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The application of betacyanin microcapsules as natural food colorant on beverage model

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Abstract. Betacyanin microcapsules were made from betacyanin extract (extracted from red dragon fruit peel) and coated with coating material, consist of maltodextrin + gum arabic. The effect of heating on the stability of betacyanin content and color in beverage model containing betacyanin were studied. Betacyanin microcapsules were applicate in water with different pasteurization temperatures (65°C, 70°C, 75°C, 80°C) and time heating (10 minutes, 20 minutes, and 30 minutes). The result showed betacyanin content was not significantly decreased after it heated for 10 minutes to 20 minutes. This indicated betacyanin microcapsules from red dragon peel was potential to be natural food colorant in beverage model.

1. Introduction

Colour is one quality attribute in food, because it affect consumer in the acceptance of food. Food colorant can be obtained from plant. One of source of the food colorant is red dragon fruit peel. Red dragon fruit peel usually is taken away. But it contains rich betacyanin pigment which used as natural food colorant. Betacyanin pigment stable in pH 3-7 [1]. Betacyanin pigment extracted from red dragon fruit peel using water-ethanol solvent mixture [2]. Then it can be microencapsulated with coating materials. Microencapsulation will protect the pigment from degradation process and extent the shelf life [3]. This study was evaluated the application of betacyanin microcapsules on beverage model.

2. Materials and methods

2.1. Materials

Red dragon fruit was obtained from traditional market in Malang City, Indonesia. Maltodextrin and gum Arabic (coating materials) was obtained from chemical store in Malang City, Indonesia.

2.2. Extraction and microencapsulation of betacyanin pigment

The extraction of betacyanin used solvent mixture with ratio of water:ethanol is 20:80 (v/v) [2]. The microencapsulation of betacyanin extract used maltodextrin + gum Arabic as coating materials. The ratio of coating materials : extract is 3:1 (w/w) [4]. The mixture then stirred for 15 min (600 rpm) and lyophilized using freeze dryer (Christ LMC-2, Martin Christ, Germany) at -41 °C in vacuum condition. The encapsulated extracts were grinded and sieved using 80 mesh sieve.



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2.3. Effect of heating conditions on color and betacyanin stability in beverage model

The effect of heating on the stability of colour and betacyanin were observed with modification [5]. Betacyanin microcapsules (1%) was mixed with water and stirred (500 rpm, 5 min). Samples were heated at 65°C, 70°C, 75°C, and 80°C for 10 min, 20 min, and 30 min. Betacyanin content and colour were analysed before and after the heating process.

2.4. Colour

Colour (L^* , a^* , b^*) were measurement using a colorimeter (CR-10, KONICA MINOLTA, INC., Japan) [6]. Total colour difference (ΔE) was calculated to study colour changes [7].

$$\Delta E = [(L_i^* - L_o^*)^2 + (a_i^* - a_o^*)^2 + (b_i^* - b_o^*)^2]^{0.5} \quad (1)$$

L_o^* , a_o^* , b_o^* : the values of untreated sample

L_i^* , a_i^* , b_i^* : the measured values of each sample with treatment.

2.5. Statistical Analysis

Data was analyzed using Minitab 16 (Minitab Inc., United States) with paired t-test.

3. Results and discussion

Longer time of heating process was resulted higher ΔE (total colour difference) value of the solution. Heating process at 80°C during 30 min had the highest ΔE value (21.61) (Table 1). High value of ΔE indicated more colour changes during treatment [8] [9]. High value of ΔE related to the colour parameter (lightness value increased, redness and yellowness value decreased) and betacyanin content of the solution.

Higher temperature with longer time was resulted lower betacyanin content of the solution. Betacyanin content of the solution that heated for 10 and 20 min were not significantly different with betacyanin content before the heating process. While at 30 min heating time there was a significant difference of betacyanin content (Table 4). This result indicated degradation of betacyanin may started after 30 min or more hating. Heating process will damage the redness color which caused by hydrolysis reaction [10] [11]. During the heating process, betanin compound (type of betacyanin which was found in red dragon fruit) was possibly degraded due to isomerisation and decarboxylation reactions. The isomerized betanin compound turned into an isobetanin compound and underwent a decarboxylation reaction then transformed into a 15-decarboxy-betanin (red) compound or a 17-decarboxy-betanin (orange-red) compound [11].

Table 1. Colour and betacyanin content in beverage model before and after heating to different time and temperature.

Treatment	Colour				Betacyanin content before and after heating	
	L	a	b	ΔE	Betacyanin content (mg/L)	Sig
Before heating	62.83 ± 0.31	16.73 ± 0.12	-7.80 ± 0.17	-	1.63 ± 0.01	-
65 °C, 10 min	57.67 ± 0.49	16.17 ± 0.15	-6.03 ± 0.25	5.49 ± 0.74	1.53 ± 0.12	ns
65 °C, 20 min	63.40 ± 0.26	14.40 ± 0.44	-5.93 ± 0.35	3.06 ± 0.72	1.53 ± 0.08	ns
65 °C, 30 min	77.73 ± 0.32	10.43 ± 0.21	-3.60 ± 0.10	16.72 ± 0.19	1.32 ± 0.07	*
70 °C, 10 min	67.63 ± 0.21	13.70 ± 0.10	-5.40 ± 0.10	6.17 ± 0.26	1.25 ± 0.20	ns
70 °C, 20 min	77.47 ± 0.31	8.73 ± 0.40	-4.00 ± 0.30	17.06 ± 0.35	1.16 ± 0.04	*
70 °C, 30 min	76.43 ± 0.45	8.60 ± 0.26	-3.17 ± 0.06	16.51 ± 0.33	1.04 ± 0.22	*
75 °C, 10 min	65.57 ± 0.84	12.57 ± 0.15	-4.47 ± 0.15	6.10 ± 0.35	1.17 ± 0.22	ns
75 °C, 20 min	75.67 ± 0.31	8.43 ± 0.12	-2.23 ± 0.21	16.27 ± 0.43	1.14 ± 0.38	ns
75 °C, 30 min	77.87 ± 0.21	6.87 ± 0.15	-0.83 ± 0.23	19.29 ± 0.21	0.68 ± 0.17	*

80 °C, 10 min	76.90 ± 0.44	8.03 ± 0.15	-2.67 ± 0.21	17.32 ± 0.54	1.13 ± 0.26	ns
80 °C, 20 min	72.63 ± 1.16	4.37 ± 0.15	-3.50 ± 0.00	16.39 ± 0.64	0.99 ± 0.53	ns
80 °C, 30 min	79.20 ± 0.26	4.67 ± 0.06	-0.50 ± 0.10	21.61 ± 0.25	0.65 ± 0.39	*

The displayed value was mean ± standard deviation (n=3)

Notation in Sig column (ns and *) was the result of paired t-test between betacyanin content in beverage model before and after heating process

ns = not significant

* = significant

4. Conclusion

Beverage model made of betacyanin microcapsules from red dragon fruit peel was stable in heating time less than 30 min but increasing the heating temperature caused decreasing of betacyanin content. This result indicated betacyanin microcapsules from red dragon fruit peel is a potential natural color to be applied on food product.

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