Making Virgin Coconut Oil (Vco) With Enzymatic Method Using Pineapple Hump Extract

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Abstract.
Indonesia is one of the largest coconut producer countries providing a higher opportunity for producing various products derived from coconut fruit including virgin coconut oil (VCO). The enzymatic method can be chosen as part of VCO production as it offers higher yields. This work then utilized the bromelain enzyme which could hydrolyze protein leading to better oil-water separation in the coconut milk emulsion. Around 200 ml of coconut milk and several variables such as incubation time (24 hours, 36 hours, 48 hours, 60 hours), and the concentration of pineapple hump extract (5%, 10%, 15%, and 20%) were chosen as investigated parameters in this work. The experimental procedure for VCO production followed Indonesia national standard (SNI 7381: 2008). It was found that the incubation time of 24 hr and the concentration of pineapple hump extract 5% as the optimum condition. These parameters resulted in VCO product having specific gravity 0.9150 gr/cm^3, free fatty acids 0.133%, and the acid number 1.8 meq/kg which has met Indonesia quality standard for VCO production.

Keywords: *Coconut, Enzymatic, Pineapple Hump Extract, Virgin Coconut Oil*

I. INTRODUCTION

There are various agricultural products that can be further utilized economically or recycled properly to give benefit for human life (Martini, 2021). In accordance with the usage of agricultural products such as coconut fruit, Indonesia that has many coconut (*Cocos nucifera, L*) plantation sites (Sinaga et al., 2017) has been one of certain countries which produce coconut based-commodity like virgin coconut oil (Maradesa et al., 2014).Coconut oil can be divided into two main categories, namely Refined, Bleached, Deodorized (RBD) and Virgin Coconut Oil (VCO). While RBD is made from copra (dried or smoked coconut meat), VCO is made from fresh coconut milk (Agarwal, 2017).Coconut milk is nutritious as it contains fat by 33.80%, protein by 6.10%, and carbohydrates by 5.60%. VCO production can be considered cost-effective and energy-efficient (Hasibuan et al., 2018). Compared to copra coconut oil, VCO has better quality regarding its shelf life (Rezeki, 2018).The manufacturing process of VCO includes heating, gradual heating, acidification, salting, screening, fermentation and enzymatic processes.

In terms of the enzymatic method, it has some advantages, such as resulting higher yield and being able to use natural enzymes derived from fruit like papaya and pineapple (Fitriani & Saputri, 2017).Higher yields in VCO production could lead to lower water content and free fatty acids due to hydrolyzing protein by the enzymes. Enzyme fermentation derived from pineapple extract which contained bromelain enzyme could separate oil completely from water (Palilingan & Pungus, 2018). Other study found that around 40 gr of pineapple hump with 36 hr of fermentation time could result in the yield by 28.8% (Ishak et al., 2019). The yield of VCO production with the help of papain and bromealin enzymes was 12.02% when bromealin enzyme was added by 10.27% (Rahmawatia & Khaerunnisya, 2018). Based on the literature aforementioned, this study was conducted to determine the optimum duration of fermentation and the amount of pineapple juice for VCO production. Ultimately, the percentage of the yield and free fatty acids could be analyzed.

II. METHODS

The experimental set up was prepared using laboratory equipment such as beaker glass, erlenmeyer, measuring cup, hot plate, condenser, flask, magnetic stirer, Pipette drops, Spatula, thermometer, pycnometer, and viscometer. Chemicals used were NaOH, HCl, glacial acetic acid, aquadest, chloroform, potassium iodide, sodium thiosulfate, and starch that were purchased from PT. Farah Kamila Medika, Indonesia.

The process of cream production

At this stage, coconut milk obtained from the market was left for around 2 hr until it formed two separate layers containing the cream on the top and the mixture of water and residue at the bottom (Anggraini et al., 2019)

The Process of Making Pineapple Hump Extract

Firstly, pineapple hump was separated and washed thoroughly. It then was cut into small pieces and put into a blender to get powder or extract form (Ishak et al., 2019)

VCO Making Procedure

Around 200 ml of coconut milk prepared was then put into a beaker glass followed by the addition of specific amount of pineapple hump. It was then stirred properly for 10 min before allowed to stand for certain duration (24 hours, 36 hours , 48 hours, and 60 hours) to form three layers consisting of the top layer (blondo), the middle layer (oil) and the bottom layer (water). Eventually, VCO could be obtained by filtering the oil using filter paper for further analyzing process (Rosadi et al., 2012).

Result Analysis

Several relevant analysis have been conducted in this work including the percentage yield, free fatty acid (FFA) and peroxide number in the VCO, and the density of the VCO.

The VCO percentage yield

The VCO yield was calculated comparing the weight of VCO obtained and the grated coconut used (g).

$$\text{Yield (\%)} = \frac{weight\ of\ vco\ obtained\ (g)}{grated\ coconut\ weight} \text{ x } 100\% \qquad (1)$$

The number of FFA

Firstly, around 10 gr of obtained VCO was put into a 250 mL beaker glass, then around 50 mL of 95% ethanol was added before adding 3 - 5 drops of phenophthalein indicator to the mixture. The titration using 0.1N KOH standard solution was then conducted. Furthermore, the amount of KOH used for the titration was recorded to calculate FFA content using the following equation.

$$\text{FFA (\%)} = \frac{M\ x\ A\ x\ N}{10\ gr}\ \% \qquad (2)$$

where M is the molecular weight of fatty acids (coconut oil = 205; palm oil = 263), A is the volume of KOH, N is the normality of the KOH solution, and G is the weight of the sample (gr)

The number of peroxides

In this stage, around 5 gr of VCO sample was put into a 250 mL beaker glass before adding around 30 mL of a solvent mixture consisting of 60% glacial acetic acid and 40% chloroform. Further, one gr of KI solution was added. After shaking, it was then allowed to stand for 30 min in a dark place. After that, around 30 mL of distilled water was added. The 0.1 N $Na_2S_2O_3$ solution then was titrated until the yellow color almost disappears followed by adding 0.5 mL of 1% starch solution. The result can be expressed by the following equation.

$$\text{The number of peroxides (\%)} = \frac{A\ x\ N\ x\ 1000}{G} \qquad (3)$$

Where A is the volume of the $NA_2S_2O_3$ solution (mL), N is the normality of $NA_2S_2O_3$, and G is the weight of the sample used (gr).

The density of the VCO

Firstly, the pycnometer was cleaned and dried, filled with oil. The pycnometer was then closed. The pycnometer was immersed in a water bath at 30 ºC for 30 min. Furthermore, it was taken out of the waterbath to be cleaned and dried for weighing. The weight of the VCO is the difference between the weight of the pycnometer and its contents and the weight of the empty pycnometer as stated in the following equation.

$$\text{VCO Density (30ºC)} = \frac{a-b}{c} \qquad (4)$$

Where a is the weight of the pycnometer with the sample (gr), b is the weight of empty pycnometer (gr), and c is the volume of oil at 30ºC (mL) (Aprilasani Zeffa & Adiwarna, 2014).

III. RESULTS AND DISCUSSION

The Effect of Pineapple Hump Percentage and Incubation Time on VCO Yield

Fig. 1 illustrates the effect of pineapple hump percentage and incubation time on the VCO yield. Based on figure, it can be inferred that the higher the concentration of pineapple hump extract, the more VCO yield resulted. This phenomenon could be related to higher bromelin enzymes production due to higher pineapple hump available in the mixture. This substance could breakdown the coconut milk emulsion leading to more VCO.

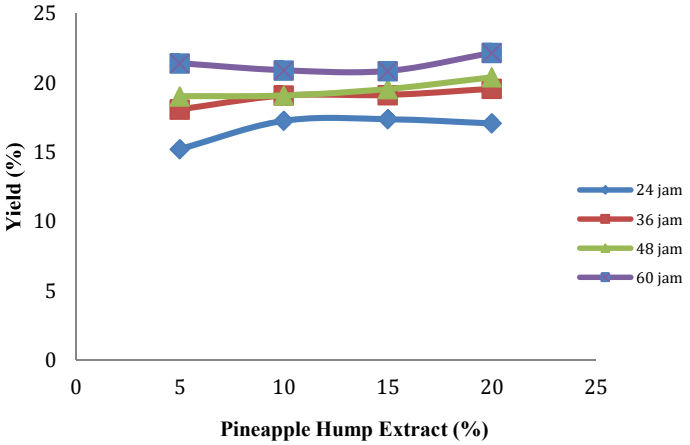

Fig 1 . The effect of adding the percentage of extract from pineapple hump and the length of incubation time on the yield

Other than that, incubation time has an important role to the VCO yield in which longer incubation time would breakdown coconut milk emulsion better resulting in an increasing protein hydrolysis reaction (Ishak et al., 2019).

The Effect of Pineapple Hump Percentage and Incubation Time on FFA

Fig. 2 shows that FFA percentage is highly influenced by the amount of pineapple hump extract added to the mixture along with incubation time parameter.

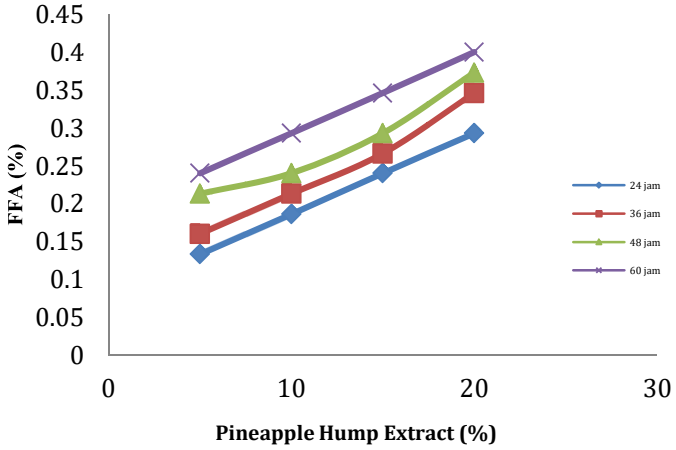

Fig 2. The Effect of Concentration of Pineapple Hump Extract and Length of Incubation Time on Free Fatty Acids in the Process of Making VCO

The figure also indicates that the lowest FFA content occurred at 24 hr of incubation time and the concentration of pineapple hump extract of 5% which resulted in FFA by 0.133%, while the highest FFA content was obtained at incubation time 60 hr and the extract was 20 % which produced FFA for up to 0.40%. It is recognized that lower FFA would result in better quality of VCO and vice versa (Rindawati et al., 2020). Longer incubation time and higher concentration of pineapple hump extract play an important role as it relates to the acceleration of the VCO hydrolysis process. (Aprilasani Zeffa & Adiwarna, 2014).

The Effect of Pineapple Hump Percentage and Incubation Time on Peroxide Numbers

The experimental data indicated that both pineapple hump percentage and incubation time have significant influence on peroxide number as seen in Fig. 3

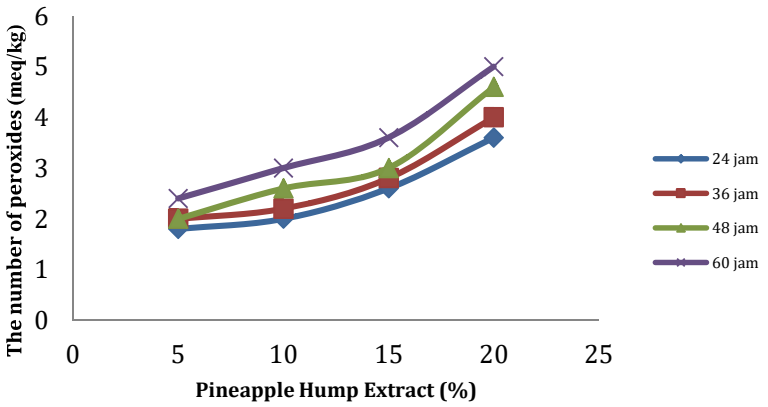

Fig 3. Effect of Concentration of Pineapple Hump Extract and Length of Incubation Time on Peroxide Numbers in VCO Production Process

It is clear that the two parameters have plausible effect of the values of peroxide number. For this reason, we understand that the lowest peroxide value happened at 24 hr incubation and 5% of pineapple extract concentration leading to 1.8 meq/kg of peroxide number. In contrast, the largest peroxide number was available at 60 hr of incubation time along with 20% of pineapple hump extract by yielding around 5 meq/kg of peroxide number.As the standard number of peroxides of the Indonesian National Standard (SNI) is 2 meq/kg, it can be seen that several samples cannot meet the standard value especially samples with larger concentration of pineapple hump extract. The peroxide number is important for determining the degree of oil damage. Unsaturated fatty acids can increase the amount of oxygen to form peroxides. In this case, higher peroxide number could lead to easier process of the oil being rancid as it is more susceptible to oxidation (Palilingan & Pungus, 2018).

The Effect of Pineapple Hump percentage and Incubation Time on VCO Density

Density is the relative ratio between the density of an object and the density of a pure liquid, and this work proved that its value could be leveraged by the concentration of fruit extract and incubation time to some extent as shown in Fig. 4.

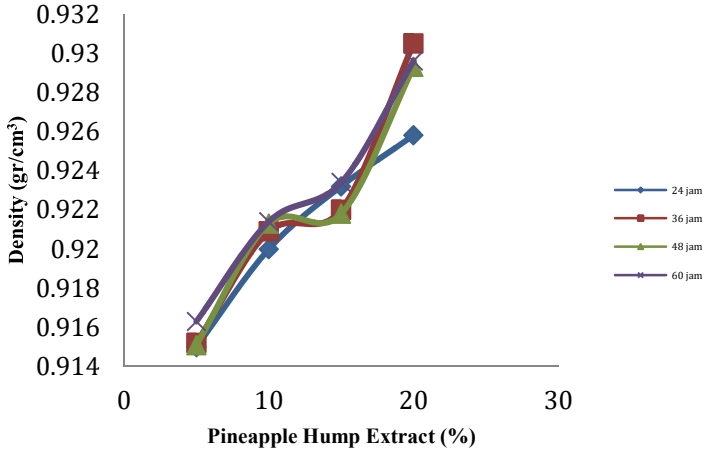

Fig 4. The Effect of Time and Concentration of Pineapple Hump Extraction Density

Fig. 4 informs that density values of VCO in this work are within 0.9150 gr/ cm^3 - 0.9244 gr/cm^3. It then confirms that the incubation time has less effect on the density than the extract percentage. This could be caused by molecular weight and unsaturation of the fatty acids. Other than that, it can also be triggered by

the presence of impurities affecting the specific gravity or density of VCO (Rahmawatia & Khaerunnisya, 2018). In contrast, the concentration of pineapple hump extract affected density more due to higher susceptibility that influence VCO density regarding more bromelain enzymes available producing more glycerol.

IV. CONCLUSION

This research found that the optimum operating condition of VCO production utilizing pineapple hump extract using standardized SNI method (SNI 7381: 2008) were at incubation time 24 hr and an extract concentration 5% which resulted in the values of density, FFA percentage, acid number, and peroxide number by 0.9150 gr/cm^3, 0.133%, 0.1870, 1.8 meq/kg, respectively. Ultimately, VCO produced in this work has met the Indonesian national standard for VCO.

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