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# Virgin Coconut Oil: Enzymatic and Acidification Methods for Production – A Review

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***Abstract*** *– Making Virgin Coconut Oil (VCO) was an important process in the coconut oil industry, which had potential for medical and beauty applications. This article discussed the method of making VCO using fermentation and enzymatic approaches. Making VCO involved several stages, including making coconut milk, adding ingredients such as pieces of young papaya, pineapple tubers, and yeast tape, and settling and separating the oil liquid. Adding papain and bromelain enzymes in the enzymatic process had been proven to increase the yield of coconut oil compared to fermentation methods without adding enzymes. Enzyme concentration and incubation time influenced the yield of VCO, with increasing enzyme concentration and optimal incubation time increasing oil production. This literature review provided insight into the potential of fermentation and enzymatic methods in VCO production, as well as provided a systematic framework for testing the effectiveness and quality of VCO produced through innovative approaches. The VCO manufacturing method using an enzymatic approach had the potential to increase coconut oil production yields and meet established quality standards.*

**Keywords:** *VCO; papaya; yeast tape; yield; enzymatic; acidification*

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## INTRODUCTION

A member of the Arecaceae family, the coconut tree (Cocos nucifera), is commonly known as the "tree of life." Among the most important plants, it is used for a variety of uses all over the world.. With pinnae that are 60–90 cm long and pinnate leaves that are 4-6 m long, it is the only species in the genus Cocos that is known to have such a tall stem, reaching up to 30 m in height. Coconut trees come in a variety of forms, including tall and coral ones. Common variants, referred to as "high," include Javanese, Ceylon, Indian, Jamaican, Malayan, and Laguna. Among the "horse" variations are Malayan, green, orange, and Fijian variants. Typically, tall varieties are developed for market. They take a long time to grow and don't start flowering for six to ten years after planting. The life expectancy of tall varieties is about 60-100 years. Coconut trees are well suited to wet tropical coastal climates; can tolerate poor sandy soil and exposure to salt water. Indonesia (3.1 million hectares), the Philippines (2.7 million hectares), and India (1.5 million hectares) are the top three countries in the world for coconut output. At about 64 billion peanuts, these nations generate three-quarters of the world's total production (in peanut equivalents). On the global market, virgin coconut oil (VCO) is mostly exported from the Philippines. The main markets for VCO are the United States, Canada, Europe, Asia and the Pacific, the Middle East, Australia, and South Africa. Coconut fruit, also known as a drupe, is light, shiny, impermeable, and is made up of 35% husk, 28% skin, 28% flesh, and 15% water. It is used to produce juice, milk, and oil. In Southeast Asia, cocos are grown as houseplants (i.e., traditional agro-forest systems as a base crop) and provide employment, income, nutrition, social needs, and a visually appealing product to the local populations involved in their growth. (Srivastava et al., 2018).

Antifungal, antioxidant, antibacterial, antiviral, hepatoprotective, low glycemic index, and immune system-boosting are just a few potential medical benefits of VCO 90%–95% of coconut oil comprises saturated fatty acids. Medium-chain adipocytes are smaller than long-chain fatty acids, which are present in plant-based oils. This allows for increased cell permeability for direct energy conversion instead of fat storage. In addition to being easier to digest than long-chain fatty acids included in plant oils, medium-chain fatty acids also have antibacterial and antifungal properties. Compared to other fats, VCO has 2.6% fewer calories (Yan et al., 2021). VCO is a luxurious addition to any beauty and wellness routine. Receiving the power of VCO can lead to healthier, radiant skin, shiny hair, and a stronger immune system. Integrating VCO into everyday life is a simple and effective way to take advantage of its many benefits.

Virgin Coconut Oil This does not require expensive costs because raw materials are easy to obtain at low prices and simple processing. Virgin coconut oil contains high levels of medium- and short-chain saturated fatty acids, namely around 92%. The benefits of young coconut oil (VCO) include increasing the human body's resistance to disease and speeding up the healing process (Idris & Armi, 2022). The potential of pineapple tubers as a by-product and young papaya, which have not been utilized optimally, is the background for this study. This research aims to find out how to make VCO (Virgin Coconut Oil) using a fermentation process, enzymatically using pineapple tubers, young papaya pieces, and tape yeast, and the purpose of adding these ingredients to the manufacturing process (Rahmawatia & Khaerunnisya, 2018).

## VCO (VIRGIN COCONUT OIL) MAKING PROCESS

VCO oil can be made using several methods, including traditional methods, fermentation, and enzymatic methods. The traditional method, the steps that need to be passed to form coconut oil, is making coconut milk. After heat treatment, coconut oil will be obtained from this coconut milk. The heating carried out depends on the size of the fire used. Generally, the temperature is around 100–110°C. This temperature is said to be ideal because at this temperature the water in coconut milk will evaporate, thus the proteins bound to the water will break down. Next, the protein will experience denaturation (damage). Thus, the protein that binds the fat (oil) from coconut milk will be damaged too. This coconut oil will then be free from emulsion bonds with protein as the emulsifier. By releasing these bonds, the oil will collect itself. Meanwhile, the proteins will also be gathered into one. This protein is known as blondo (dung oil)..

Another easy alternative fermentation method for farmers is using the addition of tape yeast as a starter for the process of breaking down the coconut milk/cream emulsion to obtain the desired VCO (Muharun and Apriyantono, 2014). The enzymatic method used to increase the yield of oil extracted from coconut milk cream can be done by adding an enzyme that can break down the protein that acts as an emulsifier in coconut milk. The breakdown of the coconut milk emulsion can occur in the presence of proteolytic enzymes. The papain enzyme is a proteolytic enzyme. This enzyme can catalyze protein breakdown reactions by hydrolyzing peptide bonds into simpler compounds (Muhidin, 2001); besides that, the enzyme that can be used to break down lipoprotein bonds in fat emulsions is the bromelain enzyme found in pineapple (Setiaji, 2006).

The general process of producing Virgin Coconut Oil (VCO) through fermentation and enzymatic methods is outlined as follows:

1. Research Design: The research was carried out with an experimental design using material factors added to the VCO manufacturing process and the resulting VCO yield factors.
2. Research Materials:
   - The ingredients used include grated coconut, water, young papaya pieces, pineapple tubers, and yeast tape.
   - The amounts and proportions of these ingredients have been determined according to research needs.
3. Research Stages:
   - Making Coconut Milk: The initial stage involves making coconut milk from grated coconut by adding water, squeezing, and standing to separate the coconut cream and skimmed coconut milk.
   - Making VCO: This is done by adding pieces of young papaya, pineapple tubers, and yeast tape to coconut milk cream, followed by the process of standing and separating the oil liquid to get VCO.
   - VCO Evaluation: The resulting VCO is physically evaluated, including weight, color, taste, and odor parameters.
4. Data analysis:
   - Data obtained from the VCO evaluation was analyzed to evaluate the effect of adding certain ingredients on the final VCO results.

- The physical and organoleptic parameters of VCO are evaluated to determine product quality.

By using an experimental approach and following a series of stages from material preparation and manufacturing process to evaluation of results, this research can provide valuable insight into the potential of fermentation and enzymatic methods in VCO production. Thus, the research method used provides a systematic framework for testing the effectiveness and quality of VCO produced through this innovative approach.

**INGREDIENTS IN VCO (VIRGIN COCONUT OIL)**

The Indonesian National Standard (SNI) used for Virgin Coconut Oil (VCO) is SNI 7381:2008. This standard specifies quality requirements for VCO, including the smell and taste, which must be typical of fresh coconut oil, not have a rancid smell, and not have a foreign taste. Apart from that, this standard also regulates the composition of fatty acids, which must comply with specified provisions. By referring to SNI 7381:2008, this research ensures that the VCO produced meets the quality standards that have been set for VCO products, including in terms of smell, taste, and fatty acid composition.

The VCO quality requirements determined according to the Indonesian National Standard (SNI) 7381:2008 are shown in Table 1. The enzymatic VCO produced is tested for its characteristic properties and then compared with this standard to determine the quality of the oil produced.

Table 1. Quality Standards for Virgin Coconut Oil (VCO) According to SNI 7381:2008

| No. | Test Type | Unit | Condition |
|---|---|---|---|
| 1. | Organolaptics: | | |
| | 1.1 Smell | - | Typical of fresh coconut, not rancid. |
| | 1.2 Taste | - | Normal, typical coconut oil. |
| | 1.3 Color | - | Colorless to yellow. |
| 2. | Water And compound Which evaporate | % | Max. 0.2 |
| 3. | Iodine number | g iodine/100 g | 4.1 – 11.0 |
| 4. | Free fatty acids | % | Max 0.2 |
| 5. | Peroxide number | mg ek/kg | Max 2.0 |
| 6. | Fatty acid: | | |
| | 6.1 Caproic acid (C6:0) | % | ND – 0.7 |
| | 6.2 Caprylic acid (C8:0) | % | 4.6 – 10.0 |
| | 6.3 Capric acid (C10:0) | % | 5.0 – 8.0 |
| | 6.4 Lauric acid (C12:0) | % | 45.1 – 53.2 |
| | 6.5 Myristic acid (C14:0) | % | 16.8 – 21 |
| | 6.6 Palmitic acid (C16:0) | % | 7.5 – 10.2 |
| | 6.7 Stearic acid (C18) | % | 2.0 – 4.0 |
| 7. | Microbial contamination 7.1 Total plate numbers | colonies/mL | Max 10 |
| 8. | Metal Contamination: | | |
| | 8.1 Lead (Pb) | mg/kg | Max 0.1 |
| | 8.2 Copper (Cu) | mg/kg | Max 0.4 |
| | 8.3 Iron (Fe) | mg/kg | Max 5.0 |
| | 8.4 Cadmium (Cd) | mg/kg | Max 0.1 |
| 9. | Arsenic (As) Contamination | mg/kg | Max 0.1 |

NOTE ND = No detection (not detected)

The data presented in Table 2 is the best data from comparison results of journals and journals according to Indonesian National Standard (SNI) 7381:2008, which aims to see how significant the addition of the enzymatic method is compared to just using the fermentation method. The focus that we want to highlight is how much yield can be produced; therefore, the yield will be in the form of a percentage (%) depending on how much coconut milk is used.

Table 2. A comparative analysis of all the journals utilized to create VCO

| Source reff. | Coconut milk used | Enzyme used | Incuba-tion time (hours) | Rende-ring results |
|---|---|---|---|---|
| Papain (Andaka & Fitri, 2017) | 100 mL | 2 g | 19 | 30% |

| | | | | |
|---|---|---|---|---|
| Papain (Perdani et al., 2019) | 150 mL | 2.25 g | 6 | 18.8% |
| Papain (Nuryati et al., 2018) | 100 mL | 3 g | 1.5 | 33.7% |
| Bromelain (Rahmalia & Kusumayanti, 2021) | 500 mL | 6 g | 30 | 9.1% |
| Bromelain (Melda, 2012) | 800mL | 600 mL | 48 | 12.1% |
| Bromelain (Adi & Prayitno, 2019) | 450 mL | 225 mL | 20 | 31.1% |
| Without adding enzymes (Asmoro et al., 2018) | 20mL | - | 48 | 31.4% |

**DISCUSSION**

From several journals reviewed, there are 3 ingredients, namely using the papain enzyme, bromelain enzyme, and without using the enzyme. In the journal (Andaka & Fitri, 2017), VCO is made using the papain enzyme with 100 mL of coconut milk. The best yield of VCO in this journal was the addition of 2 g of papain enzyme with an incubation time of 19 hours; the yield percentage was 30%. This shows that the higher the concentration of the papain enzyme used, the greater the volume of oil taken. In the journal (Perdani et al., 2019), making VCO using the papain enzyme with 150 mL of coconut milk. The best VCO yield results were the addition of 2.25 g of papain enzyme with an incubation time of 6 hours; the yield percentage was 18.80%.

A large amount of coconut milk substrate must also be balanced with the addition of a high concentration of the papain enzyme to get VCO results in large quantities. In the journal (Nuryati et al., 2018), making VCO using the papain enzyme with 100 mL of coconut milk. The best VCO yield results were the addition of 3 g of papain enzyme with an incubation time of 1.5 hours; the yield percentage was 33.75%. This shows that the more papain enzyme is used, the faster the oil will be formed and the greater the amount produced will be. The higher the concentration of papain enzyme added, the faster the catalyst will speed up the reaction rate changes along with changes in the concentration of the enzyme used. In the journal (Rahmalia & Kusumayanti, 2021), making VCO using the enzyme bromelain with 500 mL of coconut milk. The best VCO yield results were the addition of 6 g of papain enzyme with an incubation time of 30 hours; the yield percentage was 9.1%. From these results, it can be said that the higher the concentration of bromelain enzyme added, the higher the resulting yield. This may be because the higher the concentration of the bromelain enzyme, the more protein substrates will react with the bromelain enzyme. In the journal (Melda, 2012), making VCO using the enzyme bromelain with 800 mL of coconut milk.

Analysis revealed that the optimum production of VCO was reached with the application of 600 mL of papain enzyme and allowed to incubate for 48 hours; a yield percentage of 12.13% has been obtained. More pineapple tuber juice (bromelain enzyme) would thus increase oil production. In the journal (Adi & Prayitno, 2019), they prepared VCO using the bromelain enzyme with 450 mL coconut milk. The highest yield of VCO was obtained by using papain enzyme, 225 mL in amount with an incubation period of 20 hours, at which point the yield percentage is 31.11%. It is seen that the more extract is given from the pineapple, the more oil will be extracted. From table 2, it can be summarized that the more concentration of pineapple extract given, the more oil that can be extracted. This is in accordance with research conducted by Kusuma et al.(2017), in which the more the number of enzymes added, the more the oil will be collected. In the journal by Asmoro et al. (2018), VCO was made by adding 20 mL of coconut milk only, without any enzyme added.

The optimal VCO yield was obtained after 48 hours of incubation, with a yield percentage of 31.47%. This demonstrates that more oil components—that is, water, protein, and oil—can be liberated from the protein matrix in the coconut emulsion the longer the fermentation process lasts. The addition of papain enzymes to the journals (Nuryati et al., 2018) was found to have the highest percentage of outcomes from the other 6 journals out of the 7 journals. This is because the papain enzyme breaks down the proteins and cell walls of coconut milk more effectively, resulting in thinner and more oil-rich coconut milk. The difference in why the papain enzyme is more effective than the bromelain enzyme is because the papain enzyme has higher protease activity than the bromelain enzyme. This can speed up the protein breakdown process and affect the yield of VCO.

**CONCLUSION**

From a series of studies that have been reviewed, there are significant findings regarding the manufacture of Virgin Coconut Oil (VCO) using fermentation and enzymatic methods. First of all, the addition of papain and bromelain enzymes has been proven to increase the yield of VCO substantially, with the yield percentage reaching between 18.80% and 33.75%. Increased enzyme concentration and optimal incubation time have resulted in larger volumes of coconut oil. Furthermore, the results of this research also provide insight into the effect of the concentration of additional ingredients such as young papaya pieces and pineapple tubers on VCO production. It was found that the more additional materials used, the greater the yield produced. In addition, the VCO evaluation results show that the products produced meet the quality standards set by the Indonesian National Standard (SNI) 7381:2008, including in terms of smell, taste, and fatty acid composition. Thus, it can be concluded that the method of making VCO using an enzymatic approach has significant potential to increase coconut oil production with guaranteed quality.

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