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Original Paper

The Physicochemical Characteristics of Smart Food Bars Enriched with Moringa Leaf Extract And Chitosan as An Emergency Food in Disaster Times

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***Abstract*— Emergency food products are processed food specifically designed to meet human daily needs of at least 2500 Kcal/day. One of the emergency food products, namely food bars, is a high-calorie food product, enriched with other nutrients and produced in solid form. The packaging of food bars designed in a small size makes their distribution relatively easy. The purpose of this study was to characterize the emergency food products of smart food bars by utilizing local food ingredients, including flour, mackerel fish flour, moringa leaf extract, and coconut crab chitosan at various concentrations. Furthermore, it delved into the formulation and physicochemical characterization of the best smart food bars as an emergency food by substituting cassava flour and skipjack tuna flour enriched with moringa leaf extract and coconut crab chitosan. This research used a completely randomized factorial design by combining treatments with cassava flour and skipjack fish flour as well as a combination of treatment with moringa leaf extract and the addition of coconut crab chitosan (0%, 5%, 10%, 15% 20%). The results showed that the N3 treatment (15% moringa leaf extract and chitosan) with a texture value of 2,768 N/m, color values (L*, a*, b*) were 63.35, 5.30, and 11.91, respectively. The findings also highlighted 13.29% protein, 17.80% fat, 6.55% water, 0.96% ash, 60.76% carbohydrates, 7.41% antioxidants, and total calories of 230.57 kcal. The study has concluded that the use of moringa leaf extract and coconut crab chitosan can enhance the characteristics of smart food bars as emergency food during disasters.**

Keywords*— *food bars smart, moringa extract, coconut crab chitosan

I. INTRODUCTION

North Maluku's contribution to cassava production has been substantial, with a harvest area of 29.80 ha, production of 65.87 tons, and a total amount of 1.90 tons/ha in 2011. Furthermore, the people of North Maluku have widely utilized cassava as a local food ingredient. This can be seen from the harvest area and the level of food crop production by district or city, which has reached a comprehensive area of 11,770 ha with an average production of 34,621 tons/year, which is consumed directly or processed by traditional food products [4]. Cassava is processed into sago plates and is a staple food in North Maluku and has great potential as a diversified food ingredient from rice or food in general. Cassava sago is a typical food of North Maluku made from cassava flour. One of the problems with cassava flour before it is processed into cassava sago products is the flavor of the product, which is unfavorable to many people [6].

An emergency food product is a processed food product that is specifically designed to meet the daily human needs of at least 2500 Kcal/day and can be consumed in abnormal conditions such as natural disasters, wars, hunger seasons due to low-income levels, earthquakes, fires, landslides, pandemics, or other events. Under these conditions, it is possible to damage infrastructure as a means of fulfilling food needs, such as damage to agricultural land, which causes casualties and results in difficulties in accessing their food needs. Emergency food products can be given to victims of natural disasters for 15 days before more adequate assistance is available. Emergency food products can meet the minimum energy requirement of 2500 Kcal per day and are consumable to various age groups [5] [9]. There are various forms of emergency food in Indonesia that have been developed in the form of processed IMF (Intermediate Moisture Food), cookies, and food bars [5].

Food bars are high-calorie foods that are usually made from a mixture of several food ingredients (blended food), which are enriched with nutrients, which are then formed into a solid and compact form (a food bar form) [11]. Food bar packaging designed in a small size makes its distribution relatively easy [7]. Food bars available in the market today are still made from wheat and soybean flour, which are Indonesian imports. Emergency Food in the form of food bars has been widely developed, such as food bars made from pumpkin flour, soybeans, and green beans [3].

This research was conducted to enhance the properties of smart food bars products as emergency food during disasters by utilizing local food ingredients in the form of cassava flour, skipjack fish flour, and enriched with moringa leaf extract and coconut crab chitosan at various concentrations. The purpose of this study was to carry out a characterization for smart food bars as emergency food products by utilizing local food ingredients in the form of cassava flour, mackerel fish flour, and moringa leaf extract, and coconut crab chitosan at various concentrations.

II. Ingredients and Method

A. Ingredients

The ingredients used in making smart food bars are cassava flour, skipjack fish flour, moringa leaf extract, commercial coconut crabs chitosan, full cream milk, granulated sugar, margarine, BTM (food additives), and aquadest.

B. Method

This research was conducted in two stages. The first stage was manufacturing cassava flour, mackerel fish meal, and moringa leaf extract. The second stage was the production of smart food bars (emergency food) with a combination of treatment with cassava flour and skipjack fish flour (5:1) and a combination of treatment involving moringa leaf extract and chitosan coconut crabs at different concentrations (0%, 5%, 10%, 15% 20%). There were 5 treatments with 3 replications, divided into 15 experimental units. By using a factorial Completely Randomized Design (CRD), analysis of variance was carried out.

1) The Production of Moringa Leaf Extract

Fresh moringa leaves were added with water (1:5) and the mixture was then blended for 5 minutes and then filtered using a filter cloth. This filtered Moringa leaf extract was added with coconut crab chitosan (3:1) and was ready to use with treatment (N) = (0%, 5 %, 10%, 15% 20%).

2) The Production of Smart Food Bar

Smart food bars were made through several stages. These involved mixing cassava flour and skipjack fish flour (5:1), adding moringa leaf extract and coconut crab chitosan (3:1) with different treatments (0%, 5%, 10%, 15 % 20%), adding eggs, full cream milk, sugar, margarine and BTM (food additives), and mixing the ingredients using a mixer for 20 minutes at a speed of 150 rpm. The dough was allowed to stand for ±15 minutes, and then the printing was done with a size of 5x2x2 cm. These blocks of dough were roasted using an oven at a temperature of 125o C for ± 40 minutes, removed, and printed with a 1.2 psi hydraulic press, resulting in smart food bars and product analysis (Sholeh, 2009).

3) Atomic Force Microscopy (AFM)

The surface morphology of smart food bars was analyzed using an atomic microscope (Dual Scope TM DS95-50, DME, Denmark) with a scanning size of 50-50 lm at a resolution of <0.1 nm. Two statistical parameters, related to the roughness of the sample, were calculated for the roughness average (Ra), and the root mean-square-roughness (Rq). Five images were analyzed in each formulation.

4) Colors (L*, a*, b*)

The color of smart food bars was measured with a CR 310 Minolta Chroma Meter (Minolta Camera Co., Ltd) with color values (L*, a*, b*). Smoothed smart food bars were placed on a white standard plate (calibration plate), and the Hunter Lab color scale was used to measure color [10]. Each sample was measured at four different reading positions.

5) The Texture of Food Bars (Hermansyah, 2010)

Hardness was measured using the Force Gauge PCE FM200. The tool was turned on by pressing on and then pressing the memo set before measuring the compressive and tensile strength. After the measurement was complete, the memo set button was pressed again. For accessing the measurement results, the recall button has to be pressed. The data appeared according to the record. Before taking measurements again, data were deleted by pressing the on and reset buttons at the same time.

6) Proximate Analysis

Chemical properties were analyzed to find out moisture content using the oven method [1], ash content using the oven method [1], fat content using the Soxhlet method [1], protein analysis using the Kjeldahl method, and total carbohydrates using the by difference method [8].

III. Findings and Discussion

Smart food bars products are generally made of local food ingredients, namely cassava flour of the jame-jame variety. In this study, this ingredient was substituted by skipjack tuna flour (5:1) enriched with moringa leaf extract and coconut crab chitosan (3:1) has a fine product appearance in each treatment (N0-N4). Treatment N4 with the addition of 20% concentration of moringa leaf extract and chitosan can produce a fine appearance, and it is hoped that varying concentrations will result in the best product characteristics of smart food bars.

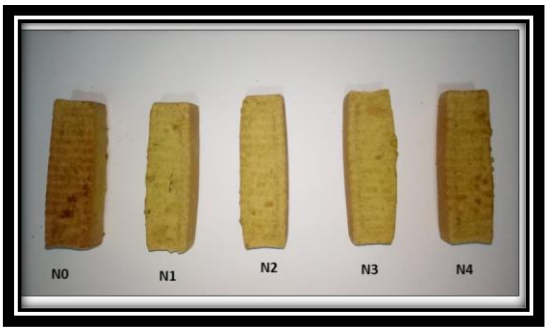

Fig. 1. Smart Food Bars Enriched With Moringa Leaf Extract and Coconut Crab Chitosan

1. The Appearance of Food Bars Smart

The observations of surface appearance are performed by using Atomic Forch Microscopy (AFM) on smart food bars products. These products are meant to be emergency food during disasters made by substituting cassava flour and skipjack fish flour with moringa leaf extract and coconut crab chitosan. Figure 2 shows that the N4 treatment showed that the surface appearance is influenced by the concentration of moringa leaf extract and chitosan at 20% concentration. Smart food bars products bind water during the roasting process due to the addition of moringa leaf extract and chitosan, which can affect the properties of the material. It can be seen that the N4 treatment will be better than the N0 treatment (control), with a flatter and smoother surface appearance.

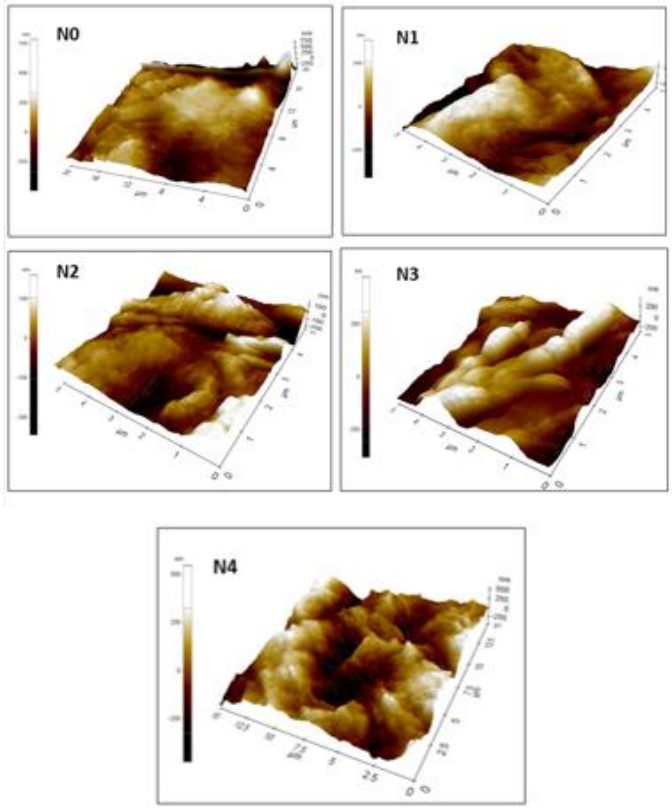

Fig. 2. Microstructure of smart food product enriched with moringa leaf extract and coconut crab chitosan observed through AFM method

2. Texture Value (N/m)

Texture measurement is performed using the Texture Analyzer tool. The crispness is expressed by the magnitude of the force at the first peak in the sample starting to change shape. The textures measured are hardness, stickiness, and elasticity. The different treatments on each smart food bar product are influenced by the pressure when pressing the product after cooking, where the N3 treatment has a fairly low texture value with the addition of moringa leaf extract and chitosan at 15% concentration. The N0 treatment has a high texture value without the addition of moringa leaf extract and chitosan. In terms of the rheological properties of food ingredients, emergency food products can be grouped into solid, semi-solid, and viscoelastic products. Emergency food is a solid product. Solid food products are products that do not change shape (deformation) when subjected to tensile forces or pressure forces. The results of testing the physical properties of the texture of the smart food bars demonstrate that the products have good potential to be developed as emergency food for daily consumption or during disaster emergencies.

Table 1. The results of a physical characteristic test of Smart Food Bars

Treatment	Texture (N/m)	Colour Value		
		(L*)	(a+)	(b+)
N0	4.621c	57.40b	5.19a	24.53d
N1	2.905a	48.14a	6.25b	16.64c
N2	3.150b	45.92a	6.47b	12.76b
N3	2.768a	63.35c	5.30a	11.91a
N4	3.004b	62.78c	9.72c	10.85a

Note: N (extract of moringa leaf : coconut crab chitosan); N0 (0%), N1 (5%), N2 (10%), N3 (15%), N4 (20%)

3. Colour Value (L*, a*, b*)

The physical characteristic test consists of a color test (brightness value (L), a pigment color intensity test using a chromameter. This tool uses an L, a, and b color system. L shows brightness with a value of 0 (dark/black) to 100 (bright/light). white), The results of testing the physical properties of color (L*, a*, b*) of smart food bars as emergency food during disasters by substituting cassava flour and skipjack tuna flour enriched with Moringa leaf extract and coconut crab chitosan.

Table 2. The results of chemical characteristic test of Smart Food Bars (100 g)

Treat-ment	Protein (%)	Fat (%)	Water (%)	Ash (%)	Carbo-hydrate (%)	Anti-oxidant (%)	Total Calories (kkal)
N0	**12.88a**	**17.19a**	**8.06c**	**0.45a**	**61.41b**	**1.01a**	**218.53a**
N1	**12.76a**	**18.69b**	**6.41a**	**0.69a**	**60.75b**	**5.03b**	**224.05a**
N2	**14.16c**	**18.38b**	**7.05b**	**0.68a**	**59.50a**	**6.67b**	**227.14a**
N3	**13.29b**	**17.80a**	**6.55a**	**0.96a**	**60.76b**	**7.41c**	**230.57b**
N4	**13.18b**	**17.30a**	**7.28b**	**1.03b**	**59.79a**	**8.97c**	**235.17b**

Note: N (extract of moringa leaf : coconut crab chitosan); N0 (0%), N1 (5%), N2 (10%), N3 (15%), N4 (20%)

4. Total Calories

Bars are solid food products in the form of rods and are a mixture of various dry ingredients such as cereals, nuts, dried fruits, which are combined together with the aid of a binder. Binder in bars can be syrup, nougat, caramel, chocolate, and others. The shape of the bars was determined because of the ease of consumption. Food in the form of bars is easy to make and can be created with a variety of ingredients. food bars made from banana puree with other ingredients such as margarine, sugar, salt, wheat flour, cassava flour, and soybean flour. The use of banana puree in the manufacture of these food bars serves as a binder. Cassava flour serves to reduce the use of wheat flour. In addition, cassava flour also functions as a texture maker. Meanwhile, soybean flour is used as a source of protein and fat in the bars.

The manufacture of food bars based on local raw materials begins with the manufacture of various flours to be used, namely

soybean and cassava flour. Next, the bars are made by mixing bananas in the form of puree, margarine, and sugar which have been mixed with a mixer first, salt, and the flours used. Afterward, the dough is molded and baked using the oven. The roasting process is carried out in stages to get a good product texture and the desired moisture content range at around 5%. The roasting process is carried out at 100°C for 40 minutes to remove most of the water from the product without causing case hardening. Furthermore, roasting is carried out at a temperature of 120°C for 20 minutes to remove water at a later stage and ripen the product.

The energy content of emergency food must meet energy needs per day. According to recommended and reported nutritional intakes from the United States and Canada, the nutritional content of emergency food should be in accordance with existing standards, which is about 2100 kcal. Information on energy needs per person in one day can be used as the basis for making emergency food prototypes [9]. The test results on the chemical properties in the form of total calories (energy content) demonstrate fine outcomes.

5. Antioxidant Content

Analysis of the average of antioxidants is performed on smart food bars enriched with Moringa leaf extract and coconut crab chitosan.

Antioxidants are substances that can neutralize or reduce free radicals through the mechanism of adding electron groups to unpaired free radical electron groups so that they become stable. Antioxidants are compounds that in certain levels can inhibit or slow down the breakdown of fats or oils due to the oxidation process.

External antioxidants are not produced by the body but come from foods such as vitamin A, beta carotene, vitamin C, vitamin E, selenium, flavonoids, and others. Antioxidants derived from food are also called secondary antioxidants. Natural antioxidants are more effective in neutralizing free radicals.

6. Protein Content

The analysis results of the average protein content of the smart food bars play a vital role.

Protein is a heterogeneous polymer of amino acid molecules [8]. In globular proteins, hydrophilic, polar side chains are on the outside and hydrophobic, while non-polar side chains are arranged on the inner surface. As such, the protein has a relatively high solubility in water or in dilute salt solutions at pH values below or above the isoelectric point. The use of food ingredients such as nuts in making emergency food can enrich the protein value of the product [2].

7. Fat Content

The analysis of the average fat content of smart food bars helps better understand the resultant products.

Fats or oils are the most effective source of energy compared to carbohydrates and proteins. Almost all foodstuffs contain a lot of fat and oil, especially ingredients of animal origin. Analysis of fat content in food can be done by extracting fat. However, pure fat extraction is very difficult, because when extracting fat, fat-soluble substances will also be extracted, such as sterols, phospholipids, free fatty acids, essential oils, and pigments.

8. Water Content

The analysis results of the average water content of smart food bars products aim at finding out moisture content, which is the amount of water contained in the material expressed in percent.

Water content is also one of the most important characteristics of foodstuffs because water can affect the appearance, texture, and taste of foodstuffs. The water content in foodstuffs determines the freshness and durability of these foodstuffs. High water content makes it easy for bacteria, molds, and yeasts to breed so that changes will occur in foodstuffs [8].

9. Ash Content

The analysis of the average ash content of smart food bars products is another parameter under investigation.

Ash is an inorganic substance from the combustion of organic compound. In food, besides ash, there are also other components, namely minerals. The ash content in foodstuffs significantly influences the properties of foodstuffs. According to [8]. ash content is the total amount of mineral elements or inorganic substances either necessary or unnecessary for the human body. The ash content of food bars based on SNI 01-2886-2000 is 1.5%.

10. Carbohydrate Content

The analysis of the average carbohydrate content of smart food bars products denotes the last phase of our investigation.

Carbohydrates are compounds that can be interpreted as ketone polysaccharides that have the formula CH_2O and its derivatives. These compounds are carbohydrates in the form of glucose and glycogen, which are important for energy sources. Several carbohydrates have important specific functions, namely ribose in cell nucleoproteins, galactose in lipids, certain lipids, and lactose in milk. Carbohydrates are found in many bowls of cereal (rice, wheat, corn, potatoes, and so on), as well as in grains that are widely distributed in nature.

IV. CONCLUSION

Based on the results of the study, smart food bars products as emergency food during disasters enriched with moringa leaf extract and coconut crab chitosan have the best physicochemical characteristics, as found in the N3 treatment enriched with moringa leaf extract and chitosan at 15% concentration. As a result, smart food bars products as emergency food during disasters have huge potential value for future development and production.

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REFERENCES

[1] AOAC, 2005. Official Methods of Analysis of The Association of Analytical Chemists, Washington D.C.

[2] Ekafitri, R., & Isworo, R. (2014). Pemanfaatan Kacang-Kacangan sebagai Bahan Baku Sumber Protein Untuk Pangan Darurat The Utilization of Beans as Protein Source for Emergency Food. Jurnal Pangan, 23(2), 134-145.

[3] Fajri, R., Basito. dan D. R. A. Muhammad. 2013. Karakteristik Fisikokimia Dan Organoleptik Food Bars Labu Kuning (Cucurbita Maxima) Dengan Penambahan Tepung Kedelai Dan Tepung Kacang Hijau Sebagai Alternatif Produk Pangan Darurat. Jurnal Teknologi Hasil Pertanian. 6(2): 103-110.

[4] Rasulu, H. (2014). Quality Improvement of Cassava Flour of Local Variety of Ternate Through Fermentation Method (Application on Traditional Food of North Maluku "Sagu lempeng"). International Journal on Advanced Science, Engineering and Information Technology, 4(6), 423-425.

[5] Rasulu, H., Rodianawati, I., Albaar, N., Umalekhoa, I., & Kamaluddin, A. K. (2021, March). Physicochemical Properties of Sago Flour Food Bars Fortified with White Sweet Potato Flour and Sidat Fish Flour. In IOP Conference Series: Earth and Environmental Science (Vol. 709, No. 1, p. 012053). IOP Publishing.

[6] Rasulu, H., Yuwono, S. S., & Kusnadi, J. (2012). Karakteris-tik tepung ubi kayu terfermentasi sebagai ba-han pembuatan cassava sago. Jurnal Teknologi Pertanian, 13(1), 1-7.

[7] Widjanarko, Simon B. 2008. Pangan Darurat (Food Bars) Berenegi Tinggi Menggunakan Tepung Komposit (Tepung Gaplek, Tepung Kedelai, Tepung Terigu) dan Tepung Porang (Amorphophallus oncophyllus) atau Konjac Flour. www.simonbwidjanarko.wordpress.com. Diakses pada tanggal 2 Januari 2021.

[8] Winarno, F. G dan Felicia Kartawidjadja. 2007. Pangan Fungsional dan Minuman Energi. Bogor: M-briopress.

[9] Zoumas,B.L., L.E. Armstrong, J.R. Backstrand., W.L. Chenoweth., P. Chinachoti, B. P. Klein, H. W. Lane. K. S. Marsh., M. Tolvanen. 2002. High- Energy, Nutrien-Dense Emergency Relief Food Product. Food and Nutrition Board : Intitute of Medicine. National Academy Press, Washington DC.

[10] Winda Amilia, Andi Eko Wiyono, Dhifa Ferzia, Andrew Setiawan Rusdianto, Ida Bagus Suryaningrat, Nidya Shara Mahardika, Bertung Suryadarma. 2021. Physical, Chemical, and Sensory Characteristics of Frozen Salted Edamame During Storage at Room Temperature. International Journal on Food, Agriculture, and Natural Resources 2 (1): 9-8.

[11] Milena Figueiredo de Sousa, Rafaiane Macedo Guimarães, Marcos de Oliveira Araújo, Keyla Rezende Barcelos, Nárgella Silva Carneiro, Daniele Silva Lima, Daiane Costa Dos Santos, Karla de Alelui Batista, Kátia Flávia Fernandes, Mayra Conceição Peixoto Martins Lima, Mariana Buranelo Egea. 2019. Characterization of corn (Zea mays L.) bran as a new food ingredient for snack bars. LWT (101): 812-818.