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# The Preparation of Virgin Coconut Oil Using Acid from Passion Fruit Extract at Different Temperature and Incubation Time

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**Abstract**

Virgin coconut oil (VCO) is a liquid coconut product with a translucent color, a characteristic coconut aroma, and long shelf life. VCO can be made in various ways, including enzymatic, centrifugation, acidification, etc. In this study, the acidification method was used to manufacture VCO whereby the acid used is sourced from passion fruit. This study aims to determine the effect of passion fruit juice addition on the preparation virgin coconut oil. Several variables were employed in the current study, including passion fruit volume of 5 and 8 ml, incubation time of 12 hours and 24 hours, and incubation temperature of 36 and 48 °C in a Factorial Design. The amount of coconut was 660 grams and 660 ml distilled water. The results showed that the production temperature greatly influenced the free fatty acids produced. The best treatment was obtained on VCO with 8 ml passion fruit addition, 12 hours of formation time and 48°C incubation temperature, with 0.12% free fatty acids.

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## Introduction

In Indonesia, coconut is one of the leading commodities whose development is conventional and hereditary and is spread throughout the archipelago. According to (Hutabarat, 2019), the area of coconut plantations is 3,876,000 ha, consisting of community plantations of 3,759,000 ha (97.07%), large state plantations covering an area of 5,000 ha (0.14%) and private plantations covering an area of 107,000 ha (2.79%). In Indonesia, Central Sulawesi Province is the major producer of coconut. In 2013, Central Sulawesi's coconut production was 189,572 tons on 214,697 hectares, or 0.88 tons/hectare.

Parigi Moutong Regency is the third largest coconut producing area after Banggai Regency with a total production of 46,733 tons, harvested area of 54,267ha and productivity of 0.86 ton/ha, Banggai Islands Regency with a total production of 17,100 tons, harvested area of 32,366 ha and productivity of 0, 52 tons/ha (Ayu & Rahim, 2020).

Fresh coconut contains 30-50 % oil. When dried into copra, the fat content reaches 63-65 %. Coconut flesh, can be extracted into coconut milk to get pure coconut oil, offers various advantages (Permatasari *et al.*, 2015). Pure coconut oil is prepared from coconut milk without high-temperature heating. Heating below 95°C, fermentation, and induction are employed to make VCO. Continuous stirring also destroys the emulsion system to separate the oil. This pure, colorless oil is stable and does not rancid quickly.

Enzymatic, inducement technique, centrifugation, hydrolysis, and other methods for producing VCOs have already been used. The hydrolysis process can use acidic liquids, one of which

is passion fruit. Passion fruit contains beneficial chemical compounds, such as citric acid, ascorbic acid, lactic acid, malonic acid, niacin, riboflavin, vitamin A and C. The use of passion fruit liquid in making VCO has not been widely studied and published. Based on these problems, it is necessary to research the use of passion fruit as a concoction in producing virgin coconut oil (VCO) to increase the process of releasing oil from lipoprotein bonds.

## Materials and Methods

### Materials

The materials used in this study were 10 coconuts, passion fruit juice, NaOH, Aquadest 660 mL and Phenolphthalein indicator. The tools used in this research are digital balance, plastic container, plastic, filter cloth, filter paper, measuring cup, clamp & stand, dropper, burette, glass stirrer, stopwatch, pH paper, glass funnel, erlenmeyer, incubator, oven, and PET bottles.

### Methods

#### Preparation of Coconut Milk

The coconut was peeled and split, and the coconut water was stored in a container. Coconut meat was removed from the tray and then grated with a grater. The grated coconut was added with water and squeezed to get coconut milk. The ratio of water to coconut was 1:1, where 660 grams of coconut and 330 ml of aquadest were added in two instances (Aprilasani & Adiwarna, 2014).

#### Skim and Water Separation

Coconut milk was put in a transparent plastic container to get coconut milk. The coconut milk was then left at room temperature for ± 2 hours. Coconut milk was divided into two parts, namely thick coconut milk (cream) and skim milk. With a spoon, the cream was carefully put into another container (Aprilasani & Adiwarna, 2014).

#### Addition of Passion Fruit Extract to Coconut Cream

Thick coconut milk was poured into a transparent plastic container. Obtained ± 489 ml of coconut milk per 660 grams of coconut, then 4 ml of passion fruit extract and 8 ml of cream were added to thick coconut milk and stirred using a hand mixer at maximum speed for 5, 10, 15 and 20 minutes, then incubated for 24 and 12 hours to get oil, *blondo* and water. Adding passion fruit extract into coconut cream (Aprilasani & Adiwarna, 2014).

#### Coconut Oil Preparation

*Blondo* (protein coagulate) and oil were separated. The resulting oil was then filtered through a filter cloth, followed by filtration with filter paper. Oil from the second filter was ready for use and packaged. The container used was a polyethene terephthalate (PET) bottle (Aprilasani & Adiwarna, 2014).

## Results and Discussion

### The Analysis of Free Fatty Acid (FFA)

The results of the analysis of levels of free fatty acids (FFA) in Virgin Coconut Oil (VCO) produced can be seen in the table and for the effect of passion fruit volume on free fatty acid levels in the figure. Based on the table, it can be seen that Virgin Coconut Oil (VCO), with the highest levels of free fatty acids (FFA), was produced in samples 1 and 6 with passion fruit volumes of 5mL and 8mL, with an incubation time of 12 hours and incubation temperatures of 36 and 48 °C, while the free fatty acids content (FFA) was lowest in samples 3 and 5 with passion fruit volume 5mL, incubation time of 24 and 12 hours and incubation temperature of 36 and 48 °C.

**Table 1** Free Fatty Acid (FFA) analysis results

| Run | Passion fruit extract volume (ml) | Incubation time (hours) | Incubation Temperature | %FFA |
|---|---|---|---|---|
| 1 | 5 | 12 | 36 | 0.12 |
| 2 | 8 | 12 | 36 | 0.02 |
| 3 | 5 | 24 | 36 | 0.004 |
| 4 | 8 | 24 | 36 | 0.01 |
| 5 | 5 | 12 | 48 | 0.004 |
| 6 | 8 | 12 | 48 | 0.12 |
| 7 | 5 | 24 | 48 | 0.004 |
| 8 | 8 | 24 | 48 | 0.01 |

According to (Hidayatulloh & Moehady, 2020), the amount of free fatty acids in the oil or fat will continue to change during the processing and storage process. Therefore, the presence of free fatty acids in oil is usually an early indicator of oil damage. Based on the table above, in addition to the passion fruit volume variable, the incubation temperature and the length of incubation time also significantly affect the levels of free fatty acids contained in Virgin Coconut Oil (VCO) produced. This is because the longer the incubation time, the more Virgin Coconut Oil (VCO) is produced. Based on SNI 7381:2008 regarding Virgin Coconut Oil (VCO) for the parameter of free fatty acid content (FFA), a maximum of 0.2%. Meanwhile, from the table above, the results of the best free fatty acid (FFA) levels closest to SNI 7381:2008 were in samples 1 and 6, with 0.12% free fatty acid content.

According to (Budimarwanti, 2014), oil is chemically triglyceride fat, producing one glycerol molecule and three long-chain fatty acid molecules if the hydrolysis process is carried out. The formation of free fatty acids is due to the hydrolysis process. The cause of oil hydrolysis is the presence of water; storage time also affects the hydrolysis of oil. Therefore, it is more likely that the oil will be hydrolyzed if it is stored for a long time (Sangi, 2011).

Gas Chromatography-Mass Spectroscopy (GC-MS) Analysis

Based on the Table 2, it can be seen that the essential fatty acid content in Virgin Coconut Oil (VCO) produced is lauric acid (dodecanoic acid), which is 34.74%. The lauric acid content in VCO has many benefits, including smoothing and moisturizing the skin, removing dead skin cells, and strengthening skin tissue so that the skin is not sagging and wrinkled (Widyasanti *et al.*, 2017). Lauric acid also functions in the human body and can act as an antiviral, antiprotozoal and antibacterial. In the cosmetic industry, it is used as a moisturizer and softener, and it is also used in the soap and shampoo industry (Pratiwi *et al.*, 2018) From the GC-MS test, it can also be concluded that the Virgin Coconut Oil (VCO) produced contains 65.8% Medium Chains Fatty Acid (MCFA) consisting of Caprylic Acid (Caprylic Acid) 7.79%, Capric Acid 7.09%, Lauric Acid 34.74%, Myristic acid 8.09%, Palmitic acid 8.09%. At the same time, those containing Long Chains Fatty Acid (LCFA) are 34.2%, including Linoleic Acid (Linoleic Acid) 3.32%, Oleic Acid 30.88%.

**Table 2** Gas Chromatography-Mass Spectroscopy (GC-MS) Analysis results

| Fatty Acid Components | Structural Formula | Content (%) |
|---|---|---|
| Saturated Fatty Acid | | |
| *Octanoic acid* | $C_8H_{16}O_2$ | 7.79 |
| *Decanoic Acid* | $C_{10}H_{20}O_2$ | 7.09 |
| *Dodecanoic Acid* | $C_{12}H_{24}O_2$ | 34.74 |
| *Tetra decanoic Acid* | $C_{14}H_{28}O_2$ | 8.09 |
| *Hexadecenoic Acid* | $C_{16}H_{30}O_2$ | 8.09 |
| Unsaturated Fatty Acid | | |
| *Oleic Acid* | $C_{18}H_{34}O_2$ | 23.15 |
| *9,12-Octadecadienoic Acid* | $C_{18}H_{32}O_2$ | 3.32 |
| *9-Octadecenoic Acid* | $C_{18}H_{34}O_2$ | 7.73 |

MCFA is a component of medium-chain fatty acids that have many benefits in the human body, namely producing energy and reducing the risk of heart disease and atherosclerosis. In addition, medium-chain fatty acids such as lauric acid play a critical role in metabolic processes, maintain immunity, aid digestion, and ensure the contribution of the serum lipid profile in maintaining health (Suirta & Astitiasih, 2020). MCFA in coconut oil, especially lauric acid, is the dominant fatty acid in coconut oil, which has the same properties as breast milk, namely as antiviral, antibacterial, and antiprotozoal. Moreover, in the body, lauric acid will change form to monolaurin to better maintain health. The LCFA includes vegetable oils, soybean oil, corn canola, and sunflower oil (Novarianto & Tulalo, 2007).

Water Content Analysis

Analysis of water content is very important because it affects the quality of Virgin Coconut Oil (VCO). According to (Ayu & Rahim, 2020), the greater the water content contained in the oil, the lower the quality of the oil because the oil is susceptible to damage. Triglycerides in fats will be hydrolyzed into glycerol and fatty acids due to the presence of acids, bases and enzymes. The hydrolysis process easily occurs in materials with a large water content. The lower the water content in the VCO, the better the quality of the VCO. Based on SNI 7381:2008 concerning Virgin Coconut Oil (VCO) the maximum water content parameter is 0.2%. While the best water content test results are found in sample 5, the water content is 0.016%.

Based on the Asian and Pacific Coconut Community (APPC), the standard water content of Virgin Coconut Oil (VCO) is below 0.1%. The same thing is also stated in the Indonesian Industrial Standard that the water content of Virgin Coconut Oil (VCO) is a maximum of 0.2% (Ministry of Industry, 1986). The results showed that the concentration of passion fruit juice had no effect on the water content of the VCO. At the lowest concentration of 8 mL of passion fruit juice (0.035%) compared to the concentration of 5 mL of lime. This is because the amount of passion fruit juice used causes the amount of VCO oil to be less due to hydrolysis. The water content in sample 5 (5mL) is the highest compared to the others. This is due to the high-water content of the VCO produced due to the imperfect filtering process because it still uses filter paper, the mass of coconut cream is formed slurry and thick, so that when taking oil, the participation of water with oil cannot be avoided, as a result the water content of VCO increases.

Temperature Analysis

In this study, the effect of environmental temperature on the VCO manufacturing process is used to determine the best temperature for the resulting product, the results show that the higher the temperature used, the higher the volume of VCO produced and the longer processing time used, the more VCO produced. However, if the temperature used is more than 50°C or higher, there will be protein breakdown caused by heating at high temperatures and oil that is not VCO but yellow cooking oil will be obtained.

pH analysis

Determination of pH in the manufacture of Virgin Coconut Oil (VCO) using pH paper. The pH test is carried out so as not to irritate the skin if the VCO

product will be used in the cosmetic industry. The effectiveness of pH in accordance with SNI ranges from 4.5 to 8.0.

pH did not significantly affect the VCO product in this study. pH stability can prevent product damage during storage where if the pH is below 4.5 it will irritate the skin if the pH is above 8.0 it will cause the skin to become scaly and dry (Amaliyah *et al.*, 2020).

**Table 4** The resulting pH in the manufacture of VCO

| Yield Volume (mL) | pH |
|---|---|
| 28 | 5 |
| 48 | 5 |
| 21 | 5 |
| 72 | 4 |
| 62 | 6 |
| 80 | 4 |
| 81 | 5 |
| 80 | 6 |

## Conclusion

Sample 6 had the highest free fatty acid concentration at 0.12%. Sample 5 had the highest lauric acid (dodecanoic acid) concentration of 34.74 % in the optimal operating circumstances fatty acid test. From the GCMS test, it can be seen that VCO includes 65.8% Medium Chains Fatty Acid (MCFA) consisting of 7.79% caprylic acid, 7.09% capric acid, 34.74% lauric acid, 8.09% myristic acid, and palmitic acid 8.09 %. Future studies should employ different kind of coconut and acid in order to observe their effects on VCO yield and quality. Additional tests must also be included, such as organoleptic, iodine, and peroxide value.

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