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Study the Components of Saturated Fatty acid on Virgin Coconut oil using Gas Liquid Chromatography

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Abstract : This study aims to (1) measure the quality of virgin coconut oil (VCO) such as yield, water content, free fatty acids (FFA), and (2) detect the components of the VCO-forming fatty acid methyl ester profile components such as caprylic acid, capric acid, lauric acid, myristic acid, palmitic acid, stearic acid, oleate acid, and linoleic acid using liquid gas chromatography. The experiments were carried out in the laboratory and in the field at the VCO small business in Kalawat Sub-district, North Minahasa District. Observation variables are (a) the yield test, (b) water content, (c) determination of free fatty acids (FFA), and (d) determination of fatty acid methyl ester profile by GLC to detect caprylic acid, capric, lauric, myristic, palmitic, stearic, oleic, and linoleic, based on the AOAC method, and (e) color determination by sensory difference level method (MCDA method). The results of the detection of methyl esther profile components of fatty acid constituents of VCO in small businesses in Kalawat Sub-district region showed the composition of lauric fatty acids VCO with the highest treatment obtained in VCO small businesses with code A (59,327%), followed by VCO small businesses with code B (58,968%), and small businesses VCO with code C (58.460%). So, the three VCO small businesses in Kalawat Sub-district are of good quality, because they meet the standards determined by Indonesian National Standard (SNI) and even the standards of the APCC (Asian and Pacific Coconut Community).
Keywords : Saturated fatty acids, virgin coconut oil, GLC.

1. Introduction

Coconut is known to the public as a multifunctional plant, considering that almost all parts of the plant, from leaves to roots, can be used. Coconut provides benefits as a source of food, as well as feed and fuel[1].

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Coconut is one of the important plantation commodities for Indonesia besides cocoa, coffee, pepper and vanilla. This commodity has long been recognized and has played a very important role in the life of the Indonesian nation, both in terms of economic and socio-cultural aspects. One part of coconut meat besides being used as raw material to produce copra, coconut cream and desiccated coconut, it can also be processed directly into a final product that is ready for consumption by consumers and can provide added value for farmers, such as processing VCO which is very popular by domestic and foreign exporters[2].

Coconut oil has a long and highly respected reputation in many cultures around the world, not only as a high-value food, but also as a powerful medicine. Coconut oil is used throughout the tropics in many traditional medical systems[3]. Meanwhile, virgin coconut oil, which is obtained from coconut flesh, is an important product that can be processed into cooking oil and is also used as an industrial ingredient for making soap, butter, pharmaceuticals and cosmetics.VCO contains free fatty acids with certain levels, therefore has a tendency to become rancid. Coconut oil, like other vegetable oils, contains natural antioxidants namely tocopherol which will protect the oil from oxidation. When coconut oil has been purified, the antioxidants in the oil have been reduced, so that the oil is more prone to rancidity and does not last long. In the international market, demand for VCO is increasing, but the quality of VCO in Minahasa District, North Sulawesi Province is not yet of high quality, therefore it is necessary to produce VCO that can last a long time if stored. Besides that, the quality of raw materials such as the coconut meat also needs to be considered. Coconut in Minahasa District, North Sulawesi Province, is naturally famous for its high saturated fatty acid content[4].

International market demand for VCO continues to increase. This has a positive impact on the income of coconut farmers in Minahasa District, North Sulawesi Province as a palm plantation area. However, quality standards are still a problem. One reason is the lack of knowledge about the content of saturated fatty acids in the VCO, which until now on the market is still varied. The content of saturated fatty acids, there are smaller than 53%. By looking at the content of saturated fatty acids the percentage varies in VCO. Therefore, in order to obtain information on the extent to which the content of saturated fatty acids can affect the quality of VCO, a study was carried out on the study of components of saturated fatty acids on VCO in Kalawat Sub-district, North Minahasa District by wet processing.

2. Material and Methods

This research was conducted at the Laboratory of Food Technology and Agricultural Products, Faculty of Agricultural Technology, Gadjah Mada University, Yogyakarta. Sampling of coconut and VCO were conducted in North Minahasa District. The duration of the study is approximately eight months. This study uses a laboratory experimental research design by using quantitative analysis methods. The components of the VCO were determined using gas liquid chromatography.

Making VCO by wet processing as follows (1) fresh coconut (11-12 months old) meat is taken then shredded, (2) the grater is added with 1: 1 water, then squeezed sococonut milk obtained (1 kg of grated coconut added with 1 liter of water), (3) leave the coconut milk for 30 minutes to form a cream and skim, (4) separate the cream and skim, centrifuge, (5) let stand for 10 hours, (6) separate the oil which is VCO from 'Blondo' (Coconut Presscake) and water, and (7) filter the VCO by using activated charcoal adsorbent (charcoal from coconut shell) and filter paper and store it in a bottle.

Detection of saturated fatty acids was done by using liquid gas chromatography.The procedure is as follows: weighed 50 ml of VCO in a round bottom flask. Added with 2 ml of NaOH Methanolate and then covered with back coolant, heated with a sand heater for 5 minutes, until all the oil dissolves. Coupled with 2 ml of BF-3-Methanolate (14%) was covered with a back coolant, and heating continued for 2 minutes. Add 4 ml of heptane solution through the cooler and reheat for 2 minutes. Add the saturated NaCl solution to the neck Erlenmeyer flask. Next, move the heptane layer (located at the top of the Erlenmeyer flask) using a drop pipette into a closed test tube and dilute it with heptane until the volume is exactly 5 ml. Then, added Na_2SO_4 to absorb water. The liquid was taken and put in a closed tube, and this liquid was ready to be injected in the GLC (modified AOAC Method).

VCO quality was tested with parametersas follows (1) rendement, (2) water content[5], (3) determination of FFA according to[5], (4)determination of methyl esther profile of fatty acids by GLC: detection of caprylic

acid, capric, lauric, myristic, palmitic, stearic, oleic, and linoleic, and (5) determination of color by the sensory level difference method(MCDA method).

3. Results and Discussion

3.1. Rendement

The results of the analysis of the yield of VCO produced by small business in Kalawat Sub-district, North Minahasa District, can be seen in the Table 1.Information from Table 1 shows that the highest average VCO yield is obtained in small businesses with code B that is 10.12%, while the lowest yield is obtained in small businesses with code C with a yield value of 9.32%. VCO yield values increase in small businesses with code B, due to the VCO processing using the wet processing method by fermentation, this is due to the presence of lipase enzymes in coconut milk and presumably due to the beneficial microbial funds contained in coconut milk coconut which is naturally found in the raw material (coconut meat). The fermentation method is done, by decomposing the organic ingredients contained in coconut milk when the fermentation process takes place. This is consistent with study[6] that VCO by fermentation provides the highest yield of VCO compared to heating.

Meanwhile, according to[7], in the manufacture of VCO with the addition of aging treatment, the greater the speed of spinning VCO from the centrifuge, the faster the breakdown of fat and protein bonds will occur so that the amount of oil produced will increase, with a high yield rate due to because the speed of the force is sufficient in breaking the emulsion on the surface of the coconut milk to produce coconut oil. The longer the separation process, the more oil droplets will be separated from the emulsion. The better the quality of the coconut used, the better the VCO quality, besides that the yield will be higher, and vice versa.

Table 1. Rendement of VCO produced by small businesses in Kalawat Sub-district

Small businesses	Replications			Total (%)	Average (%)
	1	2	3		
A	9.42	9.39	9.32	28.13	9.37
B	10.18	10.06	10.12	30.36	10.12
C	9.32	9.36	9.28	27.96	9.32

3.2. Water content

The results of the VCO water content analysis at several small business in Kalawat Sub-district, North Minahasa District can be seen in Table 2. Determination of water content in VCO is very important because the presence of water in oil will cause a hydrolysis reaction that can cause rancid oils caused by the oil turning into ketone.

Table 2. VCO water content in several small businesses in Kalawat Sub-district

Small businesses	Replications			Total (%)	Average (%)
	1	2	3		
A	0.07	0.09	0.09	0.25	0.08
B	0.07	0.07	0.06	0.20	0.06
C	0.08	0.10	0.09	0.27	0.09

Table 2 shows that the VCO water content in a number of small businesses in Kalawat Sub-district shows the highest water content found in small businesses with code C, with a value of 0.09%. While the lowest water content value of 0.06% in code B. The low water content in code B shows that the quality of VCO is good because it is not easy to become rancidity. This is due to the selection of coconut raw materials used using old coconut (aged 10 - 11 months) with the maturity level of the coconut fully ripe. The wet VCO processing in these three small businesses follows a good VCO manufacturing procedure. Purification of crude oil into pure VCO has also been done in a good way because it uses adsorbents from shell charcoal. This adsorbent adsorbs

water molecules in the VCO, resulting in a decrease in water content. Decreasing the value of water content, increasing the quality of the VCO produced.

The quality of VCO produced by several small businesses in Kalawat Sub-district is classified as good because the VCO water content is low (0.06 - 0.09%). This range of VCO water content meets the requirements of the Indonesian National Standard maximum 0.2% and the VCO quality standard requirements issued by APCC with a maximum value of 0.5%.

3.3. Free Fatty Acids

The results of the analysis of VCO free fatty acid levels in several small businessesin Kalawat Sub-district can be seen in Table 3. In Table 3, it shows that the VCO free fatty acid levels in small businesses with code B (0.034%) are the lowest free fatty acid levels. The low levels of free fatty acids in the VCO product with code B is due to the process of processing carried out using sterile containers, hygiene and the production room has adequate ventilation for air circulation (O2) into the production room. Likewise, the bottle packaging used is sterile and in the VCO processing process applies the Good Food Production Method (CPPB) by taking into account the requirements of Good manufacturing practices (GMP) for this VCO processing process[8]. While the highest value of free fatty acid levels is in code C (0.042%). The value of free fatty acid levels does not show significant differences in free fatty acid values. The quality of the VCO free fatty acid content produced by these small businesses in Kalawat District (codes A, B and C), is included in the category of meeting the requirements of the Indonesian National Standard with a maximum free fatty acid number of 0.2% and meeting the VCO Quality Standards requirements issued by APCC with a maximum value of 0.5%.

Table 3. VCO free fatty acid levels in several small businesses in Kalawat Sub-district

Small businesses	Replications			Total (%)	Average (%)
	1	2	3		
A	0.042	0.036	0.034	0.112	0.037
B	0.035	0.034	0.034	0.103	0.034
C	0.045	0.044	0.039	0.128	0.042

3.4. The composition of fatty acids in VCO in several small businesses in Kalawat Sub-district

The results of the analysis of the profile of methyl ester of fatty acids using Gas Liquid Chromatography on VCO products produced in several Small Enterprises in Kalawat District, North Minahasa Regency, can be seen in Table 4.In Table 4, the highest composition of lauric fatty acid (59,327) was obtained in the VCO processing small business with code A, followed by code B (58.968%), and code C (58.460%). VCO in the three small businesses is of good quality, in accordance with the standards determined by SNI and even the standards of the APCC.

Table 4. Profile of fatty acid methyl ester in VCO produced by several small businesses in the Sub-district of Kalawat

No.	Profile of Methyl Esters of Fatty Acids	The relative percentage of fatty acid composition (%) in:		
		A	B	C
1	C8=0	10,115	10,118	10,108
2	C10=1	8,434	8,388	8,369
3	C12=2	59,327	58,968	58,460
4	C14=3	15,030	15,120	15,204
5	C16=0	4,180	4,244	4,360
6	C18=0	0,701	0,760	0,726
7	C18=1	1,639	1,664	1,644
8	C18=2	0,340	0,348	0,352

Note:	C8	=	Caprylic
	C10	=	Capric
	C12	=	Lauric
	C14	=	Miristic
	C16	=	Palmitic
	C18	=	Stearic
	C18:1	=	Oleic
	C18:2	=	Linoleic

In Table 4, it can be seen that the composition of lauric fatty acid gives the highest relative percentage of fatty acid composition, namely a percentage of 59, 327% of other fatty acids. This is because the coconut raw material used in this study comes from the coconut area of North Minahasa Regency, namely from the type of deep coconut which naturally contains high medium chain fatty acids (lauric fatty acids> 50%). This is in accordance with the opinion with study[9]that the diversity of MCFA content and lauric acid levels is influenced by coconut varieties, height of growing area, VCO process technology and laboratory analysis site used. The content of lauric fatty acids is the dominant fatty acid and it turns out to have the same properties as breast milk (ASI), if consumed, it can turn into monolaurin which can function as a supplement to prevent degenerative diseases and diseases caused by pathogenic viruses and bacteria[10]. Lauric acid has many health benefits, contains natural antioxidants[11].Besides that lauric acid also acts as an antibiotic, destroys viruses and other pathogenic microbes. It also has a therapeutic effect on brain disorders and can help burn more fat in the body[10].

3.5 Color

The results of the analysis of the color of VCO on several small businessesin the region of Kalawat Sub-district can be seen in Table 5. Table 5 shows that the highest VCO color is obtained in small businesses with code B, which is 87.64, with a very clear color category. The lowest color value is obtained in small businesses with code A (60.74), with quite clear category.

Table 5. Color of VCO in a number of small businesses in Kalawat Sub-district

Small businesses	Replications			Total	Average
	1	2	3		
A	60,02	59,82	62,40	182.24	60.74
B	82.90	89,42	90.60	262.92	87.64
C	78.92	82.24	78.60	239.76	79.92

Note:	0 - 50	=	Turbid
	51 - 70	=	Clear enough
	71 - 80	=	Clear
	81 - 100	=	Very clear

The color of VCO is very clear due to the way the processing is done by using the filtering technique twice, and also in the process of processing crude coconut oil which is still rough with a slightly yellow color adsorbed by the compound components in the adsorbent used namely activated charcoal which has undergone first activation first, so that this VCO oil purification can take place well. In small businesses, VCO produces clear VCO colors using only one-time filtering technique.

4. Conclusions

1. VCO quality generally meets SNI and APCC Standards.

2. The results of the detection of the composition of fatty acid methyl esther on VCO in small businesses in the Kalawat Sub-district area were as follows: the highest composition of lauric fatty acids was obtained in

VCO small businesses with code A (59,327%), followed by code B (58,968%), and in code C (58.460%). The three VCO small businesses in this region produce good quality VCO that is in accordance with the standards determined by SNI and even the standards of the APCC.

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