and health. This significant correlation is due to the influence of public knowledge on public attitudes about cooking menus made from macroalgae, amounting to 77.9%. Thus, the public's knowledge about macroalgae as a source of food and health is thought to form a positive character towards the macroalgae menu, or the better the public's attitude towards the macroalgae food menu consumed, the better their liking for the macroalgae menu will be. Da Conceicao (2023), that high levels of knowledge have a big influence

on the utilization of natural aquatic resources, and the better the management of macroalage, because the knowledge that people have influences the effectiveness and efficiency of seaweed cultivation businesses. Thus, the people mastery of macroalgae or seaweed science has a positive impact on the existence of macroalgae as a source of food and health for the communities of Maluku Province.

CONCLUSION

Types of macroalgae consumed by communities in Maluku Province consist of *E. conttonii, G. salicornia, C. lentillifera, K. alvarezii, G. arcuate* species. The proximate content from five species are different. Furthermore, 83.3% of the community has knowledge about macroalgae as a source of food and health, this is in accordance with the results of the assessment of positive community attitudes of 85.8% of food products derived from highly favored macroalgae. There is a linear correlation between the knowledge and attitudes of coastal communities in several districts of Maluku Province who consume macroalgae as a source of food and health. The results of the analysis show that there is an influence of knowledge on communities attitudes about macrolaga as a source of food and health.

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