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Original article

Quality of virgin coconut oil production using pineapple flesh and skin based on chemical parameters

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Abstract

This research aims to compare the quality of VCO made using pineapple skin and flesh based on chemical parameters. The chemical parameters examined in this research are free fatty acid (FFA) content, 10 types of fatty acids, peroxide value, and heavy metal contamination consisting of iron (Fe), Cadmium (Cd), Copper (Cu), and Lead (Pb). All chemical parameter indicator data is analyzed by comparing the measurement results with the Indonesian National Standard (SNI) 7381:2008. The measurement results show that the free fatty acid content in VCO pineapple flesh is 0.55% and pineapple skin is 1.37%. Meanwhile, the fatty acid content required in SNI is a maximum of 0.2%. The content of all types of fatty acids meets the levels specified in SNI. Next, the peroxide value obtained for pineapple flesh VCO is 1.83 mg ek/kg, pineapple skin VCO is 1.63 mg ek/kg, and the levels specified in SNI are a maximum of 2.0 1.83 mg ek/kg. Measurement of heavy metal contamination data obtained for pineapple flesh VCO, namely Fe 2.66 mg/kg, Cd <0.001 mg/kg, Cu 0.172 mg/kg, and Lead <0.001 mg/kg. Heavy metal contamination for pineapple skin VCO is Fe 3.85 mg/kg, Cd <0.001 mg/kg, Cu 0.041 mg/kg, and Lead <0.001 mg/kg. Based on the measurement data that has been obtained, it can be concluded that VCO made with fruit enzymes and pineapple peel meets SNI standards for the parameters of fatty acid content, peroxide value, and heavy metal contamination, but does not meet the standards for free fatty acid content indicators. Based on this research, VCO that uses pineapple flesh is more suitable for consumption and meets SNI standards.

Keywords: VCO, pineapple flesh and skin, chemical parameters

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Introduction

One of Indonesia's potentials as a country with a tropical climate is coconut plantations. According to the Indonesian Directorate General of Plantations, the area of coconut plantations in Indonesia reaches 3.36 million hectares with a total production of around 2.77 million tons in 2021 (Maradesa et al., 2014). In Central Kalimantan Province, there are four recorded plantation locations with high coconut production, two of which are in East Kotawaringin Regency, one location is in Seruyan Regency and one location is in West Kotawaringin Regency. Based on data from the Central Statistics Agency (2022), coconut production in Central Kalimantan has continued to increase in the last three years. In line with coconut production, Central Kalimantan Province is also a pineapple-producing area which is a national pineapple production center (Astoko, 2019). Meanwhile, pineapple production in Central Kalimantan also continues to experience an increase in production in the last 3 years by more than 100% of total production (BPS, 2022).

One step to optimize coconuts and pineapples in Central Kalimantan Province is to make Virgin Coconut Oil (VCO). VCO is pure coconut oil produced from processing coconut meat (Cocos nucifera). VCO is very good for health because it contains lauric acid and caprylic acid which range between 50% and 7%. These two fatty acids are types of medium-chain saturated fatty acids that are easily metabolized by the body and have anti-microbial and anti-viral properties (Harimurti et al., 2022). The lauric acid content in VCO is also able to cure cholesterol, hyperglycemia, help maintain healthy skin, as well as several other benefits (Mulyadi et al., 2019). Increasing awareness of healthy lifestyles certainly brings benefits in terms of VCO production because it can replace the consumption of cooking oil made from palm oil

There are several methods that can be applied in the process of making VCO, including heating to a temperature of less than 60 °C, adding enzymes, centrifugation and fermentation. One of the enzymes that is usually added in making VCO is the bromelain enzyme which comes from pineapple (*Ananas comosus* L.) (Rachmayanti et al., 2020). The bromelain enzyme is not only found in pineapple flesh, but is also found in the skin. Pineapple skin is generally only used as animal feed, fertilizer and sometimes as waste. Based on research by Kumaunang & Kamu (2011), it is explained that pineapple skin contains the enzyme bromelain with optimum activity obtained at a temperature of 65 °C of 0.071 units/minute and pH 6.5 of 0.101 units/minute.

To optimize VCO products, it is necessary to standardize VCO products according to the requirements set out in the Indonesian National Standard (SNI). Chemical parameters are one of the parameters most required in VCO quality standards, including fatty acid content, free fatty acid content, peroxide value and heavy

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metal contamination. Based on this background, the aim of this research is to describe the quality of VCO which is enzymatically processed from pineapple flesh and skin based on chemical parameters.

Methods

Enzymatic VCO production

The pineapple is cleaned of the remaining leaves attached to the skin. The pineapple skin is peeled and the flesh is separated. The skin and flesh of the pineapple are blended into pineapple skin juice and pineapple flesh juice respectively. 1000 ml of skimmed coconut milk is taken and 30% pineapple flesh juice is added, then the mixture is stirred and left in a tightly closed jar for 24 hoursThe same thing has done to add an extract from pineapple skin by taking 1000 ml of skimmed coconut milk and adding 30% pineapple skin juice, then stirring thoroughly and leaving it in a tightly closed jar for 24 hours. After 24 hours, 3 layers will form, namely at the top there is blondo (the remaining dregs), the middle layer is the VCO oil produced and the bottom layer is water. The oil is then separated by centrifugation, with the oil being taken using a pipette and filtered through two filtering processes. A clean and clear VCO is thus produced.

Test chemical parameters

Carrying out FFA tests, heavy metal contamination tests, peroxide value tests at the BPJSI Banjar Baru Laboratory and fatty acid content tests at the SIG Surabaya Laboratory. Each sample consisted of three replications. Data on free fatty acid content (%FFA), peroxide value and saponification value were carried out according to procedures established by the Indonesian National Standards Agency. A total of 10-20 ml of VCO was put into an Erlenmeyer flask, then 50 mL of 95% ethanol was added. Then add 3-5 drops of phenophthalein indicator to the mixture. Next, titrate with a standard 0.1 N KOH solution until pink. Then the amount of KOH titrated is calculated to calculate the % FFA (Anwar & Salima, 2016).

Metal contamination data

The calculation formula for heavy metal contamination in VCO samples is used to determine the level of heavy metal contamination contained in pure coconut oil.

Metal Content (mg/kg) = C/m x V

where: C is the metal concentration from the calibration curve, (µg/ml) V is the final solution volume, (ml); m is the sample weight, (g).

Data analysis

Data analysis was carried out by comparing the data from the VCO quality test results with the VCO quality requirements according to the Indonesian National Standard (SNI) 7381:2008. If the VCO test results using the pineapple enzymatic method match the figures according to SNI, then the VCO produced is safe for consumption and its quality has been standardized based on chemical parameters.

Results

Production results of enzymatic VCO pineapple flesh and skin

VCO which has been produced with enzymes from pineapple skin and flesh is shown in the following figure.

Figure 1. VCO production results. A. Enzymatic VCO from pineapple flesh, B. Enzymatic VCO from pineapple skin

Based on the physical appearance of VCO showed in Figure 1, there is no difference between the enzymatic form of VCO from pineapple fruit and pineapple skin. The VCO color is clear, bright, and yellow due to the combination of pineapple. The fresh and fragrant aroma of pineapple and the taste of VCO is normal like the taste of oil in general.

Chemical parameter test results

The chemical parameters measured in this study were fatty acid levels. In the standards set by SNI, there are 10 types of fatty acids required to determine the quality of VCO. Data from fatty acid measurements are shown in Table 1 below.

Table 1. The results of calculating fatty acids in VCO meat and pineapple skin were compared with the levels in SNI

No	Parameters	Unit	Flesh	Skin	Limit Of Detection	SNI
1	Caproic Acid	%	0,6378	0,6441	-	ND -0,7
2	Caprylic Acid	%	7,3400	7,3874	-	4,6 – 10,0
3	Capric Acid	%	5,8502	5,8591	-	5,0 – 8,0
4	Lauric Acid	%	45,6902	45,6178	-	45,1 – 53,2
5	Myristic Acid	%	18,6592	18,6145	-	16,8 - 21
6	Palmitic Acid	%	9,7677	9,7562	-	7,5 – 10,2
7	Stearic Acid	%	3,4914	3,4904	-	2,0 – 4,0
8	Oleic Acid	%	6.6457	6.6816	-	5,0 – 10,0
9	Linoleic Acid	%	1.5504	1,5763	-	1,0 – 2,5
10	Linolenic Acid	%	0.0035	0,0059	-	ND – 0,2

Based on the data in Table 1, it is known that the 10 types of fatty acids required for VCO quality testing all fall within the range of values set by SNI. Based on this data, it is known that the fatty acid parameters in VCO meat and pineapple skin meet VCO quality standards.

Measurement of heavy metal contamination data as displayed in Figure 2. obtained for pineapple flesh VCO, namely Fe 2.66 mg/kg, Cd <0.001 mg/kg, Cu 0.172 mg/kg, and Lead <0.001 mg/kg. Heavy metal contamination for pineapple skin VCO is Fe 3.85 mg/kg, Cd <0.001 mg/kg, Cu 0.041 mg/kg, and Lead <0.001 mg/kg. The results of measuring heavy metal contamination have met the standards set by SNI.

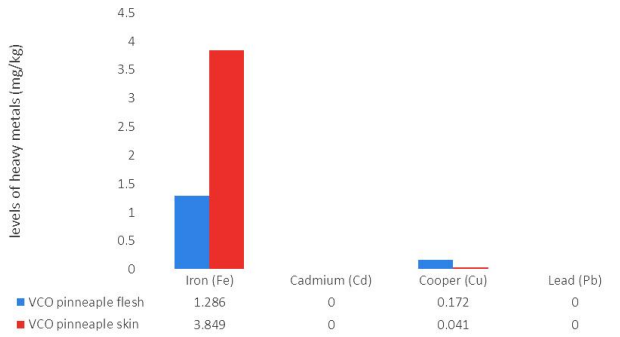

Figure 2. Levels of heavy metals contamination in VCO pineapple flesh dan VCO pineapple skin

The measurement results of free fatty acid (FFA) showed in Figure 3, the FFA content in VCO pineapple flesh is 0.55% and pineapple skin is 1.37%. Meanwhile, the fatty acid content required in SNI is a maximum of 0.2. These results indicate that the levels of VCO-free fatty acids in this study exceed the standards set in SNI.

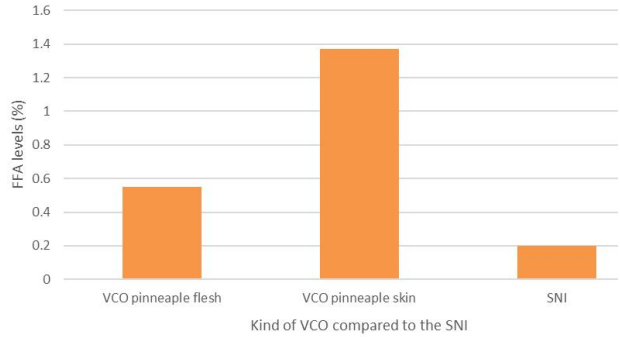

Figure 3. Levels of FFA in VCO pineapple flesh and VCO pineapple skin compared with SNI levels

Next, the peroxide value obtained for pineapple flesh VCO is 1.83 mg ek/kg, pineapple skin VCO is 1.63 mg ek/kg, and the levels specified in SNI are a maximum of 2.0 mg ek/kg. The results of measuring peroxide value have met the standards set by SNI.

Discussion

The fatty acid with the largest amount in VCO is lauric acid, which is a medium chain saturated fat with 12 carbons without double bonds and has the IUPAC name dodecanoic acid and has a molecular weight of 200. The benefit of lauric acid is that it kills various types of microbes whose cell membranes are derived from fatty acids. VCO also contains oleic and linoleic acids which have double bonds in their structure so they are easily attacked by oxygen molecules (O_2) and can cause oil oxidation reactions. It is hoped that lower levels of oleic acid and linoleic acid will also reduce the risk of oxidation reactions which can cause rancidity and reduce the quality of the oil produced (Gunarsih et al., 2014).

Free fatty acid levels in the experiment were not in accordance with the standards set by SNI. The higher the acid content. Free fat can be caused because many of the triglyceride components that make up the oil have undergone hydrolysis due to improper processing, thereby reducing the quality of the oil. The hydrolysis reaction in coconut oil will occur quickly with the influence of heat, water, acidity, and catalysts in the form of enzymes. If this hydrolysis reaction lasts longer, more levels of free fatty acids will be formed (Pramitha & Juliadi, 2019). Adding ingredients to oil will produce water and water vapor. Water and water vapor will hydrolyze triglycerides at high temperatures to produce monoglycerides, diglycerides, glycerol, and free fatty acids. This reaction will result in hydrolysis rancidity which can produce a rancid aroma in the oil. Free fatty acids (FFA) are produced through the hydrolysis of oils and fats. FFA levels depend on time, temperature and water content (Di Pietro et al, 2020). The presence of water in the ingredients will cause a hydrolysis reaction in pure coconut oil which produces free fatty acids (Mulyadi et al., 2019). In this research, the addition of enzymes from pineapple to VCO is predicted to increase the water content of VCO thereby increasing FFA levels compared to pure non-enzymatic VCO. Based on the test results, it shows that there is an effect of adding pineapple ingredients on the levels of free fatty acids contained in the VCO samples.

The peroxide number is the most important value for determining the level of damage to oil or fat. Unsaturated fatty acids can bind oxygen to form peroxide. Heating oil or fat will change the chemical and physical properties of the oil or fat. Coconut oil is a glyceride that contains a few unsaturated bonds, namely oleic acid (C7 H33 COOH) between 0.0-1.3%. Judging from the amount of unsaturated fatty acids, coconut oil is classified as an oil with relatively high rancidity resistance because the amount of unsaturated fatty acids is only small, but heat is always used in the process of making the oil so that the antioxidants contained in the oil and the unsaturated fatty acids are oxidized. In this research, VCO was not made by heating so the peroxide value obtained met the standards in SNI. .

Conclusion

Based on the measurement data that has been obtained, it can be concluded that VCO made with fruit enzymes and pineapple peel meets SNI standards for the parameters of fatty acid content, peroxide value, and heavy metal contamination, but does not meet the standards for free fatty acid content indicators. The results of the comparison of chemical parameter tests show that pineapple flesh VCO is more in line with SNI than pineapple skin VCO based on free fatty acid levels. Therefore, pineapple flesh VCO is recommended for consumption. Even so, pineapple peel VCO still needs to be researched further to reduce the free fatty acid levels so that pineapple peel waste can be utilized.

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Disclosure of Interest

The authors report no conflict of interest.

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