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A Characterization of Virgin Coconut Oil Obtained via Extraction Utilizing Tamarind Seed Skin Waste

M. Ali Ilyas[1]*, Ahmad Multazam[1], Alpiana Hidayatulloh[2], & Nefi Andriana Fajri[3]

[1] Diploma Mining Engineering Study Program, Faculty of Science, Engineering and Applied, Mandalika Mataram University of Education, Jl. Pemuda No. 59A, Mataram, Indonesia 83125.

[2] Bachelor of Civil Engineering Study Program, Faculty of Science, Engineering and Applied, Mandalika Mataram University of Education, Jl. Pemuda No. 59A, Mataram, Indonesia 83125.

[3] Bachelor of Animal Husbandry Study Program, Faculty of Animal Husbandry, Nahdlatul Wathan University, Mataram, Jl. Kaktus no 1-3 Mataram, Indonesia 83125

[*] Corresponding Author e-mail: ilyasmyung@gmail.com

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Abstract
This study aims to provide a characterization of virgin coconut oil obtained through the acidification method, using tamarind seed skin as an oil extractor. The utilization of tamarind seeds is motivated by the fact that they are considered a waste product and are not commonly used by the community. Additionally, tamarind seeds contain organic acids, such as citric acid, tartaric acid, and malic acid, which can effectively hydrolyze the bond between oil and other substances in coconut flesh, such as proteins and carbohydrates. The characterization of virgin coconut oil includes a range of tests, such as organoleptic evaluation, density measurement, moisture content determination, free fatty acid analysis, and peroxide number determination, which are compared to coconut oil produced through heating. The virgin coconut oil is extracted from grated coconut flesh by mixing tamarind seed skin, which has been mashed, with grated coconut flesh in a 1:4 ratio. This mixture is then homogenized and incubated for approximately 10 minutes to extract the oil. The organoleptic evaluation results of the virgin coconut oil produced through acidification demonstrate a light yellow color with no detectable taste or odor, while the coconut oil produced through heating has a dark yellow color, a slightly rancid smell, and a distinct coconut oil taste. The density of the virgin coconut oil produced through acidification and heating is 0.870 g/mL and 0.868 g/mL, respectively. The moisture content of the virgin coconut oil produced through acidification and heating methods is 0.1713% and 0.1700%, respectively. The free fatty acid content for the acidification and heating methods is 0.14% and 3.252%, respectively. The peroxide number test shows that the acidification method yields a higher value of 27.41 meq O_2 / kg compared to 5.694 meq O_2 / kg for heating.

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INTRODUCTION

In some regions in Indonesia, coconut oil is used as cooking oil by the locals. For example, in the Lombok area, in addition to using palm oil, local people also use coconut oil as a substitute for palm oil. The use of coconut oil is caused by the abundance of coconut trees (*Cocos nucifera*) that grow from coastal areas to areas with an altitude of 450 meters above sea level. With the abundance of coconut trees, the people of Lombok use coconuts to produce coconut oil as cooking oil (Nurhayati et al, 2022).

There are several methods in making virgin *coconut oil* (VCO), including conventional methods or often referred to as heating methods, enzyming methods and acidification methods (Huda, 2009). In this study, the method used in making VCO is an acidification method by utilizing tamarind seed shells as an oil exractor. The choice of tamarind seed skin is due to its existence which is quite abundant in the Lombok area and is not used further by the community so that it has the potential to be waste.

Coconut fruit used in making coconut fruit is coconut fruit aged 12 to 13 months. Because at this age the coconut is certainly old enough and does not yet have a *haustorium*. In addition, at the age of 12 to 13 months, the oil content is high and the water content is quite low. Coconut with an age of more than 13 months (has *haustorium*) will cause off-flavor and oily taste in the oil produced (Bawalan, 2011).

Coconut oil contains 64% medium chain fatty acids, with most of them being lauric fatty acids around 45-56% depending on the coconut variety (Bawalan, 2011). VCO contains medium chain fatty acids around 64% with the highest lauric fatty acid content around 53% (Bawalan &Champan, 2006). *Medium Chain Triglyceride* (MCT) fatty acids have high solubility so they are more easily absorbed by the body and converted into energy instantly. Therefore, MCT consumption does not cause fat accumulation in the body (Bach and Babayan, 1982).

According to Suaniti (2014) there are several characteristics of *Virgin Coconut Oil* made by enzymatic means (papain), including testing the physicochemical properties of the resulting VCO has a density value of 909.3 kg / m3, viscosity of 26.2094 mm2 / s (40 °C), and physical appearance in the form of oil with a slightly greenish yellow color, distinctive aroma of oil, and does not smell rancid, while the chemical properties in the form of iodine number are 5.1601 g Iod / 100 g oil, % FFA is 0.1725 %, and the hoarding number is 271.0596 mg - KOH / g oil. The purity level of the resulting VCO is tested with KLT using eluents 1 and 2; gives Rf of 0.67 and 0.71 respectively versus the methyl laurate standard giving Rf = 0.74.

The profile of fatty acids in an oil plays an important role as an indicator of product quality. Therefore, component analysis needs to be done using Gas Chromatography. Coconut oil is hydrolyzed into FAME (*Fatty Acid Methyl Ester*) using methanol and BF_3. After obtaining FAME, it is ready to be injected into Gas Chromatography (Nielsen, S.S., 2010).

Making VCO by acidification method has been carried out by other researchers and the extractor used is lime (Salsabila, 2016). In this study, VCO was made by acidification method by utilizing tamarind seed skin as an oil extractor. The choice of tamarind seed skin by researchers is because tamarind seeds are not further used by the community and have the potential to be waste. Tamarind seeds used in making VCO are obtained from the village of Rumbuk in East Lombok. The seeds obtained are taken from the seed coat to be used as an oil extractor. The choice of tamarind seed skin is because tamarind contains organic acids such as citric acid, tartric acid and malic acid. These acids are mostly bound by potassium including potassium bitartrate; sterols/terpenes, saponins, pectins, cellulose; sugars; vitamins A, B and C (Anonymous, 1995b). These organic acids play a role in hydrolyzing lipoprotein bonds that bind oil with proteins in coconut flesh so that coconut oil will be easily separated (Susanto, 2012).

METHODS

In this study, the sample tested was virgin coconut oil (VCO) made from the extraction method from grated coconut flesh taken from Gelogor Hamlet, Lendang Nangka Village, East Lombok.

The tools used in this study are a set of titration tools and their supporters consisting of Erlenmeyer 300 ml, magnetic stirrer, statip and clamps, condenser tools, ordinary funnels, measuring flasks, volume pipettes, statif ovens and analytical balances

Making VCO

Referring to Salsabila (2016) Virgin coconut oil (VCO) in this study was made by acidifying method where tamarind seed skin as the extractor. The grated coconut flesh is mixed with tamarind seed skin that has been mashed in a ratio of 1: 4, then let stand for ± 10 minutes and squeezed with a filter cloth.

Moisture Content Determination (Oven Method)

Determination of moisture content is carried out by weighing 100 g of VCO samples and then ovened at a temperature of 105 ^{o}C until the weight is constant. Oil weight reduction is expressed by the weight of evaporated water (Sudarmaji, et al: 1984). The calculation is done withthe equation:

$$\%\ water\ weight\ and\ volatile\ compounds = \frac{starting\ weight - final\ weight}{starting\ weight} x\ 100\%$$ ……Equation (1)

Density Test

Density measurement is carried out by weighing 100 g of VCO with an analytical balance and measuring the volume. Density is calculated by equation (Sudarmaji, et al; 1984):

$$\rho = \frac{m}{V}$$ ……Equation (2)

ρ = density or density

m = mass of VCO

V = volume VCO

Organoleptic Test

Organoleptic testing is testing that is based on the sensing process. Sensible stimuli can be mechanical (pressure, puncture), physical (cold, heat, ray, color), chemical properties (smell, smell, taste). When the sensory apparatus receives stimuli, before awareness occurs the process is physiological, that is, it begins at the receptor and is passed on to the sensory nerve system or the receiving nerve (anonymous, 2013). Organoleptic tests were carried out in the laboratory of the POM Agency in Mataram City.

Free Fatty Acids (Ketaren, 1986)

The acid number states the number of milligrams of NaOH used to neutralize free fatty acids contained in 1 gram of oil or fat (Ketaren, 1986). The acid number is a number that indicates the amount of free fatty acids contained in the oil, which is usually associated with the process of oil hydrolysis. Hydrolysis of oil by water with an enzyme catalyst / heat on triglyceride ester bonds will produce free fatty acids. The *Free Fatty Acid* (FFA) test was carried out by titrimetric method in the laboratory of the Food and Drug Administration of Mataram City and calculated with the equation:

$$FFA\ (\%) = \frac{AxNxM}{g} x100\%$$ ......Equation 3

FFA = Free Fatty Acid

A = Amount of NaOH used for titration (mL)

N = Normality NaOH

M = Molecular weight of lauric acid

g = weight of oil sample (grams)

Peroxide Number

The peroxide number is a value for determining the degree of damage to oil or fat based on the reaction between alkaline iodide in an acid solution and a peroxide bond. The iodine released in this reaction is then titrated with a solution of $Na_2S_2O_3$. The peroxide number is expressed in moles equivalent to peroxide in 1000 grams of sample (Ketaren, 1986).

A high peroxide number indicates that the fat or oil has oxidized, but a lower number does not necessarily indicate an early oxidation condition. The determination of peroxide number is carried out by titrimetric method in the laboratory of the Mataram Food and Drug Supervisory Agency using the equation:

$$Peroxide\ Number = \frac{(mL\ Tio)xN\ Tiox0.008x100}{g} \text{……Equation 4}$$

Peroxide number = levels in ppm
mL Tio = titran Tio (mL example – mL blank)
N = normality of thiosulfate
0.008 = mg O_2 equivalent
g = sample weight (grams)

RESULTS AND DISCUSSION

The characterization of virgin coconut oil (VCO) in this study includes density, moisture content, organoleptic test, acidification number test (*Free Fatty Acid* / FFA) and peroxyada number test. The following is a table of VCO characterization results made by extraction using tamarind seed shells (*Tamarindus indica L*)

Table 1. Characterization Results of Virgin Coconut Oil (VCO)

Number	**Test Type**		**Test Results (acidification)**	**Test Results (heating)**	**SNI Terms***
1.	Organoleptic (oil state):				
	a. Smell	-	a. -	a. A little rancid	a. –
	b. Taste	- -	b. –	b. Normal, typical coconut oil	b. –
	c. Color		c. Light yellow	c. Dark yellow	c. Colorless to pale yellow
2.	Density	g/mL	0,870	0,868	0,869-0,874
3.	Water content and evaporating	%	0,1713	0,170	Max 0,2
4.	compounds	%	0,14	3,2540	Max 0,2
5.	Free fatty acids	meq	27,41	5,694	Max 2
	Peroxide Number	O_2/kg			

*SNI 7381 2008 dan SNI 7709 2019

Organoleptic Test

Organoleptic test is a test that involves the five senses. Sensing is defined as a physio-psychological process, *namely awareness or recognition of the sensory apparatus of the properties of objects due to the stimuli received by the sensory apparatus derived from the object* (Anonymous 2013). The organoleptic test was carried out in the laboratory of the Food and Drug Administration of Mataram City and the test results can be seen in Table 3.

VCO made by acidification method has a light yellow physical appearance, while odor and taste are absent. This is in accordance with the requirements set by SNI where VCO must have no odor and taste requirements, while for color requirements with a range from colorless to pale yellow.

Virgin coconut oil (VCO) made by heating has a slightly rancid odor, the taste is normal typical of coconut oil while the color is dark yellow. For smell and taste, it does not meet SNI standards, while for color it is still in the category of meeting the standards that have been required by SNI.

The cause of rancidity is caused by oil damage because it is processed with a fairly high temperature. High enough temperatures cause the double bond in oil to be broken so that the level of oil saturation will be higher. Vegetable oils with high levels of saturated fatty acids are certainly harmful to health (Ratnawati and Sungkawa, 2018). Stabilizers with high enough temperatures will also accelerate the oxidation process of double bonds in oil to form peroxide groups (Pramitha and Juliadi, 2019).

Density and Moisture Test

The determination of the specific gravity of extracted coconut oil is carried out using **equation 2.** Based on the calculation results, the density is 0.870 g / mL for virgin coconut oil (VCO) made by acidification method and 0.868 g / mL for coconut oil made by heating. Both of these results are still in the category required by SNI, which is around 0.869-0.874 g / mL. For more details, the difference between the density between VCO made by acidification method and heating method can be seen in the graph below.

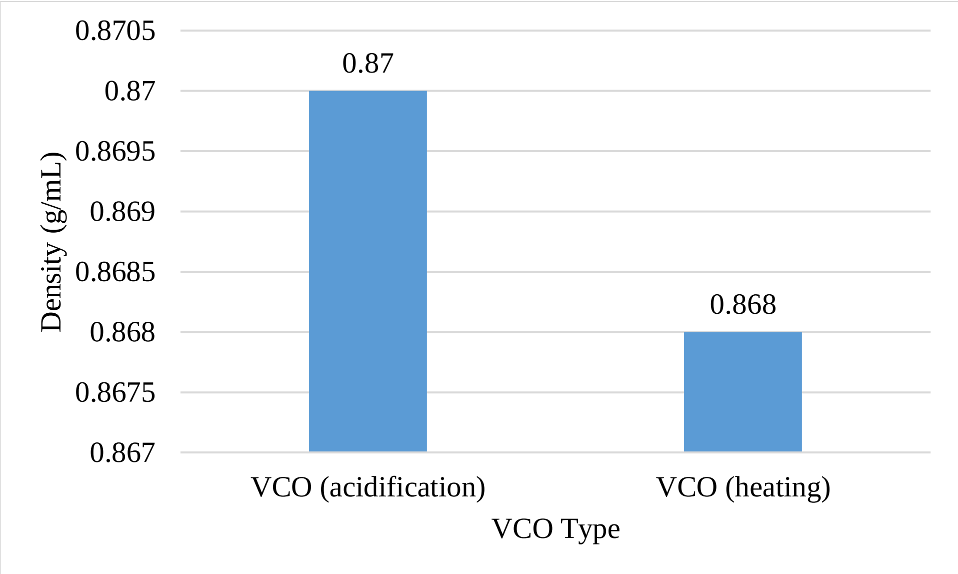

Figure 1. Density Graph

The determination of moisture content and other volatile compounds is carried out by **equation 1**. Based on the experimental results, the difference in water content and other volatile compounds between VCO made by acidification and heating was 0.1713% for VCO made by acidification and 0.1700% for VCO made by heating. The value or data obtained from the calculation results above is still in the good category in accordance with SNI requirements. The high water content will cause oil to quickly run rancid or to be damaged because water causes a hydrolysis reaction that can increase free fatty acids in oil (Noerhadi, in Nurfiqih, 2021).

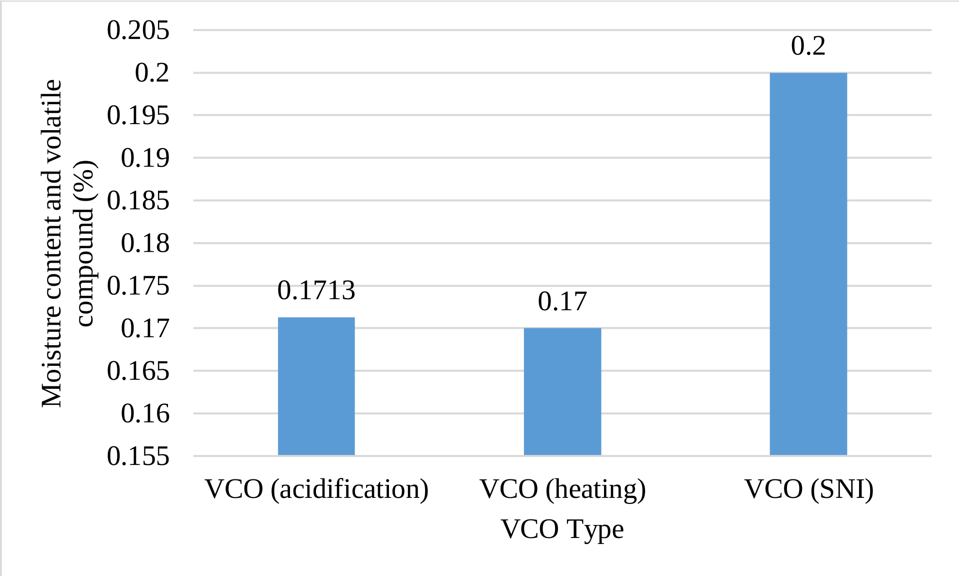

Figure 2. Graph of Moisture Content and Other Volatile Compounds.

Free Fatty Acid Test (FFA)

The amount of free fatty acids is indicated by the fatty acid value or acidification number obtained by the titrimetric method. Free fatty acids are the result of degradation of triglycerides as a result of oil damage (Bouta &; Abdul, 2020).

The value of free fatty acids obtained in this study was 0.14% for virgin coconut oil (VCO) made by acidification method, and 3.2540% for coconut oil made by heating. The value of acidification number or free fatty acids for VCO made by acidification that utilizes tamarind seed skin as an extractor is still in accordance with SNI standard standards (max 0.2%) for virgin coconut oil or VCO. Another case with coconut oil made by heating has a free fatty acid value that is not in accordance with SNI standard standards. According to meilina, (in bouta and Abdul, 2020) free fatty acids are produced through hydrolysis reactions that can be caused by a number of water, enzymes or microorganism activity. In addition, the heating process also contributes to the degradation of triglycerides in coconut oil made by heating so that the value of free fatty acids becomes high (3.2540%). Reactions that occur during the heating process are thermolytic, oxidation, and hydrolysis reactions (Mittelbach and Enzelsberger 1999).

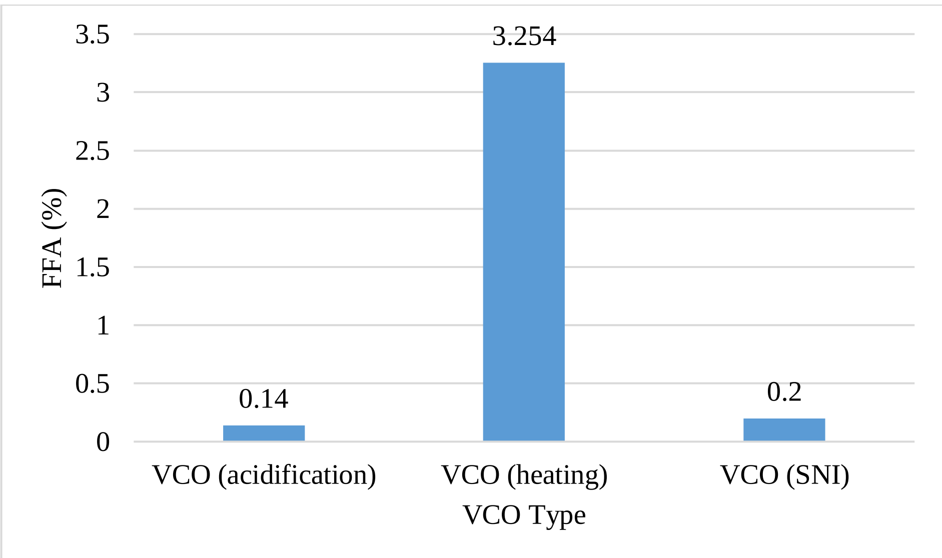

Figure 3. Free Fatty Acid (FFA) Value Graph

Peroxide Number Test

The peroxide number is an index of the amount of fat or oil that has been oxidized. The peroxide number or value is very important because it is used to identify the degree of oxidation of the oil. The peroxide number value of VCO made by acidification and heating methods is 27.41 meq O_2 / kg and 5.694 meq O_2 / kg, respectively, while the SNI standard is a maximum of 2.0 meq O_2 / kg.

The experimental results in this study show that the quality of VCO made by acidification method with tamarind seed shells as an extractor is still below SNI standards. Even the value of this peroxide number is far above coconut oil made by heating method. The higher the peroxide number value, the worse the oil quality will be, because it shows the number of unsaturated bonds oxidized into peroxide groups (Pramitha and Juliadi, 2019).

Consuming oil with a high peroxide number continuously is certainly harmful to health. The joining of peroxide in the circulatory system, resulting in a greater need for vitamin E. Based on experiments on chickens, lack of vitamin E in fat results in symptoms of encephalomalacia and if hydroperoxide is injected into the bloodstream causes cerebellar symptoms. Peroxide will form lipoperoxide compounds nonenzymatically in intestinal muscles and mitochondria, lipoperoxide in the bloodstream resulting in denaturation of lipoproteins that have low density. Lipoproteins under normal circumstances have an active function as a means of transporting triglycerides; and if lipoproteins undergo denaturation, it will result in fatty deposition in blood vessels (aorta) causing symptoms of atherosclerosis (Ketaren, 1986).

The cause of high number of peroxides in VCO in this study could be caused by the remaining organic acids in the oil constantly oxidizing (autooxidizing) so that the unsaturated bonds in the oil will turn into peroxide groups. In addition to the remnants of organic acids from the extractor (tamarind seed shell), the cause of the high number of peroxides is due to contact with open air during extraction and storage (Aprilasani and Adiwarna, 2014).

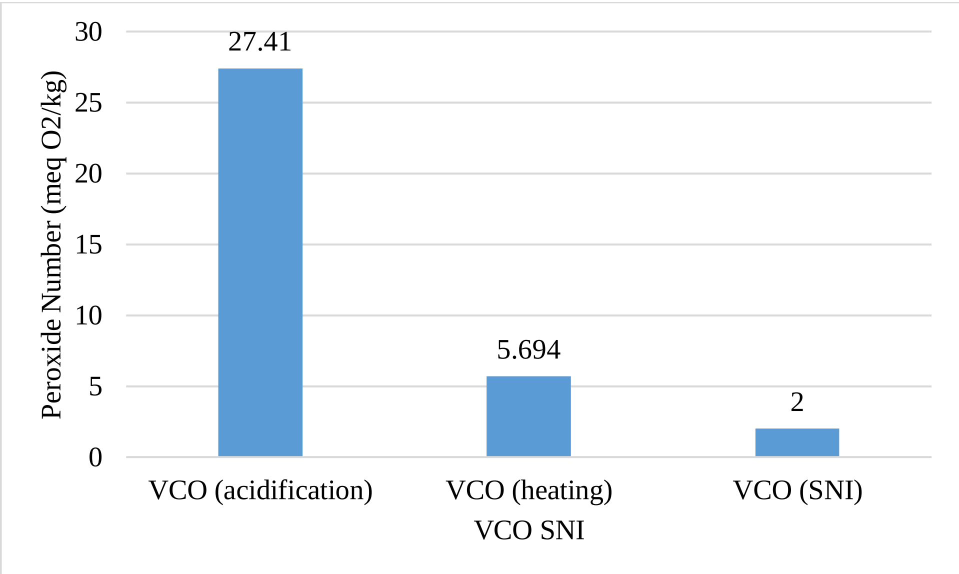

Figure 4. Peroxide Number Value Graph

CONCLUSION

In conclusion, this research demonstrates that tamarind seed skin, which is typically regarded as a waste product, can be effectively utilized as an oil extractor in the production of VCO. The peroxide number test revealed a relatively high result of 27.41 meq O2 / kg, which is still below the SNI standard of 2 meq O2 / kg, indicating that the VCO quality is somewhat low due to exposure to open air during extraction and storage. However, the acid number (FFA), organoleptic evaluation, density, and moisture content of the VCO produced by this method meet SNI requirements. These findings indicate that this method can serve as a viable alternative for efficient VCO production, with a mere incubation time of approximately 10 minutes required to extract the oil.

RECOMMENDATIONS

Based on the study results, the following recommendations are suggested for future research. Further investigations can be conducted to explore alternative coconut oil extractors in lieu of tamarind seed skin. The ratio between grated coconut flesh and seed skin should be varied and the incubation time should be optimized to enhance extraction efficiency. The residual organic acids originating from the tamarind seed skin extractor ought to be neutralized to prevent additional oxidation, thus reducing the peroxide number. It is recommended to conduct testing on the iodine number and storage stability (hoarding number) of the extracted VCO.

BIBLIOGRAPHY

Anonim. (2013). *Pengujian Organolepik*. Program Studi Teknologi Pangan Universitas Muhammadiyah Semarang: Semarang

Aprilasani, Zeffa., Adiwarna. (2014). *Pengaruh Lama Waktu Pengadukan dengan Variasi Penambahan Asam Asetat dalam Pembuatan Virgin Coconut Oil (VCO) dari Buah Kelapa*. Jurnal KONVERSI Volume 3 No1 April 2014.

Bach, A. C and Babayan, V. K. (1982). *Medium Chain Trigliseride an Update Am*. J. Clinnutr 36: 950-962.

Bawalan, D.D. and Chapman, K.R. (2006). *Virgin coconut oil production manual for micro- and village-scale processing. In FAO Regional Office for Asia and the Pacific*. Thammada Press Co. Ltd., Bangkok, Thailand.

Bouta, IM dan Abdul, A. (2020). *Nilai Bilangan Peroksida dan Asam Lemakbebas pada Virgin Coconut Oil Hasil Fermentasi yang Disuplementasi dengan Kunyit (Curcuma longa L.)*. Jambura Edu Biosfer journal (2020) 2 (2) : 51 - 56

Huda, Thorikul. (2009). *Teknik-Teknik Pembuatan Minyak Kelapa*. http://diploma.chemistry.uii.ac.id/index.php?option=com_content&task=view&id=48&Itemid=119. [10 Agustus 2022]

Ketaren S. (1986). *Pengantar Teknologi Minyak dan Lemak Pangan*. Jakarta: UI Press.

Mittelbach, M., and H. Enzelsberger. (1999). *Transesterification of Heated Rapeseed Oil for Extending Diesel Fuel*. Journal of the American Oil Chemists' Society 76 (5):545-551.

Mun'im, Abdul., Hanani, Endang., Rahmadiah. (2010). *Karakterisasi Ekstrak Etanolik Daun Asam Jawa (Tamarindus indica L.).* Nielsen S. S., *Food Anaylisis*. Departmen of Food Science. Purdue University. West Lafayette. IN 47907-2009. USA.

Nurfiqih, Delfa., Hakim, Lukman., Muhammad. (2021). *Pengaruh Suhu, Persentase Air, dan Lama Penyimpanan Terhadap Persentase Kenaikan Asam Lemak Bebas (ALB) pada Crude Palm Oil (CPO)*. Jurnal Teknologi Kimia Unimal 10:2 (November 2021) 01-14.

Nurhayati. (2022). *Penerapan Teknologi Proses untuk Keberlangsungan Produksi Minyak Goreng Kelapa di Dusun Bilatepung*. SELAPARANG, Jurnal Pengabdian Masyarakat Berkemajuan Volume 6, Nomor 2, Juni 2022.

Pramitha, Dewa Ayu., Juliadi, Debby. (2019). *Pengaruh Suhu Terhadap Bilangan Peroksida dan Asam Lemak Bebas pada VCO (Virgin Coconut Oil) Hasil Fermentasi Alami*. Cakra Kimia (Indonesian E-Journal of Applied Chemistry) Volume Nomor 2 Oktober 2019.

Salsabila, Mafaza. (2016). *Pembuatan Minyak Kelapa dengan Pengasaman (Jeruk Nipis) dan Penetralan Dengan* $NaHCO_3$ *Beserta Uji Kualitasnya*. Skripsi. Jurusan Kimia Fakultas Matematika dan Ilmu Pengetahuan Alam Universitas Negeri Semarang.

Sudarmadji, S.(1984). *Prosedur Analisa untuk Bahan Makanan dan Pertanian*. 63-64, Liberty. Yogyakarta.

Suaniti, Ni M., Manurung, Manuntun., Harta, Nadya. (2014). *Uji Sifat Virgin Coconut Oil (VCO) Hasil Ekstraksi Enzimatis Terhadap Berbagai Produk Minyak Kelapa Hasil Publikasi*. JURNAL KIMIA 8 (2) Juli 2014: 171-177.

Susanto, Tri. (2012). *Kajian Metode Pengasaman dalam Proses Produksi Minyak Kelapa Ditinjau dari Mutu Produk dan Komposisi Asam Amino Blondo*. Jurnal dinamika penelitian industri Vol.23 No. 2 Tahun 2012 Hal. 124-130