Characterization Physicochemical of Emulsion Solid Cooking Oil from Coconut Oil

Jusman, Bambang Setiaji, Triyono, Akhmad Syoufian

Abstracts: ***Research of characterization physicochemical emulsion products of solid cooking oil has been performed. The measurement using analysis parameter of water content, free fatty acids, peroxide value, and hardness test. Method of used water content (AOAC,1995), free fatty acids (AOCS Official Method Ca 5a-40 1993), and peroxide value (AOCS Official Method Cd 8-53 1993), and hardness test using universal machine testing. The characterization result of emulsion products of solid cooking oil toward the water content in the range of 0.04-0.09%, free fatty acids from 0.28 to 0.49%, and peroxide value in the range 0.61 to 0.74 mg O_2/100 g. And the result of hardness test solid cooking oil emulsion product is in the range from 8.4942 to 15.7444 gf/cm^2. Thus the solid cooking oil products produced meet the criteria of margarine and shortening.***

Keywords: ***coconut oil, solid cooking oil, emulsion, and physicochemical***

I. INTRODUCTION

Coconut oil that is extracted from fresh coconut flesh is known as virgin coconut oil (VCO). The extraction involves a process that does not use thermal treatment or food preservatives. Coconut oil contains a high level of low molecular weight saturated fatty acids, the distinctive characteristic of lauric oil [1]. In application of virgin coconut oil can be further processed as a material development of oleo chemicals through transistor fiction process to produce intermediate products.

Emulsions are complex two-phase systems, made by droplets dispersed in a continuous phase. They are widely used in different industrial fields including oil drilling, transport, cosmetics, pharmaceutics and foods [2]. Food emulsions are particularly interesting because their physical and chemical properties affect quality aspects like ‘‘texture’’ and shelf life in a complex way. When designing a new product, a relationship between macroscopic parameters (related to perceived properties) and material microstructure is necessary to understand the effects of relevant ingredients (such as fats and emulsifiers) aiming to obtain a formulation with controlled characteristics avoiding a long ‘‘trial and error’’ approach. Emulsion stability and ‘‘texture’’ (i.e. rheological properties) are probably the most important characteristics to be considered when a new product is studied. Stability affects product processing.

Revised Version Manuscript Received on November 17, 2016.

Jusman, Postgraduate Student, Department of Chemistry, Faculty of Mathematic and Natural Sciences, Gadjah Mada University, Sekip Utara, Mail box 55281 BLS Yogyakarta, Indonesia.

Bambang Setiaji, Department of Chemistry, Faculty of Mathematic and Natural Sciences, Tadulako University, Palu, Indonesia.

Triyono, Department of Chemistry, Faculty of Mathematic and Natural Sciences, Gadjah Mada University, Sekip Utara, Mail box 55281 Bls Yogyakarta, Indonesia.

Akhmad Syoufian, Department of Chemistry, Faculty of Mathematic and Natural Sciences, Gadjah Mada University, Sekip Utara, Mail box 55281 Bls Yogyakarta, Indonesia.

(e.g. shear induced separation during pumping), unit operation design (stirring systems, pumps, etc.) and shelf life (potential phase separation before commercial limits).

A significant proportion of food products are sold in an emulsified state, such as butter, margarine, sauces, soups, ice cream, desserts, beverages, and salad dressing [3,4,5]. An emulsion consists of two immiscible liquids with one of the liquids being dispersed as small spherical droplets in the other. Emulsions are thermodynamically unstable systems, and may break down through a variety of different physicochemical processes depending on their compositions, microstructures and environmental stresses, e.g. gravitational separation, flocculation, coalescence, partial coalescence, Ostwald ripening and phase inversion. Liquid oil can flow out of the droplets and reinforce the link between the two droplets. Partial coalescence of droplets causes the viscosity of an emulsion to increase, and it may even lead to phase inversion, where an oil-in-water emulsion becomes a water in oil emulsion, as during the churning of butter [6]. The susceptibility of an emulsion to partial coalescence depends on lipid composition, solid fat content (SFC), emulsifier type, particle size, temperature, shearing rate, and various other factors [6]. This research will be characterized for a dense oil emulsion compared to commercial solid cooking oil on the market. In this study will be carried out measurement of water content, free fatty acids, peroxide value, and hardness test

II. MATERIALS AND METHODS

A. Materials

The materials used in this study is solid cooking oil from PT. Tropica Nucifera Industry Indonesia. The following analytical grade chemicals were used: Alchohol (Merck, Germany, sodium hydroxide (Merck, Germany), accetic acid (Merck, Germany), sodium sulfate anhydrous (Merck, Germany), chloroform (Merck, Germany), Potassium iodide ((Merck, Germany), starch indicator, and pp indicator.

The tools used in this study are as follows: a set of laboratory glassware, a set tool of titration, and universal machine testing (Zwick/Z0.5)

B. Methods

Procedure characterization physicochemical emulsion of solid cooking oil i.e :

C. Water Content (AOAC, 19939)

Sample oil 5, 0 g put in a known weighs .Then the cup put into an oven absolute 100^{O}C to gained weight constant. Calculation the moisture content of done by using formulas:

$$KA = \frac{c-(a-b)}{c} \text{ x } 100\%$$

Description: a = heavy sample of the cup (g)

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication Pvt. Ltd.

b = heavy sample and sample the end (g)
c = heavy sample initial (g)

D. Free Fatty Acids (AOCS Official Method Ca 5a-40 1993)

Sample oil 7.05 g dissolved in 75 ml alcohol of 95 % neutral, heated for 10 minutes in hot plate while stirring, and added 3-5 drops indicators pp 1%. After that cesium with a solution of standard NaOH 0.25 N to a pink color fixed. Free fatty acids expressed as percent fatty acids, calculated to two a decimal with using formulas:

$$\text{Free fatty acids} = \frac{M \; x \; V \; x \; T}{10 \; m}$$

Description: M = Weights molecules fatty acids (256 for palm oil dan 205 for coconut oil
V = Volumes NaOH for titration (mL)
T = Normality NaOH
m = Weights sample (g)

E. Peroxide Value (AOCS Official Method Cd 8-53 1993)

Samples from 5 g dissolved in a mixture of 30 mL solution of acetic acid and glacial chloroform (2:3).Then performed additional saturated solution as many as 0.5 mL while shaken and 30 mL of water. Next titration with standard solutions of sodium thiosulphate ($Na_2S_2O_3$) 0.1 N with starch so that indicators a bluish color turned into lucid. Blank made with the same way. Peroxide value calculated by a formula:

$$\text{Milligram oxygen per 100 g} = \frac{m}{(V1-V0)x \; N \; x \; 8 \; x \; 1000}$$

Description: V_1 = Volumes solution of sodium tiosulphate for oil (mL)
V_0 = Volumes solution of sodium tiosulphate for blank (mL)
N = Normality solution of sodium tiosulphate
m = Weights oils (g)
8 = Half of atomic weight oxygen

F. Hardness Test

Parameters of products measured texture using the universal machine testing (brand zwick/z0.5). The measurement by universal machine testing is force/deformation the measure the magnitude of the force required to reduce samples to distance appointed. Where pre load is 0.02 he is speed at the needle started moving to trigger point be achieved, test speed 50 mm/min the speed needles when i get to get to touch sample emphasis appointed be achieved.

III. RESULTS AND DISCUSSION

Research will be performed measurements on some parameters that good affect on oil products the solid cooking oil. As for parameter to be measured includes: the water content, free fatty acids, the peroxide value, and hardness test.

On research would be conducted characterization solid cooking oil with the measurement of against the water content, free fatty acids, and peroxide value. At which the results products emulsion with the melting point who approached the melting point solid cooking oil commercial 46 ^oC. An emulsion of products that have the stability of an emulsion well be done characterization. Based on it then sample taken an emulsion to a code a sample a, b, c, and d will be conducted characterization of the nature of physicochemical covering the water content, free fatty acids, and peroxide value. As for the result of an analysis of the water content, free fatty acids, and peroxide value presented in table 1:

Table. 1 Results of the analysis water content, free fatty acids, and peroxide value to products emulsify solid cooking oil

No	Code Sample	Water content (%)	Free fatty acids (%)	Peroxide value (mg O_2/100 g)
1	A	0.04	0.28	0.61
2	B	0.07	0.46	0.72
3	C	0.05	0.42	0.68
4	D	0.09	0.49	0.74
5	Commercial solid cooking oil	0.12	0.91	0.98

Based on Table 1 shows that the water content of the emulsify oils solid to be around 0.04-0.09% , in which the water content was not too much different from the water content solid cooking oil commercial namely 0.12%. The free fatty acids the results of products emulsify solid cooking oil to be around 0.28-0.49%, while the free fatty acids solid cooking oil commercial (standard the 0.98%). The presence of fatty acids free in a product can be used as indicators early the damage oil/fat, in which free fatty acids more easily oxidized if compared in the form of its esters. According to Hartley [6] the existence of free fatty acids in oil there has been one since harvested and increase for processing and storage. The peroxide value of emulsify solid ranges from 0.61-0.74 mg O_2/100 g. The peroxide value shows that oil has been undergoing oxidation resulting from contact with oxygen. The resulting in the establishment of a oxidation peroxide and hydro peroxide, where in the next stage will break down into fatty acids accompanied by hydro peroxide so aldehyde and ketones and free fatty acids. According to Ketaren [7] has caused the increase peroxide value is an indicator that smelling oil and rancid. From table.1 in conclusion that the emulsify oils solid against parameters observed the water content, free fatty acids, and peroxide value is in the range of standard solid cooking oil commercial SNI (01-3741-2002) namely the moisture content of maximum 0.3%, free fatty acids maximum 2%, and peroxide value maximum 1% (mg O_2/100 g) oil.

The measurement of hardness products emulsify oils solid can be done quantitatively using universal machine testing. The principle of measuring with universal machine testing is force/deformation the measure the magnitude of the force required to reduce sample at a distance appointed. On a universal machine testing there are several the method of measurement one of them is by test standard penetration that can be used to determine the value hardness or plasticity an ingredient, in which the consistency of an ingredient

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication Pvt. Ltd.

obtained by pressing sample use suppressor standard of a needle drowned into a material sample. As for the principle of the devices is measure the depth of prick products sample of a needle suppressor per weight certain burden in a given time. The results of the analysis hardness products emulsify solid solid cooking oil is presented in Table 2:

Tabel.2 Results measurement hardness product

No	Code Sample	Hardness (gf/cm^2)
1	A	15.7444
2	B	8.4942
3	C	15.3161
4	D	15.1019
5	Commercial solid cooking oil	7.5551

From Table 2 showing that the product hardness varies from 8.4942 until 15.7444 gf/cm^2. Based on the product hardness emulsify oils solid compared with solid cooking oil commercial not too much different. In the fat as margarine and shortening with a different hardness. Results have Haighton [8] levels of hardness as presented in Table 3 :

Table 3. Classification of margarines and shortenings according to the yield value (Haighton 1959)

Yield value (gf/cm^2)	Consistency
<50	Very soft, to just pourable
50-100	Very soft, not spreadable
100-200	Soft, but already spreadable
200-800	Satisfactory plastic and spreadable
800-1000	Hard, but satisfactorily spreadable
1000-1500	Too hard, limit of spread ability
>1500	Too hard

Based on Table 3 shows that the degree of hardness to products emulsify oils solid are very soft with takes the value the comparative degree hardness products margarine and shortening. The results of value hardness products emulsify solid cooking oil enter into very soft based on Table 3 above. Hardness in the spread of value is the ability of the products to be easily applied to food.

IV. CONCLUSIONS

The characterization result of emulsion products of solid cooking oil toward the water content in the range of 0.04-0.09%, free fatty acids from 0.28 to 0.49%, and peroxide value in the range 0.61 to 0.74 mg O_2/100 g. And the results of hardness test solid-oil emulsion product is in the range from 8.4942 to 15.7444 gf/cm^2. Thus the solid cooking oil products produced meet the criteria of margarine and shortening.

ACKNOWLEDGMENT

This investigation was supported by PT. Tropical Nucifera Industry Yogyakarta Indonesia, and by Laboratory Facilities from the Department of Physical Chemistry and Organic Chemistry Laboratory, University of Gadjah Mada, Indonesia.

REFERENCES

1. M. Marina,Y. B. Che Man, S. A. H. Nazimah, I. Amin," Chemical properties of virgin coconut oil," J Am Oil Chem Soc 2009, 86:301–307.
2. McClements, D. J., 1999, Food emulsions: Principles, practice, and techniques. Boca Raton, CRC Press.
3. Dickinson, E., & McClements, D. J. (1995). Advances in food colloids. London, UK: Chapman and Hall.
4. Boode, K., Walstra, P., & Degrootmostert, A. E. A. (1993). Partial coalescence in oil-in-water emulsions 2: Influence of the properties of the fat. Colloids and Surfaces A—Physicochemical and Engineering Aspects, 81(1), 139–151.
5. Walstra, P. (1996). Emulsion stability. (Chapter 1). In P. Becher (Ed.), Encyclopedia of emulsion technology, Vol. 4. New York: Marcel Dekker.
6. Friberg, S. E., & Larsson, K. (1997). Food emulsions. New York: Marcel Dekker.
7. Ketaren, S. 1986. Oils and Fats Food Technology . UI Press, Jakarta.
8. Haighton AJ (1959) J Am Oil Chem Soc 36:345 doi:10.1007/BF02640051
9. AOCS., 1993, Official Methods and Recommended Practices of the American Oil Chemists' Society, 5th Ed. American Oil Chemist's Society Champaign, IL, U.S.A.

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication Pvt. Ltd.