Evaluation of viscosity and pH on Emulsions of Virgin Coconut Oil Beverages

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Abstract. Virgin Coconut Oil (VCO) beverages are value added products of VCO which produced by emulsifying non polar VCO in a polar solvent by adding emulsifier. In this research, stability of VCO in water emulsion beverage at various volume percentages of VCO to water using soy lecithin as natural emulsifier was studied. The beverage emulsions were prepared by homogenizing VCO in water at 5%, 10%, 15%, 20%, 25% and 30%, respectively. The soy lecithin was added to the solutions at 1% (v/v). The stability of VCO beverage emulsions was evaluated from its viscosity, pH, and volume of formed-cream of both fresh and after-cycle-emulsions. It was found from the research that in terms of viscosity and pH, the beverage emulsion at 20% of VCO was the most stable. Further research is needed to avoid the cream formation which tends to destabilize the VCO beverage emulsion.

Keywords— natural emulsifier, soybean lecithin, VCO

1. Introduction

Virgin coconut oil (VCO) is an important product of a coconut plantation. The oil contains high lauric acid (50%), a type of Medium Chain Fatty Acid (MFCA). It is reported that lauric acid may have antibiotic, antiviral, anti bacteria and antifungal effects . There is a growing positive trend to consume VCO, however VCO has an oily-unpleasant-taste when consumed directly. Emulsifying VCO into beverages may improve its taste and give benefit to consumers for its health promoting effect and consumption’s convenient. A VCO beverage is a colloid system of oil in water emulsion. The system consists of a non-homogenous liquid suspension, thus a homogenizing process is required. An emulsifier is added to stabilize the emulsion during the homogenizing process. Emulsifier are a surface-active molecule which adsorbs to the surface of oil droplets created during homogenization, thus the emulsifiers facilitate the formation of the emulsion and improves the emulsion stability. There are two types of emulsifier widely used in food industries, namely synthetic and natural emulsifiers. Combinations of synthetic emulsifiers, Tween 80 and Span 80, were used in the production of water in VCO emulsions. The results showed that the emulsion was stable at a weight ratio of water : VCO of 20:80 at emulsifier concentration of 0,5% ; 0,75% ; dan 1 %, respectively. Soybean lecithin, a natural soybean derived emulsifier which contained phosphatidylcholine (PC), phosphatidylethanolamine (PE), phosphatidylinositol (PI) and phosphatidylserine (PS), has been used in the production of oil/water and water/oil emulsions.

The instability of emulsions may be indicated by creaming which oil droplets move upwards in the emulsion systems, a change in pH levels of the emulsions and a change of viscosity of the emulsions. Creaming as an indication of a phase breakdown could be affected by a type and concentration of an emulsifier added into the emulsion. Excessive addition of emulsifiers may affect into the destabilization of the emulsion due to the oil globule could not fully absorb the emulsifier [10]. A change of pH in the emulsion systems could affect antioxidant activities resulted in oxidation process and destabilization of the emulsions. During the storage, the viscosity of beverages could change. Bacteria contaminations could be one of the cause of the viscosity change in the beverages which create destabilization of the emulsions.
In this study, VCO beverages are produced by mixing VCO in water using soybean lecithin as a natural emulsifier. Creaming, pH and apparent viscosity of both fresh and after-cycled emulsions are evaluated. After-cycled emulsions are prepared to replicate stored beverages. It is expected that this study could provide useful information for the production of VCO beverages.

2. Methodology

2.1. Materials and Equipment

Virgin coconut oil (VCO) was obtained from CV AVCOL, a local small and medium enterprise of VCO production in Makassar. Distilled water was used as aqueous medium and food grade soybean lecithin was used as emulsifier.

VCO beverage emulsions were prepared in an ultraturrax electric homogenizer and sonicator. The dynamic change of the emulsion viscosity was measured using Brookfield DV-I Prime dynamic viscometer. The change of pH in emulsions was measured using a digital pH meter.

2.2. Methods

The ratio of VCO to water in this research was varied in accordance with a recommended adult intake of VCO (between 2-3 table spoon in 150 ml of VCO beverage emulsions). The samples were prepared by dissolving VCO in distilled water at a volume percent of 5%, 10%, 15%, 20%, 25% and 30%, respectively. Soy lecithin was added to the emulsions at 1% (v/v). Fresh and after-cycled emulsions were evaluated in this study. Fresh emulsions were prepared by homogenizing the samples in an ultraturrax homogenizer at a speed of 15000 rpm for 4 minutes then followed by sonification in a sonicator for 9 minutes. The fresh emulsions then were evaluated for pH and apparent viscosity. Creaming was evaluated from the emulsion after 24 hour-storage.

To study the stability of the emulsions, after-cycled emulsions were prepared by applying stress conditions, namely by changing the storage temperatures of the emulsions at a warm temperature of 35 ºC and cold temperature of 5 ºC for a total of 5 days. The temperature conditions were changed every 12 hours. The change of pH, apparent viscosity and creaming of after-cycled emulsions were evaluated.

3. Results and Discussion

3.1. Effect of % VCO to viscosity of emulsions

Stability of the emulsions could be indicated by the its viscosity. It has been reported that adding biopolymer such as soybean lecithin may increase the viscosity of the emulsion and improve emulsion stability. Soybean lecithin is also a natural and widely used emulsifier in food industries. In this research, VCO beverage emulsions were prepared at percent volume of VCO (%VCO) of 5%, 10%, 15%, 20%, 25% and 30%, respectively. Soybean lecithin was used as an emulsifier at 1% (v/v).

The evaluations of emulsion viscosities were performed for both fresh and after-cycled emulsions. To replicate the storage conditions of emulsions, after-cycled emulsions were prepared by applying stress conditions to the emulsions. Emulsions were stored at a certain time (5 days) at repeated two different temperature conditions, namely at a temperature of 30ºC for 12 hours and then changed to a temperature of 5ºC for 12 hours. The evaluations of viscosity of fresh and after-cycled emulsions are presented at Fig. 1.
Figure 1. Effect of %VCO to viscosity of emulsions using Soybean lecithin emulsifier

Fig. 1 shows that the viscosity of the emulsion tends to increase with increase in the %VCO for both fresh and after-cycled emulsions. Generally, the VCO beverage emulsions at 1% soybean lecithin are stable in term of viscosity of the solutions. It can be seen from Fig. 1 that there are no significant changes of the viscosities of fresh and after cycled emulsions except for the emulsion of 30% VCO. At 30% VCO, the viscosity of the fresh emulsion is significantly lower than the after-cycled emulsion. At a lower percentage of VCO, the soybean lecithin emulsifier could facilitate in stabilizing the emulsion, whereas at a higher %VCO, the emulsifier seems to fail in keeping the stability of the emulsion. At 30% VCO, the emulsion could not stand into stress conditions, therefore there is a big discrepancy between viscosity of fresh and after-cycled emulsions. It is reported that there is an emulsion breakdown if the apparent viscosity of the emulsion is too high [10]. The crystallization of the oil could occur during the storage of an emulsion at a low temperature, this would affect the increase of the viscosity of the emulsions [13].

It can be seen from Fig. 1 that the fresh emulsion of 20%VCO has quite high viscosity. After applying stress conditions to the 20%VCO emulsion, the viscosity is lower than the after-cycled emulsion. This shows that in this research, the 20% VCO emulsion at 1% soybean lecithin emulsifier is the most stable emulsion.

3.2. Effect of %VCO to pH emulsions

A change of pH of an emulsion could be used to evaluate an emulsion stability. In this study, pH emulsions of fresh and after-cycled emulsions were measured at various %VCO at the addition of 1% of soybean lecithin emulsifier. The results of pH measurements were presented at Fig. 2.

Fig. 2 shows that the pH of emulsions at different % VCO is relatively constant. The beverage emulsions with different %VCO have a pH of 6. However, pH of after-cycled emulsions tend to decrease with the increase in %VCO. During the storage in stress conditions, the carbohydrates in emulsions could be digested by microorganisms inherently present in the emulsions if the conditions are suitable for the microorganism. The carbohydrate will undergo a complex reaction to form alcohol and carbon dioxide triggering the formation of acid [14]. A stable emulsion could be observed if the pH of fresh and after-cycled emulsion is relatively constant. It can be observed from Fig. 2 that emulsion of 20%VCO is the most stable emulsions in this research. The pH of after-cycled emulsion is lower than the fresh emulsion, however the difference is not significant.
3.3. Effect of %VCO to Creaming

Creaming is a destabilization process occurred during the storage of the emulsions. An emulsifier is added into the emulsions to lower the interfacial tensions between oil and water, stabilize the system and prevent the breakdown of the emulsion [4], [5], [7]. Creaming as an indication of break-down of the emulsion could be observed from the phase separation in the emulsion. The volume of cream could be used to measure the stability of emulsion. In this study, volume of cream is measured from both fresh and after-cycled emulsions after the emulsions have been further stored for 1x24 at a room temperature. From the observation, creaming is not observed in the early hours of storage (2-3 hours). The results of creaming observations are presented in Fig. 3.

Fig. 2. Effects of %VCO to pH emulsions

Fig. 3. Effect of %VCO to creaming on VCO beverage emulsions

Fig. 3 shows that creaming is occurred in all %VCO emulsions both in fresh and after cycled emulsions. It can be observed from Fig. 3 that for both fresh and after cycled emulsions, the volume of the cream increases with increase in %VCO. The fresh emulsions seem to be less stable than the after cycled emulsions in term of creaming. A lower cream volume obtained from emulsions with a lower %VCO. To prevent the occurrence of creaming, a suitable emulsifier and additive could be added into the emulsion [5]. However, although the creaming is present in all emulsions, the creaming tends to disappear by shaking the emulsions. In the implementation, a shaking before drinking will be recommended for VCO beverage emulsions.
4. Conclusion

A study on the stability of VCO in water beverage emulsions has been performed at various percentage (v/v) of VCO (%VCO) of 5%, 10%, 15%, 20%, 25% and 30%, respectively. The results show that the VCO beverage emulsion of 20% is the most stable emulsion in terms of viscosity and pH. The viscosity of 20%VCO emulsion is quite constant in both fresh and after-cycled emulsions. The pH of both fresh and after-cycled beverage emulsions of 20%VCO does not vary significantly. In term of creaming, all emulsions exhibit creaming. Shaking the emulsions will help to make the creaming disappear. To improve the stability of VCO beverage emulsions in all aspects, better operations conditions and more suitable emulsifier and additive are needed.

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6. References

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