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Technical Paper

A Simple Refining Technique of Coconut Oil for Small Holder Industries

Teknik Penjernihan Minyak Kelapa Sederhana Untuk Industri Kecil

Sugeng Triyono[1] dan Agus Haryanto[1]

Abstract

A simple refining equipment and process for small holder industries of edible coconut oil has been investigated. The equipment consisted of 20-L filtering and NaOH neutralization bottles. Filtration was intended to remove impurities such as gums and pigment, while neutralization was to remove free fatty acids (FFA) and other non-fat materials. In the experiment, the crude coconut oil was found to have impurity of 0.16%, FFA of 8.02%, saponification number of 270, and water content of 0.33%. The results showed that either granular activated carbon (GAC) or zeolite filtration can be chosen individually to remove physical impurity. The GAC or zeolite-filtered coconut oil contained impurity less than the SNI standard of 0.05%. In term of FFA; however, the NaOH neutralized coconut oil did not meet the SNI standard of 0.3%. After NaOH neutralization, the GAC filtered oil contained 1.20% FFA; while the zeolite filtered oil contained 1.32%. These FFA contents were definitely higher than the SNI standard, but could satisfy APCC standard for grade IV coconut oil which is 5%. The refined coconut oils could also satisfy the SNI standard of saponification number which is 196 – 206 at minimum. In term of water content, either the filtered or the neutralized oil could also satisfy the SNI standard of 0.3%. In short, the proposed technique could help farmers refine their raw coconut oil, and hopefully improve its marketability.

Keywords : *retining, coconut oil, small holder industry*

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Introduction

Coconut tree is cultured by a lot of Indonesian farmers with many reasons such as social, culture, and economy. Covering 3.78 million ha or 27% of total plantation in Indonesia, the area of coconut plantation is the largest plantation in Indonesia nowadays (Tondok, 1998). Major portion of the total coconut plantation, 3.59 million ha or 96%, was grown by small farmers, which involve 20 million people, and those that grow naturally in many remote islands (Kasryno et al., 1998).

Coconut nut can be processed to produce various products. Among other are copra, coconut milk, coconut oil, coconut cream, coconut jam, coconut yogurt, sweetened coconut, toasted coconut, coconut chips, and nata de coco. Diversification of the coconut products for high quality oil, protein and other edible products is increasingly more important with respect to malnutrition (especially protein deficiency) and food situation in developing countries (Ranasinghe, 1996).

Rural people usually harvest ripe coconuts and use them for making copra, coconut milk, or coconut oil for cooking. As an edible produce, coconut oil has played important roles both in supplying market demand and farmers income. When palm oil (the competitor) disappeared from domestic markets due to high international demand for bio-fuel, coconut oil could readily substitute it. Even when the price dropped, small producers of coconut oil could exist because they could produce the oil from rejected size coconuts. Bigger size coconuts are normally sold for coconut milk or other products and more expensive, but small size coconuts are cheaper and can be processed to produce copra and coconut oil. Hence, coconut oil production is still valuable to farmers.

Small-holder industries or rural people traditionally produce the coconut oil by wet process method where the coconut milk extracted from ripe kernels is gently heated for several hours to evaporate water. However, coconut oil produced by small-holder industries has not been refined yet. It is crude oil, has low quality and short storage time. Quality of the raw coconut oil is easily deteriorated because it contains some physical impurities (mostly gums) and unstable substances such as free fatty

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acids (FFA). Other impurity may include non-fat materials, pigment, and water. This research was to create and investigate a simple refining equipment and process of the coconut oil. The result of this research was aimed to give help small-scale coconut oil producers so that they can get some added value and sustain their production.

Materials and methods

The material (crude coconut oil) was taken from a small producer of coconut oil in Pagelaran Village, Tanggamus County Lampung Province. The refining process consisted of two main steps; filtration and neutralization. There were two alternates of filtering bottles used, the first for granular activated carbon (GAC) filtration and the second for zeolite filtration. The GAC and zeolite filtrations were used mainly to remove soluble solids or physical impurities. Both of the filtering media were well known for their high adsorption capacities (PDI, 1998). The filtering bottles were made of 20-L mineral water bottles (Figure 1). The bottles were cut at the bottom and inverted up side down. A tap was attached to each mouth of the inverted bottles. The bottles were then filled with the filtering media, GAC or zeolite, to one-third of the volumes respectively. The oil was poured from the top of the inverted bottles. After a particular minute, the tap was slightly opened so that the oil dripped. Before the filtration, the oil was warmed to about 80^{o}C and pre-filtered by using cotton cloth to remove rough dirt.

In the neutralization process, a similar bottle as in the filtration (but without filtering media) was used as a soap stock separator. NaOH was used as the neutralizing reagent to remove FFA and non-fat materials. The oil was first mixed with 0.1M NaOH solution in a vessel with ratio of 2 (oil) to 1 (NaOH solution), and then continuously stirred in a few minutes. Impurity, mainly FFA and other non-fat materials will react with NaOH to form insoluble soap which is so called soap-stock. The mixed oil and soap stock were then poured to the separator. After about 6 hours the soap stock almost completely settled at the bottom, while the oil remained at the top layer. The tap was then slightly opened, so the soap (together with water) seeped down. When the oil was already free of water and soap, the tap was closed .

The neutralized oil was then drained from the separator, washed with boiling water with 1 to 1 ratio, and continuously stirred within 15 minutes in a vessel. The rinsed oil was then poured again to the separator, to separate water from the oil. Finally, the refined oil was drained and warmed by using little fire to evaporate the remaining water.

Eight treatments assigned were raw coconut oil (control), cloth filtration (pre-filtration), cloth+GAC filtrations, cloth+zeolite filtrations, cloth+GAC filtrations + NaOH neutralization, cloth+Zeolite filtrations+NaOH neutralization, cloth+GAC+Zeolite filtrations, and cloth+GAC+Zeolite filtrations + NaOH Neutralization. The experiment was preformed in a completely randomized design with three replications, about 20-L coconut oil each. Data, in terms of solid impurity, FFA, saponification number, and water content, was analyzed by using analysis of variance (ANOVA) at 5% significant level and followed by least significant difference (LSD) multiple comparison as necessary, with SAS. Solid impurity and water contents were measured gravimetrically, FFA was determined by using Jacobs method, and saponification number was determined by using hopper method.

Results and discussion

The results showed that all the treated coconut oils, but the raw and cloth-filtered coconut oils, passed the Indonesian National Standard (SNI) in term of physical impurity content. The SNI 3741-1996 limit for impurity is 0.05% while the raw coconut oil contained 0.16%, and the cloth-filtered oil contained 0.08% impurity (Figure 2). The cloth pre-filtration was, in fact, great by removing 50% impurity. But, because the impurity content of the pre-filtered oil did not meet the SNI standard, it could be said that the cloth pre-filtration alone was not sufficient to refine the coconut oil. The cloth filtration, as commonly practiced by small producers, could only remove rough solids.

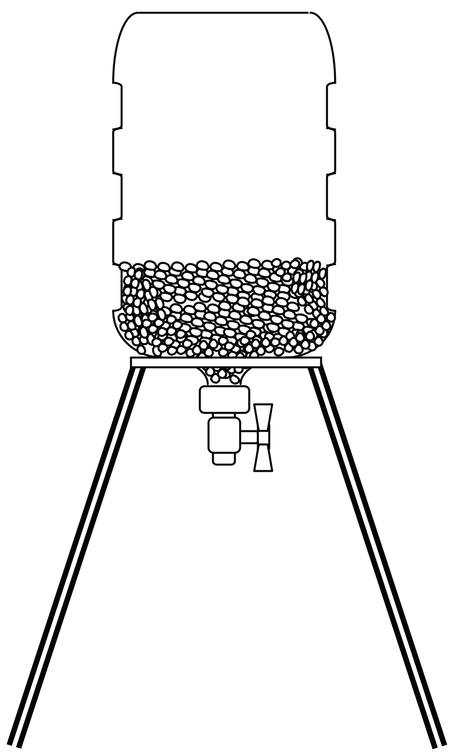

Figure 1. Filtering equipment

On the other hand, the cloth filtration followed by GAC filtration showed a very significant reduction of physical impurity. The GAC filtered oil contained 0.03% impurity, satisfying the SNI standard. So, the GAC filtration alone removed 62.5% impurity which was mainly soluble solids and pigment. The cloth pre-filtration and the GAC filtration combined removed 81.25% impurity. Similar performance was shown by zeolite filtration. The GAC and zeolite filtrations had no significant different performances. Thus, either GAC or zeolite filtration could be chosen individually to improve the filtration process which was traditionally practiced by farmers. Because the GAC and the zeolite filtrations had individually met the SNI standard, further filtrations or their combinations such as GAC+zeolite filtrations were not necessary. Additional filtration processes did not significantly improve the physical impurity removal from oil.

The results also showed that the NaOH neutralization did not have a significant capacity of solid reductions. In term of FFA removal; however, NaOH neutralizations were very effective. The raw coconut oil contained 8.02% FFA, and after pre-filtered by using the cotton cloth, the FFA content decreased to 7.75% (Figure 3) which were definitely higher than the SNI standard which is 0.3%. When the pre-filtered oil was filtered by using the GAC, the FFA content slightly decreased to 7.14%. Even after the GAC-filtered Oil was neutralized using NaOH, the FFA content dropped to 1.20% (85% reduction), the FFA did not meet the SNI standard. Although this

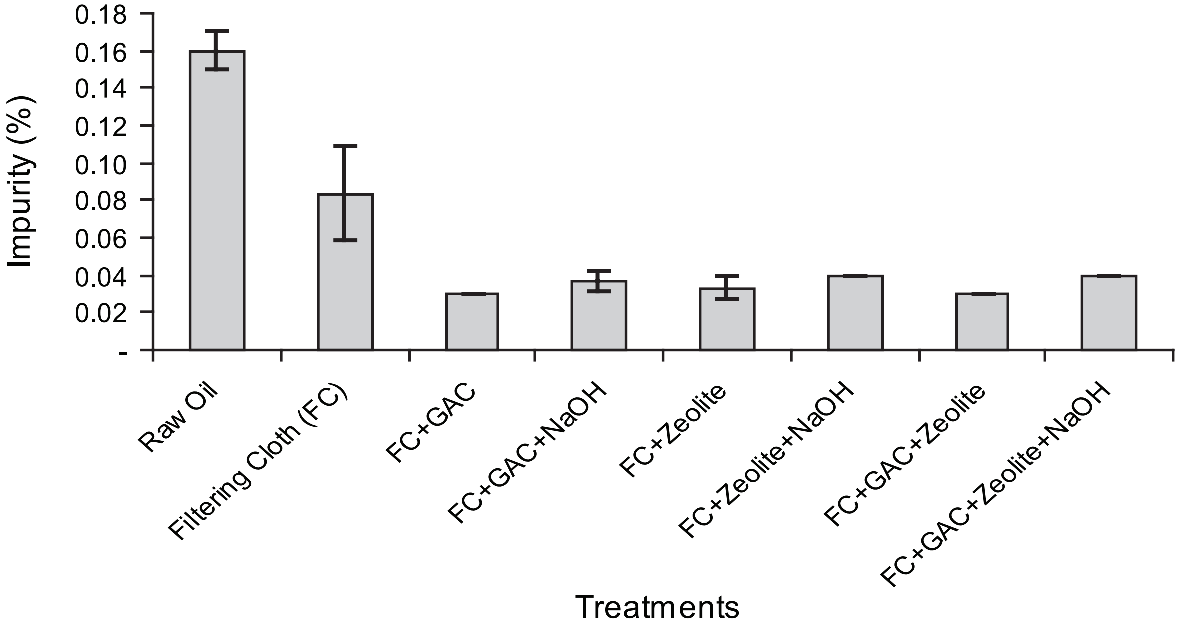

Figure 2. Effect of different treatments on impurity content of coconut oil

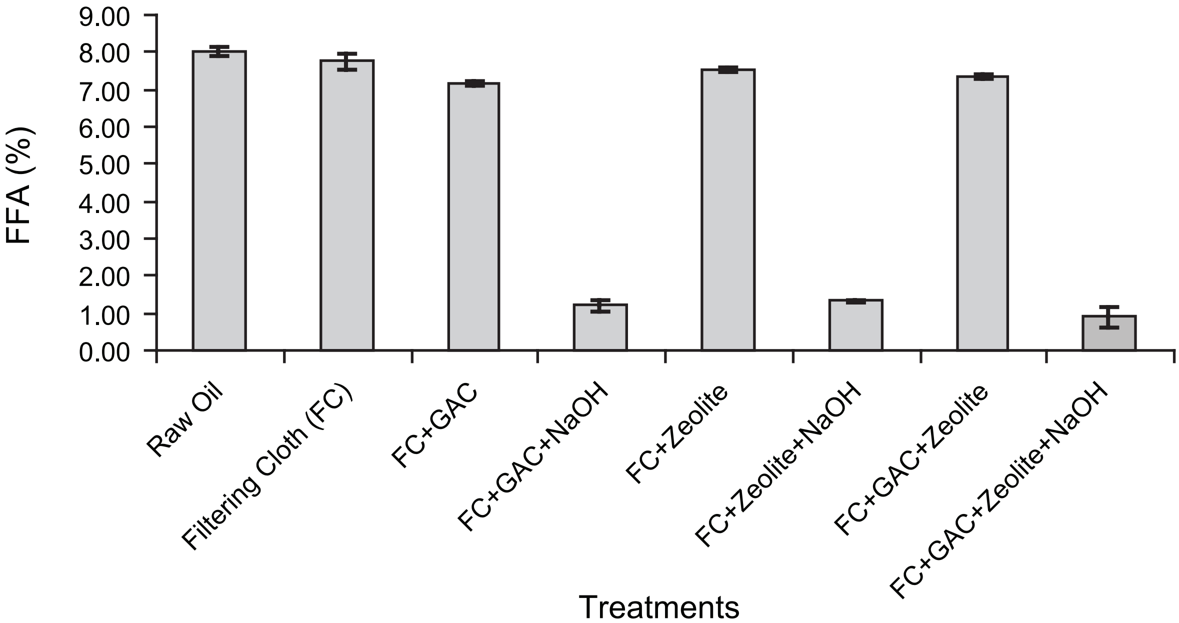

Figure 3. Effect of different treatments on FFA content of coconut oil

FFA content did not pass the SNI standard of 0.3%; however, it satisfied the APCC standard of 5% for Grade IV coconut oil (by extraction process).

A similar situation also occurred to the zeolite filtered oil. When the pre-filtered oil was filtered by using zeolite, the FFA content decreased to 7.53% which was not a significant reduction. After the zeolite filtered oil was neutralized using NaOH, the FFA content significantly decreased to 1.32%, but had not met the SNI standard of 0.3% yet. Even the combined filtrations (GAC+zeolite) showed a little capacity of FFA reduction. The FFA content of the GAC+zeolite filtered oil was 7.34%. After the GAC+zeolite filtered oil was neutralized using NaOH, the FFA content dropped to 0.90%. This FFA content was significantly the lowest, but still had not met the SNI standard either. Although all the neutralized oils did not meet the SNI standard, the FFA contents of the NaOH neutralized oils satisfied the APCC standard of 5% for the grade IV coconut oil.

Other important parameter of edible oils is saponification number or value. It basically refers to the number of milligrams of KOH needed to saponify 1g of fat. The saponification value represents the sized or nature of the fatty acid chains esterified to glycerol. The larger the length of these chains the higher the saponification number, and the more soluble soap that can be made from it. The SNI standard of saponification number for coconut oil is at least 196 to 206. The results of the experiment showed that raw and all un-neutralized filtered oils contained saponification number above the SNI. The raw coconut oil contained saponification number of 270 (Figure 4). After the GAC filtration the saponification number was 266 and after the

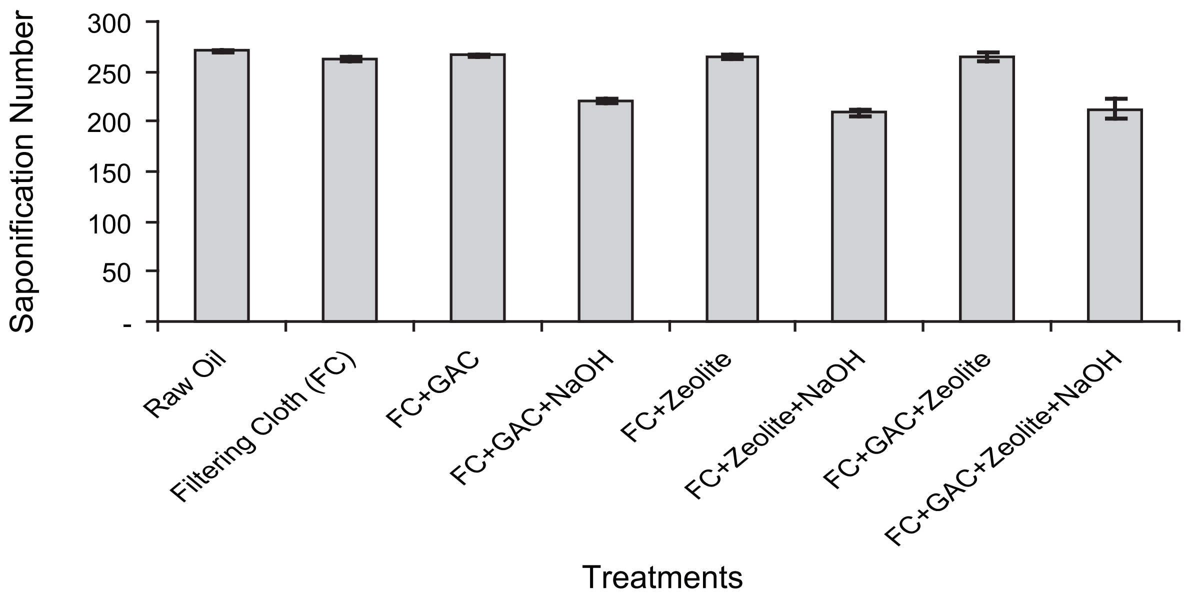

Figure 4. Effect of different treatments on saponification number of coconut oil

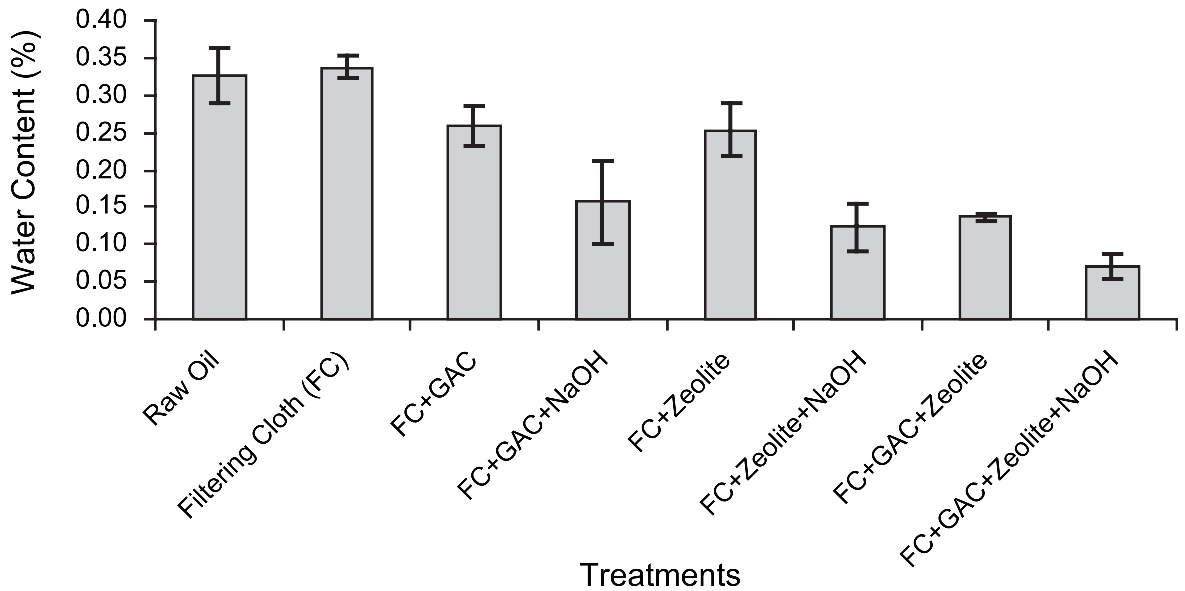

Figure 5. Water content of raw and refined coconut oil

zeolite filtration the saponification number was 265 which were higher than the SNI standard. After the NaOH neutralization, the GAC and the zeolite filtered oils had saponification number of 220 and 209 respectively which were still higher than the SNI standard.

Water contents of raw and cloth filtered oils were just slightly above the SNI standard which is 0.30%. Even for the raw coconut oil, the water content was 0.33% (Figure 5). It might be understandable because the oil was extracted from dry copra by using a screw press (Sudarya et al., 2002) where temperature was so high (as the friction effect) that some water evaporated from the raw oil. After the GAC filtration and zeolite filtration, the water contents significantly decreased to 0.26% and 0.25% respectively, and were already below the SNI standard. Thus, both GAC and zeolite filtrations were able to make the coconut oil satisfy the SNI standard.

In the neutralization processes, NaOH solution was added to the filtered oil, and the soap formed in the neutralization process was then separated. Warm water was added to the neutralized oil to wash the oil from the remaining soap. The neutralized coconut oil was warmed on a little fire in order to evaporate the remaining water from the oil after all. So, the low water contents of neutralized oils did not reflect the effect of the NaOH neutralization process but as the result of the evaporation process. The water content of the neutralized oil discussed here; however, was rather to show that the simple neutralization process proposed could maintain the water content of the filtered oils below the SNI standard.

Conclusions

The simple refining technique of edible coconut oil appeared be sufficient to satisfy the SNI standard or the APCC standard, and would be hopefully applicable for those small producers. Either GAC or zeolite filtration can be chosen individually as the same effective to remove physical impurity, and met the SNI standard of 0.3%. In term of FFA removal; NaOH neutralization was so far effective. Although the FFA contents of all neutralized oils did not meet the SNI standard of 0.03%, they could satisfy the APCC standard of 5% for the grade IV coconut oil which is processed by extraction. The results also showed that all the refined coconut oils also had saponification number above the SNI minimum limit of 196 – 206. The GAC and zeolite filtrations, and also their NaOH neutralizations, could satisfy the SNI standard of 0.30% water content.

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