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## The Effect of Tempe Yeast Inoculum Amount on the Quantity and Quality of *Cocos nucifera viridis* Virgin Coconut Oil (VCO)

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### ABSTRACT

This study aims to determine the effect of tempeh yeast inoculum on the color, odor, and yield in the manufacture of Virgin Coconut Oil (VCO) from *Cocos nucifera viridis*. This research was conducted in November 2020 in Brebes, Magelang, and Lampung. This research employed the descriptive quantitative method. The population of this experiment was coconut fruit found in Lampung, Brebes, and Magelang. The sample used was green coconut (*Cocos nucifera viridis*) found in Lampung, Brebes, and Magelang. The working procedure of this research consisted of fermenting the sample and observing the oil produced by Virgin Coconut Oil. This research's data collection techniques were observation, documentation, and products calculation. Based on the observations, the researchers found the highest yield in the experiment of 80 ml cream with an inoculum of 8 grams (30.4%), followed by a volume of 80 ml of cream with a 6-gram inoculum (28.4%). The smallest yield was formed at a volume of 80 ml cream with inoculum 4 grams (14.6%). The VCO obtained in this research had a distinctive aroma of coconut oil and was clear in color. Therefore, the amount of tempeh yeast inoculum affects the color, odor, and yield in the manufacture of Virgin Coconut Oil (VCO) from *Cocos nucifera viridis*.

#### ***Pengaruh Jumlah Inokulum Ragi Tempe Terhadap Jumlah dan Kualitas Virgin Coconut Oil (VCO) dari Cocos nucifera viridis***

**ABSTRAK:** Penelitian ini bertujuan untuk mengetahui pengaruh jumlah inokulum ragi tempe terhadap warna, bau, dan rendemen yang dihasilkan pada pembuatan Virgin Coconut Oil (VCO) dari *Cocos nucifera viridis*. Penelitian ini dilaksanakan di bulan November 2020 bertempat di wilayah Lampung, Brebes dan Magelang. Jenis penelitian ini adalah deskriptif kuantitatif. Populasi dari eksperimen ini adalah buah kelapa yang terdapat di Lampung, Brebes dan Magelang. Sampel yang digunakan adalah kelapa hijau (*Cocos nucifera viridis*) yang terdapat di Lampung, Brebes dan Magelang. Prosedur kerja dalam penelitian ini terdiri dari fermentasi sampel dan melakukan pengamatan minyak yang dihasilkan Virgin Coconut Oil. Teknik pengumpulan data yang dilakukan dalam penelitian ini yaitu observasi, dokumentasi dan menghitung produk yang dihasilkan. Berdasarkan hasil pengamatan, jumlah rendemen terbanyak

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*terdapat pada percobaan volume krim 80 ml dengan inokulum 8 gram sebanyak 30,4%, diikuti dengan volume krim 80 ml dengan inokulum 6 gram sebanyak 28,4%, dan rendemen terkecil terbentuk pada volume krim 80 ml dengan inokulum 4 gram sebanyak 14,6%. VCO yang diperoleh dari penelitian ini memiliki aroma khas minyak kelapa dan berwarna jernih. Maka dari itu, dapat disimpulkan bahwa jumlah inokulum ragi tempe yang ditambahkan pada pembuatan Virgin Coconut Oil (VCO) dari *Cocos nucifera viridis* berpengaruh terhadap jumlah produk, rendemen, serta warna dan bau minyak yang dihasilkan.*

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## INTRODUCTION

After the Philippines, India, and Brazil, Indonesia is the world's largest producer of coconuts (Baskara *et al.*, 2018). Indonesia can produce 18 million tons of coconut each year (Dirjenbun, 2020). However, since the coconuts are sold in bulk directly by huge companies in the form of whole coconuts or processed coconut goods, coconut farmers have not felt the benefit. Furthermore, coconut producers believe that the price of coconut they sell is still poor at the moment (Orin Tamungku, Rosalina A.M Koleangan, 2019). One of the solutions is the development of coconut derivative goods with higher added value. Virgin coconut oil (VCO) is one of the many products derived from coconuts (Han & goleman, daniel; boyatzis, Richard; Mckee, 2019).

Virgin Coconut Oil (VCO) is a processed product made from coconut meat that comes in a transparent, tasteless liquid with a distinct coconut odor (Aziz *et al.*, 2017). Making virgin coconut oil (VCO) does not require high costs because the raw materials are inexpensive and simple to process. Virgin coconut oil contains approximately 92 percent medium and short-chain saturated fatty acids. At this time, numerous ways of processing coconut oil have been created, such as acidification, adding oil, adding salt, heating, and so on (Aziz *et al.*, 2017). The demand for coconut goods, such as virgin coconut oil (VCO), is increasing in domestic and foreign markets due to the growing consumer awareness of healthful coconut processed products (Karouw *et al.*, 2019).

Virgin Coconut Oil is a processed product circulating commercially in the

market and is recognized to have bioactive chemicals that are beneficial to human health (Marina *et al.*, 2009). The advantages of Virgin Coconut Oil (VCO) include increased disease resistance and faster wound healing (Sutanto & Ratnawati, 2017). Because of its high antioxidant activity and high lauric acid concentration, VCO is also known to lower cholesterol levels in blood serum (Syukur *et al.*, 2017). VCO is also frequently utilized in the cosmetic industry (Asmawit, 2010). VCO is superior to regular coconut oil due to saturated fatty acids and the scent. Furthermore, the small VCO molecule arrangement makes it easier to absorb into the skin, provides a soft and smooth feel to the skin, and prevents water evaporation (Suhery *et al.*, 2018).

Several past investigations on processing Virgin Coconut Oil procedures, such as pacing oil, salting techniques, and ultrasonic techniques, have been conducted (Aziz *et al.*, 2017a; Irwan, 2017). Farmers who are processing VCO for the first time, on the other hand, frequently find it difficult to employ these approaches. As a result, another, simpler method of breaking the coconut milk/cream emulsion during the fermentation process is required. Farmers can utilize tempeh yeast as a starter to break the coconut milk/cream emulsion to achieve the appropriate VCO.

As is generally known, tempeh yeast is one of the materials for creating tempeh that can be easily bought in the general market, making it easier for coconut farmers to use this technique. However, to discover the most successful formula for using tempeh yeast, we intended to perform a study to assess the influence of inoculum amount on

the manufacture of Virgin Coconut Oil (VCO) from *Cocos nucifera viridis* using tempeh yeast. The benefit of this research is that the inoculum employed is simpler, making it easier to manufacture. The goal of this study was to see the number of *Rhizopus* sp. affected the quantity and quality of Virgin Coconut Oil (VCO) produced.

## METHOD

This research was performed in Lampung, Brebes, and Magelang in November 2020. The researchers employed the quantitative descriptive method. Quantitative data covered the amount of VCO produced and the yield. The observation results are also explained descriptively and presented in tabular form. This experiment's population consisted of coconuts found in Lampung, Brebes, and Magelang. Green coconut (*Cocos nucifera viridis*) from Lampung, Brebes, and Magelang was used as the sample.

In this research, the working process consisted of fermenting the sample and observing the oil produced by Virgin Coconut Oil. The first step was to make coconut milk. The fiber and shell of green coconut (*Cocos nucifera viridis*) were removed. The coconut was then grated and squeezed with a little water until the coconut milk emerged. Ensure your hands are sterile to avoid bacteria or other foreign things from entering the coconut milk. The coconut milk was then separated from the coconut pulp through a tea filter. This technique was repeated until pure coconut milk was obtained. The next step was to separate the cream from the skim. After separating the coconut milk from the pulp, the mixture was left for an hour to separate into two portions (cream on the top and skim on the bottom).

Furthermore, the cream and skim were separated using a hose or spoon. The addition of tempe yeast accomplished the fermentation of coconut cream. Each cream with a volume of 80 ml received 4 grams, 6 grams, and 8 grams of yeast. The incubation

and fermentation processes were then completed, resulting in three layers: the bottom layer of water, the middle layer of protein coagulant, and the top layer of VCO oil. The generated Virgin Coconut Oil was separated from the remaining components.

The data was gathered through observation, documentation, and calculation of the result. Observations were made on fermentation to distinguish the results of Virgin Coconut Oil formed based on the shape, smell, color, yield, and the resulting VCO. Documentation in the form of green coconut milk (*Cocos nucifera viridis*) and the formed Virgin Coconut Oil.

## RESULT AND DISCUSSION

The production of Virgin Coconut Oil (VCO) in this study uses green coconut (*Cocos nucifera viridis*) and is fermented using various ratios of a tempeh yeast inoculum. This process aims to determine the effective comparison between coconut cream and inoculum in producing quality VCO. The process of VCO production can be seen in the following figures:



Figure 1. The Process of Fermenting Coconut Cream with Inoculum

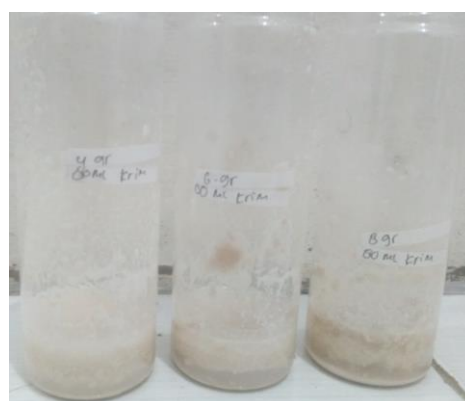


Figure 2. The Results of Fermentation

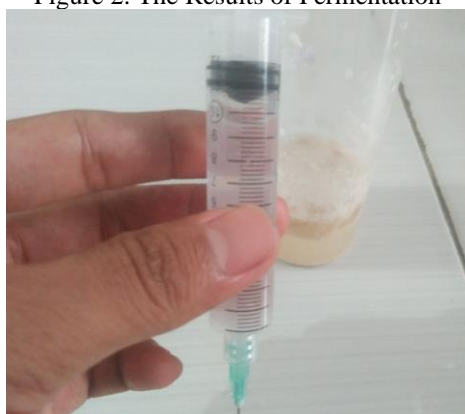


Figure 3. Taking the Resulting VCO

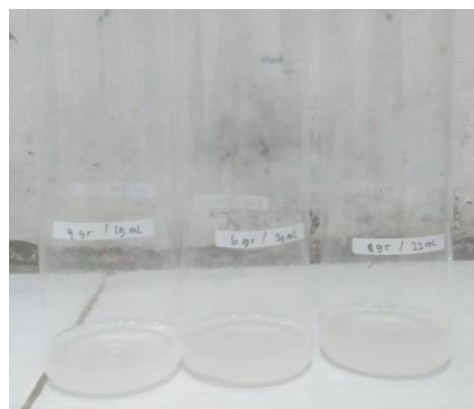


Figure 4. VCO Final product

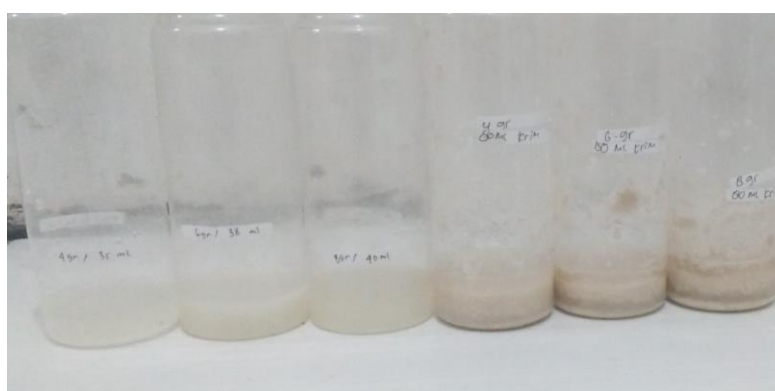


Figure 5. Separating Fermentation Components

The figures above depict a series of the Virgin Coconut Oil making process. The fermentation was done by mixing coconut cream with various amounts of a predetermined tempe yeast inoculum.

The comparison fermentation results of various amounts of inoculum with cream can be seen in Table 1.

**Table 1.** The Comparison of VCO Results

Treatment	The volume of oil formed		
	1 <sup>st</sup> Iteration	2 <sup>nd</sup> Iteration	3 <sup>rd</sup> Iteration
80 ml cream + 4 gram Inoculum	19 ml	20 ml	20 ml
80 ml cream + 6 gram Inoculum	20 ml	24 ml	24 ml
80 ml cream + 8 gram Inoculum	22 ml	25 ml	26 ml

Table 1 shows the comparison results between coconut cream and various amounts of tempe yeast inoculum. 80 ml of coconut cream was used with various amounts of inoculum: 4 grams, 6 grams, and 8 grams. The treatment was repeated three times in each experiment. From these data, it can be seen that the addition of 8 grams of starter to 80 ml of coconut cream resulted in a higher amount of VCO than

the addition of other inoculums. The lowest VCO yield was produced by 4-gram tempeh yeast inoculum with 80 ml coconut cream. These results can also be seen in Figure 6.

The repetition data was then processed to get the average value of the experiment to determine the accumulation of VCO produced in the study.

Based on the observations table, the highest average amount of VCO was

produced by adding 8 grams of yeast. The average VCO produced was 24.3 ml. Meanwhile, the lowest average amount of VCO was produced by adding 4 grams of yeast. The average VCO produced was 19.7

ml. The relationship between the effect of the inoculum on the amount of VCO product is shown in Figure 6.

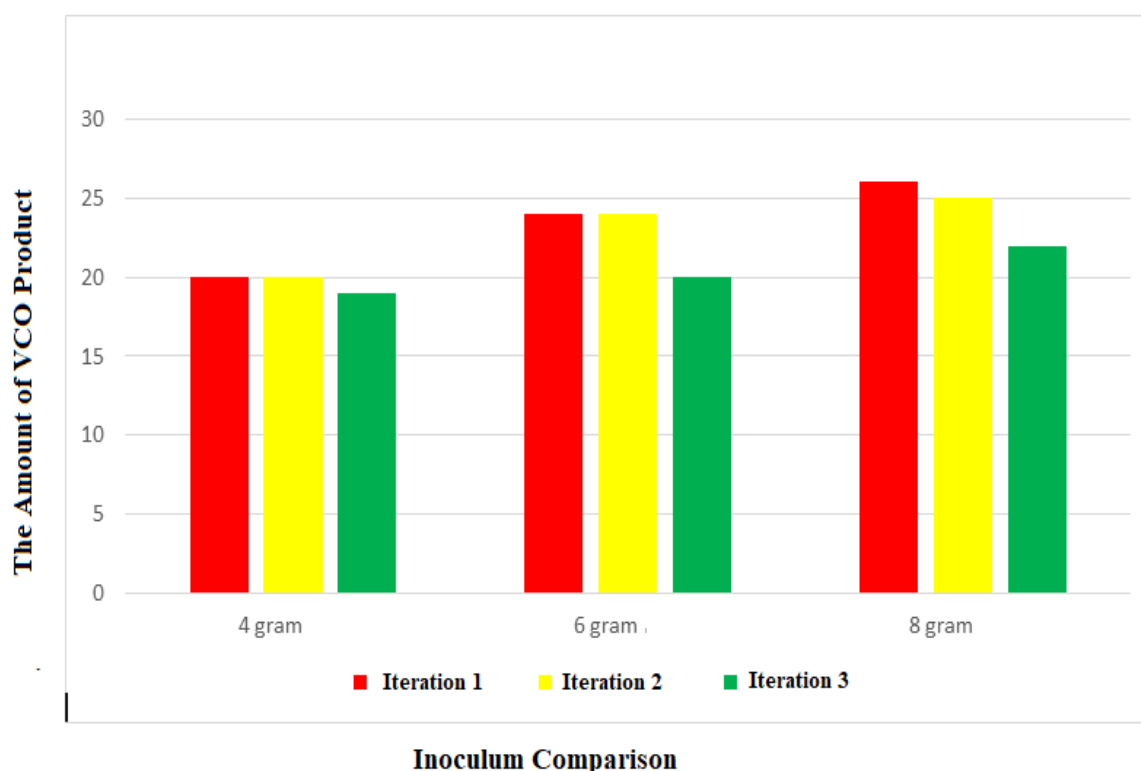


Figure 6. Graph of the Number of Inoculum and the number of VCO Product

The graph above compares VCO from various amounts of inoculum in three regions, Lampung, Brebes, and Magelang. Next is the calculation of the yield content to determine the quality of the VCO obtained

from the experiment. The data from the calculation of the amount of yield is presented in table 2.

Table 2. Fermentation Yield

Coconut Milk Cream	Inoculum (gram)	Obtained Oil Volume			Average	Yield
		1	2	3		
80 ml	4 gram	19 ml	20 ml	20 ml	19,7 ml	24,6%
80 ml	6 gram	20 ml	24 ml	24 ml	22,7 ml	28,4%
80 ml	8 gram	20 ml	24 ml	26 ml	24,3ml	30,4%

Table 2 contains the results of the yield calculation in the VCO manufacturing process. The highest yield was found in the

80 ml cream volume experiment with 8-gram tempeh yeast inoculum (30.4%). The smallest yield was found in the 80 ml

coconut cream experiment with 4 grams of inoculum (24.6%). The yield affects the quality of the formed VCO. The yield was calculated using the average VCO oil produced compared to the volume of

fermented coconut cream. The indicators observed in this study were the color and smell of the resulting VCO. The data for the color and smell of the VCO is in Table 3.

**Table 3.** The Color and Smell Data of the VCO

Treatment	Indicators	
	Color	Smell
80 ml cream + 4 gram Inoculum	Transparent	Coconut
80 ml cream + 6 gram Inoculum	Transparent	Coconut
80 ml cream + 8 gram Inoculum	Transparent	Coconut

Making VCO with the fermentation technique is quite simple, especially for farmers who want to sell more than just coconuts by processing them first into goods with a greater selling value. Fermentation with tempe yeast inoculum is an option that can be pursued. Tempeh yeast is a good inoculum in the fermentation process and is easy to obtain. *Rhizopus* sp. is a mold found in tempe yeast (Rahayu *et al.*, 2019). This study used tempe yeast inoculum in the manufacture of VCO, and the results showed that the administration of different amounts of inoculum affected the resulting VCO because yeast acted as a fermenter for coconut milk by utilizing it as a nutrient, producing VCO yields that tended to increase with the amount of yeast. These findings are consistent with (Andaka dan Fitri, 2017), who discovered that the right ratio of yeast to coconut cream as a nutrient in the fermentation process affects the fermentation results.

The amount of yeast employed in the experiment significantly impacts the amount of virgin coconut oil produced. This is related to the fermentation process that occurs. The more yeast is present in the fermentation medium (cream of coconut milk), the formed white tissue (mycelium). Mycelium will produce a huge number of the sporangium and its spores, allowing the fermentation process to proceed swiftly and

the oil produced to become increasingly concentrated (Nugroho, 2009).

The percentage of coconut oil produced from coconut milk is the oil yield (Yadi *et al.*, 2018). The yield was computed to determine the amount of VCO derived from the fermentation of coconut cream (Maradesa *et al.*, 2014). The yield is calculated by dividing the weight of the oil produced by the weight of coconut cream (Anwar dan Salima, 2016). According to the table above, adding 8 grams of tempe yeast resulted in the maximum output (30.4 percent). Meanwhile, the addition of 4 grams of tempeh yeast yielded the lowest yield (24.6 percent). These findings demonstrate that yield varies depending on the treatment.

On the other hand, the increase in yield was not always directly proportionate to the amount of enzyme added. Under some conditions, enzymes will reach a saturation threshold. This is consistent with the findings of (Yazid dan Nuha, 2017), who discovered that increasing the concentration of papain enzyme on particular substrates might increase the rate of enzymatic reactions. To a certain extent, the rate of the enzymatic reaction is directly proportional to the concentration of the enzyme until it reaches equilibrium. After the equilibrium point has been reached, increasing the concentration of the enzyme will not enhance the reaction rate.

The addition of tempeh yeast, which was then agitated until all of the yeast was evenly dispersed, could intervene in the emulsion system, influencing the integration of the oil mass. This mechanism is regulated by digesting enzymes produced by tempe yeast, such as amylase, lipase, and protease. The protease enzyme degrades the protein layer that coats the emulsion in coconut cream, causing the protein in coconut milk to lose its surface-active properties (Cahyani et al, 2021). The tempeh yeast then pulls the oil globules in the coconut milk until the oil entirely coalesces. This pull will cause the coconut cream's previously bound water and protein to become detached and unstable. Standing for around 24 hours will release the oil and produce a distinct layer separated from the other portions (Sukartini Sitangguri, 2005).

The VCO produced in this research had a distinct coconut oil scent. According to SNI standards, VCO should have a distinct aroma or smell of fresh coconut and is not rancid (Sulasminingsih *et al*, 2017). Kayu dan Cinnamomum (2015) states that rancidity can be caused by various reactions, including oxidation and hydrolysis.

Good coconut oil is clear yellow and has a pleasant flavor and aroma. At the same time, rancid coconut oil has a yellowish-brown color and a terrible flavor and odor. The VCO has a clear color, according to the results (clear). According to Anwar & Salima (2016), the color of the VCO created during the fermentation process is slightly yellowish because the brown skin of the coconut meat mixes with the coconut meat when grated, altering the ultimate result the VCO. However, the inoculum can perform well enough to produce clear coconut oil with enough fermentation time.

Because VCO is not combined with other materials or contaminants, it must be white or transparent, like crystal. There will normally be white lumps if there is still

water in it. This water will hasten the rancidity process. Furthermore, these lumps could contain a component of belondo (protein) that has not been completely filtered out. Contaminants like this will directly impact the quality of VCO (Setiaji, 2006).

The amount of tempeh yeast influences the resulting VCO. In this research, the best comparison was the addition of 8 grams of tempeh yeast to 80 mL cream. The amount of oil produced, the yield, the fragrance, and the color of the VCO were all used to determine the quality of the VCO. Although the three trials have the same scent and color, the amount of oil generated varied.

## CONCLUSION

Based on the discussion, it can be concluded that the amount of tempe yeast inoculum added to the manufacture of Virgin Coconut Oil (VCO) from *Cocos nucifera viridis* affects the amount of product, yield, color, and odor of the oil produced. The more inoculum added, the more the amount of product (pure coconut oil) and the resulting yield. Also, the Virgin Coconut Oil (VCO) produced in this experiment was clear and had a distinctive coconut oil smell.

In the manufacture of Virgin Coconut Oil (VCO), it would be better to separate Virgin Coconut Oil (VCO) from the protein, and water layers are carried out carefully so that the best quality VCO can be obtained.

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