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Quantification of 10-Gingerol Content in Various Encapsulation of Red Ginger Extract Using HPLC Method

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Abstract

Red ginger is a rising traditional medicine with its benefits, i.e., anti-inflammation, antioxidant, antiemetic, antibacterial, and antidiabetics. The most active polyphenol chemical constituent of red ginger (and ginger in general) is gingerol, which creates its sharp smell and strong taste. Gingerol is a thermolabile compound that transforms into shogaol. This research aims to quantify 10-gingerol content in an encapsulated red ginger extract with maltodextrin and Arabic gum. A chromatographic method is applied using a validated Agilent 1220 HPLC system with Zorbax RP C18 column. Water: Acetonitrile mobile phase is used as the mobile phase. The result showed that encapsulation of red ginger extract, maltodextrin, and arabic gum with ratio 2:1:1, 3:1:1, 1:1:0, and 1:1:1 contains gingerol in sequent 74.99 ppm, 66.41 ppm, 12.96 ppm, and 4.49 ppm of 10-gingerol. The research concludes that red ginger extract, although it has gone through a heating process to form encapsulated extract, still contains gingerol, with its pharmacological benefit.

Keywords: Red ginger, gingerol, encapsulation, HPLC

INTRODUCTION

Red ginger has a spicy and warm taste, which is caused by some of the chemicals in red ginger, including gingerol, flying oil, limonene, α-linoleic acid, aspartic, β -sitosterol, caprylic acid, capsaicin, chlorogenic acid, and farnesol (Hartati, 2012). To minimize the loss of beneficial chemical compounds contained in red ginger, it is necessary to use proper treatment methods while processing it, including washing time, slice thickness, temperature, and drying method (Kusumawati et al., 2017).

One possible way to maintain the quality and quantity of active components present in red ginger and facilitate the handling and packaging of the product is by encapsulating it with a maltodextrin coating (Nurlaili et al., 2014). Red ginger powder is added with maltodextrin in order to increase the volume and weight of the powder produced and speed up drying (Gonnissen et al., 2008). Maltodextrin is one of the encapsulation agents that has natural properties of fast dispersion, high solubility (in cold water), to form a films/membrane, forms low hygroscopic properties, is able to inhibit crystallization, and has strong binding power (Hardjanti, 2008). Arabic gum in food products can also function as a unifier or combiner, preventing sugar crystallization and maintaining the taste, flavor, and texture of the mixed product (Tantono et al., 2017).

The microencapsulation method is a coating technology for solid, liquid, or gas forms to protect active ingredients that are sensitive to damage due to oxidation processes, which result in

the protection of taste, flavor, texture, and loss of nutrients of the food. This method is suitable to be used in water-soluble foods because they can convert unstable active compounds in liquid form into a dry powder that is easily mixed in dry food systems (Anandharamakrishnan & S, P.I. 2015).

Based on the background described above, the research aims to quantify 10-gingerol content in an encapsulated red ginger extract with maltodextrin and Arabic gum, as a source of antioxidants, with good processing, carried to extend the shelf life, which is safe and suitable for consumption and leads to community health improvement.

METHODOLOGY

Research tools and materials

The raw material used was red ginger (*Zingiberace officinale* var. Rubrum) obtained from the Experimental Plantation of the Manoko Spice and Medicinal Plant Research Institute, Lembang, West Java, Indonesia. Extracted by the maceration method, the materials and tools used were distilled water, maltodextrin, arabic gum, 100 ml beaker glass, magnetic stirrer.

The chemicals used in the chromatographic test stage were acetonitrile (HPLC grade) Merck KGaA, 64271 Darmstadt Germany CAS no 67-56-1, water (bidestilata) 40:60 ratio, and 10-gingerol 98% Sigma-Aldrich; Merck KGaA Darmstadt Germany CAS no 23513-15-7. The tools used are digital analytical balance (Mettler Toledo), Agilent HPLC model 1220 Infinity LC, Agilent Chem Station, Agilent Zorbax SB C-18 column (4.6 ID x 250 mm, particle size: 10 m), micropipette, microsyringe, 0.45 m membrane filter, Vortex stirrer, magnetic stirrer, sonicator, Eppendorf tube, and other glass equipment commonly used in laboratories.

Red Ginger Powder Preparation and Encapsulation

Generally, the manufacturing process of red ginger simplicia at this stage used the same steps, which are washing to clean dirt from the rhizome, slicing at 0.3 mm, drying of the material, and continuing to powder the simplicia, and then sieved using a 200 mesh (Kusumawati et al., 2017).

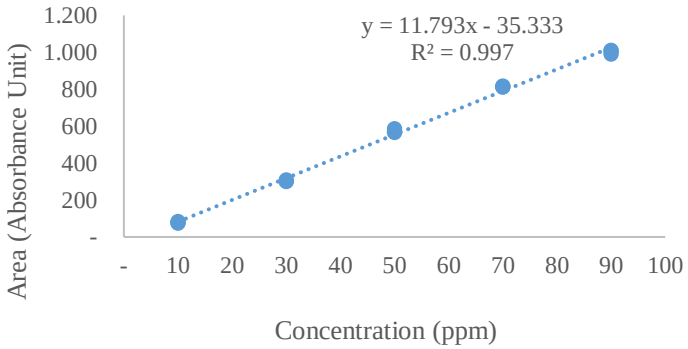
The extraction is done by using the maceration method three times in 24 hours with 96% ethanol solvent, while macerate was collected daily. The extract was then dried using a vacuum rotary evaporator at 50 ^{o}C, and the thick extract was obtained. The extract is then stored in a closed container and protected from sunlight. The results of the extraction will be added with maltodextrin and arabic gum in a ratio of 2:1:1, 3:1:1, 1:1:0, and 1:1:1.

Analysis of gingerol content in encapsulated extract was done using the validated HPLC method.

RESULTS AND DISCUSSION

Applying the HPLC method on gingerol standard compound, the linearity test was conducted to determine the ability of the analytical method to provide a direct response so that the test results were proportional to the analyte concentration in the sample. The calibration curve in Figure 1 showed a linear regression equation $y = 11.793x - 35.333$ with a correlation coefficient, r, of 0.9985 with a significant value, R^2, of 0.997. The results show a positive linear correlation between the concentration data and the area under the curve.

Figure 1: Calibration Curve of 10 Gingerol Standard Compound



Result of the analysis on encapsulated extract by using the validated HPLC method presented in Figure 2, where encapsulation with ratio 2:1:1 of red ginger extract, maltodextrin, and arabic gum, showed the highest content of gingerol with 74.99 ppm, followed by ratio 3:1:1. This data was then analyzed using ANOVA statistics presented in Table 1 and followed by the Duncan Range Test in Table 2.

Figure 2: Content of Gingerol in Encapsulated Extract

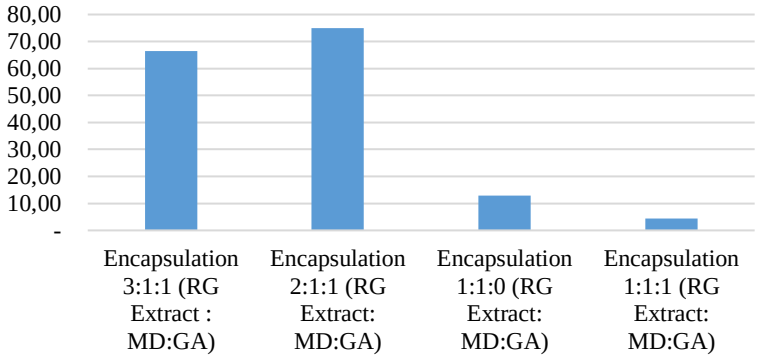


Table 1: ANOVA Statistical Analysis of Encapsulation of Red Ginger Extract.

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	11,741.30	3	3,913.76	253.97	0.000
Within Groups	123.28	8	15.41		
Total	11,864.58	11			

Table 2: Duncan Range Test Analysis of Encapsulation of Red Ginger Extract.

Extract type	N	Subset for alpha = 0.05			
		1	2	3	4
Encapsulation 1:1:1	3	4.49			
Encapsulation 1:1:0	3		12.96		
Encapsulation 3:1:1	3			66.41	
Encapsulation 2:1:1	3				74.99
Sig.		1.000	1.000	1.000	1.000

The results of the ANOVA statistical test showed that there were differences in the effect of various encapsulated concentrations of red ginger extract, maltodextrin, and arabic gum, with p = 0.000 (smaller than = 0.05). The Duncan test results show that the encapsulation ratio of 2:1:1 is the best (74.99 ppm).

CONCLUSION

The encapsulation of maltodextrin and Arabic gum in the red ginger extract can be detected and quantified by the HPLC assay method. The results showed the encapsulation of red ginger extract, maltodextrin, and arabic gum with a ratio of 2:1:1, 3:1:1, 1:1:0, and 1:1:1. Determination of 10-gingerol content in the encapsulated red ginger extract was still can be identified and quantized with sequential concentration values of 74.99 ppm, 66.41 ppm, 12.96 ppm, and 4.49 ppm. The results of the study concluded that red ginger extract, even though it had gone through a process to form an encapsulated extract, still contained gingerol, with its pharmacological benefits.

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