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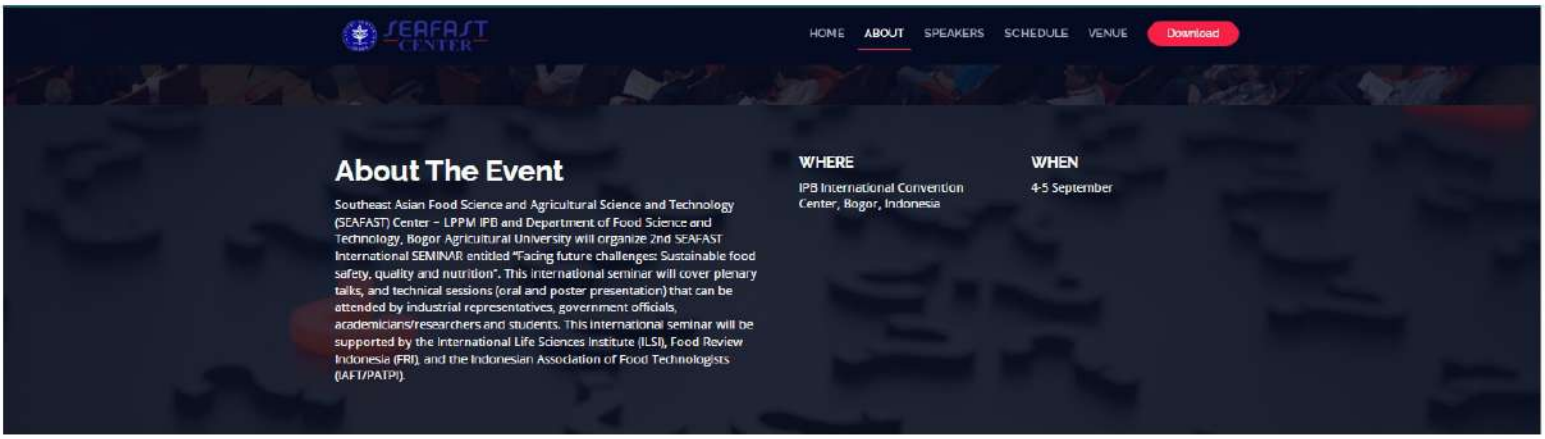

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Dietary Fiber and Texture Property of Seaweed Jelly with Pomelo Albedo Substitution

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Keywords: Dietary Fiber, Gelatin, Pomelo Albedo, Seaweed.

Abstract: **Background:** Pomelo is a fruit with a high nutritional value, but its use as food ingredients has not been optimized. Seaweed can lose its nutrients content due to various treatments in processing. Pomelo albedo was known for its fiber and pectin content, and its substitution can increase nutritional value in the food. **Objective:** This study aimed to increase the nutrient value in seaweed jelly product by pomelo albedo as a substitution and its pectin expected to replace the use of gelatin in jelly production. **Methods:** This research was an experimental study with a completely randomized design (CRD) method with one factor, that is the addition of pomelo albedo. **Results:** There was a significant difference in dietary fiber content in each treatment group (p-value 0.000). The highest content of dietary fiber was found in samples by 45% pomelo albedo substitution with dietary fiber 2.60%. The texture of jelly shows a significant difference with p-value 0.041. **Conclusion:** The substitution of pomelo albedo gave a significant difference in increasing dietary fiber content in seaweed jelly and the right amount of pomelo albedo can be used as a substitute for gelatin.

1 INTRODUCTION

Indonesia was the second largest producer of seaweed carrageenan in the world after Philipines (Parenrengi & Sulaeman, 2007). The production was ranked first in total fisheries production of fish, shrimp and other commodities (Hamid & Kamisi, 2011). Seaweed jelly is made with a method of boiling for quite a long time, the boiling process aims to inactivate the enzyme and reduce the number of microbes. In the other hand, this process can also affect the levels of fiber in seaweed. Boiling seaweed with a temperature of 90^{O}C for 5 minutes, is known to reduce total dietary fiber by 3.8%, soluble food fibers by 5.0%, crude fiber by 0.85% (Chrystiawan, 2015).

Seaweed jelly is a product with a chewy texture. This texture is formed due to the presence of gel, which is gelatin added to the manufacturing process. Gelatin with its extensive use in the food and pharmaceutical industries has always been a becoming pivotal issue. Gelatin production in the world reaches 326,000 tons/year in detail. The production of gelatin that comes from pork skin is the highest (46%), followed by cows skin (29.4%), beef bone (23.1%) and other sources (1.5%) (Suptijah, et al., 2013). Islam emphasizes the Moslem to earnestly pay attention to the foods and beverages that will be consumed. In addition to good quality, food must also be of the halal type. The use of gelatin in seaweed jelly still raises concerns about its halal status, because of the possibility of using animal gelatin which is forbidden as a pork skin in the process of making jelly (Rismandari, et al., 2017).

Pomelo albedo contains pectin quite high compared to other types of citrus. Pectin in the pomelo albedo has the ability to form a gel. The ability of gel formation from pectin due to acid addition and the heating treatment which help in forming elasticity in the resulting products (Octaviana, et al., 2013).

Seaweed jelly in this study is made from seaweed substituted with pomelo albedo as a source of pectin to replace gelatin which commonly used as a gel-forming material, the main source of concern about jelly halal status as an effort to provide the tranquillity of consumers in consuming jelly. The substitution of seaweed jelly with pomelo albedo is also expected to increase the nutritional value of the production of jelly so that foods with high nutritional value are obtained. The general objective of this study was to analyze dietary fiber content and the texture property of seaweed jelly (*Eucheuma cottonii*) with pomelo albedo (*Citrus maxima*) substitution.

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2 MATERIALS AND METHODS

The type of research used in this study is an experimental study in the food and nutrition technology laboratory. In this study, a completely randomized design (CRD) method was used with one factor. That is the addition of pomelo albedo with 3 analysis treatments by 2 replications of samples, each of which fiber content and texture property were analyzed. The data obtained was analyzed by ANOVA test which if there is a difference, the analysis is continued using the Post hoc test. The experiment sample consisted of four substitution formulations, there are three experimental groups and one control group. Then, the control group with no substitution was given a C code which was a comparison to the group given experimental treatment. Samples with 15% substitution were given code SJ 1, substitution of 30% was given code SJ 2, and 45% were coded SJ 3. Experiments in this study were carried out two repetitions, which meant making seaweed jelly with pomelo albedo substitution was repeated twice with the same basic ingredients.

This research was conducted in December 2018 until February 2019. The production of seaweed jelly was carried out at laboratory of the Faculty of Science and Technology, University of Darussalam Gontor. Analysis of dietary fiber and texture property were carried out at the CV Chem-Mix Pratama Yogyakarta Laboratory.

The instrument used in making seaweed jelly includes spoons, knives, basins, blenders, stoves, pans, moulds and scales. The instrument used in the analysis of the content of seaweed jelly are:

a. Dietary fiber analysis: Analytical scales, water purifiers, Erlenmeyer glasses, ovens, incubators, filter paper, and desiccators.
b. Texture analysis: Texture analyzer. The ingredients used in making seaweed jelly includes seaweed (*Eucheuma cottonii*), granulated sugar, citric acid, vanilla, NaCl, pomelo albedo and whiting. The material used in the analysis of seaweed jelly content of dietary fiber are buffer phosphate ph 7, alpha amylase enzyme, distilled water, 1 N HCl, 1% pepsin enzyme, 1N NaOH, beta amylase enzyme, ethanol, acetone.

This study was divided into 4 stages, the first step was determining the percentage of pomelo albedo substitution. The percentage of pomelo albedo substitution determined at this stage was 15%, 30% and 45%. Pomelo albedo added during the cooking process of seaweed jelly. The second stage was the preparation. Before experiments were carried out, the instruments and materials used in this study need to be prepared. The preparation stage must be carried out carefully and thoroughly so that in the future the research process regarding the analysis of fiber content and the texture property of seaweed jelly with the substitution of pomelo albedo run smoothly without any obstacles. Material preparation also includes the selection of raw materials and additional materials to obtain good sample quality.

The material used in this study is seaweed (*Eucheuma cottonii*) which will be processed into jelly with pomelo albedo (Citrus maxima) substitution by grouping samples into 4 sample groups, namely: C (control group), SJ 1 (15% substitution) , SJ 2 (30% substitution), and SJ 3 (45% substitution). The third stage was making seaweed jelly with pomelo albedo substitution. The fourth stage of this research was the analysis of dietary fiber content and texture property in seaweed jelly with pomelo albedo substitution. The procedure for making jelly in this study was a modification of the formulation and procedure for processing seaweed jelly by Yuliati, et al., (2016).

a. Making seaweed jelly begins with washing dried seaweed and soaking for 3 days with a 20:1 ratio of water:seaweed until the seaweed blooms with soaking water which is replaced every 12 hours.
b. Peel pomelo and separate the albedo with the green outer part. Wash pomelo albedo with running water then cut and soak using 2 litres of water with 31 g whiting for 12 hours and wash again.
c. Previously, prepare seaweed and albedo, then weighed according to the treatment group and smoothed using a blender and water.
d. The dough that has been smooth is then cooked until the solubility is evenly distributed with 30 minutes cooking time and then add the other ingredients.
e. Pour the cooked mixture into the mould and cooled.

The total dietary fiber tested in this study was all of the insoluble fibers and soluble fibers and will be carried out by multi-enzymatic methods. Calculation of total dietary fiber content (Total dietary fiber = insoluble food fiber + dissolved food fiber). Jelly texture analysis is done by using a texture analyzer by placing the sample on the object table. The probe on the device is lowered to touch the sample then the tool will run automatically.

3 RESULTS AND DISCUSSION

3.1 Analysis of Pomelo Albedo Substitution Effect on Dietary Fiber Content in Seaweed Jelly

Based on ANOVA test of dietary fiber content in the seaweed jelly, it could be concluded that different percentage of pomelo albedo substitution significantly affected the dietary fiber content with a significance value of p-value 0.000. ANOVA test results on dietary fiber content in seaweed jelly sample are shown in *Table 1*.

Table 1: Anova Test Results for Dietary Fiber (%) Contents.

Group	Mean ± SD	p-value
C	0.43 ± 0.118^{a}	0.000
SJ 1	1.10 ± 0.212^{b}	
SJ 2	1.64 ± 0.169^{c}	
SJ 3	2.60 ± 0.285^{d}	

Note: C = Substitution 0%, SJ 1 = Substitution 15%, SJ 2 = Substitution 30%, SJ 3 = Substitution45% Sample with a different alphabet in one column shows a significant difference between group.

Analysis of dietary fiber in various seaweed jelly with pomelo albedo substitution shows the different percentage of fibers contained in each jelly formulation group. The analysis of fiber content in seaweed jelly with pomelo albedo substitution in Table 1 shows a significant effect on dietary fiber levels of each group. Dietary fiber content increase along with increased of pomelo albedo substitution. The analysis of dietary fiber content shows that the sample with the best dietary fiber content is a sample with code SJ 3 (2.60% ± 0.285) while the sample with the lowest dietary fiber content value is in the sample with code C (0.43% ± 0.118).

The high fiber content of a product depend on the content and concentration of the ingredients used (Wintirani, 2016). Pomelo albedo is the white, spongy and cellulosic tissue as the principal citrus peel component and a functional product that can be used as food ingredients due to its high fiber content. Pomelo albedo is also expressed as a low- calorie food ingredient (Zain, et al., 2014). The dietary fiber content in jelly products is increased with increasing percentage of pomelo albedo substitution. Based on the analysis results of dietary fiber content shown in *Table 8*, it can be concluded that the highest content of dietary fiber is owned by the sample of seaweed jelly with code SJ 3 (2.60%) and the lowest content of dietary fiber found in jelly formulation coded C, which is 0.43%.

Pomelo albedo is a food that contains pectin. The pectin content in pomelo albedo is quite high compared to other types of citrus (Octaviana, et al., 2013). The addition of the percentage of pomelo albedo in various formulations can increase the pectin content in jelly formulations depending on the number of pomelo albedo substituted. According to Dewi (2017), the results of fiber analysis showed that along with the addition of more pectin extracts in one sheet jam formula, the fiber content produced tends to increase.

3.2 Analysis of Pomelo Albedo Substitution Effect on Gel Strength of Seaweed Jelly

Texture analysis performed on jelly samples can determine the gel strength values of the samples and express in Newton (N) units. *Figure 1* which is the result of ANOVA test on gel strength of seaweed jelly products shows a significance value of p-value 0.041. Significant values in ANOVA test shows that there were at least 2 groups with significantly different gel strength values. The post hoc test results showed that there was no significant difference between the group with the addition of pomelo albedo substitution to the value of seaweed jelly gel strength with the codes C, SJ 2 and SJ 3 while the sample with code SJ 1 had a noticeable difference compared to the other samples.

The average value of gel strength from the control group is 0.114 N ± 0.024 based on these data, it can be stated that the gel strength of the experimental group who approached the control group is a sample with formulation SJ 3 with a gel strength value of 0.172 N ± 0.066, and a sample that had a considerable distinction was sample of formulation SJ 1 with gel strength values of 0.495 N ± 0.328.

The jelly candy texture is related to hard and soft or the elasticity of the product produced. The jelly candy texture produced was influenced by several factors, there are water content, sugar concentration, and pH. The high water content in the product will affect the texture to be soft (Octaviana, et al., 2013). Some things that can affect the texture of food are temperature and cooking time, this was because the higher the temperature and the longer time used when processing food causes the moisture content in the evaporating material to make the product hard. While high sugar levels will cause food to become hard (Nilasari, et al., 2017).

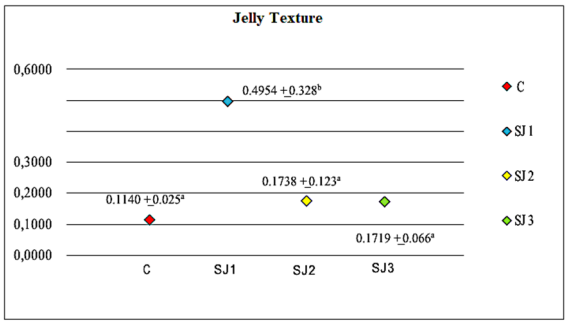

Figure 1: Anova Test Results for Texture (N) of Seaweed Jelly.

Note: C = Substitution 0%, SJ 1 = Substitution 15%, SJ 2 = Substitution 30%, SJ 3 = Substitution45% Sample with a different alphabet in one column shows a significant difference between group.

Pectin is widely used to modify texture, so the product has a chewy texture. Pectin cannot form a gel well without sugar and acid. Supporting materials that affect the elasticity of jelly candies are fructose syrup, sucrose, carrageenan and citric acid (Sahputra, et al., 2018). The pectin content found in pomelo albedo is quite high when compared to other types of citrus (Octaviana, et al., 2013). The content of pectin found in fruit pulps and the citrus peel will be very useful if processed as marmalade or jelly candy and the research from Nianti (2017) showed that the higher the concentration of adding citrus peel powder decreases the elasticity and brightness of jelly candy. Increasing the concentration of pectin can reduce water content (Syarifuddin & Yunianta, 2015).

Addition of pectin to food can improve the texture and make the texture of food more solids and compact. The process of cooking and heating can affect the character and texture of food. Research by Dewi, et al., (2013) showed that the heating process made the consistency of the albedo jam rather fluid due to the heating of the albedo in the form of a sponge absorbing a lot of water so that the texture was destroyed and the jam produced by the texture became rather liquid. Texture product can depend on the content and concentration of the ingredients used. The raw material used in this study was albedo in fresh form and not albedo pectin extract. The results of this study indicate that the value of gel strength continues to decline with the addition of pomelo albedo substitution, pomelo albedo is a white raw material with spongy texture so that the decrease in gel strength of the sample is estimated because of the large amount of water absorbed by pomelo albedo during the cooking process resulting in gel strength continues to decrease with the addition of the percentage of pomelo albedo substitution.

Gelatin production in the world reaches 326,000 tons/year and 46% of it is gelatin made from pork skin. In this study, making seaweed jelly with the substitution of pomelo albedo included aims to replace the use of gelatin with natural pectin ingredients contained in pomelo albedo so that produced products that have a more guaranteed halal status and reduce concerns when consuming jelly.

4 CONCLUSION

Jelly dietary fiber continues to increase with the increasing percentage of pomelo albedo substitution and shows significant differences between each formulation group (p-value 0.000) and the highest fiber content found in the sample with 45% of pomelo albedo substitution (2.60%). The jelly texture shows a significant difference results with p-value 0.041. The difference shows in a sample with SJ 1 code, but samples SJ 2 and SJ 3 do not show a significant difference, so with the right amount, pectin in pomelo albedo can be used as a substitute for gelatin.

The jelly formula in this study is a basic formula in making jelly and can be developed to make other jelly formulations so that it can increase the variety of processed seaweed and pomelo albedo products. A hedonic test is needed to determine which formulation is acceptable and preferred by consumers.

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