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The Effect Of Stearic Acid And Triethanolamine (Tea) On Physical And Chemical Properties Of Cosmetic Emulsion Using Coconut Oil As Raw Material

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ABSTRACT

The aim of this research was to study the effect of stearic acid and TEA concentration on physical and chemical properties of cosmetic emulsion using coconut oil as raw material. The emulsion was made by emulsification of water phase (glycerin, aquadest and TEA) and oil phase (coconut oil, stearic acid, lanolin, cetyl alcohol). To determine the effect of stearic acid and TEA concentration on properties of emulsion, these components were added in various concentrations. The physical and chemical properties of emulsions were then measured such as pH, viscosity and droplet size. The result showed that the viscosity of emulsions was increased by increasing stearic acid concentration, on the other hand the droplet size decreased. The pH of emulsion was in the range of 7. 58-7. 96. If the TEA concentration was increased, the pH and viscosity were also increased, but it caused a decrease in droplets size. These mean that stearic acid and TEA concentration affected the physical and chemical properties of cosmetic emulsions.

Key word: stearic acid, triethanolamine, physical and chemical properties, cosmetic emulsion, coconut oil

1. INTRODUCTION

Coconut oil is vegetable oil which can be obtained from coconut fruit meat (*Cocos nucifera*, L). This oil contains a high percentage (92 %) of saturated fatty acids [1], causing resistance to oxidation [2], serves as an antiviral and antibacterial [3]. Coconut oil can maintain skin elasticity, moisturize and soften the skin [4; 5], so it can be used as a skin moisturizer [6]. This oil has a Sun Protection Factor (SPF) of 7. 119, thus potentially as an additional ingredient in sunscreen [6]. Because this oil has many benefits, so in recent years, coconut oil is favored by the people, not only for cooking, but also used widely in the manufacture of cosmetics to enhance the beauty and health.

Most of skin care cosmetics sold in the market are in the form of creams and lotions, which are included in a class of emulsion. The emulsions are heterogeneous dispersed systems made of two immiscible liquids dispersed one into each other under the shape of drops with 0. 1-100 micrometers diameter [8]. Such systems are thermodynamically unstable and will separate in two distinct phases after a sufficient period of time [9], therefore it is necessary to add materials to stabilize the emulsion, which is called an emulsifier. Skin care cosmetics such as cleansers, moisturizers and sunscreen cosmetic can be made in the form of a cream with surfactant as an emulsifier. The surfactant can be produced from the reaction between stearic acid with a sufficiently alkaline. Sodium Hydroxide (Na OH), potassium hydroxide (KOH) and triethanolamine (TEA) were the alkali, which can be used to make the surfactants. Because the emulsifier plays an important role in the manufacture of emulsions, it is necessary to study the influence of the concentration of stearic acid with a base, especially TEA on to the properties of cosmetic emulsions made of coconut oil.

2. EXPERIMENTAL SECTION

2. 1 Materials and apparatus

Coconut oil (from PT Tropica Nucifera Industry, Indonesia), stearic acid, cetyl alcohol, lanolin, glycerin, TEA (from PT Bratacho, Indonesia) and distilled water.

The apparatus which were used in this research include, laboratory glassware such as beaker glass, measuring cups, mixing glass, watch glass, glass funnel, thermometer, electric stove, electric scales, pH meters, Olympus CH 20 binocular micrometer microscope and Brookfield viscometer.

2. 2 Preparation and characterization of emulsions

2. 2. 1 Variation of the concentration of stearic acid

The emulsion was made by, a certain amount of water phase included 12 g (6% w / w) glycerol, 1. 5 g (0. 75% w / w) of TEA and 154. 5 g (77. 25% w / w) distilled water were put into a glass beaker of 250mL, then the mixture was heated to 70 °C. A certain amount of oil phase included 20 gram (10% w / w) of coconut oil, 8 gram (4% w / w) stearic acid, 2 gram (1% w / w) lanolin and 2 gram (1% w / w) cetyl alcohol were put into a glass beaker of 500mL, and then the mixture was heated to 70 °C. The aqueous phase was poured into the oil phase gradually while stirring until homogeneous and the mixture reached a temperature of ± 35 °C. The emulsion

formed was characterized to determine the physical and chemical properties include shape, color, pH, viscosity and droplets size. The pH of the emulsion was determined using a digital pH meter by dipped this apparatus to creamy emulsion. Observations were carried out in duplo and it performed once time a week for 1 month. The viscosity of the emulsion was determined using Brookfield viscometer with spindle 7 and 50 rpm. Observations were carried out in duplo, once time a week for 1 month. Emulsion droplets size was determined by using an Olympus CH 20 binocular micrometer microscope. The above experiment was repeated using stearic acid in different concentrations (6%, 8%, 10% and 12% w / w), and the amount of distilled water was added until reached the emulsion weight of 200 g (100% w / w).

2. 2. 2 Variation of the concentration of TEA

By using procedure 2. 2. 1 above, the emulsions were prepared using a fixed concentration of stearic acid, but the TEA was added in different concentration (0. 25%, 0. 5%, 0. 75%, 1%, 1. 25%, 1. 5% and 1. 75% w /w), and the amount of water was added until reached the emulsion weight of 100% w / w.

3. RESULTS AND DISCUSSION

3. 1 Effect of stearic acid concentration on the properties of emulsions

In this research, it has been prepared and characterized 5 emulsions with varied concentrations of stearic acid (4%, 6%, 8%, 10% and 12% w / w). The properties of emulsions were in form of cream, white color with a soft texture. The data (pH, viscosity and droplets size) obtained were presented in Figure from 1 to 3.

Figure 1 showed that in the addition of stearic acid with different concentrations, the pH of the emulsion, which were observed every 1 time a week for 1 month were in the range of 7. 58 to 7. 96, and the pH of the emulsions were increased every week. This was do to, in this process, it occured a reaction between stearic acid and TEA to produce TEA stearate as an emulsifier. According Zhu (2007), at room temperature, some of the TEA stearate will turn into TEA and stearic acid undergo hydrolysis reaction [10]. TEA is a weak base, so resulting in an increasing a pH of emulsion every week.

Figure 2 indicated that the viscosity of the emulsions increased as the stearic acid concentrations were increased. This was due to the increasing stearic acid concentration caused the amount of stearic acid that reacted with TEA to produce TEA stearate as an emulsifier also increased. TEA stearate has a lipophilic group ($CH_3(CH_2)_{16}$-) that can bind to the oil phase and hydrophilic group (-COO^+ NH $(CH_2CH_2OH)_3$ which can bind with water phase. When the amount of TEA stearate increased, the amount of water phase and oil phase which can be stabilized to form an emulsion increased too. As a result, the viscosity of the emulsion also increased. The once time a week for 1 month observation showed that the viscosity of emulsion decreased every week. These was likely due to a hydrolyzed of TEA stearate to produce TEA and stearic acid, so that the amount of TEA stearate which stabilized the emulsion was reduced. Consequently, the viscosity of the emulsion decreased too.

Figure 3 showed the higher concentration of stearic acid, it caused the small droplets size of the emulsions.

This was due to the increased amount of stearic acid added, it would be more and more also a TEA stearate as an emulsifier formed. As a result, the more the surface tension of the oil phase and water phase were lowered, and it prevented the recombination between dispersed phase, causing the droplet size become smaller and produced a stable emulsion. TEA stearate coated the dispersed phase by forming the thin layer outside and it prevented the dispersed phase not to recombine.

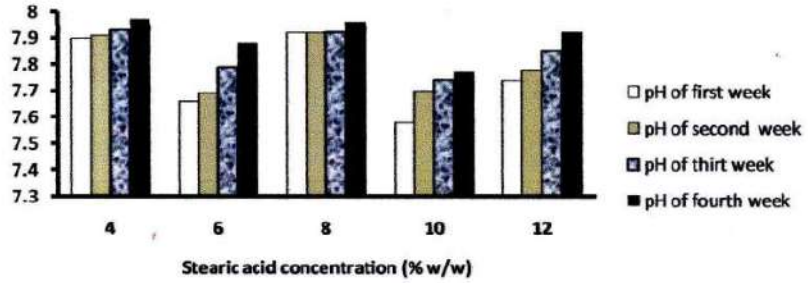


Figure 1. Effect of stearic acid concentration on pH of emulsion

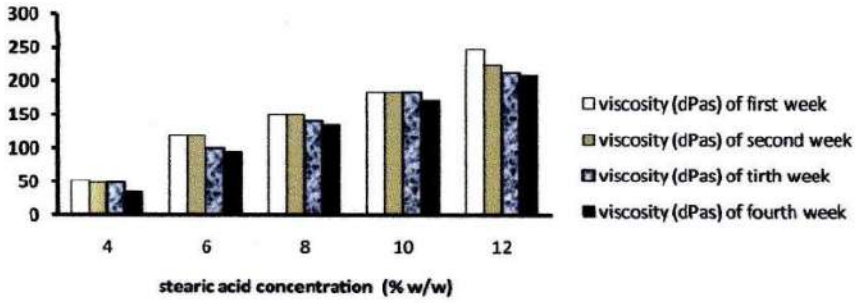
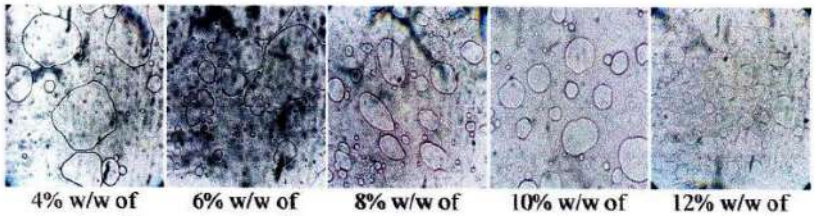


Figure 2. Effect of stearic acid concentration on viscosity of emulsion



4% w/w of stearic acid | 6% w/w of stearic acid | 8% w/w of stearic acid | 10% w/w of stearic acid | 12% w/w of stearic acid

Figure 3. Effect of stearic acid concentration on droplets size of emulsion

3. 2 Effect of TEA concentration on the properties of emulsions

In this study, it has been prepared and characterized 7 emulsions with different concentration of TEA (0. 25%, 0. 5%, 0. 75%, 1%, 1. 25%, 1. 5% and 1. 75% w / w). The form of resulting emulsion was a cream, white color and a soft texture. The data of pH, viscosity and droplets size were presented in Figures 4, 5, and 6.

From Figure 4, it could be seen that when the addition of TEA concentration increased, the pH of the emulsion generally increased too. The pH of the emulsions were in the range of 7. 44-8. 03. Determination of the emulsion pH for 1 time a week in 1 month showed that the pH of emulsions increased every week. This was caused by the TEA was an alkaline, if the concentration of the added TEA increased, in a fixed of stearic acid concentration, so it could occurred an excess of alkaline, causing the increase of emulsion pH. According Zhu (2007), at a room temperature, some of the TEA stearate will turn into TEA and stearic acid undergo hydrolysis reaction [10]. TEA is a weak base, so resulting in an increasing of an emulsion pH every week.

Figure 5 showed, if the TEA concentration increased, the viscosity of the emulsions were also increased. This was do to increasing the TEA concentration caused the amount of produced TEA stearate as an emulsifier also increased, so that the water phase and oil phase which could be emulsified by this emulsifier increased as well. As a result, the viscosity of emulsion could be high. The 1 time a week for 1 month observation showed that it occurred a decrease in emulsion viscosity. Decreasing the emulsion viscosity, maybe caused by hydrolyzed reaction of some TEA stearate as an emulsifier to form TEA and stearic acid. Figure 6 showed that the droplets size of emulsion become small size as the added TEA concentration increased.

This was due to the increasing amount of stearic acid, it would be more and more also TEA stearate as an emulsifier formed. As a result, the more the surface tension of oil phase and water phase were lowered, and it prevented the recombination between dispersed phase, causing the droplets size become smaller and produced a stable emulsion. TEA stearate coated the dispersed phase by forming the thin layer outside and it prevented the dispersed phase not to recombine.

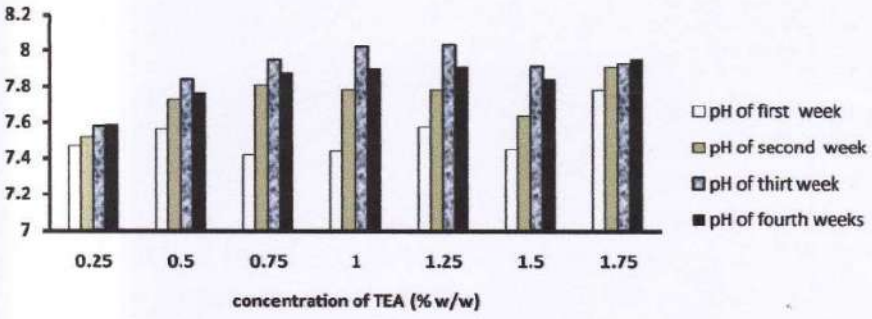


Figure 4. Effect of TEA concentration on pH of emulsions

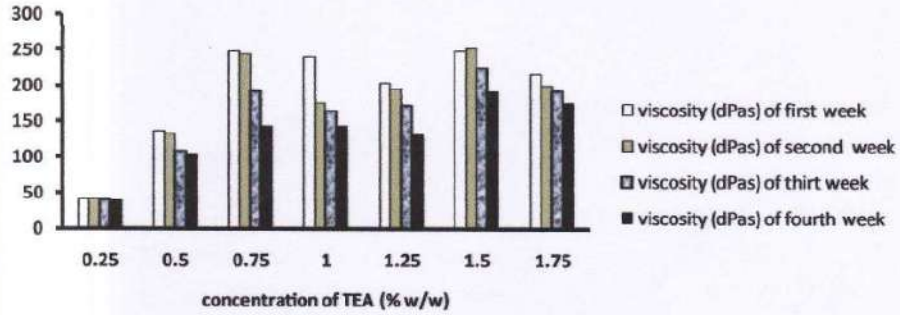


Figure 5. Effect of TEA concentration on viscosity of emulsion

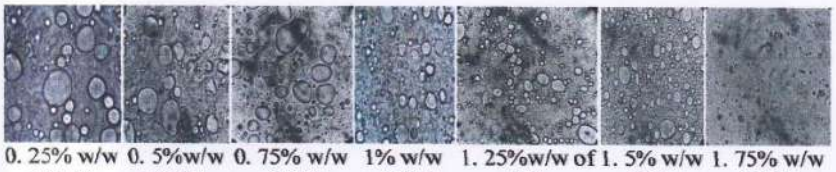


Figure 6. Effect of TEA concentration on droplets size of emulsion

4. CONCLUTION

The viscosity of emulsion was increased by increasing concentration of stearic acid, on the other hand, the droplet size was decreased. The pH of emulsions was in the

range of 7. 58-7. 96. If the concentration of TEA increased, the viscosity and the pH of emulsion increased as well, but the droplet size of emulsion become smaller. These mean that concentration of stearic acid and TEA affected the physical and chemical properties of emulsions.

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