

The Effect of Adding Bread Yeast, Tempehh Yeast, and Tape Yeast on The Process of Making VCO from Coconut

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ABSTRACT

Coconut (*Cocos nucifera* L.) is one of Indonesia's agricultural products with potential. The most valuable coconut product is coconut oil, which can be obtained from the flesh of fresh coconuts or from copra. Virgin Coconut Oil (VCO) or pure coconut oil is the result of processing from the coconut plant in the form of a clear liquid with a distinctive coconut smell and has a long shelf life. Pure coconut oil or VCO has many benefits for body health, such as natural antibacterial, antiviral, anti-fungal and anti-protozoal properties. This study aims to compare the effect of Tempehh yeast, bread yeast, tape yeast, and without yeast on variations in the ratio of grated coconut and water are 1: 1; 1:1,5 and 1:2, on the amount of VCO produced. The experiment was carried out again and then the average volume of VCO produced by each yeast was taken. The average VCO results obtained ratio 1:1 were 209.5 mL for adding bread yeast, 153.5 mL for not using yeast, and 150.5 mL for adding Tempehh yeast. Meanwhile, adding tape yeast produce the smallest yield 89 mL . Based on the ratio of grated coconut and water (1 kg: 1 liter) the optimum yield is 1:1. While the minimum yield is 1:1,5 ratio. The most VCO obtained is by adding bread yeast to thick coconut milk in the second fermentation process. The order of highest yield based on the addition of yeast is bread yeast, Tempehh yeast, and tape yeast. The yield of VCO yeast Tempehh was slightly better than the yield without adding yeast. The organoleptic results and some of the VCO test results based on SNI 7783:2008 have fulfilled the specified requirements.

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1. Introduction

Coconut oil is one of the processed coconut products that is in high demand; it accounts for around 10% of the global market's oil and fat requirements [1]. Meanwhile, virgin coconut oil (VCO) is defined as oil obtained from the meat of fresh old coconuts (*Cocos Nucifera* L.), processed by pressing with or without water, and heated to a maximum of 60°C. It is safe for consumption, according to Indonesian National Standards (SNI) 7381-2008 concerning VCO [2]. VCO contains around 66% oil, 6-7% protein, 48% water, 5% crude fiber, and ±2% ash. Virgin coconut oil contains fatty acids, sterols, vitamin E, and phenolic acid. These chemical components exhibit antioxidant activity in plant materials, food products, and biological systems [3]. VCO has numerous benefits, including antiviral, antibacterial, antifungal, and antiparasitic properties. It can also aid in the

treatment of metabolic disorders, such as digestive issues, absorption of amino acids and soluble vitamins in fat, diabetes management, and improved blood circulation. VCO is commonly used in beauty treatments to retain skin suppleness. VCO is also utilized as a raw material in soap production [4]. When VCO is absorbed into the skin and the tissue cell structure, it helps to build connective tissue. In this way, VCO can minimize tissue damage caused by over exposure to sunlight [5].

Researchers are interested in VCO due to its potential health benefits, such as lowering the risk of cancer, preventing viral infections, boosting the immune system, maintaining soft and smooth skin, being cholesterol-free, and not contributing to obesity [6]. VCO contains alkaloids and saponins, which are effective anti-inflammatory and antibacterial agents [7].

Five processes are used in the production of VCO are gradual heating, fishing methods oil, fermentation, enzymatic, centrifugation, and ultrasonic approaches. The microbe *Saccharomyces cerevisiae*, also known as bread yeast, is used in the fermentation process to create VCO. The conditions of pH, temperature, energy source, and free water all affect the growth of bread yeast bacterium. At 30 °C, *Saccharomyces cerevisiae* can grow to their maximum potential. The method of gradual heating involves heating coconut milk to a temperature below 90 °C, and then returning the heated oil to a low temperature (below 65 °C). Using a specific ratio, fishing oil is added to coconut milk in order to employ the oil fishing method. Whereas, to carry out the fermentation process, yeast is added to coconut milk [8-9]. The oil-protein linkages in the coconut milk emulsion phase can also be broken down with the aid of enzymes in the enzymatic technique. In this case, protein rather than fat is harmed. Inside-out protein Protease enzymes are a class of protein enzymes that break down lipoprotein connections. Enzymes of the following kinds can be employed to dissolve inner lipoprotein bindings in fat emulsions: papain, bromelain, and protease enzyme. Centrifugal force was used to spin coconut milk in an attempt to disrupt the fat-protein linkages therein. Since oil has a lower specific gravity than water, centrifugation will force the two to separate on their own, 20,000 rpm was the rotational speed employed [10]. Meanwhile, the ultrasonic technique of producing VCO employs direct ultrasonic waves to break down the VCO and water emulsion, with the goal of increasing yield and improving VCO quality [11].

The addition of yeast to coconut milk emulsion can also be accomplished by the activities of microorganisms that produce proteolytic enzymes, such as *Rhizopus Oligosporus*, which is present in tempeh yeast. Protease enzymes are hydrolases that can break down proteins into simpler molecules. A class of hydrolases known as proteases is capable of easily breaking down proteins into other molecules. Protease enzymes are used to break down the lipoprotein links that hold the proteins in coconut milk together. When these lipoproteins are destroyed, the oil that is held by the bonds breaks free and becomes one [12]. Coconut milk's lipoprotein linkages are broken down by protease enzymes, releasing the oil attached to them. This bacterium can create protease enzymes, which can degrade the protein bonds that surround the fat globules in coconut milk cream emulsions [13]. Adding bread yeast to VCO affects peroxide value, iodine value, acid number, percentage free fatty acid (FFA) or acid free fat, and organoleptic test of VCO aroma. However, the substrate does not impact all VCO analyses [14]. Tape yeast can be used to make virgin coconut oil (VCO), which is produced by fermentation. The amount of tape yeast used to create the most virgin coconut oil (VCO) is 160.2 mL (yield 16.1%) [15]. The reason why yeast tape is utilized in VCO processing is because it contains microflora, such yeast, which can produce lipase, which breaks up the coconut milk emulsion. Yeast tape is typically employed in tape production. Thus, chemical bond breakage will occur during the fermentation process [16]. Bread yeast contains *Saccharomyces cerevisiae*, which produces proteolytic and amylolytic enzymes when grown in an emulsion. Amylolytic enzymes degrade carbs to generate sour. The presence of acid lowers the pH of coconut milk until it reaches the protein's isoelectric point, causing it to coagulate. The coagulated proteins are then broken down by enzymes called proteolytics, and they may be easily removed from the oil [12].

Good quality VCO appears clear as crystal, does not smell rotten, and has a unique coconut flavor. This indicates that it is not blended with any other substances, such as water. The presence of water in oil can promote hydrolysis or oxidation events that produce a rotten odor. The hydrolysis reaction converts oil into free fatty acids and glycerol [17]. This research aims to determine the amount of VCO produced from variations in the use of yeast and the ratio between the weight of grated coconut and water. This fermentation method uses tape yeast, tempeh yeast, and bread yeast.

2. Research Methodology

2.1. Materials

The ingredients used in this research were grated coconut, water, tempehh yeast, tape yeast, and bread yeast. The tools used in this research are coconut milk filter, measure, basin, small filter, 2 kg plastic bag, plastic bottle, measuring cup, digital scale, small straw.

2.2. Procedures

Grated coconut obtained from the Giwangan market is added to warm water according to the weight ratio (w/w) 1:1; 1:1.5; 1:2. Then knead and filter to obtain coconut milk that is free of dregs. Next, put the coconut milk obtained in a clear plastic bag and leave it for 3 hours. After 3 hours there will be two sediments, namely the top part in the form of concentrated coconut milk, and the bottom part in the form of water. Then, separate the concentrated coconut milk from water. After that, put the concentrated coconut milk into a new clear plastic bag and add 1.5 grams of yeast starter. Then stir well and store for 12 hours in a warm room. After 12 hours, the concentrated coconut milk will produce 4 layers, namely remaining water, coconut cream (blondo) sediment, VCO, and floating coconut milk sediment. Next, prepare a container to take the VCO. Then, measure the volume of VCO obtained.

VCO Quality Testing According SNI 7381-2008

Testing of VCO results was carried out at the Chemix Pratama Bantul Yogyakarta laboratory, where the samples were repeated once (duplo) and then averaged.

a. Organoleptic test

Color test

Analyze samples organoleptically using the sense of sight (eyes). VCO colors that fulfill SNI 7381:2008 specifications (table 1) range from colorless to pale yellow.

Smell test

Conduct organoleptic analysis of samples using the sense of smell (nose). The odor of the VCO sample meets the specifications outlined in SNI 7381:2008 for VCO odor requirements. It should smell normal, that is, typical for oil. Fresh coconut with no rancid scent.

Taste test

Perform organoleptic examination on samples using the sense of taste (tongue). The VCO samples meet the SNI 7381:2008 criterion for VCO taste, which requires a characteristic coconut oil flavor with no alien taste.

Table 1. VCO quality requirements are based on SNI 7381:2008

| Test type | Units | Requirement |
|---|-------------|-----------------------------------|
| Smell | - | Typical fresh coconut, not rancid |
| Taste | - | Normal, typical coconut oil |
| Color | - | Colorless to pale yellow |
| Water and evaporated compounds | % | Max 0.2 |
| Iodine number | g iod/100 g | 4.1 – 11.0 |
| Free Fatty Acid (calculated as lauric acid) | % | Max 0.2 |
| Peroxide number | mg ek/kg | Max 2.0 |

b. Water content

The weighing bottle is cooked in an internal oven at 105°C for one hour. After cooling in a desiccator for ½ hour, record the weight. After adding 5 grams of pure coconut oil (VCO) to the bottle, weigh the result. Preheat oven to 105°C for 1 hour, then chill in a desiccator for 30 minutes.

Weigh the weighing bottle with the sample inside. Repeat heating and weighing until a consistent weight is achieved. Water content is represented as a percentage of weight per weight, calculated to two decimal places using the following formula:

$$\text{Water content (\%)} = \frac{w_1 - w_2}{w_1} \times 100\%$$

Whereas :

w_1 = sample weight

w_2 = sample weight after drying

c. Iodine number

The Wijs technique is used to determine the iodine number. This method requires numerous reagents, including chloroform or carbon tetrachloride, sodium solution, 0.1 N thiosulfate standard, 15% KI solution, starch indicator, and Wijs reagent. Use a covered Erlenmeyer flask to collect samples up to 0.5 grams. Add 10 mL chloroform and 25 mL iodine-bromide reagent. Allow to stand for 30 minutes in a dark room. Add 10 mL of KI 15%. Titrate with 0.1 N $\text{Na}_2\text{S}_2\text{O}_3$ until the color turns to bright yellow. Add 3 drops of starch indicator and titrate again until the blue hue is gone. The iodine number is expressed as grams absorbed per decimal, using the formula:

$$\text{Iod number} = \frac{12,69 \times T \times (V_0 - V_1)}{w}$$

Whereas :

T = Normality of sodium standard solutions thiosulfate 0.1 N

V_0 = Volume of 0.1 N Na thiosulfate solution required for blank screening (ml)

V_1 = Volume of 0.1 N Na thiosulfate solution required for sample titration (ml)

w = weight sample (gram)

d. Peroxide number

Weigh the sample 0.3–5.0 grams. To dissolve the sample, shake the Erlenmeyer briskly with 10 mL of chloroform. Next, add 15 mL of glacial acetic acid and 1 mL of saturated potassium iodide solution. Close the Erlenmeyer immediately and shake for 5 minutes in a dark room at 15-25°C. Titrate using a standard sodium thiosulfate solution (0.02 N) and use starch solution as an indicator. Perform a blank determination. The peroxide number is reported as milligrams of active oxygen per kilogram. Calculated to two decimal places with the formula :

$$\text{Peroxide number (mg/kg)} = \frac{N \times (V_1 - V_0)}{w} \times 1000$$

Whereas :

V_0 = The volume of $\text{Na}_2\text{S}_2\text{O}_3$ is 0.02 N which required for blank titration (mL)

V_1 = The volume of $\text{Na}_2\text{S}_2\text{O}_3$ is 0.02 N which required for sample titration (mL)

N = Normality of $\text{Na}_2\text{S}_2\text{O}_3$

w = weight sample (gram)

e. Fe metal contamination

The sample is placed in 100 mL glass cups and shaken to ensure homogeneity. After that, 5 mL of nitric acid was added and heated in an electric heater until the solution was nearly dry. Add 50 mL of distilled water to this solution, then strain it through filter paper into a 100 mL measuring flask and fill to 100 mL with distilled water. Dilute to desired heavy metal concentrations (0.0 mg/L, 1.0 mg/L, 5.0 mg/L, 10.0 mg/L, 15.0 mg/L, and 20.0 mg/L). Heavy metal levels were detected using SSA at a wavelength of 283.3 nm [18].

3. Results and Discussion

3.1. Yield VCO

The most optimal yield was obtained with a 1:1 ratio of shredded coconut to water of 209.5 mL using Bread yeast (Table.2). Overall, bread yeast produces the highest output when compared to other yeasts or no yeast. In general, a 1:1 ratio of grated coconut to water results in greater VCO than other ratios. On average, Tempehh yeast outperforms sans yeast by a little margin and tape yeast. The addition of tape yeast resulted in the least yield of 77 mL. The ratio of grated coconut to water has an optimum value at a ratio of 1:1 and a minimum value at a ratio of 1:1.5 in this study.

Table 2. Yield VCO with variations of yeast and grated coconut to water ratio.

| The ratio of grated coconut to water | Experiment | Original (mL) | Tape yeast (mL) | Tempehh yeast (mL) | Bread yeast (mL) |
|--------------------------------------|------------|---------------|-----------------|--------------------|------------------|
| 1 : 1 | 1 | 114.0 | 87.0 | 100.0 | 198.0 |
| | 2 | 193.0 | 91.0 | 201.0 | 221.0 |
| | Average | 153.5 | 89.0 | 150.5 | 209.5 |
| 1 : 1.5 | 1 | 130.0 | 57.0 | 145.0 | 111.0 |
| | 2 | 128.0 | 55.0 | 132.0 | 168.0 |
| | Average | 129.0 | 73.0 | 138.5 | 139.5 |
| 1 : 2 | 1 | 130.0 | 68.0 | 155.0 | 143.0 |
| | 2 | 131.0 | 70.0 | 140.0 | 171.0 |
| | Average | 130.5 | 69.0 | 147.5 | 157.0 |
| Average | | 137.6 | 77.0 | 136.5 | 168.6 |

3.2. Organoleptic Test Result

The VCO produced is clear in color, smells like coconut oil, and tastes bland (Figure 1). This meets the requirements for virgin coconut oil set by the Indonesian national standard. According to SNI 7381-2008 the standard VCO must be clear to pale yellow and smell like fresh coconut oil, not rancid. Based on table 3, the results are presented organoleptic properties of odor in coconut oil This is the typical smell of fresh coconut oil, not rancid. According to SNI 7381: 2008, scent VCO shall not be rancid and contain the aroma of coconut oil. This signifies that the odor of coconut oil already fits the criteria. The organoleptic results of the taste investigation match the standards of SNI 7381:2008, namely the usual taste of fresh coconut and not rancid.



Fig 1. Original VCO appearance and with the addition of yeast (from left to right: original, tempehh yeast, tape yeast and bread yeast)

Table 3. Results of organoleptic testing of coconut oil

| Parameter | Original | Tempehh yeast | Tape yeast | Bread yeast |
|-----------|--|--|--|--|
| Color | Clear white | Clear white | Clear white | Clear white |
| Smell | The distinctive smell of fresh coconut oil and no rancid smell | The distinctive smell of fresh coconut oil and no rancid smell | The distinctive smell of fresh coconut oil and no rancid smell | The distinctive smell of fresh coconut oil and no rancid smell |
| Taste | Typical taste of fresh coconut oil | Typical taste of fresh coconut oil | Typical taste of fresh coconut oil | Typical taste of fresh coconut oil |

3.3. VCO Quality Testing Results According SNI 7381-2008

Water content testing is done to determine oil resistance. Internal water content. Coconut oil (VCO) has a significant influence on quality. Oil with high water content typically has a short shelf life. The table displays the water content of coconut oil (VCO). The average water content of the VCO produced is 0.074%, meeting Indonesian National Standards (SNI) 7381: 2008 for oil quality criteria for pure coconut oil (VCO) of no more than 0.2%. VCO's high water content reduces its durability. Apart from that, the presence of water in VCO causes a hydrolysis process. If there is water in the oil, it will hydrolyze, resulting in free fatty acids and glycerol, which will turn the oil rancid [19].

Table 4. VCO Quality Testing Results

| Parameter | Water content (%) | Iod number (g I ₂ /100g) | Peroxide number (mg ek/kg) | Fe metal contamination (mg/kg) |
|--------------|-------------------|-------------------------------------|----------------------------|--------------------------------|
| SNI Standar | Maximal 0.20 | 4.1 – 11.0 | Maximal 2.0 | Maximal 5.0 |
| Original | 0.092 | 0.3554 | 1.231 x 10 ⁻⁴ | 1.342 |
| Tempel yeast | 0.078 | 0.3456 | 8.49 x 10 ⁻³ | 1.377 |
| Tape yeast | 0.062 | 0.3456 | 8.67 x 10 ⁻³ | 1.620 |
| Bread yeast | 0.062 | 0.3355 | 8.81 x 10 ⁻³ | 1.614 |

The result of water content, iod number, peroxide number and Fe metal contamination were showed in Table 4. The iodine number reveals how unsaturated the fatty acids in oils and fats are. Unsaturated fatty acids can bind iodine, forming saturated molecules. The amount of iodine attached reflects the number of double bonds found in the oil. When it combines with iodine, it forms a saturated molecule. The experiment yielded 3.455 mg/g of coconut oil iodine (VCO). These data show that the produced coconut oil has a lower value than the determined SNI. Heating or frying can cause the breaking of unsaturated bonds in oil to become saturated, lowering the iodine content.

The peroxide number analysis is used to evaluate how oxidized the oil is. Oil quality improves with a lower peroxide number, while a higher peroxide number leads to lower quality. The data obtained shows a peroxide number below 2.0 g iod/100g, which indicates a very low peroxide level. This means that the VCO produced is of very high quality and more difficult to oxidize.

According to the Fe content test findings, the four types of VCO were extremely low, with average 1.488 mg/L. This value fulfill SNI 7381:2008. Given the significance of the Fe element as an oxygen binder in the blood, the presence of Fe is required for VCO, which is used to treat a variety of disorders. However, it is important to note that if it exceeds the limit, it will undoubtedly become poison for the body.

4. Conclusion

According to the findings of the research, the highest yield of Virgin Coconut Oil (VCO) was obtained by adding bread yeast, Tempel yeast, and tape yeast in order of size. The highest average VCO results obtained ratio 1:1 were 209.5 ml for adding bread yeast, 153.5 ml for not using yeast, and 150.5 ml for adding Tempel yeast. Meanwhile, adding tape yeast produce the smallest yield 89 mL. Organoleptically, the VCO results met the standards of SNI 7381-08. The results of the quality test revealed that the water content (<0.20%), peroxide number (<2.0 mg ek/kg) and Fe metal contamination (<5.0 mg/kg) met SNI 7381-2008 standards. Meanwhile, the iodine number was beyond the established standard limits (4.1-11.0 g iod/100g). A little iodine number suggests a high level of saturation. The smaller the amount of iodine indicates the less unsaturated fatty acids.

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