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Reducing free fatty acid and peroxide levels in refining used cooking oil made from activated carbon from Barangan banana peels

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ABSTRACT

Everyday life requires a food processing component known as cooking oil. Repeated use of cooking oil can reduce its quality and cause it to have high levels of free fatty acids and peroxides. The purpose of this study was to find out how to purify cooking oil using activated carbon made from Barangan banana peels to reduce the amount of free fatty acids and peroxide value. The activated carbon samples used in this study were sample A (5.5 g), sample B (10.5 g), and sample C (15.5 g). Sample C with 15.5 g of activated carbon had a free fatty acid test result of 0.16% and a peroxide number of 3.91 mek O_2/kg which was the best result in this study, and was in accordance with SNI 01-7709-2019.

Keywords: Activated carbon, Barangan banana peel, used cooking oil

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INTRODUCTION

Cooking oil is a crucial need in society. Cooking oil is usually used as a frying medium, but is also often used as a raw ingredient in commercial kitchens. Usually cooking oil after frying, which is called used cooking oil. Used cooking oil is produced when more frying is done, and usually causes the oil to smoke, darken, and have an unpleasant taste. Repeated use of cooking oil poses health risks. Cooking oil will be damaged if cooked repeatedly at high temperatures (150ºC to 200ºC), so it can harm the body and trigger various diseases such as fat buildup in blood vessels, cancer, and other conditions [1]. The nutritional value and quality of fried foods will be affected by oil damage. Some cooking oils will oxidize when heated at very high temperatures. Food that has been contaminated by oxidation will taste less delicious, have an unattractive color, and cause damage to some vitamins and degradation of fatty acids [2].

Cooking oil refining is a strategy used to reduce the amount of used oil used. In the purification process, activated carbon is used as an adsorbent. Amorphous carbon compounds, such as activated carbon, can be made from carbon-containing materials that have undergone certain expansions to increase their surface area. Activated carbon has a surface area of 300 – 3,500 m^2/g and functions as an adsorbent [3]. Materials that contain carbon elements, one of which comes from waste such as banana peels, can be used to make active carbon [4].

Banana peel has a carbonization value of 96.56% and is a substance that contains the element carbon [5]. Bananas are a fruit that is relatively popular among people [6]. Banana plants are considered flexible plants. All parts such as roots, stems, leaves, and tubers have benefits [7].

Bananas are quite productive, but the amount of banana peels that are wasted is also increasing. These banana skins are simply thrown away after post-harvest of the bananas without further processing. Therefore, it causes a lot of banana peel waste to be thrown away, so there is a need for improvement efforts to increase the usability of banana peels [8]. The cellulose and lignin content of banana peels ranges from 7.6% – 9.6% and 6% – 12% respectively. Banana peels absorb better and do not interfere with the adsorption process if the lignin content is less than 15%. Banana peel waste is expected to act as an adsorbent [9].

RESEARCH METHODS

Experimental methodology is being used in this research. The research instruments were a knife and cutting board, mortar, size 42 Whatman filter paper, funnel, beaker glass, Erlenmeyer, thermometer, 80 mesh sieve, magnetic hotplate stirrer, digital balance, oven, and furnace. Remains of banana peels from household waste, used cooking oil from fried food sellers and distilled water are the materials used in this research.

The procedures carried out in this research were making activated carbon from Barangan banana peels, testing used cooking oil before purifying it, and purifying and testing used cooking oil using activated carbon made from Barangan banana peels.

Making Activated Carbon from Barangan Banana Peels

Banana skin is cleaned and then cut into small pieces. After that, it was dried using an oven at a temperature of 180ºC for 3 hours and 20 minutes, then the Barangan banana peel was carbonized using a temperature of 400ºC with a holding time of 1.5 hours, after that, it was activated using a temperature of 600ºC with a holding time of 45 minutes, then carbonized. actively washed using distilled water and ground using a mortar then sieved using an 80 mesh sieve.

Testing Used Cooking Oil before the Refining Process

Prepare a sample of used cooking oil, then test it using the peroxide value and free fatty acid test parameters. Next, the test results are compared with SNI 01-7709-2019.

Purify and Test Used Cooking Oil Using Activated Carbon Made from Barangan Banana Peel

Put used cooking oil into 3 beakers, 50 g each. Then add 5.5 g, 10.5 g, and 15.5 g of activated carbon to each beaker glass. After that, stir each beaker glass using a magnetic hotplate stirrer at a temperature of 100ºC – 110ºC for 80 minutes. After stirring, it is cooled and then filtered using Whatman filter paper number 42. Then the results of each filter are placed in a sample bottle and tested. After that, the test results are compared with SNI 01-7709-2019.

RESULTS AND DISCUSSION

The results and discussion in this research are testing the levels of free fatty acids and peroxides before and after purification using activated carbon from Barangan banana peels.

Free Fatty Acids in Used Cooking Oil before and after Refining

The test results of used cooking oil before and after refining can be seen in Table 1.

Table 1. Free fatty acids before and after refining used cooking oil.

Sample	Free fatty acid test results		SNI 01-7709-2019 (%)
	Before purification (%)	After purification (%)	
A	1,46	0,41	
B	1,46	0,23	0,3
C	1,46	0,16	

From Table 1 above, the value of free fatty acids in used cooking oil before refining is 1.46%. The free fatty acid values after purification using activated carbon for samples A, B, and C were respectively 0.41%, 0.23%, and 0.16%.

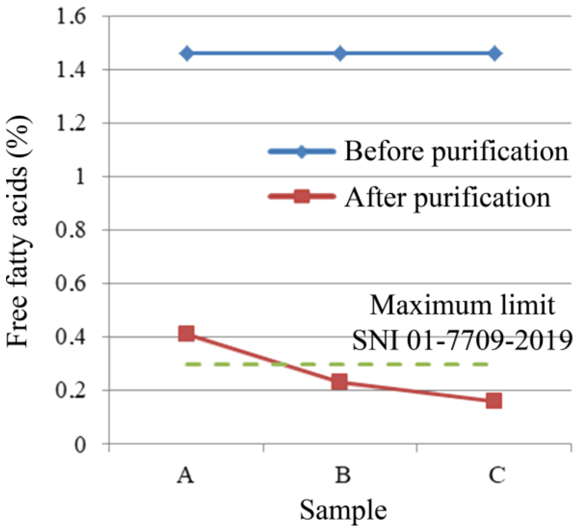

Figure 1. Graph of free fatty acids from used cooking oil before and after refining

Based on Table 1 above, free fatty acids in used oil before and after refining can be seen in Figure 1. Based on the graph, the greater the variety of activated carbon used, the better the purification results will be. This is also by the research of Oko *et al.* (2020) [10].

The decrease in free fatty acid values in sample A was 71%, sample B was 84% and sample C was 89%. This decrease is due to the presence of silanol groups (Si-OH) in carbon that has been activated with acid. The silanol group will be linked to the carbonyl oxygen group (C=O) on the free fatty acid so that the free fatty acid molecule can be adsorbed on the surface of the activated carbon [11].

Peroxide Number in Used Cooking Oil before and after Refining

The peroxide number is a quality standard for cooking oil that must be met. The test results of used cooking oil before and after refining can be seen in Table 2.

Table 2. Peroxide numbers before and after refining used cooking oil.

Sample	Peroxide value test results		SNI 01-7709-2019 (**mek O_2/kg**)
	Before purification (%)	After purification (%)	
A	4.82	4.79	
B	4.82	4.73	10
C	4.82	3.91	

From Table 2 above, the peroxide value in used cooking oil before refining produces a result of 4.82%. When purifying using activated carbon, sample A obtained a yield of 4.79%. When purifying using activated carbon, sample B obtained a yield of 4.73%. When purifying using activated carbon, sample C obtained a yield of 3.91%. For more clarity, you can see in Figure 2.

From the research that has been carried out, the more variations of activated carbon used, the better the purification will be and will result in a reduction of 0.6% for sample A, 1% for sample B, and 18% for sample C. The decrease in content is because activated carbon has the following adsorbent properties [3]. This is also by research by Oko *et al.* (2020) which states that the more variations of carbon used, the better the purification results will be [10].

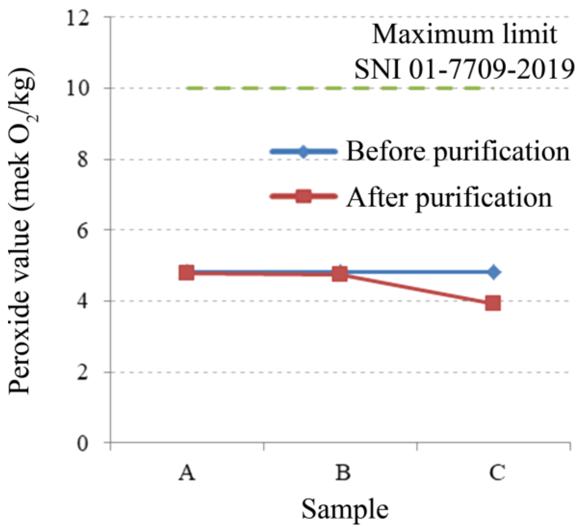

Figure 2. Graph of the peroxide value of used cooking oil before and after refining.

CONCLUSION

Based on this research, it can be concluded that the results obtained from testing used cooking oil before refining using activated carbon from Barangan banana peels obtained a free fatty acid value of 1.46%, and a peroxide value of 4.82 mek O_2/kg. Purification of used cooking oil using a variation of sample A activated carbon produced 0.41% free fatty acids which did not meet SNI 01-7709-2019 and the peroxide value decreased to 4.79 mek O_2/kg which still met SNI 01-7709-2019. The activated carbon variation of sample B produces free fatty acids, namely 0.23% and a peroxide value of 4.73% which meets SNI 01-7709-2019. The activated carbon sample C produces 0.16% free fatty acids and a peroxide value of 3.91 mek O_2/kg which meets SNI 01-7709-2019.

REFERENCES

1. Ariani, D., Yanti, S. & Saputri, D. S. (2017). Studi kualitatif dan kuantitatif minyak goreng yang digunakan oleh penjual gorengan di kota Sumbawa. *Jurnal Tambora*, **2**(3).
2. Noriko, N., Elfidasari, D., Perdana, A. T., Wulandari, N. & Wijayanti, W. (2012). Analisis penggunaan dan syarat mutu minyak goreng pada penjaja makanan di food court UAI. Jurnal Al-Azhar Indonesia Seri Sains dan Teknologi, **1**(3), 147–154.
3. Dewi, R., Azhari, A. & Nofriadi, I. (2021). Aktivasi karbon dari kulit pinang dengan menggunakan aktivator kimia KOH. *Jurnal Teknologi Kimia Unimal*, **9**(2), 12–22.
4. Lubis, R. A. F., Nasution, H. I. & Zubir, M. (2020). Production of activated carbon from natural sources for water purification. *Indonesian Journal of Chemical Science and Technology*, **3**(2), 67–73.
5. Abdi, C., Khair, R. M. & Saputra, M. W. (2015). Pemanfaatan limbah kulit pisang kepok (Musa acuminate L.) sebagai karbon aktif untuk pengolahan air sumur kota Banjarbaru: Fe Dan Mn. *Jukung (Jurnal Teknik Lingkungan)*, **1**(1).
6. Rai, I. N., Sudana, I. M., Astawa, I. N. G., Dwiyani, R. & Fitriani, Y. (2019). Direct organogenesis in vitro propagation of local balinese banana with thidiazuron. *International Journal of Life Sciences*, **3**(3), 32–40.
7. Hartono, A. (2013). Pelatihan Pemanfaatan Limbah Kulit Pisang Sebagai bahan dasar pembuatan kerupuk. *AJIE (Asian Journal of Innovation and Entrepreneurship)*, **2**(3), 198–203.
8. Nasir, N. S. W., Nurhaeni, N. & Musafira, M. (2014). Pemanfaatan arang aktif kulit pisang kepok (*Musa normalis*) sebagai adsorben untuk menurunkan angka peroksida dan asam lemak bebas minyak goreng bekas. *Natural Science: Journal of Science and Technology*, **3**(1).
9. Widayana, S., Kurniawati, I. & Susilowati, S. (2022). Pemanfaatan Limbah Kulit Pisang Kepok Sebagai Bioadsorben pada Penurunan Warna Minyak Bekas Penggorengan. *Jurnal Pendidikan Tambusai*, **6**(2), 10191–10202.
10. Oko, S., Mustafa, M., Kurniawan, A. & Muslimin, N. A. (2020). Pemurnian minyak jelantah dengan metode adsorbsi menggunakan arang aktif dari serbuk gergaji kayu ulin (Eusideroxylon zwageri). *Jurnal Riset Teknologi Industri*, **14**(2), 124.
11. Sari, R. M. & Kembaren, A. (2019). Pemanfaatan karbon aktif ampas dalam mereduksi asam lemak bebas (free fatty acid) pada minyak goreng bekas sebagai biodiesel. *Talenta Conference Series: Science and Technology (ST)*, **2**(1), 124–128.

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