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## Stability Analysis of Ginger (*Zingiber officinale*) Emulsion Affected by Iota Carrageenan

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## Stability Analysis of Ginger (*Zingiber officinale*) Emulsion Affected by Iota Carrageenan

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**Abstract.** Ginger is commonly used by Indonesian community as a main ingredient for making traditional beverages. Separation of solutions in the production process of traditional beverage based on ginger emulsions is often found and may reduce consumer interest. Addition of iota carrageenan is expected to increase emulsion stability that could be detected by the amount of sedimentation. This study was aimed to determine the emulsion stability of ginger emulsion with the addition of iota carrageenan. Ginger emulsion formulation contained iota carrageenan was prepared from 1–3% b/v of iota carrageenan added to 10–30% v/v ginger emulsion. The heat was applied to emulsion at 70°C. Emulsion stability was analysed by spectral analysis using UV-Vis spectrophotometer and calculating the amount of separated sediment for 10 minutes. The percentage analysis was applied to measure the emulsion stability. The results showed that iota carrageenan was suitable to maintain the emulsion stability up to the 10 minutes with while no iota addition was less maintain the stability. It showed that iota carrageenan could enhance the ginger emulsion.

### 1. Introduction

Carrageenan is one of the hydrocolloids that could be derived from red seaweed (*Rhodophyta*) [1]. Due to its stabilizing, thickening and gelling property, carrageenan has been widely used in food industry [2] and also used in non food industry [3]. However, the utilization of carrageenan as emulsifier in the manufacture of Java's traditional beverages has not been much explored, whereas the use of carrageenan is expected to improve the desired physical properties especially in terms of emulsion stability [4] where most of Indonesian signature beverages had ginger as its main ingredient.

Ginger is commonly used in Indonesia as basic ingredient for making traditional beverages. This is due to the presence of 6-gingerol that play a role in the pharmaceutical and preventive agent of various diseases [5] due to the presence of carbon chains C1 to C5 which plays an important role to exhibit different pharmacological properties [6]. Sedimentation appearance in ginger emulsion is commonly occurred, and may reduce consumer interest, thus the emulsifier is required to provide stable emulsion and hindered the sedimentation [7]. The choice of emulsifier should also be considered since ginger contains flavonoid of about 3% that may break the mechanism of binding [8].



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The aim of the study was to analyse ginger emulsion with and without iota carrageenan as emulsifier as the amount of sediment and spectral analysis.

## 2. Materials and Methods

### 2.1. Materials

Iota carrageenan were purchased from CV. Karagenan Indonesia. Ginger (*Zingiber officinale*) and brown sugar was purchased from Banyumanik traditional market in nearby Diponegoro University.

### 2.2. Methods

#### 2.2.1. Manufacturing ginger emulsion

A total of 3 kg of ginger, peeled, cut into small pieces of 2 x 2 cm, and steamed for 30 minute. Extract of ginger was obtained using juicer. Ginger extract was further filtered by a filter cloth and dried using dryer (Lincat SCH1085, China) at  $40\pm 1^\circ\text{C}$  for 24 hours with 0.15 m/sec airflow. This process produced 500 g ginger powder. The preparation of ginger emulsion was following the method from previous researcher [9] by mixing 5 g of ginger powder and 20 g of brown sugar into 15 ml of distilled water containing 0.8 g of carrageenan (2% w/v). The ginger emulsion was heated at  $70\pm 2^\circ\text{C}$  for 5 minutes and stirred continuously. After cooling 15 ml of ginger emulsion was collected into the tube and an emulsion stability test was then performed. The ginger emulsion was divided into two group which were with and without iota carrageenan.

#### 2.2.2. Emulsion stability analysis

An emulsion stability analysis was performed using a diluted sample with aquadest at a ratio of 1:9 (v/v) then was homogenized using vortex at 3600 rpm. Emulsion stability analysis was performed by calculating the amount of sediment [10] every 2 minutes until 10 minutes. The data were then converted in a percentage.

#### 2.2.3. Spectral analysis

Sample preparation was done by making dilution of the sample with aquadest at ratio of 1:9 (v/v) then the sample was homogenized using vortex at 6000 rpm for 15 minutes. Spectral analysis was performed using spectrophotometer UV-Vis at wavelength 190-600 nm. This method was adopted from previous study [11].

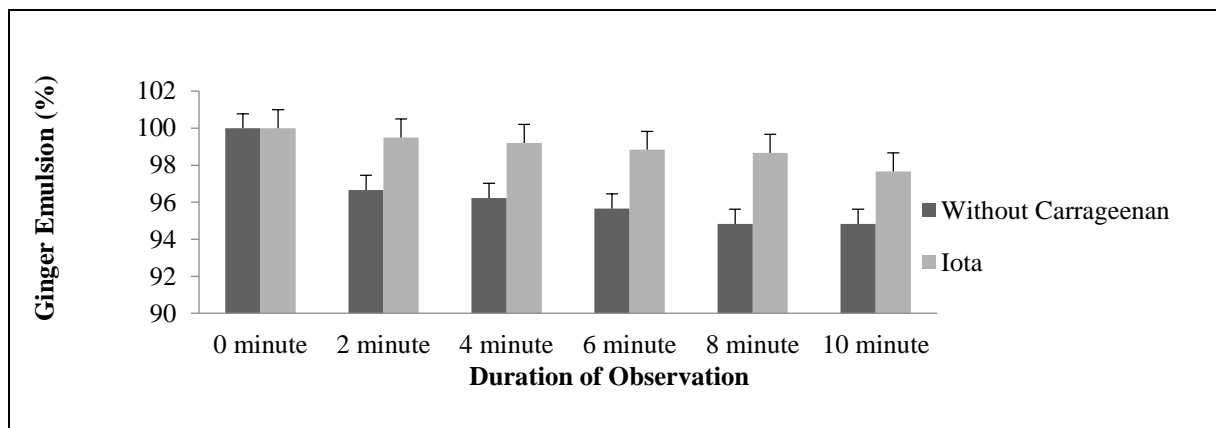
#### 2.2.4. Data analysis

Data of emulsion stability were processed using Microsoft Excel 2010 then calculated the average  $\pm$  standard deviation. Meanwhile, the result of spectral analysis was presented in the form of graphic. Both of the data were described descriptively.

## 3. Results and Discussion

### 3.1. Emulsion stability

This study measured the emulsion stability that was obtained from the calculation of the amount of increase in sediment of the emulsion for 10 minutes of observation (Fig. 1). The value of 100% emulsion stability means no sediment was formed. The formation of the sedimentation was started at 2<sup>nd</sup> minute of exploration, but the sediment was not found in the emulsion containing the iota. This indicates that the iota carrageenan exhibited higher emulsion stability than that of no carrageenan.



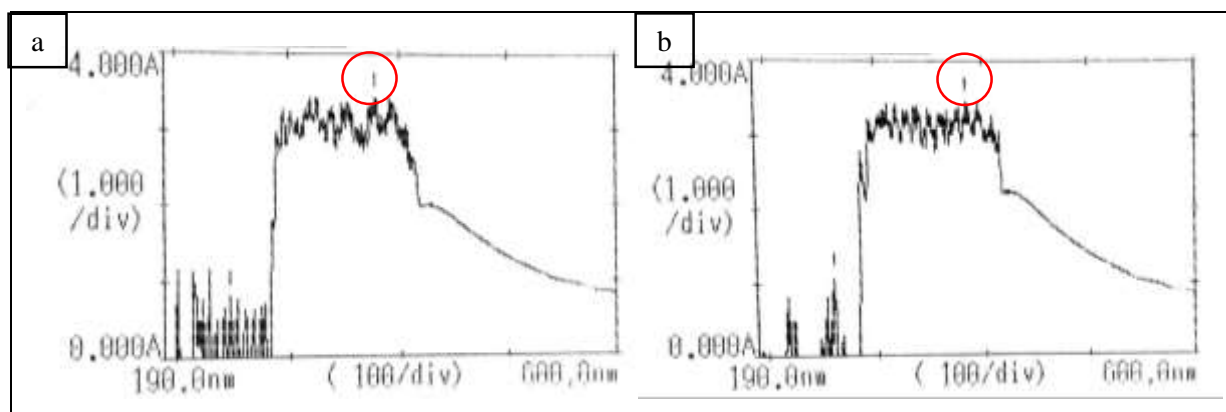
**Figure 1.** Stability test of ginger emulsion without carrageenan addition, with Iota carrageenan, and with Kappa carrageenan.

The highest sedimentation was found in the 10<sup>th</sup> minute of storage at room temperature providing a remarkable difference of 95% emulsion stability for without and with addition of iota carrageenan, respectively. The effect of decreased emulsion stability was closely related to the length of storage time [12] and the presence of emulsifier [13]. The carrageenan was prominent in maintaining emulsion since it bound to the three carbon chain of the carbohydrate chain and maintain protein functionality with only 19% decrease in stability for 2 days of storage, while the protein treated without emulsifiers could decrease its quality by 66% [14]. Kappa and iota carrageenan are commonly used as emulsifiers [15] but the stability of carrageenan emulsion is much higher in iota than kappa carrageenan. This is understood since iota and kappa have different compounds, kappa carrageenan contain higher 3,6-anhydro-D-galactose with fewer sulphate group that has hydrophobic properties affecting on less viscosity than iota carrageenan [3]. The addition of carrageenan to the ginger emulsion enhanced the stability of emulsion also because of the formation protective films in the solution components [16]

The use of iota carrageenan as emulsion stability was used commonly in soluble food, such as ginger emulsions as they play a role in maintaining the viscosity. The carrageenan is water soluble compound which facilitates maintaining the stability of the emulsion, as well as having a thickening function [17]. While the kappa carrageenan much contributes to the formation of gels with a compact structure so that it does not have a proper action to maintain the stability [18].

### 3.2. Spectral Analysis

Based on the results of the study, highest peak was achieved at 378.65 nm and 385 nm, respectively, for ginger emulsion without iota carrageenan addition and ginger emulsion with iota carrageenan addition (Fig. 2). Peak value is closely related to the absorbance value and dominant color of the sample [19]. In the wavelength range of 300-380 nm renders a yellow substance which is flavonol compound [20]. Wavelength used in the sample treated without the addition of iota carrageenan was used to determine the absorbance value in iota carrageenan treatment.



**Figure 2.** Result of spectral analysis of ginger emulsion (a) without iota carrageenan addition and (b) with iota carrageenan addition

**Table 1.** Ginger emulsion absorbance that was measured at 378.5 nm using UV-Vis Spectrophotometer

Treatment	Absorbance ( $\text{\AA}$ )
Without carrageenan	3,418
Iota Carrageenan	3,400

Table 1 showed that ginger emulsion with iota carrageenan addition had lower absorbance than ginger emulsion without iota carrageenan addition. The higher absorbance value indicated the higher turbidity while the lower the absorbance value indicated the higher clarity of the solution. Turbidity is one of emulsion stability indicator. The clearer the solution generated the more stable emulsion. Thus, iota carrageenan could act as an encapsulant that has a good ability to bind and protect components in ginger emulsion [21] and iota carrageenan was able to bind compound stronger than kappa carrageenan due to much more amount of sulphate group [3].

#### 4. Conclusion

Emulsion stability of ginger emulsion could be enhanced by the addition of iota carrageenan. The result indicated that iota carrageenan addition could maintain the emulsion stability up to 10 minutes and had lower absorbance value while no iota addition was less maintain the stability with higher absorbance value.

#### 5. References

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