The Effects of Tomato Concentration on Sensory and Chemical Properties of Jelly Drink

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The Effects of Tomato Concentration on Sensory and Chemical Properties of Jelly Drink

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ABSTRACT

Tomatoes, which have a limited shelf life must be processed further, one of which will be used as a jelly drink. In Indonesia, tomatoes are relatively inexpensive, but beverage products made from tomatoes are still limited. Jelly drinks are common among the general public, and they also serve as a hunger suppressant and a good source of fibers for digestion. *Eucheuma cottonii* seaweed is used as a gelling agent in the making of jelly drinks. Yet, the concentration of seaweed and tomato in the jelly drink formula was still unknown. This study aims to determine the effect of different concentrations of tomatoes on sensory properties of tomato jelly drinks, and to determine the most preferred tomato jelly drink by panellists for chemical properties analysis. The research consists of two phases, phase 1 (determining seaweed concentration) and phase 2 (determining tomato concentration). The sensory analysis, which included colour, aroma, texture, and taste, was used to determine the most preferred tomato jelly drink by the panelists. The chemical content is determined based on the most preferred tomato jelly drink by the panelists, that include vitamin C, pH, sucrose, and crude fiber analysis. This experiment used randomized block design (RBD) with one factorial, which was the concentration of tomatoes, consisting of three levels,54%, 57% and 60%. The results showed that the concentration of tomato had significant effects on the score of the taste and texture of jelly drinks in sensory analysis, but had no significant effect on the score of the colour and the aroma of jelly drinks. The most preferred jelly drink was obtained from the tomato concentration of 57%. The product had a colour score of 3.00 (normal - like); aroma score of 3.23 (normal - like); texture score of 3.47 (normal - like); taste score of 3.97 (normal - like), pH 4.37; sucrose 31.35%; crude fiber 3.28%; and levels of vitamin C 23.76 mg / 100g.

Keywords: *Eucheuma cottonii seaweed, Jelly drink, Tomatoes.*

1. INTRODUCTION

Jelly drinks are widely known and favored by people from children to adults. The market for jelly drink products is quite large. [1] Jelly drinks are not just ordinary drinks, but can also be consumed as a hunger delay. Jelly drinks are made from fruit juices with the addition of sugar, acid and gelling agent, so that a thick texture is formed in the form of a gel but can still be easily consumed with the help of a straw. Jelly drink is a drink in the form of a gel that can be consumed with the help of a straw, the texture is easily crushed but the gel form is still felt in the mouth.

One type of fruit that can be used as raw material for making jelly drinks is tomato. Tomato (*Solanum lycopersicum* L.) is one of the most widely cultivated agricultural commodities in Indonesia. According to The Central Statistics Agency and the Directorate General of Horticulture, tomato production in Indonesia reached 1,020,333 tons in the past year. [2] Although the level of tomato production is high, the types of processed tomato products are still few. In general, the processing of tomatoes in Indonesia is limited to being used as sauce, juice, or pasta. Tomatoes have a fairly high water content which causes the shelf life of tomatoes to be relatively short. Addition of tomato juice in the jelly drinks may affect its sensory parameters, specially the slightly sour taste. Tomatoes are known to contain nutrients that are beneficial to the human body, such as vitamin C. [3]

In addition to its fresh taste, tomatoes are also rich in nutrients such as carbohydrates, Ca, Fe, Mg, vitamin C, as well as vitamin A, phosphate, potassium, and lycopene so that they can meet the nutritional needs of the community. Tomatoes contain lycopene which functions as an antioxidant that has the ability to provide protection from the risk of various diseases, including cancer and coronary heart disease. [4] Some research results show that lycopene is more easily absorbed by the body if the tomatoes are processed into processed tomato products.

To produce a jelly drink with a good gel structure, it is necessary to add a gelling agent. Jelly drinks that are currently circulating in the market use carrageenan powder as a gelling agent. The function of carrageenan powder as a gelling agent can be replaced by using seaweed and one of the is *Eucheuma cottonii*. [5]

The most common types of seaweed found in Indonesian waters are *Gracilaria, Gelidium*, Eucheuma, and Sargassum. [6] Of the various types of seaweed, which are cultivated, developed and widely traded in Indonesia are the caraginophyte species (among them Eucheuma spinosum, *E. cottonii*, *E. edule*, *E. serra*, and *Eucheuma. spp*) which are used as raw materials for various industries because it is a source of carrageenan (seaweed flour), agar and alginate. *E.cottonii* is one of the carrageenan-producing seaweeds. Carrageenan contains high fiber. Carrageenan is one of the gelling agents that is suitable to be used to form a gel structure in jelly drinks.

Despite having good nutritional content for the body and also high water content, tomato shelf life is relatively short. Therefore, further processing of tomatoes is needed in order to obtain a longer shelf life and at the same time increase the economic value of tomato commodities. To increase the shelf life of tomatoes, one of them is to make jelly drinks. The jelly drink also uses *E.cottonii* seaweed which acts as a gelling agent. The problem is that the exact formulation of the basic ingredients of tomatoes and *E.cottonii* seaweed is not known. The seaweed is used as a gelling agent in jelly drinks in order to get a jelly texture that is easily destroyed when consumed with the help of a straw, but the gel form is still felt in the mouth. *E.cottonii* seaweed was also used to make jelly drinks in previous research. [7]

The purpose of this research is to use tomatoes and seaweed *E.cottonii* in jelly drinks. This study aims to determine the effect of different concentrations of tomatoes on sensory properties of tomato jelly drinks, and to determine the most preferred tomato jelly drink by panellists for chemical properties analysis.

2. MATERIALS AND METHOD

The materials used in the production of tomato jelly drinks are tomatoes obtained from Bukit Indah Market, South Tangerang City; dried *E.cottonii* obtained from Lebak District, Banten; sugar; and water. Other materials are used for chemical analysis manufactured by Merck and Loba Chemie PVT.LTD (pH, sucrose, vitamin C, and crude fibers).

The research consisted of two phases, namely phase 1, and phase 2. Phase 1 was conducted to determine the concentration of E.cottonii seaweed which will be used as a reference in phase 2.Phase 2 was conducted to determine the concentration of tomatoes in jelly drink production. The jelly drink production process of this study refers to previous research. [8]

2.1. Phase 1

Phase 1 is a preliminary study to know the amount of *E.cottonii* added in jelly drinks. Variations of *E.cottonii seaweed* (0.5%; 2.5%; 4.5%; and 6.5%) will be tested. Descriptive analysis was done in phase 1, by describing the characteristics of the tomato jelly drink based on sensory parameters. Sensory parameters were done based on colour, aroma, texture, and taste. The focus of Phase 1 was to know the right concentration of *E.cottonii* in order to get the similar texture of a commercial jelly drink. Commercial jelly drinks were only used as a comparison of texture. The preliminary research diagram is presented in Figure 3.1.

The study began with washing tomatoes using running water and the preparation of other materials. Washed tomatoes then weighed and cut into several parts. The tomatoes then are crushed in a blender with the addition of water and then filtered to get tomato juice.

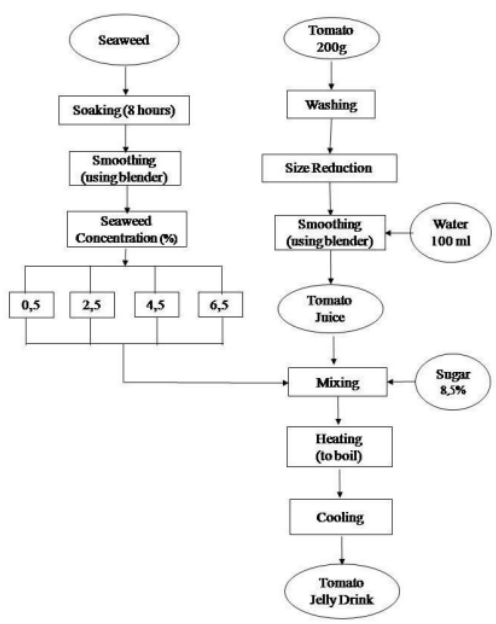

Figure 1. Phase 1 Research diagram.

Furthermore, the seaweed is also crushed using a blender for a few seconds. The next process is mixing the ingredients, namely tomato juice, blended seaweed and sugar into a saucepan and then heated to a boil. After that, put it in a bottle to cool. The cooling process is carried out at room temperature to form a jelly drink. The different variations of tomato jelly drinks were described based on sensory analysis. Sensory analysis is carried out to provide quality assessment of the products using human senses as the main tool. The sensory analysis carried out was a preference test or hedonic test with assessments covering taste, aroma, colour, and texture.

2.2. Phase 2

In phase 2, the process of making jelly drinks was carried out based on the result of phase 1. The concentration of seaweed used in the main study was based on the best seaweed concentration obtained from the research phase 1. The process of making jelly drinks completely follows the stages of making jelly drinks in phase 1. In this phase 2, variations in the tomato's concentration were 54%; 57%; and 60%. The phase 2 research diagram can be seen in Figure 2.

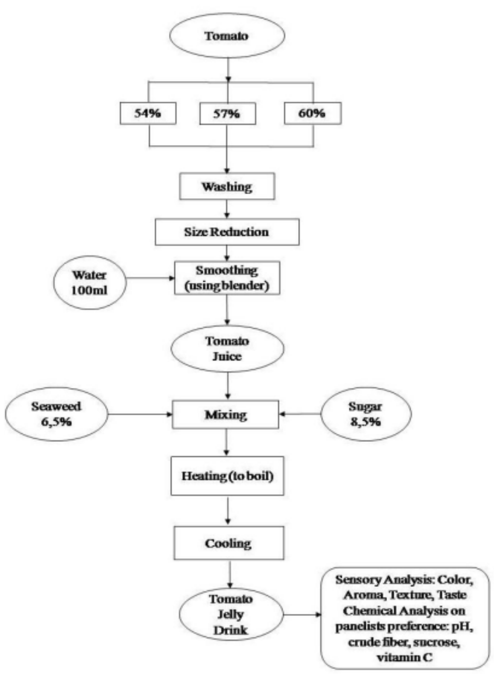

Figure 2. Phase 2 Research diagram

Sensory analysis was carried out by giving 3 (three) samples of jelly drink with 3 (three) digit random numbers to 30 panelists. The result was statistically analyzed using Anova. The experimental design used in this study was a Randomized Block Design. Further test, namely Duncan's Multiple Distance Test (DMRT) was done to determine the effect of the treatment.

As for chemical properties, pH analysis referred to SNI 606-6989 11-2004. [9] Sucrose analysis was based on SNI 01-2892-1992. [10] Crude fiber analysis referred to the SNI 01-2891-1992 method [11]. Vitamin C Analysis of tomato jelly drinks using the Iodometric method [12] .

Ethical clearance in this study was approved and provided by Komisi Etik Penelitian Kesehatan, Kementrian Kesehatan RI through Ethical Approval Letter No. LB.02.01/1/KE/31/203/2021 dated March 29, 2021.

3. RESULTS AND DISCUSSION

3.1. Phase 1

The results of sensory analysis which include colour, aroma, texture, and taste can be seen in Table 1. Based on the results of qualitative observations in the table, at a concentration of 0.5%; 2.5%; and 4.5% jelly drinks still had liquid texture, had not formed a gel and has a distinctive tomato taste. At a concentration of 6.5% the texture of the jelly drink was condensed, thick and yet easy to drink with the help of a straw. Due to the focus of phase 1 was to get the right amount of seaweed in the tomato jelly drink, it was necessary to compare the texture of tomato jelly drink with the commercial jelly drink. Unfortunately, commercial tomato jelly drinks are not available in the Indonesian market. Thus, commercial strawberry jelly drink was used as a comparison, for this research. The tomato jelly drink with 6.5% seaweed and commercial strawberry jelly drink showed similarity in its texture.

Table 1. The Result of Phase 1 Sensory analysis

Seaweed Concentration (%)	Sensory Parameter			
	Color	Aroma	Texture	Taste
0.5	Red	Tomato	Liquid	Sour
2.5	Red	Tomato	Liquid	Sour
4.5	Dark Red	Tomato	Liquid	Sour
6.5	Dark Red	Tomato & seaweed	Condense	Sweet + sour
Commercial Jelly Drink	-	-	Condense	-

It can be explained that E.cottonii produce carrageenan, a hydrocolloid that is able to bind large amounts of water. Hydrocolloid is a polymer component that can dissolve in water, is able to form colloids, can thicken or form a gel from a solution [13]. Since 6.5% of seaweed concentration produced a good texture of jelly drink, then it will be used in phase 2

3.2. Phase 2

The result of sensory analysis in phase 2 of this study can be seen in Table 2, the tomato concentration of 54% produced a jelly drink with a sweet taste and thick texture; thus, it was difficult to drink using straw. This is due to the use of a small concentration of tomatoes compared to other concentrations so as to produce a thicker texture when compared to other concentrations.

At a concentration of 57%, tomatoes produce a texture that is not much different from a concentration of 60% which is less condensed and has a sweet and sour, a typical taste of tomatoes. The colour and aroma produced at each concentration are the same, which is dark red in colour and has a distinctive aroma of tomatoes and a slight seaweed.

The sensory analysis covering parameters of texture, taste, colour, and aroma was performed on 30 panelists. The average scores from sensory analysis are described in Table 3. The 57% concentration of tomato showed the highest overall score and there weren't any scores below 3.

Table 2.The Result of Phase 2 Sensory Parameters

Tomato Concentration	Appearance of Tomato Jelly Drink	Sensory Parameter
54%		Color :Dark Red Aroma : Tomato and slightly seaweed Texture :condensed Taste :Sweet
57%		Color :Dark Red Aroma : Tomato and slightly seaweed Texture :less condensed Taste :Sweet-sour
60%		Color :Dark Red Aroma : Tomato and slightly seaweed Texture :less condensed Taste :Sweet-sour

Based on colour preference, the highest average yield was at 57% tomato concentration. Panelists did not like the colour of the jelly drink at a concentration of 54% because less concentration of tomatoes produced less red colour. The panellist found that the colour becomes less attractive.

As for the aroma, the highest average score was the use of 57% tomato concentration. At a concentration of 54%, the panelists did not like the aroma produced because the distinctive aroma of seaweed was stronger than the aroma of tomatoes. Panelists tend to prefer the aroma at a concentration of 57% compared to a concentration of 60% because according to the panelists the distinctive aroma of tomatoes was not too strong. The distinctive aroma in tomatoes is due to the presence of terpenoids compounds. [14]

The use of different concentrations of tomatoes produces very significant different results on the texture of the jelly drink produced. Based on Figure 1, the highest average texture score for tomato jelly drinks was at tomato concentration of 57%. Panelists did not like the texture of the jelly drink at a concentration of 54% because the resulting texture was too condensed. This is due to the least addition of tomato concentration and the addition of seaweed will make the texture more condense. Carrageenan from *E. Cottonii* is a hydrocolloid capable of binding large amounts of water [15]. Carrageenan in this case is able to bind the water contained in tomatoes, forming a gel, so that at lower concentrations of tomatoes the texture will be denser than at higher concentrations of tomatoes.

Based on the histogram, the panelists preferred the taste of jelly drinks at a concentration of 57%. This can be seen from the results of the highest average test value. The taste preference for jelly drinks is at a concentration of 57%. The use of different concentrations of tomatoes in jelly drinks has a very significant effect on the taste of the jelly drinks produced. Panelists tend to dislike the taste of jelly drinks at concentrations of 54% and 60%. At a concentration of 60%, the panelists did not like the taste of the jelly drink produced because the sour taste of tomatoes was stronger than at a concentration of 57%.

According to the results obtained from the score value of sensory analysis, statistical analysis using ANOVA with one factor showed that there were no significant differences for colour and aroma, but different for texture and taste. Therefore, further test, DMRT was performed to determine the effect of the treatment (tomato concentration) on texture and taste. The result of DMRT is described using notation "a" and "b" on Table 3.

The data on Table 3 shows that according to the DMRT, there was significant difference in terms of texture and taste between jelly drinks using 54% and 57% tomato. It also shows there was a significant difference between jelly drink using 54% and 60% tomato.

Table 3. Result of Statistical Analysis

Tomato Concentration	Average of Panelists Score			
	Color	Aroma	Texture	Taste
54%	2,57	2,80	$2,67^{b}$	$2,80^{b}$
57%	3,00	3,23	$3,47^{a}$	$3,97^{a}$
60%	2,93	3,17	$3,37^{a}$	$3,63^{a}$

Yet, there was no difference between a jelly drink using 57% and 60% tomato. Therefore, selection of the right tomato concentration is based on the efficient economical use of the materials, both in terms of costs and results obtained. Thus, using 57% of tomato is the chosen treatment, since it has more economical value.

Chemical analysis was carried out on the chosen treatment, which is using 57% of tomato. Chemical analysis carried out included analysis of pH, crude fiber, sucrose, and vitamin C.

The pH analysis carried out on the tomato fruit jelly drink refers to SNI 606-6989 11-2004. Based on the results of the analysis carried out on the tomato jelly drink, the pH of the tomato fruit jelly drink was 4.37. This result was close to the pH of Pineapple jelly drink, that is 4.70, but the pH of Belimbing Wuluh jelly drink was so low, that is 2.63. [16], [17] If the pH is too low, it can cause syneresis, causing the texture of the resulting jelly drink to be not sturdy [4]. On the other hand, if the pH is too high, it will produce a stiff gel. The optimum pH for gel formation is at pH 4-7 [18].

Sucrose content of tomato jelly drink corresponded to pineapple jelly drink, less than 2%. [16] In tomato jelly drinks, the results showed that the sucrose content was 31.35%, whereas pineapple jelly drink was 33.18%. The sucrose is mainly used as a source of energy for the consumers.

Table 4. Chemical analysis of the Preferred Jelly Drink

Parameters	Tomato Jelly drink	Pineapple Jelly Drink [16]	Belimbing Wuluh Jelly Drink [17]	Belimbing Manis Jelly Drink [18]
pH	4.37	5.74	2.63	4.3-4.7
Crude fiber (%)	3.28	-	-	0.006
Sucrose (%)	31.35	33.18	-	-
Vitamin C (mg/100g)	23.76	24.89	9.62	-

The crude fiber content produced in the tomato jelly drink is 3.28%. Compare to other research, the crude fiber in tomato jelly drink was much higher than Belimbing Manis jelly drink which was only 0.006%. [18] Crude fiber content in the tomato jelly drink increased due to the addition of *E.cottonii* seaweed. Besides functioning as a gelling agent, *E. cottonii* also functions as a good source of fiber for the human digestive tract.

The results of the vitamin C analysis in the tomato jelly drink was 23.76 mg/100g. The content of vitamin C in the tomato jelly drink was quite high compare to Belimbing wuluh jelly drink, which was 9.63 mg/100g. [17] Yet, compare to pineapple jelly drink, the content of vitamin C in tomato jelly drink is 1.13 mg/100g lower. [16] If there is an addition of ingredients containing hydrocolloids in the manufacture of jelly drinks, more and stronger colloidal dispersion (double helix structure) will be formed so that it will inhibit the oxidation of vitamin C and can maintain vitamin C. With a high double helix structure, vitamin C will be more protected.

Tomato jelly drinks have a low or acidic pH. This result in accordance to Belimbing Manis Jelly drink, which had are range of 4.3-4.7. [18] Belimbing wuluh jelly drink showed lower pH, while pineapple jelly drink showed higher pH compare to tomato jelly drink. [17] [16] Vitamin C is basically an acid with the chemical name ascorbic acid. The oxidation of ascorbic acid or vitamin C can be inhibited by acidic conditions or by low temperatures. [19] Generally, vitamin C has a pH range of 2 to 4. The tomato jelly drink has a pH of 4.37, so in this condition the vitamin C content is relatively high.

4. CONCLUSION

The preferred product according to panelists was tomato jelly drinks using seaweed concentration of 6.5 % and tomatoes concentration of 57%. The average panelists score for the product in color preference was 3.00 (ordinary), aroma preference was 3.23 (ordinary – likes); texture preference was 3.47 (normal – like),and taste preference was 3.97 (ordinary – like). Chemical properties of the preferred product were as follows: pH 4.37, sucrose content 31.35%, crude fiber content of 3.28%, and vitamin C content of 23.76 mg/100g.

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