

Development Of Analog Rice By Utilizing Red Seaweed (*Eucheuma Spinosum*) and Native Sago From The Riau Islands, Indonesia

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Abstract. Riau island province is consisting of several islands with an area of 251,810.71 km². The area consists of ocean area of (95.79%) while the rest is land area with an area of (4.21%). One type of superior commodity in the fisheries sector is seaweed which can be found in Indonesian waters, which has the potential to be developed as a food export product. Rice is one of the main carbohydrates in the diet of people in Indonesia, but has a low protein content. One type of processed food that resembles the characteristics and shape of rice is analog rice. This analog rice has been developed as an alternative ingredient to replace rice using local flour. This alternative is almost the same as or even exceeds rice in terms of its carbohydrate content. This study aims to see the best formulation of analog rice from red seaweed (*Eucheuma spinosum*) based on hedonic testing and to determine the nutritional value of analog rice by using red seaweed (*Eucheuma spinosum*) and sago flour. The benefits of this research are: Increasing knowledge and experience in making analog rice from seaweed, Being able to determine the nutritional value of analog rice based on proximate tests), Producing healthy food, namely rice with low sugar content.

1 Introduction

The Riau Islands Province is a province consisting of several islands with an area of 251,810.71 km². The area consists of an ocean area of 241,215.30 km² (95.79%) while the rest is land area with an area of 10,595.41 km² (4.21%), (Law Number 25 of 2002). The capital of the Riau Islands is in Tanjungpinang. The Riau Islands Area incorporates Tanjung Pinang City, Batam City, Karimun Rule, Bintan Rule, Anambas Rule, Lingga Rule and Natuna Rule, the Riau Islands area comprises of 42 sub-districts and 256 sub-districts/villages with a add up to of 2,408 expansive and little islands, of which 40 percent are anonymous and uninhabited.

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One of the leading commodities in the fisheries sector is seaweed that can be found in Indonesian waters, which has the potential to be developed as a functional food export product. Seaweed has a fiber content that plays an important role in health [1]. Several studies have shown that seaweed containing carrageenan, alginate, and agar have significant effects in preventing certain diseases. The water-soluble fiber content in seaweed is higher than other land plants (dry fiber reaches 55%).

Rice is one of the main carbohydrates in the diet of people in Indonesia, but it has a low protein content [2]. Rice is a staple food in Indonesia that is not easily replaced. Rice is a source of carbohydrates for the body. In addition to rice, there are various other local food sources that can be used as sources of carbohydrates such as cassava, corn, sago, sweet potatoes, and others for nutritional variations in staple foods. Not many people are familiar with these local foods because most people still view rice as a staple food. Because of the simple way of processing rice, people have difficulty switching from rice as a staple food. One type of processed food that resembles the characteristics and shape of rice is analog rice.

This analog rice has been developed as an alternative to rice using local flour or rice flour. This alternative is almost the same or even exceeds rice in terms of its carbohydrate content [3-5]. This analog rice can be cooked and eaten as usual, and can also be served with side dishes. In addition to utilizing fishery products, it can also be used as a diversification of fishery products by utilizing seaweed. The nutritional content of analog rice can be adjusted to the target group such as having a low glycemic index value and high fiber content [6].

Water-soluble fiber can prevent colon cancer. Water-soluble fiber in red seaweed (*Eucheuma spinosum*) plays a role in lowering blood cholesterol, diabetes, liver disease and cancer [7]. This seaweed has a fairly complete nutritional content, namely carbohydrates (33.3%), protein (54%), water (27.8%), fat (8.6%), ash (22.5%), and fiber (3%) [6]. The addition of seaweed as a source of dietary fiber affects the digestibility of starch and fiber content in the resulting artificial rice. The higher the proportion of seaweed added as a source of fiber, the lower the starch digestibility will be [8]. Meanwhile, the addition of sago flour containing high resistant starch mixed with dietary fiber can improve intestinal microflora that can absorb water and combine with glucose, thereby reducing the availability of glucose.

The purpose of this research is to see the best formulation of analog rice from red seaweed (*Eucheuma spinosum*) based on hedonic testing and to determine the nutritional value of analog rice by utilizing red seaweed (*Eucheuma spinosum*) and sago flour.

2 Research methods

2.1 Time and Place

This research was conducted in July to August 2024. The research was conducted at the Chemistry Laboratory, Marine Product Laboratory and Saraswanti *Indo genetech*, Bogor. Faculty of Marine Sciences and Fisheries, Raja Ali Haji Maritime University, Tanjungpinang, Riau Islands, Indonesia.

2.2 Tools and Materials

Table 1. Tools used

No	Tool	Function
1	Chopper	Smoothing seaweed
2	Knife	As a tool for cutting
3	Cutting Board	As a base for the cutter
4	Basin	As a container for dough
5	Steamer	As a container for steaming rice
6	Electric oven	Drying rice
7	Baking Pan	As a place to heat the rice in the oven
8	Analytical balance	Measure the materials to be used
9	Stainless Steel Tray	As a container for rice
10	Mold	To print rice grains
11	Petri Dish	As a Sample Container
12	Desiccator	To Cool Tools and samples
13	Crucible Porcelain	As a Sample Container
14	Furnace	Heating the Sample
15	Hotplate	Heating/ Homogenizing the Sample
16	Kjeldhal Pumpkin	As a Sample Container
17	A Set of Distillation Equipment	Extracting substances
18	Burette and Clamp	For titration and clamping a tool
19	Erlemeyer	To measure volume and contain chemicals
20	A set of Soxhlet apparatus and condenser	To condense in the condenser
21	Heating Mantle	To heat the media
22	Glass Beaker	As a Sample Container
23	Thermometer	To Measure Temperature
24	Clamp	For Cup Clamp
25	Filter Paper	To Filter Samples
26	Mortar	To refine the sample
27	Plastic gloves	To protect the processing process
28	Plastic clip bag	Storing rice
29	MOBILE PHONE	Documentation
30	Cotton	As a test tube cover

Table 2. Materials Used

No	Material	Function
1	<i>Eucheuma Spinosum</i>	Raw materials for making analog rice
2	Soybean flour	Additional ingredients for making analog rice
3	Sago flour	Additional ingredients for making analog rice
4	CMC	Additional ingredients for making analog rice
4	Analog Rice	Materials For Samples
5	Concentrated H2SO4	To Speed Up Reaction
6	CuSO4	As a chemical
7	H2SO4	As a Chemical
8	40% NaOH solution	As a Chemical
9	Boric Acid Solution 4%	As a Chemical
10	0.1 N Hydrochloric Acid Solution	As a Chemical
11	BCG-MR Indicator Solution	As a Chemical
12	N-Hexane Solvent	As a Chemical
13	Aquadest	As a Solvent

2.3 Methods and Procedures

The method in this study uses an experimental method. The experimental method is used with the aim of seeing the influence of certain formulations on others under controlled conditions [9]. The research procedure consists of several stages, namely taking samples of red seaweed (*Eucheuma spinosum*) obtained in the Batam area, and sago obtained from place in Lingga area, Riau Islands. The second stage determines the formulation, manufacture of analog rice, proximate content analysis, and organoleptic test.

2.3.1 Formulation for Making Red Seaweed Analog Rice (*Eucheuma Spinosum*)

Table 3. Analog Rice Formulation

Material	Formulation Composition (%)		
	F1	F2	F3
Seaweed	40%	45%	50%
Sago flour	50%	45%	40%
Soybean Flour	9%	9%	9%
CMC	1%	1%	1%
Total	100%	100%	100%

2.3.2 Research Parameters

Proximate Test

Water Content (SNI 01-2354.2-2006)

Water substance was analyzed by gravimetric strategy. The test was weighed to ±5 gr which has known dry weight. The test was at that point dried in an stove at 105 °C for 3 hours. After being broiler dried, it was cooled in a desiccator for 15 minutes, at that point weighed and rehashed until it come to a steady weight. The calculation of water substance can be calculated utilizing the taking after equation:

Water content = $\frac{(A+B)-C}{B} \times 100\%$

Information:

A = Weight of empty cup (g)

B = Test portion weight (g)

C = Constant weight of container + test portion after heating (g)

Ash content analysis is determined gravimetrically. In the initial stage, weigh the sample as much as 5g (B) into a porcelain cup to obtain its weight (A), then char it until there is no smoke. The next stage, the sample is put into the furnace using a temperature of 550°C until it gets perfect ashing approximately (±4 hours). The sample is then cooled in a desiccator. Weigh until a constant weight is obtained (C). The calculation of ash content is as follows:

Ash content = $\frac{(C-A)}{B} \times 100\%$

Information:

A = Weight of empty cup (g)

B = Sample weight (g)

C = Permanent weight of cup + after spawning (g)

Fat content analyzed using direct extraction method with soxhlet. Weigh 5 grams of test portion into filter paper sleeve (hulls) that have been lined with cotton, then dry in an oven at 105°C for 10-15 minutes. It has been dried and the weight has been known, add hexane through soxhlet until half the volume of the fat flask and all parts of the hulls in the soxhlet are submerged with a condenser and water bath then extract the test portion for 3 hours, distill hexane and dry the fat residue in an oven at 105°C. Then weigh the weight, repeat the drying stage in the oven at 105°C until a constant weight is achieved. The calculation of fat content can be calculated using the formula below:

$$\text{Fat content} = \frac{C-A}{B} \times 100\%$$

Information:

A = Weight of empty fat flask (g)

B = Sample weight (g)

C = Weight of fat flask = sample after heating (g)

Protein substance examination was carried out utilizing the strategy (SNI-01-2891-1992) with the rule that nitrogen compounds are changed over into ammonium sulfate by concentrated H₂SO₄. The discharged smelling salts is bound with boric corrosive and after that standard corrosive arrangement. Weigh carefully 0.051g of test, put it into a 100 ml kjeldhal jar. Include 5g of blended selenium and 25 ml of concentrated H₂SO₄. Warm over an electric radiator or burner until bubbling and the arrangement gets to be clear greenish in 2 hours, let it cool at that point weaken and put it into a 100 ml measuring jar, alter to the line stamp, pipette 5 ml of 30g NaOH and a number of drops of PP marker. The holder employments 10 ml of 2% boric corrosive arrangement that has been blended with the pointer at that point flush the conclusion of the cooler with refined water, titrate with 0.001 N HCl arrangement. The calculation of protein substance can be gotten utilizing the taking after equation:

$$\text{Protein Content (\%)} = \frac{(V_p - V_b) \times NP \times 1.4007 \times FK}{\text{Sample weight(g)}} \times 100\%$$

Information :

V_p = Volume of 0.2 N HCl required for sample titration (ml)

V_b = Volume of 0.2 N HCl added blank titration wound (ml)

N = Normality of HCl 0.2

F_k = Protein conversion factor

W = Sample weight (g) or sample volume (ml)

Protein content is expressed in units of g/100 g sample (%)

Determination of carbohyd rates by calculating the amount of carbohydrates using the difference formula, namely by calculating the ratio of 100% to the amount of protein, fat, water and ash. Therefore, the determination of carbohydrates can affect the content of other nutrients. Here is the formula for calculating carbohydrate content:

$$\text{Carbohydrates (\%)} = 100\% - (\% \text{ Water} \% \text{ Protein} \% \text{ Ash} \% \text{ Fat})$$

Organoleptic testing is a sensory test or sensory test that uses human senses as the main tool for measuring product acceptance. The organoleptic test carried out is a hedonic test by looking at changes that occur in the color, aroma, and texture of a product. This hedonic test uses 80 untrained panelists with an assessment of the level of preference based on a scale of 1 to 3. The scores used are 1 (dislike), 2 (neutral), and 3 (like) [10].

2.3.3 Data Analysis

The analysis in this study consisted of 3 levels of treatment and 3 replications, namely F1, F2, F3. Data analysis used a Completely Randomized Design (CRD), hedonic testing using the non-parametric Kruskal-Wallis test method and if it showed a significant effect, it would be further tested with the Mann-Whitney test. Proximate data analysis used the ANOVA test and if it showed a significant difference, it would be continued with the Duncan test. Analysis of research data was calculated using Microsoft Excel 2010 and SPSS. The mathematical model of the completely randomized design is as follows:

$$y_{ij} = \mu + A_i + \epsilon_{ij}$$

Information:
 i : 1, 2, ... ,
 j : 1, 2, ... ,
 Y_{ij} : observation at (actual mean value)
 A_i : the influence of treatment factors at the i th level
 ϵ_{ij} : the influence of experimental error on the i th treatment and the j th replication.

3 Results and Discussion

3.1 Red Seaweed Analog Rice (*Eucheuma Spinosum*)

Analog rice is rice processed from red seaweed (*Eucheuma Spinosum*), sago flour, soybean flour, and CMC. Analog rice has a slightly duller color than rice in general. Below is the result of processing red seaweed and sago flour into analog rice which can be seen in the following picture.

Seen from the Figure 1 above, analog rice shows that the addition of seaweed (*Eucheuma Spinosum*) and sago flour in each treatment gives different results in terms of color, aroma, taste and shape. Analog rice with the addition of seaweed, sago flour and soybean flour aims to increase nutritional value and is able to reduce the consumption of rice with high glucose levels. Analog rice with extraordinary useful properties has exceptionally great prospects, such as analog rice items that are wealthy in fiber can be valuable for decreasing cholesterol, anticipating weight or for diabetics who have to be expend low-calorie carbohydrates [11]. The blend of ocean growth and supporting fixings such as sago flour, soybean flour, and CMC is set in a holder. There are 3 details of ocean growth (*Eucheuma Spinosum*) comparison with sago flour, specifically F1 (40:50), F2 (45:45), and F3 (50:40) [12].

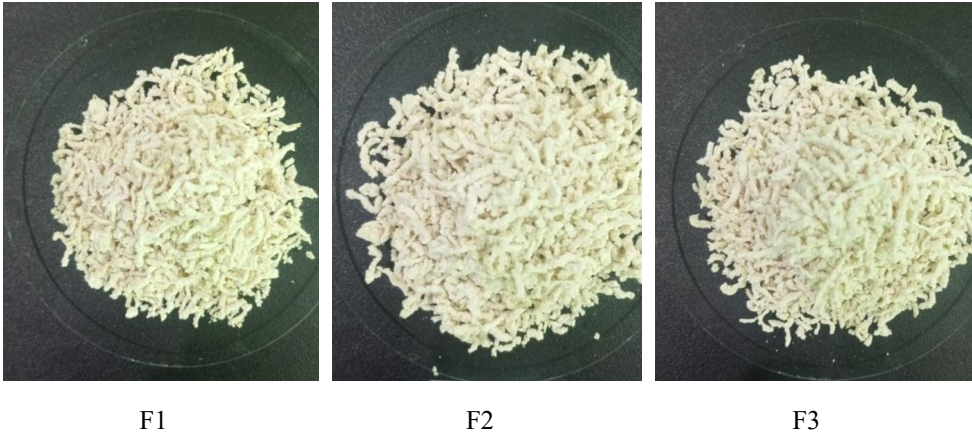


Fig. 1. Analog Rice

3.2 Proximate Analysis of Rice Analogue (*Eucheuma Spinosum*)

Table 4. Average value of the proximate test analysis of seaweed analogue rice (*Eucheuma Spinosum*)

Sample	Proximate Analysis				
	Level Water	Level Ash	Level Fat	Level Protein	Carbohydrate
F1	0.89±0.006 ^a	0.22±0.02 ^a	0.02±0.001 ^a	5.57±0.09 ^a	6.696±0.006 ^a
F2	0.89±0.001 ^a	0.25±0.09 ^a	0.02±0.002 ^a	5.71±0.13 ^a	6.869±0.009 ^b
F3	0.89±0.003 ^a	0.23±0.04 ^a	0.03±0.009 ^a	6.45±0.18 ^b	7.601±0.014 ^c

3.2.1. Water content

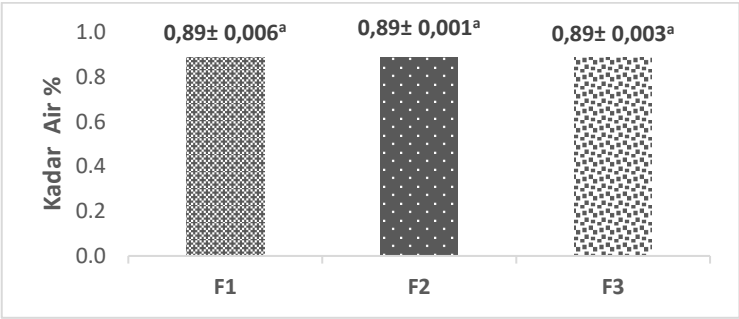


Fig 2. Histogram of water content values of analog rice from red seaweed (*eucheuma spinosum*)

The water content of analog rice from this study was not significantly different and was 0.89%. This is because all the ingredients used to make analog rice are made from seaweed and sago flour with a difference of 5% and the same drying time so that there is no significant difference in the water content of analog rice. High water content in analog rice can cause it to be easily damaged. In this study, the F1, F2, F3 treatments obtained a water content of 0.89%, this water content is lower when compared to the results of the study by Aini *et al.*, (2019) which showed the water content in corn-red bean flour was 5.15%.

The results of the analysis of variance (F test) showed that the proportion of seaweed: sago flour, the addition of soybean flour and CMC did not significantly affect the water content of analog rice. Because the results of the ANOVA test of the parameter value on the

water content of analog rice obtained a significance value of 0.957 $P > 0.05$ indicating that H_0 was accepted so that there was no significant difference in treatment (F1, F2, F3) on the water content of analog rice with the addition of seaweed and sago flour. Based on SNI 6128-2015, the water content of analog rice is a maximum of 14%. The results in this study have met SNI requirements. Rice with a water content of more than 14% will cause the rice to be easily damaged and rotten. All samples of red seaweed analog rice, sago flour, soybean flour and CMC have a long shelf life because their water content is below 14%. High water content can also cause the growth of bacteria and fungi [13].

3.2.2. Ash Content

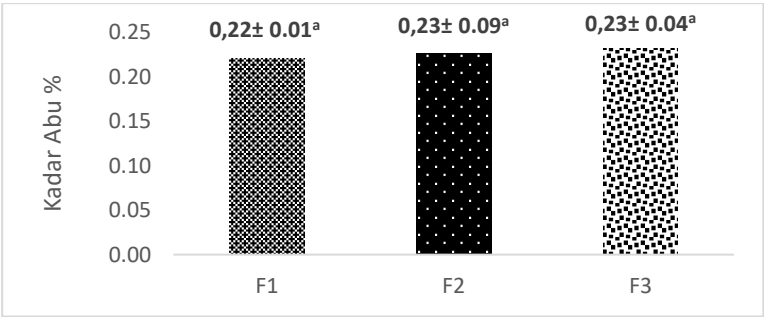


Fig 3. Histogram of Ash Content of Red Seaweed Analog Rice (*Eucheuma spinosum*) and sago flour

Based on Figure 3 above, it shows that the ash content value in analog rice ranges from 0.22% - 0.23% with the F2 treatment getting the highest value and the lowest value in analog rice in the F1 treatment. When compared to IR 36 rice which has a standard ash content of 0.20%, the ash content in analog rice from red seaweed, sago flour, soybean flour and CMC is not much different. Based on research on analog rice from daluga tubers conducted by Rahman *et al.*, (2015), the ash content results were 2.4% - 2.6% so that it was not much different from rice. This shows that the increasing use of seaweed and sago flour will cause the ash content of analog rice to increase. Ash content shows the amount of minerals contained in a material which is the mineral residue remaining after the high temperature combustion process. The results of the ash content analysis of analog rice from red seaweed, sago flour, soybean flour and CMC in various compositions ranged from 0.22% - 0.23%.

In the results of the ANOVA test calculation, the parameter value of the ash content of analog rice obtained a significance value of 0.853 $P > 0.05$, H_0 was accepted so that there was no significant difference in treatment (F1, F2, F3) on the ash content of analog rice with the addition of seaweed and sago flour seen from each treatment. Sago which is included in the main ingredient for making analog rice produces a fairly high ash content. The ash content value in healthy food according to the SNI 01-7111.1-2005 standard is no more than 3.50%. The ash content produced in this study is still within the range of the standard ash content that has been set, so the ash content of analog rice produced in this study has met the SNI requirements. Determination of ash content aims to determine whether or not a processing is good and to find out the type of material used as well as a determinant of the nutritional value parameters of a food ingredient [14].

3.2.3. Fat Content

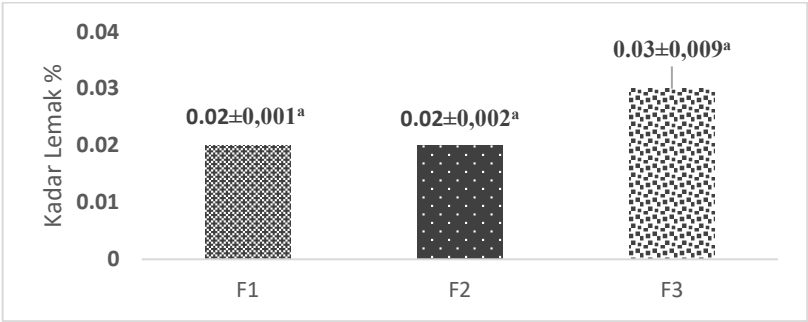


Fig. 4. Histogram of fat content of red seaweed analog rice (*Eucheuma spinosum*) and sago flour

Based on Figure 4 above, it shows that the fat content value in analog rice ranges from 0.02% -0.03% with the F3 treatment getting the highest value and the lowest value in analog rice with the F1 treatment. This causes the increasing use of red seaweed, the fat content will increase, and vice versa if the use of red seaweed is small, the fat content in analog rice will decrease.

In the statistical analysis results of the ANOVA test, the parameter value on fat content obtained a significance value of 0.234 $P>0.05$, HO was accepted so that there was no significant difference in treatment (F1, F2, F3) on the fat content of analog rice with the addition of seaweed and sago flour. This also happened in the study of Muslikatin (2012), that the addition of 3-7% seaweed flour had no significant effect on analog rice from basic ingredients of rice grits with extrusion technology. The fat content of analog rice from the study of Muslikatin (2012) ranged from 0.34-0.62% [9]. Analog rice has a low fat content so it is not easily rancid. Based on SNI 01-2987-1992, the quality requirements for good analog rice fat content must contain 0.7% fat, the fat content produced in this study has met SNI requirements.

3.2.4. Protein Content

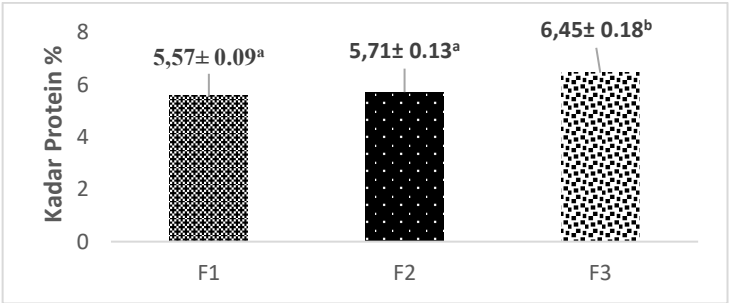


Fig. 5. Histogram of protein content of red seaweed analog rice (*Eucheuma spinosum*) and sago flour

Based on Figure 5 above, it shows that the protein content in analog rice ranges from 5.57% - 6.45% with the highest treatment in the F3 treatment of 6.45% and the lowest value in the F1 treatment of 5.57%. The increasing use of red seaweed (*eucheuma spinosum*) causes the protein content to increase. This result is not much different from the standard protein content of analog rice, which is 7.39%. In the study of Pudjiastuti *et al.*, (2021) the

results of the analysis of analog rice protein made from cassava flour, black soybeans and corn with various compositions ranged from 5.72% to 7.86% [11]. When compared to paddy rice, the protein content of analog rice is still higher than that of paddy rice, which is 3.35%.

In the results of the ANOVA test calculation, the parameter value of the protein content obtained a significance value of 0.014 $P < 0.05$, H_0 was rejected so that there was a significant difference in treatment (F1, F2, F3) on the protein content of analog rice with the addition of seaweed and sago flour. To see the differences in each treatment, further testing was carried out which was significant, namely the Duncan test. Based on the comes about of the Duncan assist test, it appeared that the protein substance of F1 was altogether diverse from F3, the protein substance of F2 was altogether distinctive from F3, the protein substance of F3 was altogether distinctive from F1 and F2. The comes about of the Duncan test appeared that there was no contrast in F1 and F2 but there was a distinction in (F1-F3) and (F2 - F3). Based on SNI 01-2987-1992, the quality standard for analog rice has a good protein content containing 6.8%. The protein content produced in this study has met SNI requirements.

3.2.5. Carbohydrate

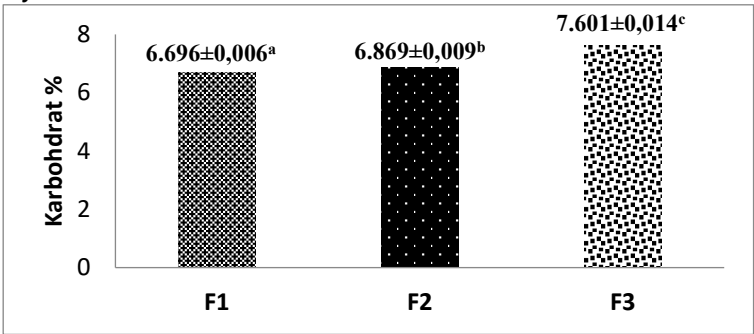


Fig. 6. Histogram of red seaweed analog rice (*Euclidean spinosum*) and sago flour

Based on Figure 6 above, it shows that the carbohydrate value in analog rice ranges from 7.601% - 6.696%. In the F3 treatment there is the highest value while in F1 there is the lowest carbohydrate value. This is because the carbohydrate content in seaweed is quite high, in previous research conducted by Muslikatin *et al.*, (2012) the content that produces carbohydrate levels ranges from 79.57–81.82% [9]. The carbohydrate content in analog rice with different formulation concentrations in each treatment is higher in seaweed carbohydrate content compared to more sago flour.

In the results of the ANOVA test calculation, the parameter value for carbohydrates obtained a significance value of 0.000 ($P < 0.05$), H_0 was rejected so that there was a real difference in the treatment of F1, F2 and F3 for analog rice carbohydrates with the addition of seaweed and sago flour. To further explore which group was significant, the Duncan test was carried out.

The comes about of the Duncan test appeared that F1 carbohydrates were essentially diverse from F2 and F3, F2 carbohydrates were essentially distinctive from F1 and F3, F3 protein levels were essentially distinctive from F1 and F2. Since they have distinctive images, the comes about of the Duncan test appear that there are contrasts in F1, F2 and F3. Based on SNI 01-2987:1992, the quality requirements for good analog rice carbohydrates, namely 78.9% of the carbohydrates produced in this study, have met SNI requirements. If humans lack carbohydrates in the body, it will cause the body to no longer form enough energy and

can result in carbohydrate deficiency. Carbohydrate deficiency is caused by a lack of food intake from plant sources (Sumbono, 2021).

3.3 Organoleptic Test Results of Red Seaweed Analog Rice (*Eucheuma Spinosum*)

Table 5. The average organoleptic value of Red Seaweed (*Eucheuma Spinosum*) analog rice and sago flour

Sample	Parameter			
	Color	Aroma	Texture	Form
F1	2.73a ± 0.477 ^a	1.83 ± 0.689 ^a	2.08 ± 0.612 ^a	1.88 ± 0.582 ^a
F2	2.64 ± 0.484 ^a	2.04 ± 0.489 ^{ab}	1.78 ± 0.693 ^{ab}	1.60 ± 0.648 ^{ab}
F3	1.99 ± 0.738 ^b	2.30 ± 0.664 ^b	1.48 ± 0.675 ^b	1.30 ± 0.582 ^b

3.3.1. Color

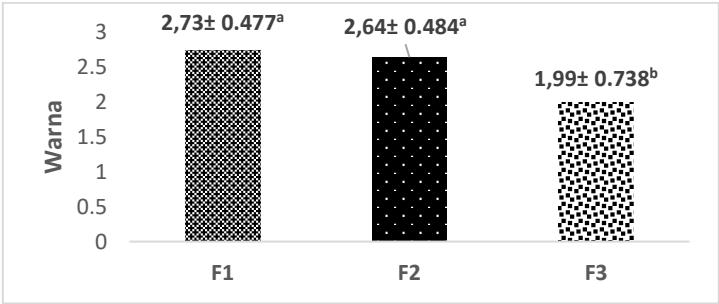


Fig. 7. HistogramRed Seaweed (*Eucheuma Spinosum*) analog rice color

Based on Figure 7 above, it shows that the color parameter value of analog rice ranges from 2.73% - 1.99%, with the F1 treatment getting the highest value while the lowest value in analog rice in the F3 treatment. In the calculation results of the non-parametric Kruskal Wallis test, the parameter value for the color of analog rice gets a significance value of 0.000 ($P < 0.05$) H_0 is accepted because there is a real difference in the F1, F2, F3 treatments on the color of analog rice, each treatment is then tested further using the Mann-Whitney test. Based on the results of the Mann-Whitney test, the results for F1 and F2 are not significantly different, the results of F1 and F3 show a real difference in the F2 color of analog rice, while the results of F2 and F3 show a real difference from F1 analog rice color.

3.3.2. Aroma

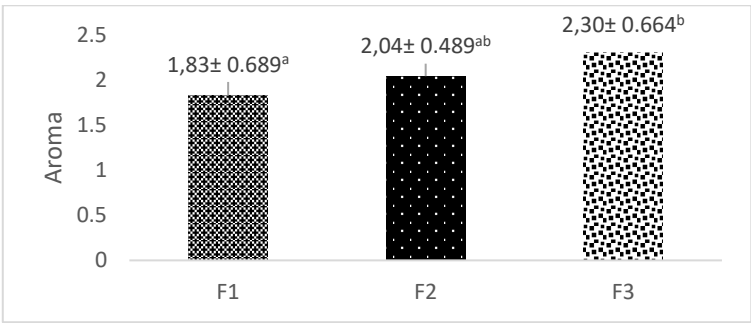


Fig. 8. Histogram Red Seaweed (*Eucheuma Spinosum*) analog rice aroma

Based on Figure 8 above, it shows that the parameter value of the analog rice aroma ranges from 2.30% - 1.83%, with the F3 treatment getting the highest value while the lowest value is in F1. The aroma of analog rice comes from soy flour which has a slightly pungent aroma so that the addition of soy flour in the manufacture of analog rice is used as much as 9% for each treatment.

In the calculation results of the non-parametric kruskal wallis test, the parameter value of the aroma of analog rice obtained a significance value of 0.000 ($P < 0.05$) because there was a real effect or there was a difference in each treatment F1, F2, F3 on the aroma of analog rice, further testing was carried out using the Mann-Whitney test. Based on the results of the Mann-Whitney test, the treatments F1 and F2 had a real effect on the treatment or there was a real difference in the aroma of F3. In the treatments F1 and F3 there was a real difference in the aroma of F2. In the treatments F2 and F3 there was a real difference in the aroma of F1. Assessment of the aroma of food can be used as a determinant of the deliciousness of a food and the aroma produced can be received through the nose and brain, the aroma released from food or beverage products is an attraction to stimulate the sense of smell that can arouse appetite when consumed.

3.3.3. Texture

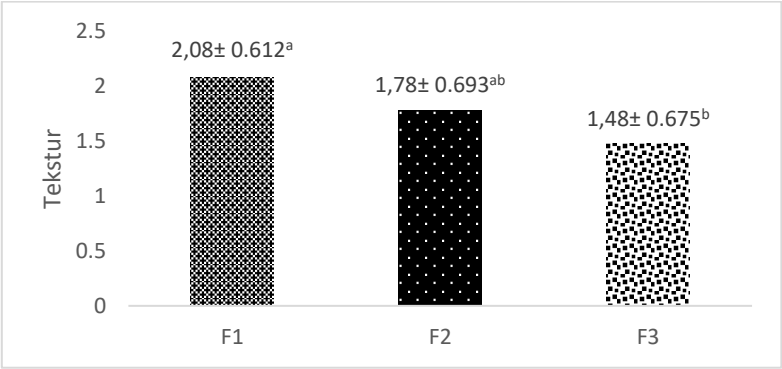


Fig. 9. Histogram Red Seaweed (*Eucheuma Spinossus*) analog rice texture

Based on Figure 9 above, it shows that the parameter value of the analog rice texture ranges from 2.08% - 1.48%, with the F1 treatment getting the highest value while the lowest value is in the F3 treatment. This shows that the texture assessment of the F3 treatment of analog rice concentration is still less acceptable to the panelists because it is too hard, while the F1 and F2 panelis still accept the texture because it is not too hard.

In the calculation results of the non-parametric kruskal wallis test, the parameter value of the analog rice texture obtained a significance value of 0.000 ($P < 0.05$) because there was a real effect or there was a difference in each treatment. Further testing was carried out using the Mann-Whitney test that each treatment had a real effect or there was a difference in the texture of F1, F2, F3. In treatments F1 and F2 there was a real difference in F3.

Treatment F1 and F3 showed significant differences in F2 analog rice aroma, Treatment F2 and F3 showed significant differences from F1 in analog rice aroma. Texture is useful for seeing the fragility or ease of breaking of rice after being molded. The stronger and less fragile the analog rice, the better the quality of the analog rice. Therefore, the use of seaweed and sago flour in making analog rice can increase the level of elasticity and sensory value of the resulting product [15]. This texture score is greater when compared to analog rice from previous studies which ranged from 2.14-3.08 with a rating scale of 1-5 [16-18].

3.3.4. Form

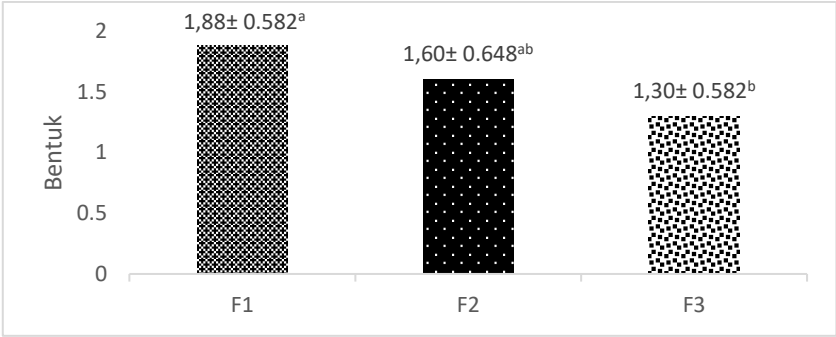


Fig. 10. Histogram Red Seaweed (*Eucheuma Spinosum*) analog rice texture

Based on Figure 10 above, it shows that the parameter values in the analog rice form range from 1.88% - 1.30%, with the F1 treatment getting a higher value while F3 gets the lowest value. This shows that the assessment of the form of all concentrations of analog rice is acceptable to the panelists.

In the calculation results of the non-parametric kruskal wallis test, the parameter value of the analog rice form obtained a significant value ($P < 0.05$) indicating that in the treatment of the amount of seaweed concentration there was a real effect or there was a difference in each treatment because there was a real difference in the treatment of F1, F2, F3 on the form of analog rice. Further testing was carried out using the advanced Mann-Whitney test. Based on the results of the advanced Mann-Whitney test, each treatment had a real effect or there was a difference in the form of F1, F2 and F3. The comes about of the F1 and F2 encourage tests appeared a genuine distinction in F3, the comes about of the F1 and F3 advance tests appeared a genuine contrast within the F2 smell of analog rice, the comes about of the F2 and F3 assist tests appeared a genuine contrast in F1 so that they got diverse documentations.

4 Conclusion

Based on the comes about of the inquire about that has been carried out, the comes about gotten from the investigation information related to ruddy ocean growth analog rice (*Eucheuma spinosum*) and sago flour are the comes about of hedonic testing carried out with 80 untrained panelists on the F1 treatment with the expansion of ocean growth and sago flour as much as 40% : 50% get results best by the panelists since it incorporates a uniform color appearance, a slightly smooth surface and the coming about color isn't as well dull, the unmistakable aroma of soy flour isn't as well thick, and the shape isn't as well great since it is compelled by the printing.

Proximate value of analog rice with the addition of seaweed and sago flour concentration in F2 treatment (45%: 45%) produced water content (0.89%), ash content (0.25%), fat content (0.02%), protein content (5.71%) and carbohydrates (6.869%). Red seaweed analog rice of all treatments has met the SNI 01-2987: 1992 standard so that the use of seaweed and sago flour as ingredients for making analog rice is very safe for consumption and can be used as a substitute for rice that is low in sugar and high in nutrition.

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