The Comparison of making coconut oil with the addition of Crustachea substrate

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ABSTRACT

The abundance of coconut plants in Indonesia which is in contrast with the price of oil, demands research that can bridge the problem, namely the process of making coconut oil which implements procedures that are easy, inexpensive and with low energy. This study aims to determine the comparison of the results of coconut oil obtained with the help of Crustachea animal substrate. The research method was carried out experimentally, each sample had three replications. Ingredients in the form of coconut each 300g plus substrate from animals Crustachea (100gr, 75gr, 50 gr, 25gr, and control 0 gr). The volume of oil formed between 100-150 ml. The coconut oil formed was each tested, first organoleptically, obtained by a fragrant and slightly fishy aroma. Furthermore testing with various measuring instruments; 1) freezing point test was carried out at 5^{o}C, a significant result was obtained on the crab substrate. Crab freezes longer than crab, which is 45 minutes and crab 30 minutes;; 2) free fatty acid (FFA) levels were tested using the titration method and the results obtained, crab (Scylla serrata) 6.232 ml / L and crab (Portunus pelagicu) 24,598 ml / L. Based on data from FFA (Free Fatty Acid) content, oil with crab substrate has good potential for health due to low FFA levels, compared to oil from small crab substrate.

Keywords: Coconut oil, Crustachea, FFA

BACKGROUND

The main product processing coconut meat (Cocos nucifera L.) in the form of coconut oil or cooking oil. Coconut oil is processed from coconut flesh. The process of making coconut oil starts from drying and squeezing the coconut milk. The chemical composition of coconut flesh as a basis for making oil consists of 46% water, 34.7% fat, 3.4% protein and 14.0% carbohydrates (23). Coconut oil has a total of 91% saturated fatty acids consisting of caproic acid, caprylic acid, capric acid, lauric acid, myristic acid, palmitic acid, stearic acid and arachidic acid (11). The content of lauric acid is dominant with 45%. Lauric acid consists of 12 carbon atoms and these fatty acids are classified as medium-chain fatty acids. High amounts of saturated fatty acids cause an increase in melting and freezing and increase conductivity. But coconut oil is more stable when dealing with air. Therefore oxidative rancidity is less significant in coconut oil, the composition of medium-chain fat is high and the molecular weight is low. From its physical properties, coconut oil has important physical properties such as viscosity 29 CST, pour point 23 ° C, flash point 170 ° C-225 ° C, the density of 0.917 kg / dm3 and moisture content of 1 mg/kg.

At present, many views are stating that coconut oil is harmful to health due to negative issues spread by the American Soybean Association (ASA) (18). ASA states that coconut oil contains saturated fatty acids which can form plaque on the walls of blood vessels causing coronary heart disease, hypercholesterolemia, and hypertension. Various scientific studies in recent years have proven that virgin coconut oil contains saturated fatty acids that are unique and different from saturated fatty acids in general. Saturated fatty acids in coconut oil are medium and short-chain saturated fatty acids (22). Today the role of coconut oil as a component of medicine has increased compared to other vegetable oils. Other vegetable oils or vegetable oils contain high enough

unsaturated fatty acids that are easily oxidized when in contact with air at high temperatures and can turn into trans fatty acids when heated.

Making coconut oil in a wet way begins with making coconut milk which is an oil emulsion from coconut flesh in water, then the emulsion is broken down so that the oil can be taken (9). Wet oil production includes traditional methods/heating/evaporation, multilevel heating, centrifugation, lava, inducement, and enzymatic (1). Making coconut oil by traditional heating is relatively easy and the equipment used is also relatively simple, but the quality of coconut oil produced is not good because during heating at high temperatures (100-110^{o}C) the protein, fat, and antioxidants contained will be damaged. Also, the oil produced is not clear and does not last long, only lasts around 2-3 weeks (1). The wet method with multilevel heating aims to perfect the process traditionally. In this way, the temperature used is lower, which is 60 -75oC so that important substances in oil are not damaged. But in this way, it is difficult to control the temperature so it stays below 80oC because it still uses a stove fire that must be turned off and turned on repeatedly to maintain the temperature. The wet method of acidification begins with making the coconut milk emulsion in an acidic state. The acid will break the bond of fat-protein in coconut milk so that the oil can be separated. The acid that is mixed in coconut milk can only work optimally under suitable pH conditions. In making VCO, the optimum pH is 4.3 (1). In the context of improving the quality of virgin coconut oil which can be used as pharmaceutical raw materials, the production of virgin coconut oil is carried out in a wet manner using a variety of chemical (acidification) and physical techniques (with low-temperature heating and evaporation).

The acidification technique used acetic acid in several pH conditions to determine the optimum pH in the manufacture of coconut oil. Acetic acid is used because this ingredient is easily obtained and physiologically acceptable because it is an additive in food known as vinegar acid. In the heating technique, the temperature is set using an oven and the evaporation technique is tried using microwave technology as an effort to control the temperature and speed up the process.

VCO has the potential to be developed as a medicinal preparation because it contains lauric and oleic acids which can play a role in softening the skin. Also, effective and safe VCO is used as a moisturizer on the skin so that it can improve skin hydration, and accelerate healing of the skin (19). Lauric acid contained in VCO is useful as an antibiotic and can increase the body's metabolism (16). Nevin & Rajamohan (14) reported the results of their study of rat samples that were given VCO injections in their blood serum, VCO was beneficial in reducing levels of lipid components compared to ordinary coconut oil. VCO reduces total cholesterol, triglycerides, phospholipids, low-density lipoprotein (LDL) and very-low-density lipoprotein (VLDL) cholesterol levels and can increase high-density lipoprotein (HDL) cholesterol in serum and tissues. This is thought to be caused by the content of polyphenol compounds present in the oil which play a role in biological activity.

The results of Momuat's research, (12) explained that groups of animals that were given VCO feed had greater plasma malondialdehyde (MDA) than animals that were not fed VCO. Rats are tested as experimental animals because their metabolic systems are the same as humans. This shows that consuming VCO can reduce the level of oxidation in plasma. There are several ways to make VCO, namely through the process of fresh-dry, cooling and thawing, enzymatic, and fermentation (15). The making of VCO by enzymatic means the making of VCO from coconut milk with the help of enzymes. Oil protein bonds in the coconut milk emulsion can be broken down with the help of an enzyme, the protease enzyme. VCO produced from the enzymatic process has advantages including clear colored VCO, the content of fatty acids in the VCO does not change much so that its properties remain high, it is not easy to rancid because the composition of the fatty acids does not change much. The yield produced is high.

The Senphan & Benjakul (17) research suspects that the protease enzyme in crustaceans is used to degrade lipoprotein bonds in coconut milk. However, this cannot be ascertained because there has been no in-depth study of the protease enzyme contained in crustaceans that function to break lipoprotein bonds. the. Based on this explanation, further research is needed to extract enzymes from crustaceans and to test the enzyme extracts obtained in the VCO manufacturing process and determine the yield and quality of the VCO produced.
Thus, based on this background, the problem can be formulated as follows: how does the comparison of the quality of VCO with the addition of crustacean extracts, Are there differences in physical-chemical characteristics between coconut oil produced from enzymatic reactions of crustaceans through physical methods?

MATERIALS AND METHODS

The tools and materials in this study are 1. Plastic Tools Size 1 kg, basin, filter, measuring cup, glass beaker, scales, thermometer, pounder/blender Ingredients: 1 kg of shredded coconut for each crustacea Crustachea (Crab, Shrimp, and Yuyu) that has been pulverized Method experimental research. The experimental design used was a completely randomized block design. Each sample was in the form of 1200gr grated coconut divided by 4x replications. Each 300 g was added with the substrate of each crushed crustacea (100gr, 75gr, 50gr, 25gr, 10gr and 0gr). The comparison of grated coconut and crustaceans is as follows: 1: 0.50, 1: 0.25, 1: 0.10, and 1: 0. The substrate of each crustacean was mixed evenly with a coconut solution and then left for 24 hours in a tightly closed plastic. After that, the grated coconut turns brown like Srondeng. Then dried in the sun from 7-3 pm. then squeezed with an online cloth. After the oil is measured, the volume is measured and then put in the freezer to find out the freezing time. Freezing resistance. Then the FFA test is done using a titration and tested in the integrated laboratory of UNDIP.

RESULTS AND DISCUSSION

Table 1. Physical tests of Coconut Oil formed with Crustachea extract

Types of extracts	Oil color	Smells	Room temperature	Temperature <5º (freezing time)
Mangrove crabs	Red orange	Tasty slightly fishy	Liquid	45
freshwater crab	Light Yellow	Tasty slightly fishy	Liquid	15
Sea Crab	Light orange	Tasty slightly fishy	Liquid	35
Control	Clear Yellow	Tasty/smells good	Liquid	10

From the table above, it can be seen that crabs freeze for longer 45 minutes compared to crab 35 minutes, and longer than yuyu. Based on table 1, the observation above that crustachea can be used to make coconut oil easily and save energy by utilizing the protease enzyme contained in the crustachea animal substrate. The physical properties of oils and fats are largely determined by the temperature they experience. In general, the physical properties of oils and fats are determined by the composition of these fatty acids in triaciglycerol. In this experiment several oil samples were used, namely oil with protease enzymes from kepitng, shrimp, crab and yuyu, and the control, VCO. The characteristics of each oil are different. So that even when given heat treatment the changes vary in terms of color, odor and condition or state of solid or liquid

Figure 1 changes color before and after freezing

Only low temperature crabs are still liquid, which means that crabs have an advantage over the others and the color is very sharp, red orange. Color in oil can be caused by the presence of pigments in oil (carotene, xanthofil, chlorophyll, and anthosianin). It is also caused by enzymatic reactions and oxidation of oils and pigments. At room temperature and cold temperature, klentik oil and VCO oil have differences with other oils, which are clear at room temperature and white at low temperatures.

Other results show that mangrove crab extracts provide the most amount of oil in the ratio of starter and coconut milk cream 0.7 5 l, this shows that mangrove crab extract is the best biological catalyst to break lipid and protein bonds. In addition, the ratio of inoculum and extract determines the amount of oil produced, this is in accordance with the concept that the amount of substrate will occupy the exact number of active enzymes, so that the addition of excess extract will not affect the amount of oil produced (6).

It is also suspected that in the digestive tract of mangrove crabs there is Lactobacillus sp. Which has been identified as having the ability to hydrolyze proteins and fats (3). The ability of lactobacillus probiotic bacteria in the digestive tract of mangrove crabs has amylolytic, cellulolytic, lipolytic and proteolytic activity, thereby increasing the amount of oil produced. One of the enzymes that can be used to break lipoprotein bonds in fat emulsions is the protease enzyme from white shrimp by Senphan & Benjakul (17) The results of his research show that protease enzymes can be used to make VCO enzymatically with an average yield of 17.5% with acid numbers 0.56 (head) and 0.44 (body).

These results provide the most optimum results, this shows the extract contact and the biocatalyst must be perfect, besides stirring will encourage the breakdown of oil from the water-oil emulsion can be solved, besides stirring encourages the entry of oxygen into the extract, this will also help the water-emulsion bond oil. In quality testing, oil with a shelf life of up to 5 weeks gives the highest peroxide rate of 4.4, according to SII, the maximum peroxide number for coconut oil is 5.0 mg oxygen / 100 grams of oil. The average iodine number produced in this study is 8.1, this is in accordance with those set by the Indonesian Industrial Standards (SII), which is 7.5-10.5. (10). The characteristics of coconut oil according to Pharmacopoeia Indonesia IV (FI, 1995) are: melting temperature 23-26oC, refractive index 1.448-1.450 (40^{o}C), maximum acid number 0.2 / 20g, Iodum number 7.0-11.0, saponification number 250-2264, non-soapy substances maximum of 0.8% (19. According to the Indonesian National Standard (SNI, 2008) quality coconut oil must meet the requirements including: a maximum water content of 0.5%, Iod number 4.1 - 11 g / 100g, maximum peroxide number 2.0 mg Oxygen / g, acid Maximum free fat is 0.2%. These trans fatty acids can increase levels of Low Density Lipoprotein (LDL) so that it can cause coronary heart disease, hypertension, and stroke (Sutarmi and Rozaline, 2006). While pure coconut oil is predominantly composed by medium chains of fatty acids (MCFA), such as lauric acid (48%), capric acid (7%), caprylic acid (8%), and caproic acid (0.5%) (23).

MCFA in the body is broken down and used to produce energy, and rarely stored as body fat or accumulate in arteries (20). MCFA has the ability to increase the immune system, can also help the absorption of magnesium, calcium and amino acids by the body (2). Coconut oil has high levels of omega-3 polyunsaturated fatty acids, eicosapentaeinoic acid (EPA) and docosahexaenoic acid (DHA) which can reduce Very Low Densit Lipoprotein (VLDL) (4). The raw material used for making virgin coconut oil is deep coconut or local coconut. Making coconut oil can be done by wet or dry method (13). Making coconut oil dry way is by drying coconut meat through minimum heating and then pressing mechanically on dried fruit. Through this method the yield of coconut oil is low and sanitation of copra drying is usually lacking so that the copra can be overgrown with fungi which will consequently not be consumed directly. In order to be consumed, the coconut oil must go through several processes such as refining, bleaching, deodorizing (9, 7).

Table 2. FFA test results

No	Sample Name	Parameter	FFA	Unit	Method
1	Sea Crab (*Portunus pelagicus*)	FFA	24,598 24,572	ml/L	Titration
2	Mangrove Crab (*Scylla Serrata*).	FFA	6,232 6,232	ml/L	Titration

A low acid number indicates less free fatty acid levels, the smaller the acid number, the better oil quality (Jones, 1989) Through the fermentation process, oil extraction is obtained by breaking the protein bonds that act as emulsion stabilizers. Coconut milk fermentation occurs because of the role of microbes in coconut milk. The microbes produce the protease enzyme which hydrolyzes proteins into polypeptides. Protein breakdown in coconut milk emulsion will cause a separation between the oil layer at the top layer, water in the lower layer and protein in the middle layer. Because the specific density of oil is smaller than water, the oil layer is more easily separated from the water layer. To separate the oil layer from protein is done by filtering using filter paper.

In the research results also showed that while the VCO oil which is processed using a chemical method appears more intense yellowish color to the oil produced. The oil produced by fermentation, produces a high component of lauric fatty acid (46.70%). Lauric acid contained in fermicles has a very important role for health. The content of lauric acid in fermicles is equivalent to the content of lauric acid in breast milk (ASI), indicating an important role in the formation of antibodies in the human body. Therefore, the higher the content of lauric acid in food consumed, the higher the value of its health benefits,To find out the biological function of the VCO fermicles produced, further research is needed.

CONCLUSION

From the results of the study it can be concluded that, virgin coconut oil (VCO) can be produced by fermentation method using a biocatalyst, which is in the form of crustacean extract. The most superior results starting from mangrove crab,sea crab and freshwater crab. Crabs produce the highest yield of fermented oil, which is around 23% with the highest yield. While the quality of the oil produced has the nature of a greener oil product which shows the highest content of lauric acid. The quality of pure oil produced meets edible oil standards.

SUGGESTION

Process development is needed, remembering the production process of virgin coconut oil (VCO) with the fermentation method is a production process that does not damage the quality of the oil

REFERENCES

1. Asiah, N., Cempaka, L., & Maulidini, T. (2018). Sensory Evaluation And Yield Value of VCO Produced By Various Culture. *AGRICULTURAL SCIENCE*, *2*(1), 36-44.
2. Ayu Widiyanti, R. (2016). Utilization of Coconut Into a VCO (Virgin Coconut Oil) as Antibiotics in an Effort to Support The Health Of Indonesian Healthy Vision 2015. Research Report.
3. Bairagi, A., Ghosh, K. S., Sen, S. K., & Ray, A. K. (2002). Enzyme producing bacterial flora isolated from fish digestive tracts. *Aquaculture International*, *10*(2), 109-121.
4. Bilheimer, D. W., Eisenberg, S., & Levy, R. I. (1972). The metabolism of very low density lipoprotein proteins I. Preliminary in vitro and in vivo observations. *Biochimica et Biophysica Acta (BBA)-Lipids and Lipid Metabolism*, *260*(2), 212-221.
5. Frazier, W.C. and D.C. Westhoff. 1988. Food Microbiology. Fourth Edition. McGraw-Hill : USA. pp. 11-80.
6. Frobisher, M. 1962. Fundamental of Microbiology. Seventh Edition. W.B. Saunders : USA. pp. 99-106, 172-177, 248-251.
7. Isworo, J. T. (2014). Pengaruh Lama Fermentasi Pada Produksi Minyak Kelapa Murni (Virgin Coconut Oil) Terhadap Sifat Fisik, Kimia, dan Organoleptik. *Jurnal Pangan dan Gizi*, *4*(2).
8. Jones, L. H. (1989). Prospects for biotechnology in oil palm (Elaeis guineensis) and coconut (Cocos nucifera) improvement. Biotechnology and Genetic Engineering Reviews, 7(1), 281-296.
9. Ketaren, S. (1986). Pengantar teknologi minyak dan lemak. *Jakarta: Universitas Indonesia*.
10. Kusumayanti, H., Susanti, M. T., & Yulianto, M. E. (2005). Aplikasi Rhizopus oligosporus, rhizopus oryzae, isi tubuh kepiting dan enzim bromelin pada bioekstraksi krim santan kelapa menjadi virgin coconut oil. *METANA*, *3*(2).
11. Laureles, L. R., Rodriguez, F. M., Reaño, C. E., Santos, G. A., Laurena, A. C., & Mendoza, E. M. T. (2002). Variability in fatty acid and triacylglycerol composition of the oil of coconut (Cocos nucifera L.) hybrids and their parentals. Journal of agricultural and food chemistry, 50(6), 1581-1586.
12. Momuat, L. I., Sangi, M. S., & Purwati, N. P. (2011). Pengaruh VCO mengandung ekstrak wortel terhadap peroksidasi lipid plasma. *Jurnal Ilmiah Sains*, *11*(2), 296-301.

13. Muis, A. (2018). Pengaruh Metode Pengolahan dan Umur Panen Kelapa terhadap Kualitas dan Kandungan Senyawa Fenolik Virgin Coconut Oil (Vco). *Jurnal Penelitian Teknologi Industri*, *8*(2), 97-106.
14. Nevin, K. G., & Rajamohan, T. (2009). Wet and dry extraction of coconut oil: impact on lipid metabolic and antioxidant status in cholesterol coadministered rats. *Canadian journal of physiology and pharmacology*, *87*(8), 610-616.
15. Pudyastuti, B., Marchaban, M., & Kuswahyuning, R. (2016). Pengaruh Konsentrasi Xanthan Gum terhadap Stabilitas Fisik Krim Virgin Coconut Oil (VCO). *Jurnal Farmasi Sains dan Komunitas (Journal of Pharmaceutical Sciences and Community)*, *12*(1).
16. Rampengan, V. F. (2006). Beberapa karakteristik virgin coconut oil yang diolah secara fermentasi. *Journal Eugenia*, *12*(3), 229-234.
17. Senphan, T., & Benjakul, S. (2017). Comparative study on virgin coconut oil extraction using protease from hepatopancreas of pacific white shrimp and Alcalase. *Journal of Food Processing and Preservation*, *41*(1), e12771.
18. Setiaji, B., & Prayugo, S. (2006). Membuat VCO Berkualitas Tinggi. *Penebar Swadaya, Jakarta*, 5-22.
19. Suciati, T., & Patricia, L. (2012). Formulasi Natrium Ascorbyl Phosphate dalam Mikroemulsi A/M VCO. *Acta Pharmaceutica Indonesia*, *37*(3), 90-94.
20. Sugiharto, C. S., Aman, I. G. M., & Iswari, I. S. (2018). Oral administration of palm oil (elaeis) increases abdominal fat more than oral administration of coconut oil (cocos nucifera) in wistar male rats. *IJAAM (Indonesian Journal of Anti-Aging Medicine)*, *2*(1), 1-4.
21. Widiandani, T., Purwanto, H. S., Tri, P. B., Susilowati, R., & Diyah, N. W. (2010). Upaya Peningkatan Kualitas Minyak Kelapa yang dibuat dari Cocos Nucifera L dengan Berbagai Metode Kimiawi dan Fisik. *Surabaya, Departemen Kimia Farmasi, Fakultas Farmasi Universitas Airlangga*.
22. Widyasanti, A., Junita, S., & Nurjanah, S. (2017). Pengaruh Konsentrasi Minyak Kelapa Murni (Virgin Coconut Oil) dan Minyak Jarak (Castor Oil) terhadap Sifat Fisikokimia dan Organoleptik Sabun Mandi Cair. *Jurnal Teknologi dan Industri Pertanian Indonesia*, *9*(1), 10-16.
23. Yong, J. W., Ge, L., Ng, Y. F., & Tan, S. N. (2009). The chemical composition and biological properties of coconut (Cocos nucifera L.) water. *Molecules*, *14*(12), 5144-5164.