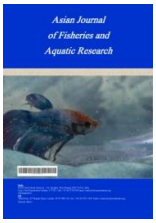

Asian Journal of Fisheries and Aquatic Research

12(5): 33-43, 2021; Article no.AJFAR.69013
ISSN: 2582-3760

Chemical and Organoleptic Characteristics of Seaweed Jelly Candy (*Eucheuma cottonii*) with the Addition of Red Ginger (*Zingiber officinale Roscoe*) Extract

Suci Rizkia Amalia[1*], Iis Rostini[1], Mega Laksmini Syamsuddin[1] and Rusky Intan Pratama[1]

[1]Department of Fisheries, Faculty of Fisheries and Marine Science, Padjadjaran University, Sumedang Regency, West Java, Indonesia.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJFAR/2021/v12i530246
Editor(s):
(1) Dr. Pınar Oguzhan Yildiz, Ataturk University, Turkey.
Reviewers:
(1) Dzulsuhaimi Daud, Universiti Teknologi Mara, Malaysia.
(2) Hind Mikdame, Sidi Mohamed Ben Abdallah University, Morocco.
Complete Peer review History: http://www.sdiarticle4.com/review-history/69013

Original Research Article

Received 25 March 2021
Accepted 31 May 2021
Published 14 June 2021

ABSTRACT

Eucheuma cottonii is one of seaweed species that has beneficial economic value and widely cultivated in Indonesia. Diversifying product into seaweed jelly candy could be carried out to utilize the source. The seaweed distinctive aroma is one of problem in producing jelly candy. Ingredient with strong aroma such as red ginger is needed to covered the smell. This research was aimed to determine the optimum concentration of red ginger (*Zingiber officinale Roscoe*) extract and seaweed (*Eucheuma cottonii*) to produce high quality jelly candy based on chemical and organoleptic characteristics. This research used an experimental method consisting of 4 different concentration of red ginger extract (0%, 40%, 50% and 60%) with 20 panelists as evaluators. Chemical composition (water content, protein content, fat content, carbohydrate content, crude fiber content) and organoleptic characteristics (appearance, aroma, texture, taste) of jelly candy were observed as parameters in this research. The results showed that the addition of 50% red ginger extract to jelly candy produced the best organoleptic characteristics and most preferred by

**Corresponding author: Email: sucirizkia8@gmail.com;*

panelists. The chemical analysis showed the jelly candy contained 6,22% water, 0,88% protein, 0,19% fat, 96,82% carbohydrate, and 1,54% crude fiber. Addition 50% of red ginger extract is recommended to produce seaweed jelly candy that has the best and most preferred characteristics.

Keywords: Eucheuma cottonii; jelly candy; red ginger; organoleptic characteristics; chemical composition.

1. INTRODUCTION

Indonesia is a country that has potential to produce large seaweed and is known as one of the seaweed exporters in Asia [1]. Seaweed is one of the fishery commodities that has beneficial economic value and potential to be developed. Seaweed production in Indonesia reached 10,32 million tons in 2018 and 9,91 million tons in 2019 [2].

Eucheuma sp is type of seaweed which widely cultivated in Indonesia and has important economical value [3]. This type of seaweed is generally used for food. *Eucheuma cottonii* seaweed is one species of seaweed that produces carrageenan in the form of polysaccharide compounds [4]. This type of seaweed contains ingredients that are rich of dietary fiber which is good for health, but its utilization for food products in Indonesia is still very limited. Therefore, utilization efforts are needed to encourage these fishery products. One of its uses is by diversifying product into seaweed jelly candy.

Jelly candy is a soft textured candy which processed with the addition of hydrocolloid components such as agar, gum, pectin, starch, carrageenan, and gelatin which is used to modify the texture, so that chewy candy is produced [5]. Jelly candy is a product that is liked by many people from children to adults because it has a chewy and distinctive candy texture.

The use of *Eucheuma cottonii* in making jelly candy is intended as a hydrocolloid material to produce chewy candy products. One of the hydrocolloid ingredients in seaweed is carrageenan. One of the problems in using *Eucheuma cottonii*, both fresh and dry, in making jelly candy is the distinctive aroma of seaweed. Therefore, a material that has a strong aroma is needed to cover the distinctive aroma of the seaweed. One of the ingredients that has a strong aroma is ginger [5].

Ginger has a distinctive aroma due to the essential oil content and the specific taste of spicy flavor derived from oleoresin compounds [6]. Red ginger extract has the highest volatile (essential oil) and non-volatile (oleoresin) components than other types of ginger, namely the essential oil content of around 2,58% - 3,90% and oleoresin 3% [7]. The selection of red ginger in seaweed jelly candy products is because red ginger has a higher content of essential oils than other types of ginger. In addition, red ginger has various benefits that are good for the body. Essential oil is a component that gives ginger a distinctive aroma [8].

The addition of red ginger extract to seaweed jelly candy can cover the distinctive aroma of seaweed, so the quality of the jelly candy produced can be better. Therefore, the research of making jelly candy needs to be done to get the right formulation between red ginger extract and seaweed (*Eucheuma cottonii*) to produce jelly candy with good quality based on chemical and organoleptic characteristics and accordance with the quality standard of jelly candy based on SNI 3574.-2-2008. The organoleptic test was carried out because so far the jelly candy on the market is rarely added with ginger. Organoleptic testing plays an important role in measuring product acceptance and assessing the quality of food products. Based on this, it is necessary to carried out an organoleptic test to find out whether this product can be liked by consumers or not.

2. MATERIALS AND METHODS

2.1 Time and Place

This research was conducted during August-October 2020. The study was conducted in the Fishery Product Processing Laboratory, Faculty of Fisheries and Marine Sciences, Padjadjaran University, Sumedang Regency, West Java, Indonesia.

2.2 Materials and Tools

The materials used are *Eucheuma cottonii* seaweed 100 g from Kemis Market Tangerang Regency, Banten, Indonesia; red ginger (*Zingiber officinale Roscoe*) 300 g from Tamansari, Bogor Regency, Indonesia; water; and granulated sugar 250 g. The tools used are basin, blender, measuring cup, stove, baking sheet, bowl, spatula, analytical scales, needle thermometer, pan, knife, sieve.

2.3 Research Procedure

2.3.1 Procedure of making red ginger extract

The procedure for making red ginger extract was carried out according to the study of Bactiar et al. [5]. Red ginger was weighed as much as 300 g and peeled the skin. After that, the red ginger was washed using running water. Then the red ginger was cutted into several pieces. Then, red ginger was mashed using a blender and added mineral water with a ratio of 1:1. After being crushed, the red ginger prorridge was filtered using a sieve to obtain an extract of red ginger. The red ginger extract obtained was 400 ml from 300 g of red ginger.

2.3.2 Procedure of making seaweed jelly candy with the addition of red ginger extract

The procedure for making seaweed jelly candy was carried out according to the study of Sukotjo and Asmira [1]. The cleaned dried seaweed (*Eucheuma cottonii*) was soaked using rice washing water [9] for 24 hours and with clean water for 18 hours. Then, seaweed was washed and weighed as much as 100 g. After that, seaweed was mashed using a blender with a comparison of seaweed: water = 1:5. The mashed seaweed was cooked at a heating temperature of 95ºC until the volume of the solution was reduced by half. Then, the red ginger extract and granulated sugar were added. Then, the solution was heated at a heating temperature of 95ºC until it thickens. After that, put the jelly candy dough in the baking sheet and let it stand for 1 hour at room temperature. Then, put the jelly candy in the refrigerator for 24 hours. After that, cut the jelly candy using a knife. Then, the jelly candy was dried by drying in the sun for three days until the candy was dense and chewy.

2.4 Research Methods

This research used an experimental method consisting of 4 different treatments of red ginger extract (0%, 40%, 50%, 60%, respectively) with 20 panelists as evaluators. The panelists used are semi-trained panelists [10] who are students of the Faculty of Fisheries and Marine Science University Padjadjaran who previously knew and studied organoleptic testing. The parameters observed in this study were the chemical composition (water content, protein content, fat content, carbohydrate content, crude fiber content) which tested in all treatments and organoleptic characteristics (appearance, texture, aroma, taste) of the jelly candy based on the panelists' preference level using the hedonic test. The hedonic test was aimed to determine the panelist's preference level with a value scale, namely: very dislike (1), dislike (3), neutral / ordinary (5), like (7) and very like (9) [10]. Testing of water content used gravimetric method, protein content used Kjeldahl method, fat content used Soxhlet method, carbohydrate content used by difference method, and crude fiber content used gravimetric method [11].

2.5 Data Analysis

The data obtained from the preference test (hedonic test) were analyzed using Friedman's two-way variant analysis to determine the effect of adding red ginger extract to the preference level of seaweed jelly candy. If the Friedman test shows significant result, the test results are continued with multiple comparison tests, while to determine the best treatment used bayes method [12]. Chemical test data were analyzed descriptively. Data water content, protein content, fat content, carbohydrate content, and crude fiber content from single determination.

3. RESULTS AND DISCUSSION

3.1 Chemical Characteristics of Seaweed Jelly Candy

3.1.1 Water content

The results of the water content test of seaweed jelly candy with the addition of red ginger extract are presented in Table 1.

Based on the test, the highest water content was found in jelly candy with the addition of red ginger extract treatment as much as 60%, which was 7,36%, while the lowest water content was found in jelly candy without the addition of red ginger extract which was 5,36%. Jelly candy with the addition of red ginger extract has a higher water content than jelly candy without the

addition of red ginger extract and the more concentration of adding red ginger extract, the water content of the jelly candy is higher. This is because fresh ginger has high water content, so it can affect the water content of the product. Fresh red ginger has 70,48% water content [13].

Overall, jelly candy in all treatments had low water content, but the jelly candy was still in accordance with the quality standard for the water content of jelly candy in SNI 3547.2-2008, which is maximum of 20%. The low water content is due to the water evaporation process that occurs at the time of cooking at a temperature of 95°C. In addition, the use of granulated sugar in the making of jelly candy can absorb and bind water to the product, so it can reduce the water content in the product. The drying process of the jelly candy which causes the jelly candy to dry on the surface can also result in decreasing levels of water content of jelly candy. In addition, the use of seaweed in this study can also bind water, so it can lower the water content in the product. Seaweed contains a lot of hydrocolloid components in the form of agar, carrageenan, and alginate. Hydrocolloids are polymer components derived from vegetables, animals, or microbes which generally have the ability to absorb and bind water. Hydrocolloids have characteristics that can absorb and bind water well [14]. Jelly candy that has a low water content can be caused by an even stirring process, resulting in large water evaporation [15].

3.1.2 Protein content

The results of the protein content test of seaweed jelly candy with the addition of red ginger extract are presented in Table 2.

Based on the test, the highest protein content was found in jelly candy without the addition of red ginger extract treatment, which was 1,37%, while the lowest protein content was found in jelly candy with the addition of red ginger extract as much as 60%, which was 0,71%. Protein content in jelly candy decreased along with the addition of red ginger extract. This is because fresh red ginger used in making jelly candy has a high water content, so the more concentration of the extract of red ginger are added on jelly candy will cause the protein content decreases. Protein content is influenced by water content and fat content, where there is an inversely proportional relationship between protein and water content, the higher of the water content in a food ingredient that is added will make the protein content decrease because myogen and protein are water soluble [16].

The seaweed jelly candy from this study has low protein content because the protein in the jelly candy has been denatured due to the heating process at the time of making jelly candy and the drying process. The boiling process can result in decreased protein content in food product [17]. Processing using high temperatures will cause protein denaturation, resulting in coagulation and solubility or the ability of the dissolution will be decreased. The reaction that occurs when heating protein can damage the condition of the protein, so that protein content can be decreased [17]. The heating process will cause the protein degradation and this condition not only causes the nutritional value to decrease, but protein activity as enzymes and hormones will be lost [18].

3.1.3 Fat content

The results of the fat content test of seaweed jelly candy with the addition of red ginger extract are presented in Table 3.

Based on the test, the highest fat content was found in jelly candy without the addition of red ginger extract treatment, which was 0,16%, while the lowest protein content was found in jelly candy with the addition of red ginger extract as much as 60%, which was 0,92%.

Fat content in jelly candy decreased along with the addition of red ginger extract. This is because water content has an inversely propotional relationship with fat content which is the higher the water content, the lower the fat content [19]. This is accordance with the results of this study, where the fat content of jelly candy decreases along with the addition of red ginger extract and the water content increases along with the addition of red ginger extract.

The seaweed jelly candy from this study has low fat content because the fat contained in the jelly candy has been damaged due to the heating process at the time of making jelly candy and the drying process. Continuous heating will cause the fat content to degrade. Fat damage will be increased along with the high temperature used [20]. In addition, the seaweed and red ginger has low fat content, so the fat content of jelly candy produced is low. *Eucheuma cottonii* has 0,37% fat content [21]. Fresh ginger has 1% fat content

[22]. In this study, the fat content of jelly candy decreased along with the addition of red ginger extract.

3.1.4 Carbohydrate content

The results of the carbohydrate content test of seaweed jelly candy with the addition of red ginger extract are presented in Table 4.

Based on the test, the lowest carbohydrate content was found in jelly candy without the addition of red ginger extract treatment, which was 95,92%, while the highest carbohydrate content was found in jelly candy with the addition of red ginger extract as much as 60%, which was 96,93%. The results showed that carbohydrate content of seaweed jelly candy with the addition of red ginger extract is higher than jelly candy without the addition of red ginger extract and the more concentration of red ginger extract added, the carbohydrate content are getting higher. This is because the fresh ginger used in making of jelly candy contains carbohydrates, so that ginger also affects the carbohydrate content in jelly candy. Fresh ginger has 10% carbohydrate content [22]. Ingredients that contain carbohydrates will increase the carbohydrate content during the cooking process when added to a food product [23].

The seaweed jelly candy in this study has high carbohydrate content due to the use of seaweed and the addition of granulated sugar to the jelly candy dough. Carbohydrates from seaweed consist of cellulose and amorphous in the form of agar or carrageenan [24]. *Eucheuma cottonii* was able to produce kappa carrageenan at 65,75% [21]. The high content of carrageenan in seaweed can cause high content of carbohydrates in jelly candy. The high carbohydrate content of jelly candy in this study was also caused by low levels of other nutritional components, namely water content, fat content, and protein content. Carbohydrate levels are influenced by other nutritional components, the lower the other nutritional components, the higher the carbohydrate content. Nutritional components that affect the amount of carbohydrate content include the content of protein, fat, water and ash [25].

3.1.5 Crude fiber content

The results of the crude fiber content test of seaweed jelly candy with the addition of red ginger extract are presented in Table 5.

Based on the test, the lowest crude fiber content was found in jelly candy without the addition of red ginger extract treatment, which was 1,42%, while the highest crude fiber content was found in jelly candy with the addition of red ginger extract as much as 60%, which was 1,75%. The presence of crude fiber content in jelly candy is caused by the use of seaweed and red ginger. *Eucheuma cottonii* has 1,39% crude fiber content [14].

The results showed that the crude fiber content of jelly candy increased along with the addition of red ginger extract. This is because ginger contains crude fiber, so the more concentrations of ginger extract added, the crude fiber content will be increased. Fresh ginger has crude fiber content of 7,53% [15].

3.2 Organoleptic Characteristics of Seaweed Jelly Candy

3.2.1 Appearance

The hedonic average value of seaweed jelly candy appearance are presented in Table 6 and description of jelly candy color are presented in Table 7.

The results showed that the average appearance value of jelly candy for all treatments ranged from 6,5 to 7,4. The product acceptance limit is an average value of ≥ 5, meaning that if the product tested has a value equal to or greater than 5 then the product is declared still accepted or liked by the panelists [10]. This indicates that the panelists' acceptance rate for the appearance parameter ranges from normal to like, so it can be said that all treatments are still accepted or liked by the panelists. Friedman statistical test showed that the addition of red ginger extract to the seaweed jelly candy did not have a significant effect on the panelists' preference for the appearance of the seaweed jelly candy. This is because the appearance of the seaweed jelly candy produced has a uniform shape in all treatments, so the panelists liked all jelly candy even though the color of the jelly candy produced was different. The addition of ginger extract to a product, regardless of the concentration, will only affect the taste but not for the color [7].

In the control treatment or without the addition of red ginger extract, the color of the seaweed jelly candy produced was brownish yellow. In the addition of 40%, 50%, and 60% red ginger extract treatment, the color of seaweed jelly

candy was light brown (+) to dark brown (+++). The color of jelly candies is more determined by the natural color of red ginger extract and the browning reaction during the process of making jelly candies. The cooking process at high temperatures and for a long time can cause caramelization of sugar, causing a brownish color to the product [26]. Component of ginger color is oleoresin. Oleoresin is a phenolic compound in ginger that is dark brown, so the product with the added ginger will turn brown [27]. Ginger has oleoresin which is easily oxidized, where oxygen will activate the polyphenol oxidase (PPO) enzyme, then the PPO enzyme will catalyze the phenol compounds contained in ginger oleoresin, so that a brownish melonoidin pigment will be formed. This will affect the color of the food product with the addition of ginger. The color of the food products produced tends to have a yellow to brownish color [28].

3.2.2 Aroma

The hedonic average value of seaweed jelly candy aroma is presented in Table 8.

The results showed that the average aroma value of jelly candy for all treatments ranged from 5 to 7. The product acceptance limit is an average value of ≥ 5, meaning that if the product tested has a value equal to or greater than 5 then the product is declared still accepted or liked by the panelists [10]. This indicates that the panelists' acceptance rate for the appearance parameter ranges from neutral or normal to like, so it can be said that all treatments are still accepted by the panelists. Friedman statistical test showed that the addition of red ginger extract to the seaweed jelly candy had a significant effect on the panelists' preference for the aroma of the seaweed jelly candy. The control treatment (0%) was significantly different from the 40%, 50%, and 60% treatments, while the 40%, 50%, and 60% treatments were not significantly different. This is because the panelists prefer jelly candy with the addition of red ginger extract than jelly candy without the addition of red ginger extract. Seaweed jelly candy with the addition of red ginger extract has distinctive aroma of ginger that can cover the distinctive aroma of seaweed. Jelly candy without the addition of red ginger extract has the lowest average aroma value because the jelly candy smells of sugar and has slight smell of seaweed, so the panelists not preferred it.

The distinctive aroma of seaweed comes from organic compounds. Dimethylsulfoniopopionate (DMSP) is a compound found in algae cells, which acts as an osmolite (maintains cell volume and water levels). This compound can be broken down by enzymes and bacteria, and this can produce Dimethylsulfide (DMS). DMS is considered a major component of the smell of the sea which can affect the smell of seaweed, so that the seaweed has distinctive aroma [29].

Ginger has distinctive aroma due to the essential oils contained [5]. Essential oils are volatile compounds in ginger that gives ginger a distinctive aroma. Red ginger extract has the highest volatile (essential oil) and non-volatile (oleoresin) components than other types of ginger, namely the essential oil content of around 2,58% - 3,90% and 3% oleoresin [6]. The fragrant aroma of ginger is produced by essential oils. The main components of ginger essential oil are sesquiterpenes-zingiberen, zingiberol, phenol, acetate, linalool, citrate and metal hetenone [30]. Zingiberen and zingiberol are components of ginger essential oil which cause the distinctive scent of ginger [30]. The essential oil content in red ginger causes red ginger to have a sharp aroma [8]. The addition of red ginger extract to jelly candy acts as a masking agent that can mask the distinctive aroma of seaweed. Masking agents are complex compounds combined with modifiers, inhibitors and enhancers that can mask unwanted flavor characteristics by producing a new flavor sensation [31]. The mechanism action of masking agent is to cover unwanted flavor characteristics through the presence of other sensations, competing with specific receptors, or by increasing other flavors [32]. Flavor in question is the aroma and taste [32].

3.2.3 Texture

The hedonic average value of seaweed jelly candy texture is presented in Table 9.

The results showed that the average texture value of jelly candy for all treatments ranged from 7,4 to 7,6. The product acceptance limit is an average value of ≥ 5, meaning that if the product tested has a value equal to or greater than 5 then the product is declared still accepted or liked by the panelists [10]. This shows that the panelists's acceptance rate for the texture parameter is like, so it can be said that all treatments are liked by the panelists. Friedman statistical test showed that the addition of red ginger extract to the

seaweed jelly candy did not have a significant effect on the panelists' preference for the texture of the seaweed jelly candy. This is because the amount of seaweed used for all treatments is the same, so the texture of the jelly candy for all treatments is relatively the same. The texture of the jelly candy is influenced by the hydrocolloid material, so the addition of red ginger extract has not effect on the texture of the jelly candy.

The jelly candy texture for all treatments is chewy, dense and sandy. The chewy texture of the jelly candy is due to the use of *Eucheuma cottonii* seaweed in the jelly candy dough. In *Eucheuma cottonii* seaweed, there are hydrocolloid material that can make the chewy jelly candy. The hydrocolloid material in *Eucheuma cottonii* is carrageenan. *Eucheuma cottonii* seaweed is able to produce kappa carrageenan with a strong and dense gel type [33]. *Eucheuma cottonii* has 65,75% carrageenan content [21]. The sandy texture of jelly candy is due to the formation of sugar crystals on the surface of jelly candy due to the process of drying jelly candy. The high carrageenan content in *Eucheuma cottonii* seaweed causes a chewy and strong candy texture. The chewy texture of jelly candy is formed because the caragenan polymer chain traps water in it, then a strong and rigid gel structure is formed [1]. Seaweed that has a high carrageenan can form gels when gotten heat treatment [34]. Gel formation is a process of merging or crosslinking polymer chains, so that a three-dimensional network is formed. This network binds the water in it and forms a strong texture [5].

The texture of the jelly candy is affected by the water content of the product. Increased water content can reduce the hardness of the candy where water will diffuse into the gel, so the gel formed becomes soft and causes the hardness to decrease [35]. The low water content of the candy will result in chewy jelly candy and instead [36]. This is accordance with the results of this study, where the jelly candy has low water content, so the texture of the jelly candy produced is chewy.

3.2.4 Taste

The hedonic average value of seaweed jelly candy taste is presented in Table 10.

The results showed that the average taste value of jelly candy for all treatments ranged from 6,1 to 7,9. The product acceptance limit is an average value of ≥ 5, meaning that if the product tested has a value equal to or greater than 5 then the product is declared still accepted or liked by the panelists [10]. This shows that the panelists' acceptance rate for the taste parameter ranges from normal to like, so it can be said that all treatments are liked by the panelists. Friedman statistical test showed that the addition of red ginger extract to the seaweed jelly candy had a significant effect on the panelists' preference for the taste of the seaweed jelly candy. The control treatment (0%) was significantly different from the 40%, 50%, and 60% treatments, while the 40%, 50%, and 60% treatments were not significantly different. This is because the panelists prefer jelly candy with the addition of red ginger extract than jelly candy without the addition of red ginger extract. Seaweed jelly candy with the addition of red ginger extract provides another variation of flavors, namely distinctive taste of pungent ginger.

Distinctve taste in ginger caused by oleoresin content. Red ginger has oleoresin content as much as 3% [7]. Ginger has distinctive taste because the phenolic components in ginger. Ginger contains phenolic derivatives that cause distinctive taste in ginger with characteristic heat, sharpness, and a stinging sensation in the mouth called pungent (spiciness). The pungent characteristic of fresh ginger is found in ginger oleoresin which is caused by phenylalkylketone which is a derivative of vanillin. This group of compounds is known as gingerols [37]. Ginger has an oleoresin content consisting of gingerol, shogaol, and resin components which causes a spicy taste in ginger [38]. The characteristic spicy taste of ginger is a spicy taste in the throat which causes a warm sensation. The addition of 50% red ginger extract treatment had the highest average flavor organoleptic value than other treatments. Seaweed jelly candy in this treatment has a sweet taste that comes from the addition of granulated sugar and the distinctive taste of pungent ginger. The lowest average taste value was found in the control treatment or without the addition of red ginger extract. Jelly candy without the addition of red ginger extract only had sweet taste of sugar, there is no other taste variation. In addition, the use of seaweed affected the taste of the jelly candy without the addition of red ginger extract, so the panelists tended to give the value in the normal category.

3.3 Decision Making Using the Bayes Method

Decision making with the bayes method is carried out by considering the weight criteria from the appearance, aroma, texture, and taste of jelly candy. The results of the calculation of the weight criteria for appearance, aroma, texture, and taste of jelly candy are peresented in Table 11.

Based on the bayes test, taste is the most important criteria compared to appearance, texture and aroma. Seaweed jelly candy with the addition of 50% red ginger extract obtained the highest alternative value of 7,47. The lowest alternative value is found in without the addition of red ginger extract treatment of 6,20. Based on the preference test parameters that have been carried out, seaweed jelly candy with the addition of 50% red ginger extract is the best treatment and most preferred by panelists. This is because that treatment has the highest median value on the parameters of appearance, aroma, texture, and taste of jelly candy and the alternative value obtained is higher than the other treatments.

Table 1. Water content of seaweed jelly candy

Concentration of Red Ginger Extract (%)	Water Content (%)
0	5,36
40	5,42
50	6,22
60	7,36

Table 2. Protein content of seaweed jelly candy

Concentration of Red Ginger Extract (%)	Protein Content (%)
0	1,37
40	1,16
50	0,88
60	0,71

Table 3. Fat content of seaweed jelly candy

Concentration of Red Ginger Extract (%)	Fat Content (%)
0	0,92
40	0,34
50	0,19
60	0,16

Table 4. Carbohydrate content of seaweed jelly candy

Concentration of Red Ginger Extract (%)	Carbohydrate Content (%)
0	95,92
40	96,65
50	96,82
60	96,93

Table 5. Crude fiber content of seaweed jelly candy

Concentration of Red Ginger Extract (%)	Crude Fiber Content (%)
0	1,42
40	1,52
50	1,54
60	1,75

Table 6. Average appearance value of seaweed jelly candy

Concentration of Red Ginger Extract (%)	Median	Average
0	7	6,8[a]
40	7	6,5[a]
50	7	7,4[a]
60	7	7,3[a]

Note : The numbers followed by different letters on the average treatment indicate a significant difference according to the multiple comparison test with a significance level of 5%

Table 7. Description of jelly candy color

Concentration of Red Ginger Extract (%)	Jelly Candy Color
0	Brownish yellow
40	Light Brown (+)
50	Dark Brown (++)
60	Dark Brown (+++)

Note : The more (+) the color is getting darker

Table 8. Average aroma value of seaweed jelly candy

Concentration of Red Ginger Extract (%)	Median	Average
0	5	5[a]
40	7	7[a]
50	7	7[a]
60	7	6,8[a]

Note : The numbers followed by different letters on the average treatment indicate a significant difference according to the multiple comparison test with a significance level of 5%

Table 9. Average texture value of seaweed jelly candy

Concentration of Red Ginger Extract (%)	Median	Average
0	7	7,5[a]
40	7	7,4[a]
50	7	7,6[a]
60	7	7,4[a]

Note : The numbers followed by different letters on the average treatment indicate a significant difference according to the multiple comparison test with a significance level of 5%

Table 10. Average taste value of seaweed jelly candy

Concentration of Red Ginger Extract (%)	Median	Average
0	6	6,1[b]
40	7	7,2[a]
50	8	7,9[a]
60	7	6,7[a]

Note : The numbers followed by different letters on the average treatment indicate a significant difference according to the multiple comparison test with a significance level of 5%

Table 11. Decision matrix for assessment of seaweed jelly candy

Concentration of Red Ginger Extract (%)	Criteria				Alternative Value	Value of Priority
	Appearance	Aroma	Texture	Taste		
0	7	5	7	6	6,20	0,22
40	7	7	7	7	7,00	0,25
50	7	7	7	8	7,47	0,27
60	7	7	7	7	7,00	0,25
Weight Criteria	0,21	0,17	0,15	0,47		

4. CONCLUSION

Based on the research, it can be concluded that seaweed jelly candy with the addition of red ginger extract as much as 50% is the most preferred by panelists and has the best organoleptic characteristics based on appearance, aroma, texture, and taste of the jelly candy.The average value of the hedonic test of seaweed jelly candy with the addition of 50% red ginger extract to appearance was 7,4 (like); aroma 7,0 (like); texture 7,6 (like); and taste 7,9 (like). The jelly candy contained 6,22% water, 0,88% protein, 0,19% fat, 96,82% carbohydrate, and 1,54% crude fiber. Addition 50% of red ginger extract is recommended to produce seaweed jelly candy that has the best and most preferred characteristics.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Sukotjo S, Asmira. Formulation of seaweed jelly candy with ginger flavor. Technopex-2018. Institute of Technology Indonesia; 2018.
2. Marine and fisheries ministry. Ministry of marine affairs and fisheries annual report 2019. Marine and Fisheries Ministry. Jakarta; 2019.
3. Hernanto AD, Rejeki S, Ariyati RW. Growth of seaweed (*Eucheuma cottonii* and *Gracilaria* sp.) cultivation using the long line method in bulu jepara beach. Journal of Management and Cultivation Technology. 2015;4(2):43-51.
4. Anggadiredja JT, Zatnika A, Purwanto H, Istini S. Seaweed. Jakarta: Penebar Swadaya; 2006.
5. Bactiar A, Ali A, Rossi E. Making red ginger extract jelly candy with addition of carrageenan. Journal of Agricultural Technology. 2017;1(4):1-13.
6. Juwita W, Rusmarilin H, Yusraini E. Effect of pectin and carrageenan concentration on the quality of ginger jelly candy. Journal of Food Engineering. 2014;2(2):42-50.
7. Koswara S, Diniari A, Sumarto. Production process guide of instant red ginger drink. Research institutions and community service. Bogor Agricultural Institute; 2012.
8. Kusumaningati RW. Analysis of total ginger phenol content (*Zingiber officinale* Rosc). Thesis. Jakarta: University Indonesia; 2009.
9. Djelantik NPA, Suter IK, Sugitha IM. Study of the use of *Eucheuma spinosum* seaweed as a filler against the chemical, physical and sensory properties of ice cream. Journal of Food Science and Technology. 2016;5(1):1-10.
10. Agusman. Organoleptic testing. Semarang: University Muhammadiyah Semarang; 2013.
11. Association of Analytical Communities (AOAC). Official methods of analysis. Washington: Association of Official Analytical Chemists; 2005.
12. Daniel WW. Applied nonparametric statistics. Jakarta: PT. Gramedia Pustaka; 1989.
13. Pujilestari T, Lestari N. Analysis of chemical compounds in three types of ginger and their use for industrial purposes. Journal of Industrial Technology Research. 2009;3(6):32-38.
14. Herawati H. Potential of hydrocolloids as additives to quality food and non-food products. Journal of Agricultural Research and Development. 2018;37(1):17-25.
15. Salamah E, Erungan AC, Retnowati Y. Utilization of *Gracilaria* sp. in making jelly candy. Bulletin of Fishery Products Technology. 2006;9(1):39-48.
16. Hadiwiyoto. Fishery product processing technology. Yogyakarta: Liberty; 1993.
17. Sundari D, Almasyhuri, Lamid A. Effect of cooking process on nutritional composition of food ingredients. Litbangkes Media. 2015;25(4):235-242.
18. Damayanthi E, Eddy. Food technology. Jakarta: Directorate General of Primary and Secondary Education; 1995.
19. Suzuki T. Fish and krill protein: Processing technology. London: Publishers Ltd; 1991.
20. Muchtadi T, Sugiyono R. Food science. Department of education and culture. Bogor Agricultural Institute; 1992.
21. Istini. Benefits and processing of seaweed. Agency for the assessment and application of technology. Jakarta; 1986.
22. Koswara. Ginger and its processed products. Jakarta: Pustaka Sinar Harapan; 1995.
23. Sunarwati DA. Effect of breadfruit flour substitution on the quality of steamed brownies. Thesis. Semarang: Semarang State University; 2011.
24. Astawan M, Koswara S, Herdiani F. Utilization of *Eucheuma cottonii* seaweed

to increase iodium and food fiber levels in jams and dodol. Journal of Technology and Food Industry. 2004; 15(1):61-69.
25. Sugito A, Hayati. Addition of snakehead fish (*Ophicephallus strianus*) and freezing applications in making gluten pempek. Indonesian Journal of Agricultural Sciences. 2006;8(2):147-151.
26. Buckle KA, Edwards RA, Fleet GH, Wootton M. Food science. UI-Press. Jakarta; 2007.
27. Pebiningrum A, Kusnadi J. The effect of ginger varieties (*Zingiber officinale*) and the addition of honey on the antioxidant activity of kombucha ginger fermented drinks. Journal of Food and Life Sciences. 2018;1(2):33-42.
28. Hidayati PY, Pramono YB, Nurwantoro N. Physical characteristics and hedonic quality of "Tuljaenak" jelly candy from PT sido muncul ginger starch. Semarang: University Diponegoro; 2017.
29. Garcia FS, Mirzayeva A, Roldan A, Castro R, Palacios V, Barroso CG, Guerrero ED. Evolution of volatile compounds and sensory characteristics of edible green seaweed (*Ulva rigida*) during storage at different temperatures. Journal of the Science of Food and Agriculture. 2019; 99(12):5475–5482.
30. Hernani, Monoraharjo. Antioxidant efficacious plants. Jakarta: Penebar Swadaya; 2002.
31. Pszczola DE. Taste modulation: a new sense. Journal of Food Technology. 2010;64(1):44-55.
32. Gascon M. Masking agent. New York: CRC Press; 2006.
33. Fardhyanti DS, Julianur SS. Characterization of edible film based on carrageenan extract from seaweed (*Eucheuma cottonii*). Journal of Renewable Natural Materials. 2015;4(2):68-73.
34. Nurlia S, Wahyuni N, Asyik. Shelf life assessment of sweet potato sago noodle products added mixed seaweed porridge (*Eucheuma cottonii*) and dragon fruit skin (*Hylocereus polyrhizus* sp.) using sensory analysis. Journal of Food Science and Technology. 2017;2(5):844-854.
35. Muhandri T, Subarna. Effect of water content, NaCl and passing amount on the rheological characteristics of corn noodles. Journal of Technology and Food Industry. 2009;20(1):71-77.
36. Desideria D. Characteristics of white turmeric jelly candy (*Curcuma mangga val.*) formulated using gelatin concentration. Thesis. Semarang: Semarang University; 2019.
37. Shahidi F, Naczk M. Food phenolics: sources, chemistry, effects, and applications. USA: Technomic Publishing Company; 1995.
38. Paimin FB, Murhananto. Agribusiness series processing cultivation, ginger trading. Jakarta: Penebar Swadaya; 2008.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/69013