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ANALYSIS OF NUTRITION BISCUITS COMBINATION OF RED ALGAE (*Eucheuma Denticulatum* (Burman) *Collins at Harvey*) EXTRACTS AND TEMPE AS A FUNCTIONAL FOOD

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Abstract: The red algae Euheuma denticulatum species (Burman) Collins at Harvey contains important elements including calcium, copper, iron, iodine, and nitrogen, chlorophyll pigments A and B, carotene, lutein, fikoeritrin, fikosinin, and polysaccharide compounds. Tempe is a food made from the fermentation of soybean seeds containing fatty acids, vitamins, minerals, antioxidants, and so forth. This study aims to produce biscuits from a combination of red algae and tempe which will be beneficial for functional food, besides that this biscuit will be tested by chemical analysis. The research method uses an experimental laboratory, the red algae of the Eucheuma denticulatum species is extracted by kinetic maceration with water solvents, the tempeh is dried and caught, after that a formulation is made in the form of biscuits, and after becoming biscuits tested for nutritional content in the form of carbohydrates, proteins, fats, crude fibers , water content, ash content, and calories. Nutrition data analysis was carried out by the one-away Anova test and followed by the LSD posthoc test. From the results of the study obtained biscuits formula 1, 2 and 3 contains (65.31%, 64.66%, 64.98% carbohydrates), (6.01%, 10.52%, 8.34% water content) (1.69%, 2.44%, 2.55% ash content), (18.90%, 18.03%, 18.10% protein), (14.10%, 14.87%, 14.35% crude fat), (1.70%, 1.72%, 1.40% crude fiber), and (4341.0 kcal.kg, 4399.5 kcal.kg, 4424.0 kcal.kg calorie). In conclusion, the formula for biscuits combination of red algae extract and tempe has a large enough calorie according to the existing biscuit standards. The contribution of this research is to produce biscuits that will be used as a functional food for people with dyslipidemia.

Keywords: red algae, tempe, nutrition, extracts

Introduction

Seaweed (algae) has traditionally been used as food and medicine, because it is rich in minerals, macro and micro elements. However, seaweeds contain compounds other than carrageenan, such as

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proteins, which could also be extracted (Naseri A et al., 2020). Eucheuma denticulatum or commonly known as "Spinosum", is an economically important red alga that naturally grows on coral reefs with moderately strong currents in tropical and sub-tropical areas (Othman R et al., 2019), Several types of algae contain important minerals that are useful for the body's metabolism such as iodine, calcium and selenium. Along with the times, algae is not only consumed directly, but can be processed into a product (Kim D et al., 2020). Algae utilization can be maximized by verifying processed algae products which is one of the efforts to increase the usability, nutritional value, and economic value of algae. The verified effort is to process algae into one of the ingredients for making biscuit products. Red algae (Eucheuma denticulate) plays an important role in the biotechnology industry as a source of agar and agrose which are widely used in the food, pharmaceutical and cosmetic industries. Eucheuma dentuculate (N.L.Burman) or another name for Eucheuma spinosum has a carrageenan structure consisting of sulfated polysaccharides (Hung LD et al., 2015). Eucheuma spinosum also has secondary metabolites where secondary metabolites can be a potential source. Secondary metabolites are used as antioxidative, anti-bacterial, antitumor, anti-hypercholesterolemic, anti-inflammatory and amylase inhibitory activities (Tong KTX et al., 2021). The secondary metabolites contained in Eucheuma spinosum are alkaloids, flavonoids, isoperenoid, mono terpenes, diterpenes, and myrcene (Inayah, 2021).

Soybeans are a type of legume that is high in protein, even the Protein Efficiency Ratio (PER) value in soybeans is equivalent to animal protein, soybeans can be fermented into tempeh (Handajani et al., 2020) Tempe is a traditional food made from fermented soybeans or other ingredients, fermented using several types of Rhizopus mold. In tempeh the nutritional content is better compared to soybeans and other derivative products. These ingredients include Vitamin B2, Vitamin B12, Niacin, and also pantorenic acid (Azzahrah, 2019). Tempeh is a fermented food made of mainly soybeans and is a nutritious, affordable, and sustainable functional source of protein (Ahnan et al., 2021).

Biscuits in Indonesia are dominated by large industrial processed products that are not support the efforts of the Indonesian government in achieving food security (Hermayanti et al., 2016). One of government efforts to achieve resilience food is food diversification. this attempt can be realized through utilization and development of local food, which ingredients The raw materials come from the local area (Vegh R et al., 2022).

Combination biscuits made from red algae and tempe powder are good for use as a snack that is rich in nutrition. Eucheuma denticulate red algae contain secondary metabolites of alkaloids, flavonoids, isoperenoid, monoterpenes, diterpenes, and myrcene. And tempeh powder serves as a good source of protein. Both of these ingredients have good content for the body so they are good for consumption as snacks (Van der Sman et al., 2018).

Materials and Methods

Materials

Some of the materials needed in this research are sago flour, red algae extract (Euchemua denticulate), tempe powder, stevia sugar, vanila powder, and mineral water.

Table 1: The product formulation for biscuits is a combination of red algae (Eucheuma denticulatum) and tempe powder.

Ingredients	**Each 5 g**		
	F1	F2	F3
Ekstract of Red Algae	0.08 g	0.16 g	0.18 g
Tempe Powder	1.8 g	1.8 g	1.8 g
Sago flour	30 g	30.5 g	31 g
Stevia Sugar	3 drops	3 drops	3 drops
Powder Vanila	Qs	Qs	Qs
Water	Qs	Qs	Qs

Methods

The method used in this study was an experimental laboratory at the formula development stage by providing treatment in the form of different proportions of raw materials in each biscuit formula. Nutrition data analysis was carried out by the one-away Anova test and followed by the LSD posthoc test.

The initial step in this study was to extract samples of Red Algae (Eucheuma denticulate) using the kinetic maceration method or commonly called digestion maceration. Kinetic maceration is an extraction method using continuous stirring and using hot temperatures higher than room temperature. In general, it is carried out at a temperature of 40-50ºC (Milic et al., 2012). In this study, the yield of red algae extract (Eucheuma denticulate) was 14.07% and tempeh extract was 7.32%. This result meets the requirements of the Indonesian Herbal Pharmacopoeia (FHI), which is a yield of not less than 7.2% (Ministry of Health RI, 2000).

Results and Discussion

The results of the nutrition analysis of the biscuit product combination of red algae (eucheuma denticulate) and tempeh powder can be seen in table 2. Proximate analysis is a very important test in analyzing the nutritional content and quality of biscuit products. The proximate analysis method

includes moisture content, ash content, protein content, fat content, fiber content, and carbohydrate content. Moisture content is one of the things that plays an important role in determining the organoleptic quality and shelf life of biscuit products. High water content in a food can provide opportunities for microorganisms to grow. The results of the analysis of the water content of the biscuit product combination of red algae (eucheuma denticulatum) and tempeh powder in table 2 show formula one has an average moisture content of 6.01%, formula 2 has an average moisture content of 10.52% while formula 3 has an average moisture content of -average water content 8.34%. The results of research on the water content of biscuit products do not meet the SNI requirements where the water content in biscuits according to SNI is a maximum of 5%, this is related to red algae extract and tempeh powder has a high water content. The formula that has a low water content is close to the SNI requirements for biscuits, namely formula 1 with an average moisture content of 6.01%.

Table 2: Results of Nutritional Analysis of Biscuit Product Combination of Red Algae (Eucheuma denticulatum) and Tempe Powder

	Parameter						
	Water content (%)	Ash content (%)	Protein (%)	Crude fat (%)	Crude fiber (%)	Carbohydrates (%)	Calorie
Formula 1	6.01	1.70	18.90	14.10	1.70	65.31	4341.0
Formula 2	10.52	1.72	18.03	14.87	1.72	64.66	4399.5
Formula 3	8.34	1.40	18.10	14.37	1.40	64.98	4424.0

Table 3. Average Nutritional Content of Biscuit Products

	Biskuit			Nilai P
	F1	F2	F3	
Protein	18,90±0,05	18,03±0,27	18,10±0,24	0,004
Lemak	14,10±0,86	14,87±0,40	14,37±0,12	0,001
Serat	1,70±0,08	1,72±0,10	1,40±0,05	0,006
Karbohidrat	65,31±0,10	64,66±0,24	64,98±0,32	0,011
Energi	4341±14,00	4399±1,52	4424±1,00	0,001

The results of the analysis of the ash content of biscuit products in table 2 show that formula 1 has an average ash content of 1.69%, formula 2 has an average of 2.44% and formula 3 has an average of

2.55% from the analysis results of ash content biscuit products that meet the requirements, namely formula 1 with a content of 1.69% in accordance with the requirements of SNI 2011, namely a maximum of 1.6% based on the research results of formula 2 and formula 3 do not meet the requirements, this is related to the addition of red algae found in formula 2 and formula 3, the amount of ash contained in red algae (eucheuma denticulate) is high because red algae live in mineral-rich sea waters. Ash content is a mixture of inorganic or mineral components found in foodstuffs, ash content can indicate the total minerals contained in a food ingredient. The high or low ash content of a biscuit product is caused by the raw materials used (Azzahrah N. I., 2019).

The results of the analysis of the protein content of biscuit products are in table 2, formula 1 has an average protein content of 18.90%, formula 2 has an average of 18.03%, and formula 3 has an average of 18.10% from the analysis of protein content Biscuit products meet SNI requirements, namely a minimum of 9%. The formula that has a high protein content is formula 1 where the average protein content is 18.90%. Based on research results, the high protein content in biscuit products is caused by the high protein content found in tempeh. The high protein content in tempe comes from soybeans. The more tempeh used, the higher the protein content. Tempe has a high protein content because during the tempeh fermentation process, amino acids are released (Mustakim, 2016). Protein is a food substance that is quite important for the body, because this substance has a function as fuel in the body and also as a building and regulatory substance (Azzahrah N. I., 2019).

The results of the analysis of the fat content of biscuit products are in table 2, formula 1 has an average fat content of 14.10%, formula 2 has an average of 14.87%, and formula 3 has an average of 14.37%. Based on the results of the analysis of fat content, it has met the SNI requirements, namely a minimum of 9.5%, this is caused by the fat content in tempeh powder, the high fat content in tempeh powder makes biscuits have a high fat content. The fat content in tempe will increase after going through the drying process due to water loss. This is in accordance with the statement of Young & Mebhratu (1998) which states that soybeans contain 36.9% protein and 18.3% fat. Fat is needed by the body because it is the main source of energy formation and as a constituent of cell membranes (Azzahrah N. I., 2019).

The results of the analysis of the crude fiber content of biscuit products are in table 2, formula 1 has an average fiber content of 1.70%, formula 2 has an average of 1.72% and formula 3 has an average of 1.40%. Based on the results of the analysis, the crude fiber content does not meet the SNI requirements, namely a maximum of 0.5%. From the results of this study, the formula that has a low crude fiber content is Formula 3 with an average crude fiber content of 1.40%, this is influenced by tempeh powder where the crude fiber content in tempe powder is very high, namely 5.91%, this is because in the process of making tempe the soybean epidermis should be removed but some are still

milled so that there are still many fiber components in the tempe epidermis which do not dissolve and left behind in tempeh (Wibowo, 2016).

The results of the analysis of the carbohydrate content of biscuit products are in table 2, formula 1 has an average carbohydrate content of 65.31%, formula 2 has an average of 64.66% and formula 3 has an average of 64.98%. Based on the results of the analysis, the carbohydrate content did not meet the SNI requirements, namely a minimum of 70%, this was caused by the low carbohydrate content in red algae (eucheuma denticulate) and tempeh powder. Carbohydrates are the main source of energy and are needed by the body. Another function of carbohydrates is to launch the digestive system, because foods that are high in carbohydrates have fiber (Azzahrah N.I., 2019).

The results of the analysis of the calorie content of biscuit products in table 9 show that formula 1 has an average calorie content of 4341.0 Kcal/Kg, formula 2 has an average of 4399.5 Kcal/Kg and formula 3 has an average of 4424.0 Kcal /Kg. Based on the results of the analysis of calorie content, it meets the SNI requirements, namely a minimum of 400 kcal, a formula that has a high calorie content, namely formula 3 with an average of 4424.0 Kcal/Kg. Calorie is a unit that can be used to measure the energy value obtained by the body when consuming food/drinks (Azzahrah N. I., 2019).

Analysis using the One Way Anova test and continued with the LSD test showed protein levels in biscuits formula 1 (18.90), formula 2 (18.03), formula 3 (18.10), the three biscuits had a significant difference, in carry out the LDS follow-up test to find out the significant difference between the formulas, namely the comparison of formulas 1 and 2, and formulas 1 and 3 there is a significant significant difference ($p < 0.05$) while formulas 2 and 3 have no significant difference because it is significant ($p > 0 , 05$). The fat content in the biscuits formula 1 (14.10), formula 2 (14.87), formula 3 (14.37), the three biscuits had significantly significant differences, from the results of the LSD follow-up test there were significant differences between formulas, where the comparison formulas 1 and 2, formulas 1 and 3, formulas 2 and 3 have significant values ($p < 0.05$). Fiber content in biscuits formula 1 (1.70), formula 2 (1.72), formula 3 (1.40), the three formulas had a significant difference, an LSD follow-up test was carried out to find out a significant difference between the formulas. In Formulas 1 and 2 there is no significant difference because it is significant ($p > 0.05$), while in Formulas 1 and 3, Formulas 2 and 3 have a significant difference because it is significant ($p < 0.05$). Carbohydrate content in biscuits formula 1 (65.31), formula 2 (64.66), formula 3 (64.98), the three biscuits had a significantly significant difference, the LSD follow-up test was carried out in the LSD follow-up test, there was a significant difference between formulas, namely the comparison between formulas 1 and 2, formulas 1 and 3, formulas 2 and 3 are significant because ($p < 0.05$). The calorie content of formula 1 biscuits (4431 Kcal.kg), formula 2 (4399 Kcal.kg), formula 3 (4424 Kcal.kg) of the three

biscuits had a significant difference. The results of the LSD follow-up test between the formulas were significantly different because ($p < 0.05$).

Conclusion

The formula for biscuits combination of red algae extract and tempe has a large enough calorie according to the existing biscuit standards. The contribution of this research is to produce biscuits that will be used as a functional food for people with dyslipidemia

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References

Ahnan-Winarno AD, Cordeiro L, Winarno FG, Gibbons J, Xiao H. Tempeh: A semicentennial review on its health benefits, fermentation, safety, processing, sustainability, and affordability. Compr Rev Food Sci Food Saf. 2021 Mar;20(2):1717-1767. doi: 10.1111/1541-4337.12710. Epub 2021 Feb 10. PMID: 33569911.

Ashma Sattarkar, A. J. (2013). Phytochemical investigation of the roots of Grewia microcosLinn. *Journal of Chemical and Pharmaceutical Research*, 5(7):80-87.

Azzahrah, N. I. (2019). Formulation for Making Biscuits Made from Purple Uwi (Dioscorea alata), Seaweed (Euchema Cattonii), and Soybean Tempeh (Glycine max). *Teknologi pangan*, 1-2.

Hermayanti, M., Rahmah, N., & Wijana, S. (2016). Biscuit Formulation as an Alternative Emergency Food Product*: Jurnal Teknologi dan Manajemen Agroindustri, 5*(2), 107-113. doi:http://dx.doi.org/10.21776/ub.industria.2016.005.02.7

Hlaváčová Z, Ivanišová E, Harangozo Ľ, Petrović A, Kušteková D, Gálik B, Hlaváč P, Božiková M, Vozárová V. Physico-Chemical and Sensory Profiles of Enriched Linz Biscuits. Foods. 2021 Apr 4;10(4):771. doi: 10.3390/foods10040771. PMID: 33916552; PMCID: PMC8065930.

Handajani YS, Turana Y, Yogiara Y, Widjaja NT, Sani TP, Christianto GAM, Suwanto A. Tempeh Consumption and Cognitive Improvement in Mild Cognitive Impairment. Dement Geriatr Cogn Disord. 2020;49(5):497-502. doi: 10.1159/000510563. Epub 2020 Oct 20. PMID: 33080604.

Hung LD, Hirayama M, Ly BM, Hori K. Purification, primary structure, and biological activity of the high-mannose *N*-glycan-specific lectin from cultivated *Eucheuma denticulatum*. J Appl Phycol. 2015;27(4):1657-1669. doi: 10.1007/s10811-014-0441-0. Epub 2014 Nov 5. PMID: 32214663; PMCID: PMC7088313.

Inayah, N. (2021). Free-Radical Scavenging Activity (FRSA) of Secondary Metabolite Extracted From Indonesia Eucheuma Spinosum. *Jurnal of Chemistry*, *9*, 1-6.

Kim D, Kang SM. Red Algae-Derived Carrageenan Coatings for Marine Antifouling Applications. Biomacromolecules. 2020 Dec 14;21(12):5086-5092. doi: 10.1021/acs.biomac.0c01248. Epub 2020 Nov 17. PMID: 33201682.

Milić PS, Rajković KM, Stamenković OS, Veljković VB. Kinetic modeling and optimization of maceration and ultrasound-extraction of resinoid from the aerial parts of white lady's

bedstraw (Galium mollugo L.). Ultrason Sonochem. 2013 Jan;20(1):525-34. doi: 10.1016/j.ultsonch.2012.07.017. Epub 2012 Aug 3. PMID: 22922037.

Naseri A, Jacobsen C, Sejberg JJP, Pedersen TE, Larsen J, Hansen KM, Holdt SL. Multi-Extraction and Quality of Protein and Carrageenan from Commercial Spinosum (*Eucheuma denticulatum*). Foods. 2020 Aug 6;9(8):1072. doi: 10.3390/foods9081072. PMID: 32781749; PMCID: PMC7464751.

Othman R, Abd Rasib AA, Ilias MA, Murthy S, Ismail N, Mohd Hanafi N. Transcriptome data of the carrageenophyte *Eucheuma denticulatum*. Data Brief. 2019 Mar 12;24:103824. doi: 10.1016/j.dib.2019.103824. PMID: 30984808; PMCID: PMC6444127.

Tong KTX, Tan IS, Foo HCY, Tiong ACY, Lam MK, Lee KT. Third-generation L-Lactic acid production by the microwave-assisted hydrolysis of red macroalgae Eucheuma denticulatum extract. Bioresour Technol. 2021 Dec;342:125880. doi: 10.1016/j.biortech.2021.125880. Epub 2021 Sep 4. PMID: 34592620.

Van der Sman RGM, Renzetti S. Understanding functionality of sucrose in biscuits for reformulation purposes. Crit Rev Food Sci Nutr. 2019;59(14):2225-2239. doi: 10.1080/10408398.2018.1442315. Epub 2018 Mar 9. PMID: 29521516.

Végh R, Csóka M, Stefanovits-Bányai É, Juhász R, Sipos L. Biscuits Enriched with Monofloral Bee Pollens: Nutritional Properties, Techno-Functional Parameters, Sensory Profile, and Consumer Preference. Foods. 2022 Dec 21;12(1):18. doi: 10.3390/foods12010018. PMID: 36613234; PMCID: PMC9818951.