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Development of *Monascus*-fermented durian seed jelly drink: effect of roselle extract concentration on physicochemical and organoleptic properties of the jelly drink

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Abstract. Durian seed, a waste of durian fruit processing, had been studied as a new substrate in the solid-state fermentation with *Monascus purpureus*. Moreover, the fermentation product namely *Monascus*-fermented Durian Seed (MFDS) potent to reduce blood cholesterol and glucose levels in human body. However, water extract of the MFDS has a pale redcolor and unpleasant flavor. Therefore, roselle extract was used in the MFDS jelly drink formulation. The objective of this research was to study the effect of various concentration of roselle extract on physicochemical and organoleptic properties of the MFDS jelly drink. The concentration of roselle extract used in this research were 12.5%, 15%, 17.5%, 20%, 22.5%, and 25% of the total liquid. The results showed that the various roselle extract concentration affected significantly on the physicochemical and organoleptic properties of MFDS jelly drink. The higher concentration of roselle extract at 20%-25%, caused the decrease of pH and syneresis, and the increase of suction power. Based on the sensory evaluation, addition of roselle extract at 15% resulted the best organoleptic properties with preference scores of flavor, color and mouthfeel of 5.70, 5.58, and 4.35, respectively. Physicochemical properties of the MFDS jelly drink were pH of 3.02, suction power of 6.3 mL/20 sec, 1.975% syneresis level, lightness value of 42, redness value of 60.6, yellowness value of 48.7, chroma value of 77.7, and hue value of 39.

1. Introduction

Durian seed is a waste of durian fruit processing, usually discarded. Our previous research, durian seed had been utilized as a new substrate of solid-state fermentation with *Monascus purpureus*[1-3]. *Monascus*-fermented Durian Seed (MFDS) possess antioxidant activity, antidiabetic activity *in vitro*, and potent reduce blood sugar and cholesterol levels *in vivo*[4-6].Those results showed that MFDS potent as functional food ingredient. It has been incorporated into bread formulation [7]. Another application is in the development of functional jelly drink.

Jelly drink is a semi-solid drink with a weak gel consistency. Carrageenan, especially κ-carrageenan, is commonly used as a gelling agent in the formulation. Other ingredients are sugar, citric acid, flavoring, and coloring agents [8-10]. In our preliminary study, the MFDS jelly drink has an unpleasant flavor (musty) and pale red color. Addition of roselle extract can improve the flavor and color. However, the roselle extract addition affected the jelly drink texture and syneresis. Moreover, sorbitol was used to replace sucrose in the formulation since sucrose is not suitable for antidiabetic

food [11]. Therefore, the objective of this research was to study the effect of various concentration of roselle extract on physicochemical and organoleptic properties of the MFDS jelly drink.

2. Materials and Method

2.1. Materials

Durian seed was obtained from a durian fruit processing unit in Surabaya. Pure culture of *Monascuspurpureus* M9, maintained routinely on Potato Dextrose Agar (Merck 1.10130.0500) medium. $Ca(OH)_2$, distilled water, drinking water, κ-carrageenan, sorbitol syrup, and dried roselle petals were purchased from local supplier in Surabaya.

2.2. *Durian seed fermentation and extraction*

Durian seed fermentation was carried out according to our previous research [6]. After peeling, cutting, soaking, sterilization at 121°C for 10 mins and cooling, the durian seed substrate was inoculated with *Monascuspurpureus* M9 starter culture, and then incubated at 30°C for 14 days. The fermented matter was dried at 45°C for 24 hours, ground and sieved. The MFDS was extracted with water at a ratio of 0.3:100 (w/v) at 40°C for 30 minutes.

2.3. *MFDS jelly drink processing*

MFDS extract was formulated with other ingredients i.e. roselle extract, water, carrageenan and sorbitol syrup. Roselle was extracted with water at ratio of 1:10 at 50°C for 30 min and then filtered. The roselle extract was added at various concentration (12.5%, 15%, 17.5%, 20%, 22.5% and 25% (v/v)). The mixture was stirred and heated up to 80°C, then cooled down to 40°C, poured into a plastic cup (@ 100 mL), stored in a refrigerator for 24 hours. The MFDS jelly drink was subjected to physicochemical and organoleptic analysis.

2.4. *MFDS jelly drink analysis*

The MFDS jelly drink was analyzed the physicochemical (pH, syneresis, suction power and color) and organoleptic (preference on color, taste and mouthfeel) properties. pH was measured by using pH meter. Syneresis was determined according to Imeson[12]. Slurping was measured according to Anggarini [13]. Color (L*, a*, b*, Chroma and ˚Hue) was measured by using color grab application. Organoleptic evaluation of the MFDS jelly drink was performed by using 40 untrained panelists. Hedonic method with score range of 1 to 7 (lowest to highest likeness) was used in this research.

2.5. *Statistical Analysis*

The experiment design of Randomized Completely Block Design (RCBD) was used with four replications. The obtained data were analyzed using ANOVA at $\alpha = 5\%$. Further analysis with the Duncan's Multiple Range Test (DMRT) at $\alpha = 5\%$. Statistical analysis was performed by using SPSS. The best treatment is determined based on the total preference score for color, taste, and mouthfeel. The treatment that produces the product with the highest total score was determined as the best treatment.

3. Results and Discussion

3.1. *Physicochemical properties of MFDS Jelly Drink*

The physicochemical properties of the MFDS jelly drink is presented in Table 1. The higher the concentration of rosella extract added, the pH of the jelly drink decrease. The lower pH may be due to

the content of organic acids in rosella extract, namely citric acid, malic acid, tartaric acid, hydroxy citric acid, and hibiscus acid as dominant acids, as well as oxalic acid and ascorbic acid [14].

Table 1. Physicochemical properties of MFDS jelly drink at various concentrations of roselle extract

Roselle extract concentration (%)	pH	Suction power (mL/20s)	Color				
			L*	a*	b*	C	°H
12.5	3.11^{e}	5.7^{a}	46.3^{f}	58.7^{d}	50.5^{f}	77.4^{de}	41^{f}
15.0	3.02^{d}	6.3^{b}	42.0^{e}	60.6^{e}	48.7^{e}	77.7^{e}	39^{e}
17.5	2.94^{c}	7.1^{c}	39.6^{d}	62.3^{f}	44.7^{d}	76.5^{d}	36^{c}
20.0	2.89^{b}	7.5^{c}	38.7^{c}	56.6^{c}	42.8^{c}	70.9^{c}	37^{d}
22.5	2.81^{a}	9.0^{d}	34.6^{b}	54.6^{b}	37.9^{b}	66.4^{b}	35^{b}
25.0	2.80^{a}	9.8^{e}	33.6^{a}	51.8^{a}	34.1^{a}	62.2^{a}	33^{a}

Note: different letter in the same column mean significant different at α=5%

The higher the suction power value, it reflects the jelly drink has a weak gel strength. When carrageenan heated in an acidic solution (pH <4.3), the formed gel will lose its gel strength. The part hydrolyzed is the 1,3-glycoside bond (in the 3,6-AG bond [12]) without affecting the 1,4-glycoside bond, and produces oligosaccharides with an odd number of monomers [12;15;16;17].

Color of MFDS jelly drink shown in Table 1 including L*, a*, b*, C and H. L* (Lightness) indicates the brightness of a product. The results show that the higher the concentration of roselle extract, the lower of lightness. This may be due to anthocyanin degradation and polymerization, as also found by other researchers that the reaction caused color becomes darker (brown) [18;19]. The redness value of jelly drink with the addition of rosella extract 12.5% to 17.5% has increased, but then decreased at the concentration of 20% to 25%. *Monascus*red pigmentcan decompose, change the structure of the chromophore groups so that the functional groups are released or separated by double bonds on the functional groups due to higher temperaturesmay be decomposed, changes in the structure of the chromophore group [20]. The yellowness values obtained are quite high. It may be influenced by the content of yellow pigment in MFDS. According to Puspitadewi [21], yellow pigment is the dominant pigment in the MFDS. Table 1 shows that the higher concentration of the roselle extract, the lower the yellow value Chroma is used to determine the color intensity of a sample. A high chroma value means the sample has a high color intensity. The addition of rosella extract by 15% had the highest chroma value and was not significantly different from the concentration of 12.5%. This is because the redness value at a concentration of 12.5% to 15% has increased, although the yellowness value has decreased, but is still higher than the concentration of 17.5%, 20%, 22.5%, and 25%. Roselle extract concentrations of 17.5%, 20%, 22.5%, and 25% had significantly different chroma values, namely 76.5, 70.9, 66.4, and 62.2. The decrease in chroma value due to redness and yellowness in the treatment decreases, which means the color intensity is low. Low intensity due to the color of jelly drinks tends to be dark (dull). Hue shows the color of a product, which is obtained from the angle of the color circle. The hue value at 12.5% rosella extract concentration tends towards red, while at 25% concentration tends towards purple-reddish. Rosella extract concentration of 17.5% has a lower hue value of 1°with a concentration of 20%, but the chroma value at a concentration of 17.5% is higher (76.5) than at a concentration of 20% (70.9).

Syneresis is the discharge of water from the jelly drink system during storage. The results (Figure 1.) show that syneresis increased during 14 days storage. On day 1, the value of the jelly drink syneresis is still not visible, which has a value range of 0% -0.02%. The value of syneresis increases on the 7th and 14th days. This results also shows that higher roselle extract concentration, the syneresis increased. This may be due to the interaction of several factors affecting the gel strength i.e. pH, total solid, potassium ion and other chemical composition in the jelly drink system

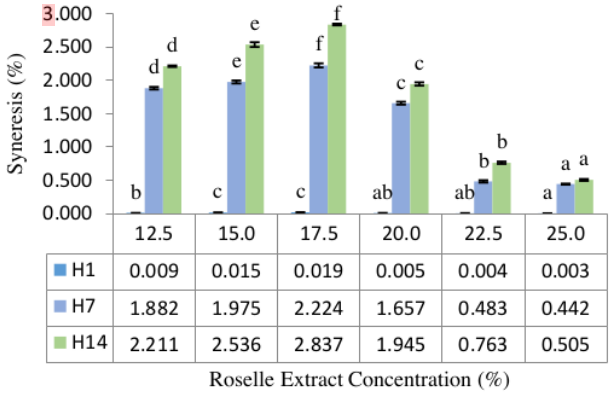

Figure 1. Syneresis of MFDS Jelly Drink with the Addition of Various Concentrations of Roselle Extract during storage for 14 days (H1: 1 day; H7: 7 days; H14: 14 days). Note: different letter on the top ofsame color bar mean significant different at α=5%

3.2. *Organoleptic properties of MFDS jelly drink*

Preference scores of MFDS jelly drink is presented in Table 2. Taste is an important parameter in determining consumer acceptance after color. The average value of organoleptic test results for taste preferences ranged from 2.60 to 5.37. The addition of a rosella extract of 15% (5.37) was most preferred by panelists. This may be because the taste of the jelly drink is not too sour. The addition of rosella extract of 22.5% and 25% caused MFDS too sour.

Table 2. Organoleptic properties of MFDS jelly drink at various concentrations of roselle Extract

Roselle extract concentration (%)	**Taste**	**Color**	**Mouthfeel**
12.5	4.77^{cd}	5.50^{d}	4.38^{b}
15.0	5.37^{d}	5.58^{d}	4.35^{b}
17.5	4.53^{c}	5.38^{cd}	4.68^{bc}
20.0	3.33^{b}	4.88^{c}	5.05^{c}
22.5	2.77^{ab}	4.10^{b}	2.50^{a}
25.0	2.60^{a}	3.35^{a}	2.10^{a}

Note: different letter in the same column mean significant different at α=5%

Color is one of the main parameters that can affect consumer acceptance. The color of a product is important to be able to attract the attention of consumers. The average score of the color preferences ranges from 3.35 to 5.58. The higher concentration of rosella extract added, the color the preference score is lower. The decrease in the color preference score of the jelly drink was probably due to the darker color of the jelly drink. This is consistent with the lightness of the jelly drink which also decreases with the increasing concentration of rosella extract.

Mouthfeel is one parameter that indicate the texture of the jelly drink when it in the mouth. In jelly drink products, the mouthfeel is defined as a gel sensation in the mouth. The average value of the preference scores of mouthfeel ranges from 2.10 to 5.05. The addition of rosella extract by 20% had the highest value (5.05), while at a concentration of 25% had the lowest mouthfeel preference (2.10) and was not significantly different from the concentration of 22.5% (2.50).

The spider web method was used to find out the best treatment for taste, color, and mouthfeel preferences of MFDS jelly drink with the addition of roselle extract. The best treatment was determined by plotting the average results of all preference tests. The best treatment was chosen based on the largest area. The results of the best treatment with the spider web method appear in Figure 2 and Table 3.

Figure 2. Spider Web Hedonic Score (Taste, Mouthfeel, and Color) of MFDS Jelly Drink Added with Different Amount of Roselle Extract

Commented The area of each treatment is obtained from the area of the triangle formed. Based on the calculation results, it was found that the addition of rosella extract by 15% gave the best results with an area of 33.5652, which appears in Table 3.

Table 3. Area of spider web based on preference scores of MFDS jelly drink

Parameter	**Rosella Extract Concentration**					
	12.5%	**15%**	**17.5%**	**20%**	**22.5%**	**25%**
Taste	11.3521	12.9554	10.5511	7.0365	4.9118	3.7715
Color	10.4194	10.5011	10.8808	10.6602	4.4384	3.0462
Mouthfeel	9.0301	10.1087	9.1770	7.2890	2.9950	2.3642
Total	**30.80**	**33.57**	**30.61**	**24.99**	**12.35**	**9.18**

4. Conclusions

Concentration of roselle extract affected on physicochemical (pH, suction power, syneresis, color) and organoleptic (taste, color, and mouthfeel) properties of the MFDS jelly drink. The higher concentration of roselle extract (12.5-25%), the pH value decrease (3.11-2.80) and the suction power value increase (5.7 mL / 20 seconds-9.8 mL / 20 seconds). Longer storage of the jelly drinks (days 1 to 14), the syneresis increased. Syneresis increases at roselle extract concentrations of 12.5% to 17.5%, but decreased at concentrations of 20-25%. The addition of rosella extract at 15% was the best treatment, with a preference scores of flavor, color and mouthfeel of 5.70, 5.58, and 4.35, respectively.

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