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Used Oil Refining Process by Using Green Tea Waste for Floor Cleaner With An Addition of Pineapple Skin Extract

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Abstract

Used cooking oil is a waste that is produced every day and is increasing. Used cooking oil cannot be consumed again because it contains dangerous substances that will cause disease, but it also cannot be thrown away since it will pollute the environment. Therefore, it is necessary to process used cooking oil, one of which is purification using the adsorption method. The adsorption method for used cooking oil can be derived from green dregs because greens contain antioxidants which can reduce the content of dangerous substances in used cooking oil. In this study, we used variations in adsorbent mass (10 gr, 20 gr, 30 gr, 40 gr, and 50 gr) and stirring time (25 minutes, 45 minutes, 65 minutes, 86 minutes, and 105 minutes) to obtain the highest purification results. was the best and it was found that the adsorbent mass of 50 grams of green dregs and a stirring time of 105 minutes had the best results in being able to reduce the peroxide value, air content and free fatty acids. Next, the purified used cooking oil will be processed into floor cleaning liquid soap with the addition of 2 ml, 4 ml, 6 ml, 8 ml and 10 ml of pineapple peel extract. The results of the floor cleaning soap showed that the best results were 2 ml based on the alkaline number, pH and anti-bacterial test.

INTRODUCTION

Cooking oil is a processed product from triglyceride fat which functions as a medium for frying. Cooking oil has high economic value so it is often used repeatedly in the frying process, but this will cause complex decomposition and produce free fatty acid compounds, peroxides, polymers and other impurities in the oil (Tirtonegoro, 2022). Cooking oil that has been used repeatedly and has been damaged is called used oil. The dangerous ingredients in used cooking oil make it unsuitable for use again because it is not good for health, one of which is cholesterol. However, direct disposal of used cooking oil will cause problems with the soil structure because the oil will block water in the soil pores. Waste cooking oil needs to be processed further to minimize problems and increase value. One way to process used cooking oil is purification, namely to improve the quality of the oil so that it can be safely reused as raw material for biodiesel, soap and cleaning products. A simple, economical and easy purification method to improve the quality of used cooking oil is adsorption with adsorbents (Aziz et al., 2016). One adsorbent that is suitable for purifying used cooking oil is green tea dregs because it contains antioxidants which can inhibit oxidation reactions.

Previous research discussing the purification of used cooking oil with organic waste adsorbents is one of them Hakim et al. (2021) namely refining used cooking oil using sugar cane bagasse varying temperatures and stirring times. The results of this research show that temperature and stirring time greatly influence the parameters of clarity, water content, free fatty acid content and

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brightness of used cooking oil. Then Abubakar et al. (2018) used turmeric powder adsorbent to purify used cooking oil. The results of the research showed that the water content was reduced from 0.6% to 0.4% and free fatty acids reduced from 1.2% to 0.2% as well as the peroxide value from 6 mg/g to 4 mg/g. Apart from that, there are also Alamsyah & Kalla (2017) has conducted research on refining used vegetable oil with an adsorption process using zeolite and moringa seeds. He has used a variety of adsorbent masses. The results obtained from his research were free fat content from 0.584% to 0.284% and peroxide content from 8.83685 to 6.4259%, water content between 0.094% and 0.065 %. Oil from refining used oil can be used as raw material for making floor cleaners as has been done by Sukmawati & Lestari (2021) making carbolic acid from used cooking oil by optimizing temperature and NaOH concentration. The research shows that at a temperature of 90°C all concentrations of NaOH carbolic produced meet BSN (SNI-06-1842-1995). Apart from that, this has also been done by Prionggo & Santoso (2013) also made floor soap from used cooking oil, the results showed that it met ISO 06-1842-1995 standards. Further research can add extracts of natural antibacterial ingredients to increase the benefits of floor cleaning, for example by adding pineapple skin waste extract because it contains flavonoids which are good as antibacterials.

Based on the considerations that have been explained, this research aims to make a cleaning fluid using pineapple peel extract from oil raw materials resulting from refining used cooking oil with green tea dregs. In the process of refining used cooking oil, variations are made in the adsorbent mass and contact time, while in making floor soap, variations are made in adding the amount of pineapple peel extract.

MATERIALS AND METHODS

Materials

In this study, the equipments used blender, beaker, heater, stirrer motor, suction vacuum, filter paper, erlenmeyer, oven, hotplate, pH test, thermometer. The materials used in this research were waste cooking oil, ground green tea dregs and pineapple skin from waste, used cooking oil from waste, NaOH solids, $CHCl_3$, glacial CH_3COOH 98%, KI solids, $Na_2S_2O_3$ solids, KOH solids, 1% phenolphthalein indicator, 96% ethanol, citric acid, tecxapon, Whattman filter paper no. 42, Whattman filter paper no. 01, 1% starch, 37% HCl.

Methods

Purification Process

Used cooking oil was heated to 90℃, next put 10 grams, 20 grams, 30 grams, 40 grams, 50 grams green tea pulp that has been mashed. This mixture was stirred for 45 minutes and the best adsorbent mass variation has been obtained. The best amount of adsorbent mass that has been obtained and then adsorbed for 25 minutes, 45 minutes, 65 minutes, 85 minutes, and 105 minutes. During the heating process, the mixture was also stirred at a speed of 50 rpm. Then, the mixture filtered using Whatman 42 filter paper and vacuum or use filter paper. Refined used cooking oil was analyzed for free fatty acid content, air content and peroxide content, from this analysis the most optimal stirring/contact time will be obtained.

Process for Making Pineapple Peel Extract

1 kg of pineapple skin was dried in the sun for 2 days until dry, then ground with a blender and macerated with 75% ethanol for 4 days. Next, the extract is filtered using filter paper to separate filtrate I and dregs. Then 50 ml of solvent was added to the dregs and shaken for 5 minutes, filtered through filter paper to produce filtrate II. Filtrates I and II were mixed and filtered using Whatman No.1 filter paper. The extract obtained was put into an evaporation flask and evaporated at a temperature of ± 40℃ with a pressure of 100 mbar. Evaporation is complete when all the solvent has evaporated. The resulting thick extract is used to make floor cleaners. Pineapple peel extract will be analyzed using GCMS.

Floor Soap Making Process

50 mL of purified used oil is added to a mixture of 100 mL of 1N NaOH and pineapple peel extract (2 mL, 4 mL, 6 mL, 8 mL, 10 mL). Next, the mixture was left for 24 hours until two layers formed. The bottom layer was taken then 100 ml of distilled water was added. Add citric acid to pH 6-11, 1 gram of HEC and 0.5 gram of Texapon while stirring. The product formed is then subjected to a pH test, free alkali concentration test, and microbial contamination test. From this analysis, the most optimal amount of added pineapple peel extract will be obtained.

RESULTS AND DISCUSSION

Results of Refining Used Cooking Oil

In this oil refining process, the function of grinding green tea pulp is to expand the contact surface of the adsorbent with used cooking oil, heating at a temperature of 90 °C which aims to speed up the reaction, and stirring which aims to increase the frequency of contact of the adsorbent with the adsorbed compound (Miskah et al., 2018).

Effect of Adsorbent Mass and Contact Time on Reducing Peroxide Number

The peroxide number is one of the values to determine the degree of oil damage. The double bonds in unsaturated fatty acids can combine with oxygen to form unstable peroxides. Peroxides can undergo further reactions to form aldehydes, ketones, etc. (Viantini & Yustinah, 2016). The higher the peroxide number, the more oxidation occurs in the oil so that the quality of the oil gets worse, indicated by the increasingly rancidity of the oil. The amount of peroxide can be determined by the Iodometry method.

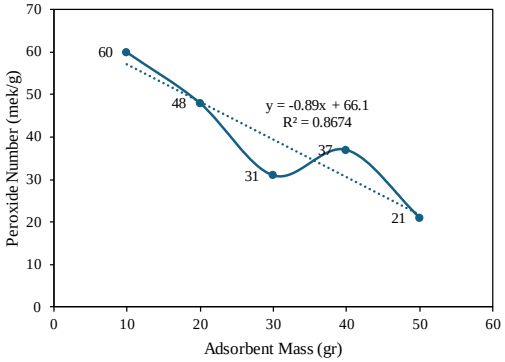

Figure 1. The influence of the variable mass of green tea dregs adsorbent on the peroxide value of refined used cooking oil.

Figure 1 shows the largest decrease in peroxide value for an adsorbent mass of 50 gr for 200 ml of used cooking oil. The peroxide number of used cooking oil before adsorption was 58 mek/g and after adsorption it became 21 mek/g. The most optimal reduction in peroxide value from the results of refining used cooking oil was obtained at an adsorbent mass of 50 gr, namely from 58 mek/g to 21 mek/g, reducing by 63.79%, the reduction ability was 1.28%/g. The results of this research show that the greater the adsorbent mass used, the greater the reduction in peroxide levels in used cooking oil. Next, with an adsorbent mass of 50 grams, purification was carried out with varying contact times of 25 minutes, 45 minutes, 65 minutes, 85 minutes and 105 minutes.

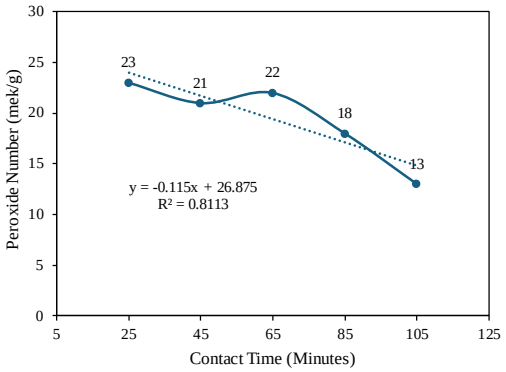

Figure 2. Relationship between adsorption time and peroxide value of used cooking oil.

Figure 2 shows that the greatest reduction in peroxide groups occurred in the oil sample that was absorbed with a contact time of 105 minutes. Unrefined used cooking oil has a peroxide concentration of 58 meq/kg and after going through purification the used cooking oil experienced a decrease in the peroxide value to 13 meq/kg, which is a decrease of 77.58%. It can be said that the longer the contact time, the better the contact between the adsorbent (green tea dregs) and the adsorbate (peroxide compound), so that the peroxide number decreases.

The decrease in peroxide levels in used cooking oil resulting from refining occurs because the cellulose in green tea dregs is able to adsorb the peroxides in used cooking oil and the catechin content of green tea dregs is an antioxidant that can be used to improve the quality of damaged cooking oil (Wardoyo, 2018). Several factors influence the adsorption process, namely the type of adsorbent, adsorbent concentration, contact surface area, temperature, particle size, pH, and contact time.(Alamsyah, et al., 2017). The results of refining used cooking oil do not meet the SNI-7709:2019 cooking oil quality standards. The reason is that the peroxide value in oil is based on a maximum cooking oil quality standard of 10 mek/g (SNI, 2019).

Effect of Adsorbent Mass and Contact Time on Reducing Free Fatty Acid Levels

Free fatty acids are an important property used to determine or control the quality of cooking

oil. This is because high levels of free fatty acids can affect the taste of the oil, causing a decrease in oil quality. The higher the FFA value, the more free fatty acids the oil contains, so that these free fatty acids will affect the chemical properties, physical properties and stability of the oil during frying. As an adsorbent, green tea dregs have the ability to reduce the concentration of free fatty acids beyond the concentration found in used cooking oil which is not adsorbed, this is due to the presence of antioxidants. Antioxidants in green tea dregs play an important role in inhibition. rancidity due to oxidation. Figure 3 shows the relationship between free fatty acids and adsorption time

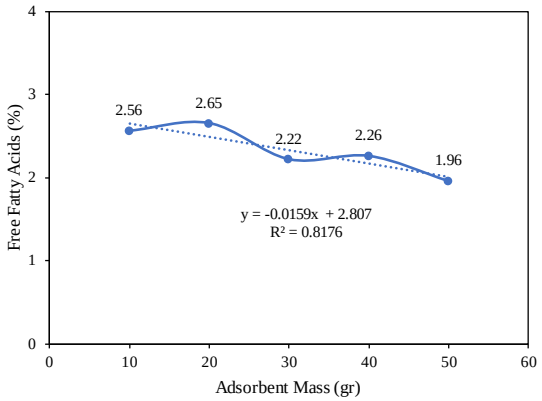

Figure 3. Effect of green tea dregs adsorbent mass on the number of free fatty acids in refined used cooking oil.

Figure 3 shows the greatest reduction in free fatty acids in an adsorbent mass of 50 gr for 200 ml of used cooking oil. The most optimal reduction in free fatty acid levels from the results of refining used cooking oil was obtained with a mass of 50 gr of adsorbent from 2.73% to 1.96% or a decrease of 38.13%, the reduction ability was 0.56%/g. The results of this research show that the greater the adsorbent mass used, the greater the decrease in free fatty acid levels in used cooking oil. Next, with an adsorbent mass of 50 grams, purification was carried out with varying contact times of 25 minutes, 45 minutes, 65 minutes, 85 minutes and 105 minutes.

Figure 4 shows that the FFA content is the smallest in used cooking oil that has been purified at a contact time of 105 minutes, amounting to 1.24%, which has decreased by 67.18%. The FFA content in unrefined used cooking oil is 3.79%. This shows that the addition of green tea dregs adsorbent plays a role in the fatty acid reduction process.

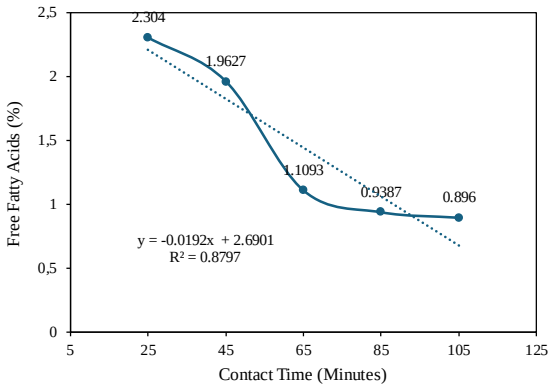

Figure 4. Relationship of adsorption time to free fatty acids in used cooking oil.

This happens because the cellulose in green tea dregs is able to adsorb free fatty acids in used cooking oil and the antioxidant content of catechins which can inhibit oxidation reactions because they have the properties of providing electrons (electron donors) and can bind free radicals.(Sudaryat, et al., 2015). Catechin derivative compounds which have the ability to prevent damage caused by free radicals and are antioxidants that are abundant and the most powerful, 200 times stronger than other antioxidants such as vitamins C and E (Mondal & De, 2018). Antioxidants in green tea dregs play an important role in inhibiting oxidative rancidity in food, preventing damage to unsaturated fatty acids and fat-soluble vitamins due to lipid peroxidation. From these results, the green tea dregs adsorbent has the opportunity to be used to purify used cooking oil.

The results of refining used cooking oil do not meet the SNI-7709:2019 cooking oil quality standards, because the free fatty acid number in the oil based on the cooking oil quality standards according to SNI-7709:2019 is a maximum of 0.3%.

Effect of Adsorbent Mass and Contact Time on Reducing Water Content

The water content in oil can cause a hydrolysis reaction. This reaction will produce free fatty acids due to the decomposition of oil or triglycerides. The free fatty acids formed can react further and form aldehydes and ketones which will trigger rancidity in the oil (Sulung, et al., 2019). This shows that high water content in oil will increase damage to the oil, so to improve oil quality you can reduce the water content in the oil.

Figure 5 shows the greatest decrease in water content for an adsorbent mass of 50 gr for 200 ml of used cooking oil. The most optimal reduction

in water content from the results of refining used cooking oil is obtained at an adsorbent mass of 50 g, namely from 4.25% to 0.32% or a reduction of around 92.35%, the reduction ability is 1.85%/gr. The results of this research show that the greater the adsorbent mass used, the greater the decrease in water content in used cooking oil.

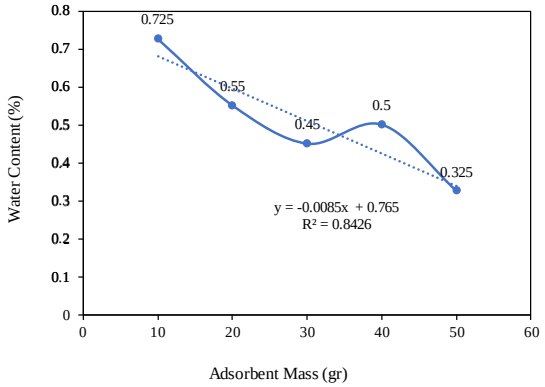

Figure 5. Effect of adsorbent mass on water content of used cooking oil.

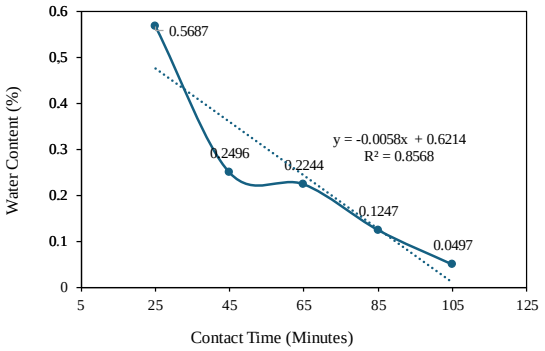

Figure 6. Relationship between adsorption time and water content of used cooking oil.

Based on Figure 6, there is a decrease in water content after absorption. Based on the picture, the longer the contact time, the lower the water content in the oil. After adsorption with an adsorption time of 105 minutes, the water concentration decreased. The lowest water content was 0.049714147%. Purifying used cooking oil with green tea adsorbent can reduce the water content in the oil. The greatest decrease in water content in used cooking oil was at 105 minutes, reduced to 98.83%, meets the requirements of Indonesian national standards of less than 0.10%. The longer the adsorption process, the longer the contact time between the oil and the green tea adsorbent, so that the adsorption process is more optimal.

This happens because the cellulose in green tea dregs is able to adsorb the water content in used cooking oil.The results of refining used cooking oil in mass variations do not meet cooking oil quality standards and the results of refining used cooking oil in variations in contact time do not meet cooking oil quality standards. Because the water content in the oil based on cooking oil quality standards according to SNI-7709:2019 is a maximum of 0.1%.

GCMS Results of Pineapple Peel Extract

Based on the results, pineapple peel extract has the form of a thick extract, dark brown in color, and has a distinctive pineapple odor. The extraction solvent determines the dye that is extracted. This is indicated by the extraction solvent. This is shown by the ethanol extraction solvent giving a blackish brown color. This shows that the polarity of the extracting solvent determines the type of dye pigment that is extracted. The effect of heat does not affect the extracted dye and this shows that heat does not damage the dye content in pineapple skin. The results of identification using the GCMS (Gas Chromatography Mass Spectrometry) method, the chemical content of pineapple skin contains the compounds in figure 7.

Results of Physical Quality Testing of Floor Cleaning Preparations

The results of the pH examination of the pineapple peel extract floor cleaner were carried out using a pH stick. The pH results of all floor cleaning soaps with pineapple peel extract meet the requirements of the 2017 Indonesian National Standard (SNI), namely the range 6-11 (BSN, 2017). Floor cleaning products have a pH that tends to be alkaline, this is because the basic ingredient in soap is NaOH, which is a strong base. A floor cleaning value that is too low can cause an increase in the absorption capacity of the skin, which can cause skin irritation, while a pH value that is too high can also cause skin irritation.

Table 2. Physical quality test results of pineapple peel extract floor cleaning preparations.

No	Amount of Extract	pH	Alkaline Free
1	2 ml	5	0.03285
2	4 ml	6	0.1095
3	6 ml	6	0.3285
4	8 ml	6	0.365
5	10 ml	7	0.4015

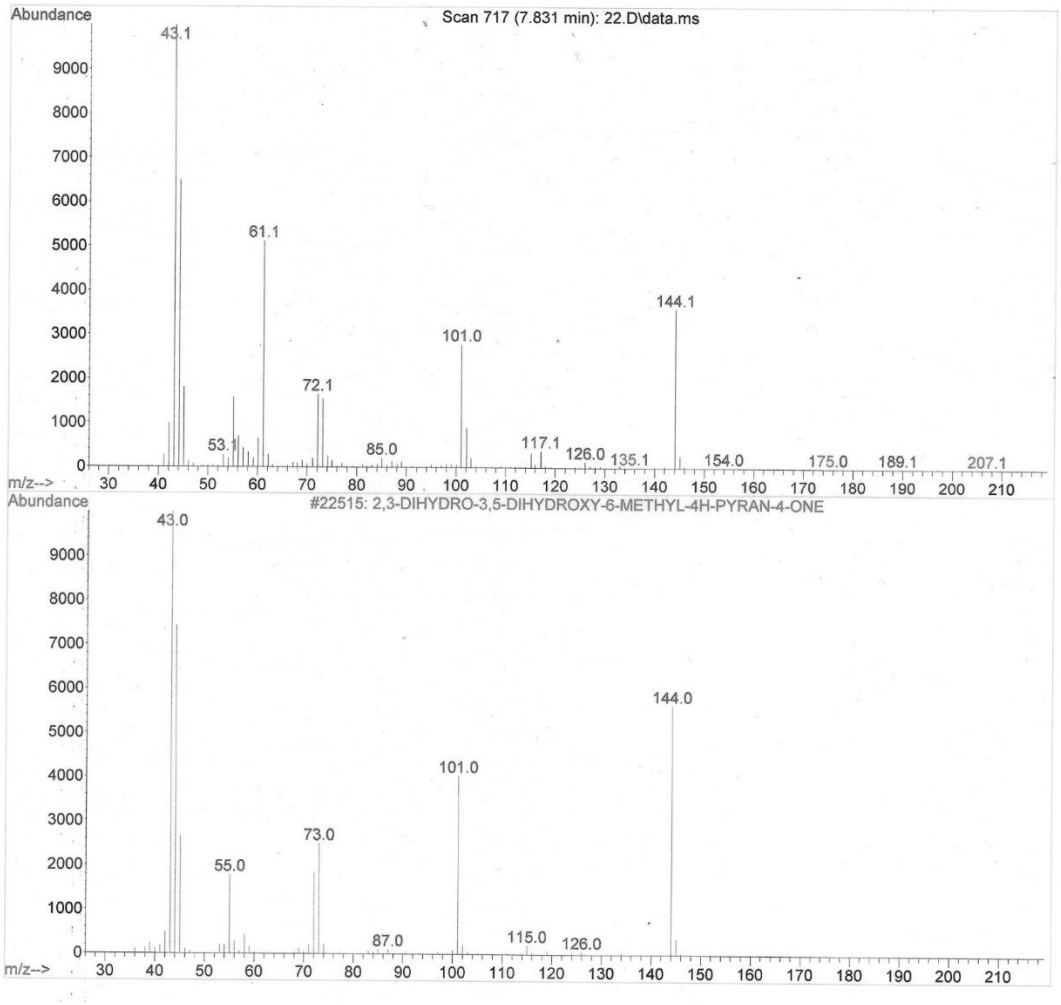

Figure 7. GCMS test results for pineapple peel extract.

Based on SNI, the standard for free alkali in floor cleaning soap is a maximum of 0.1%. This shows that the pineapple peel extract floor cleaning soap meets the requirements, namely the free alkali content in formula 2 (4 ml extract). The difference in the value of the free alkali content contained in the floor cleaning soap formula is due to the extract provided.

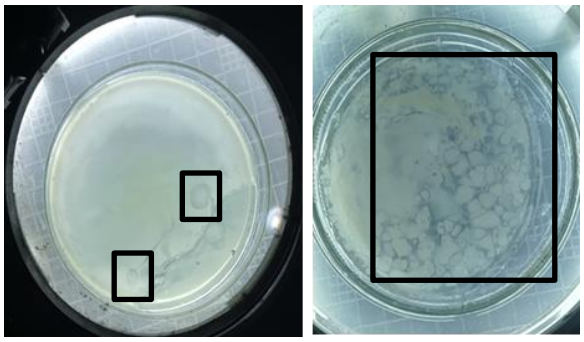

Figure 8. Anti-microbial contamination test (TPC method).

The results of purifying used cooking oil under these conditions were then made into a floor cleaning soap product with the addition of pineapple peel extract according to Figure 1 It was found that based on the pH and free alkali content of floor soap, it was best with the addition of 4 ml of pineapple peel extract. Figures 7 show a comparison of PCA that was given floor soap and that was not given floor soap. The results above show that those given floor soap had less microbial colony growth than those without floor soap

CONCLUSION

In this research, it can be concluded that green tea dregs, which is an organic waste, can be used as a solid adsorbent to reduce the water, peroxide and free fatty acid content in used cooking oil that is no longer suitable for consumption. Purification of used cooking oil using green tea adsorbent is optimal with an adsorbent mass of 50 gr and a stirring time of 105 minutes. Making floor

soap from refined used cooking oil with the addition of pineapple peel extract and it was found that the most optimal results were the addition of 4 ml of pineapple peel extract with a free alkaline number and a pH that met standards, as well as TPC test results which were proven to be able to prevent bacterial growth.

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