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# The Characteristics of Coconut Oil Products Based on Papaya Juice and Duration Fermentation using Rhizopus sp.

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***Abstract.*** *Coconut oil is a basic human need. Coconut oil can be made both traditional and enzymatically. Enzymatic manufacture of coconut oil is the separation of oil in coconut milk using protein-breaking enzymes called proteolytic enzymes. Enzymatic production of coconut oil has the advantages of easy-to-obtain raw materials, does not require much energy, and simple processing. This study was conducted to determine the effect of time and amount of papaya juice used with the coconut oil yields obtained. The results of the study at a time of 3 days with a volume of 75 ml of papaya juice, it was obtained that the volume of coconut oil was the most, which was 11.4 ml. Making coconut oil using coconut milk and papaya juice mixed and added 2 grams of tempeh yeast then measured the pH to pH 4. Next, the glass is closed so that air does not enter during the fermentation time of 3-5 days. After being fermented then separated between water and pulp from making coconut oil. Next, pulp from making coconut oil is heated to produce oil. In addition, the free fatty acid test and the saponification number test were also carried out to determine whether the coconut oil produced complies with the quality requirements of SNI 2902-2011. This indicates that some treatment effect of coconut oil compiles is possible, a quality requirement of SNI 2902-2011.*

***Keywords****: coconut oil; fermentation; papain enzyme; Rhizopus sp.*

## INTRODUCTION

Oil is one of the basic human needs. Oil sources can be obtained from vegetable and animal sources, seed oil, soybean oil, and so on. Coconut (*Cocos nucifera*) is a plant that almost all of its parts can be utilized by humans. Starting from the flesh, the coconut water (for nata de coco), the shell, the fiber, the young leaves, the sticks, and the stems. However, what has the highest economic value is the flesh of the fruit as coconut milk and coconut oil. Coconut oil is often used as an industrial raw material and in the manufacture of cooking oil. In addition, coconut oil is good to use to improve people's health (Moviana, 2013).

Coconut oil is derived from the flesh of coconuts (*Cocos nucifera*) which can be processed both dry and wet (Karouw et al., 2013). Dried coconut oil is a primary ingredient for various industries such as soap and margarine with or without a refining process. Wet process coconut oil is almost always used for cooking oil. Wetly, the manufacture of coconut oil begins with the manufacture of coconut milk which is an oil in water emulsion, this emulsion is then broken down so that oil can be obtained. There are several ways to break emulsions, including traditional (heating/evaporating) fermentation, and enzymatic methods (Edam et al., 2019). The production of coconut oil traditionally results in poor quality coconut oil caused by heating at high temperatures (100 – 110 ℃). Heating at high temperatures traditionally can damage the content of protein, fat, and antioxidants (Purwanto & Artawan, 2002). Enzymatically, the manufacture of coconut oil has advantages, namely the raw materials are easy to obtain, the processing is simple and not too complicated, and the use of energy is minimal (Sugiyono, 2007).

In the production of coconut oil enzymatically, protease enzymes such as papain, bromelain, and Kim proteolytic enzymes from fig tree sap can be used which can hydrolyze casein (Utari & Muchtadi, 1989; I. N. K. Widjaja et al., 2015). Enzymatic extraction of coconut oil with papain can be done using unripe papaya fruit

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as a source of enzymes (Ariwianti & Cahyani, 2008).

Indonesia is a large papaya (*Cocos nucifera*) producer. Currently, the area of papaya planting with a business orientation reaches 52,250 ha (Warisno, 2003). Papain is found in all parts of the papaya plant, both roots, stems, leaves, and fruit flesh (Dongoran, 2004). The papain enzyme can break lipoprotein bonds in coconut fruit content in fat emulsions. Protein breakdown causes the emulsion system to become unstable so that the oil can be separated from the emulsion system. So, three layers are formed, namely water in the bottom layer, oil in the middle layer, and protein clumps in the top layer (Silaban & Manullang, 2014).

In addition to using papain enzymes, the process of making coconut oil must be carried out by fermentation. Fermentation is the process of breaking down organic compounds into simpler compounds which are broken down with the help of microorganisms (Pangaribuan et al., 2022). In the starter fermentation process, yeast or fermenting microorganisms can be used (Rohma, 2022). The microorganisms used are the key to the success or failure of a fermentation (Wiadnya & Urip, 2019). The use of tempe yeast for oil fermentation has been investigated by Widjaja et al. (2015) with the addition of 4 gram of tempe yeast per liter of coconut cream to produce a 33.2% oil yield.

Therefore, in this research, enzymatic manufacture will be carried out with the addition of tempe yeast so that it can be known whether the coconut oil produced can meet the quality requirements according to the National Standardization Agency of Indonesia (SNI). This research is expected to obtain a method of making coconut oil that saves time and energy and produces coconut oil by the Indonesian National Standard (SNI).

## METHODS

This research was carried out at the Home-Based Innovation Center in January 2021. The equipment used in this study was a blender, coconut milk filter, test tube, erlenmeyer, burette, measuring cup, digital scale, pycnometer, dropper pipette, pH meter, volumetric pipette, glass electric beaker, and electric stove. The materials used for this research include coconut, papaya, tamarind vinegar, and rhizopus sp.

**Research procedure**

1. Coconut fruit that has been granted with a coconut grater machine is then added with water to squeeze out the coconut milk.
2. Papaya fruit is blended and then filtered to take papaya juice (papain enzyme).
3. Mix coconut milk and papaya juice with the ratio of coconut milk: papaya juice → 1: 0,25; 1:0,5; 1: 0.75 in a beaker
4. Add 2 gram of Rhizopus sp. into a mixture of coconut milk and papaya juice.
5. Stir the mixture then measure the pH until it is at pH 4.
6. Cover the beaker so that air did not enter, and ferment for 3 days, 4 days, and 5 days.
7. After 3 days, separate the water and coconut presscake then heat the remaining pulp from making coconut oil until it produces oil.
8. Measure the volume of oil produced.
9. Repeat steps 7 – 8 for day 4 and 5.

The analytical tests that will be carried out in this study are the free fatty acid test and saponification.

**Free Fatty Acid Test**

1. Weigh 1 gram of coconut oil, then put it in an erlenmeyer;
2. Addition 23.59 ml of 95% alcohol;
3. Addition 3 drops of PP indicator;
4. Titrate using 0.1 N KOH standard solution;
5. Calculating the free fatty acids of each sample.

**Saponification Test**

1. Weigh 0.5 grams of oil, and put it in a three-neck rounded flask with a volume of 100 ml;
2. Add 50 ml of standardized 0.5 N alcoholic KOH solution;
3. Then refluxed with a heater until the solution became clear (2 hours);

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4. After reflux is complete, cool and dilutes to 250 ml. Taken 25 ml;
5. The diluted solution was titrated using 0.1 N HCl using the PP indicator. The titration was carried out three times;
6. Calculate the number of saponification of each sample.

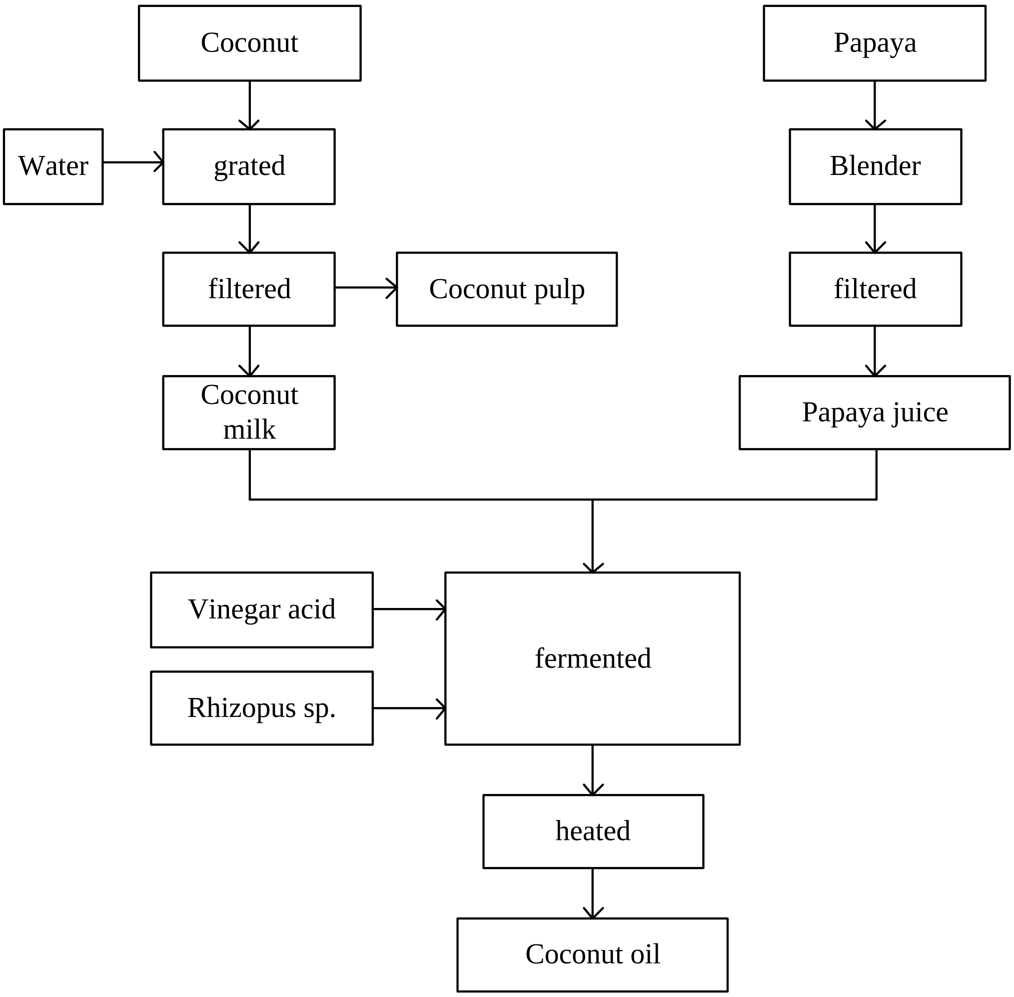


**Figure 1.** Research flow chart for making coconut oil

## RESULTS AND DISCUSSION

Making coconut oil using ingredients in the form of old coconuts that have been taken coconut milk, papaya fruit that has taken papaya juice (as papain enzyme) is shown in Figure 2. The coconut fruit used in this study is coconut which is old to produce thick coconut milk. to produce a lot of coconut oil. The papaya used in this study is papaya which is still young to produce a lot of papain enzymes.

Coconut milk and papaya juice are then mixed with Rhizopus sp. and allowed to stand to separate from the part that contains a lot of oil. The part that contains a lot of oil will be at the top and the part that contains a little oil will be at the bottom. The oil in coconut milk is surrounded by a thin layer of protein that must be broken down to produce oil. Therefore, in this study, we used papain enzymes and tempeh yeast to break down proteins and carbohydrates to produce oil.

The manufacture of coconut oil uses a variable time of fermentation with variations of 3 days, 4 days, and 5 days; The pH used was 4 and the volume of papaya fruit was 25,

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50, and 75 ml. Based on research conducted by Apriliasani (2014) at pH 4 oil extraction took place optimally. Coconut milk that has been added with papaya juice, tempeh yeast, and vinegar, is shown in Figure 3.

**Figure 2.** Papaya juice

**Figure 3.** Coconut milk fermentation

The results of the fermentation are then processed to obtain the volume of coconut oil as shown in Figure 4 and Table 1.

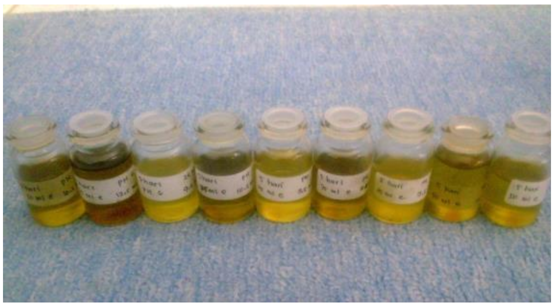

**Figure 4.** Coconut oil produced

Based on research conducted by Fitri & Andaka (2017), the volume of coconut oil produced from the manufacture of coconut oil with papain enzymes is 4 – 30 ml. This is in line with the research results listed in Table 1. The volume of coconut oil produced ranges from 8.3 to 11.4 ml.

After obtaining the volume of coconut oil from the fermentation process carried out for 3-5 days, then the coconut oil was analyzed for the free fatty acids and saponification numbers to determine whether this coconut oil was included in the quality requirements of SNI 2902-2011 (Badan Standarisasi Nasional, 2011).

**Table 1.** The volume of coconut oil produced

| Days (day) | pH | Coconut Milk Volume (ml) | Papaya Juice Volume (ml) | Volume of Coconut Oil Produced (ml) |
|---|---|---|---|---|
| 3 | 4 | 100 | 25 | 8.3 |
| | | 100 | 50 | 9.9 |
| | | 100 | 75 | 11.4 |
| 4 | 4 | 100 | 25 | 10 |
| | | 100 | 50 | 11 |
| | | 100 | 75 | 10.8 |
| 5 | 4 | 100 | 25 | 9.5 |
| | | 100 | 50 | 8.9 |
| | | 100 | 75 | 10 |

**Table 2.** Free fatty acid test

| Days (day) | pH | Coconut Milk Volume (ml) | Papaya Juice Volume (ml) | Free fatty acid | SNI 2902 - 2011 |
|---|---|---|---|---|---|
| 3 | 4 | 100 | 25 | 0.96 | |
| | | 100 | 50 | 1.00 | |
| | | 100 | 75 | 1.24 | |
| 4 | 4 | 100 | 25 | 0.58 | |
| | | 100 | 50 | 0.46 | Max. 5 |
| | | 100 | 75 | 0.38 | |
| 5 | 4 | 100 | 25 | 2.10 | |
| | | 100 | 50 | 1.78 | |
| | | 100 | 75 | 2.40 | |

## Free Fatty Acid Test

The free fatty acid test was carried out to determine the acid released on hydrolysis from fat. The dominant free fatty acid in the oil is lauric acid which includes saturated fatty acids (Winarno, 1992). Based on the quality requirements of SNI 2902 – 2011 the value of free fatty acids in coconut oil is a maximum of 5. Based on research conducted by Rindawati & Perasulmi (2020), the production of coconut oil enzymatically with

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papain enzymes produces free fatty acids of around 0.04 – 0.06. Likewise, the research conducted by Diningsih & Yaturramadhan (2021) on the production of coconut oil enzymatically produced free fatty acids of about 3.706. This is in line with the results of the analysis in Table 2. and with the quality requirements of SNI 2902-2011 for free fatty acids of coconut oil.

**Saponification Value Test**

The saponification number is the amount of alkali required to saponify a given sample of oil. The saponification number of the oil depends on the molecular weight of the triglycerides that make up the oil. The principle of the saponification number is determined by the complete saponification of the oil or fat with the amount of potassium hydroxide determined by titration (Purba, 2015; Zurairah et al., 2021). The higher the molecular weight of the oil, the lower the saponification number. According to Ketaren (1986), the amount of saponification in oil is influenced by the presence of unsaponifiable compounds in the oil such as sterols, pigments, hydrocarbons, and tocopherols which can reduce the oxidation strength of unsaturated fatty acid bonds.

**Tabel 3.** Saponification value test

| Days (day) | pH | Coconut Milk Volume (ml) | Papaya Juice Volume (ml) | Saponification Value | SNI 2902-2011 |
|---|---|---|---|---|---|
| 3 | 4 | 100 | 25 | 259.50 | 248 - 265 |
| | | 100 | 50 | 259.60 | |
| | | 100 | 75 | 260.70 | |
| 4 | 4 | 100 | 25 | 261.30 | |
| | | 100 | 50 | 262.00 | |
| | | 100 | 75 | 261.20 | |
| 5 | 4 | 100 | 25 | 261.60 | |
| | | 100 | 50 | 260.10 | |
| | | 100 | 75 | 261.40 | |

Based on the quality requirements of SNI 2902 – 2011 the value of the coconut oil saponification number is 248 – 265. The saponification number from the results of the study in Table 3 ranges from 259.50 – 262. This is in line with the research conducted by W. P. Widjaja & Anjarsari (2014), the number of saponification produced from the manufacture of coconut oil ranges from 257.46 – 262.98. From the data listed in Table 3, the coconut oil in this study meets the quality requirements of the coconut oil saponification number.

## CONCLUSION

Based on the research conducted, the highest volume of coconut oil was obtained at the time of fermentation for 3 days with the addition of 75 ml of papaya juice. The test to determine whether the coconut oil produced complies with the quality requirements using SNI 2902-2011. Based on the free fatty acid test and a saponification number of coconut oil in this study, it meets the quality requirements of SNI 2902-2011 coconut oil.

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