# The Usage of Waste Cooking Oil (Wco) In Production of Solid Dishwashing Soap with Split Gill Mushroom *(Schizophyllum commune)* Extract Addition

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**Abstract**
Disposal of waste cooking oil in an improper manner results in environmental pollution. This is very worrying because the disposal of waste cooking oil in waterways or rivers can endanger aquatic life as well as human water resources. This study aims to reduce the pollution of waste cooking oil by making it a solid dishwashing soap with the addition of split gill mushroom *(Schizophyllum Commune)* extract and to identify the effectiveness of the solid dishwashing soap based on physicochemical test and sensory test. Split gill mushroom extract was included as an additional ingredient because it has beta-glucan which is very good to maintain hand moisture. The physicochemical test result showed the value of total fatty matter (77.4%), total alkalinity (as CaCO3) (8.0%), free fatty acid (0.15%), free alkali (as NaOH) (<0.05%), content moisture (1.9%) and pH (10.34) of the solid dishwashing soap product. For the sensory test, a questionnaire was distributed randomly to 79 respondents at Politeknik Jeli Kelantan. The results were analyzed using SPSS (Mann-Whitney U Test) and it showed a significant difference between SchizoComm solid dishwashing soap and commercial solid dishwashing soap at the level of ($p < 0.05$). Moreover, this SchizoComm product gathers a lot of positive responses from the sensory evaluation in terms of odour, colour, foam, cleaning, moisture, and price compared to commercial dishwashing soap. It is hoped that this SchizoComm Solid Dishwashing Soap product can enter the market and attract the attention of the community in helping to reduce environmental pollution caused by improper disposal of waste cooking oil.

**Keywords:** Waste cooking oil, soap, split gill mushroom

## 1.0 Introduction

Waste cooking oil (WCO) is a type of domestic waste generated as the result of cooking and frying food with edible vegetable oil. WCO refers mainly to frying oil used at high temperatures, edible fat mixed in kitchen waste and oily wastewater directly discharge into sewers (De Feo et al., 2020) and it indirectly will cause pollution to our environment. Every year, there is

around 50,000 tons of waste cooking oil produced from vegetable oils or animal fats, are disposed of the environment without proper treatment in Malaysia (Daud et al., 2020).

In Malaysia, mostly waste cooking oil (WCO) is made from palm oil because it is much cheaper and easy to get or buy. Palm Oil can be used as an alternative to replace cleaning agents because generally, cleansing products use sodium lauryl sulphate (SLS) which acts as an anionic surfactant. SLS is an effective foaming agent, providing lots of bubbles and cleaning power (Bondi et al, 2015). High SLS concentration in products will causes irritation to your eyes, skin, mouth, and lungs especially for people with sensitive skin. In solving this problem, fatty acid salts are an option as a cleaning agent because it has hydrophilic and lipophilic groups (Cassiday, 2014). Fatty acid salts can be formed from the reaction of oils or fat with strong alkaline, which is known as saponification.

Many products are made from waste cooking oil (WCO) which is also welcomed openly by consumers because it is environmentally friendly and very safe to use. In addition, it also helps a little in avoiding environmental pollution where as we know oil is one of the materials that cannot be decomposed and by making it a product, it helps in reducing the pollution caused by cooking oil. WCO is a potential replacement for vegetable oils in the production of bio-diesel. Bio-diesel is synthesized by direct transesterification of vegetable oils, which is controlled by several inputs or process variables, including the dosage of catalyst, process temperature, mixing speed, mixing time, humidity and impurities of waste cooking oil that was studied in this case (Talebian et al., 2013.)

Waste cooking oil (WCO) also is a good candidate as a material to make soap. It is typically, cheaper than other oils. Combining the used cooking oil with lye (sodium hydroxide) and water, soap can be made. It takes about 2 to 4 weeks to harden and has to be left a few more days for the chemicals to completely mix and cool. This homemade soap is said to remove dirt more effectively than some of the brand soaps. It is also said to be less irritating to the skin. Instead of having to spend money on some costly soap, the locals can make soap for themselves and use it without any financial worries.

Solid dishwashing soap is a detergent used to assist in dishwashing. It is primarily used for cleaning dirty dishes to get rid of grease and leftover bits of food that could decay and host all sorts of bacteria. Many of the foods we eat are rich in oil and animal fats and protein which are not water-soluble. Running a greasy plate underwater are no used because the water will just be flowing off the plate. This is because water and oil do not mix. Therefore, its needed a substance that brings water and oil together and makes them easy to wash off. Solid dishwashing soap is generally requiring less water to produce and yield much less waste and unlike liquid dish soaps that come in plastic containers, solid dish soaps can easily be found in little to no packaging, often wrapped in recycled paper, cardboard, or nothing at all. For this reason, solid soap is popular among the zero-waste lifestyle set (Greyson, 2007).

Today's society more encouraging healthy lifestyle practices has highlighted split gill mushroom as one of the sources of health nutrition today. There are many benefits gained by adopting the use and diet based

on this split gill mushroom. Split gill mushroom containing schizophyllan which is a substance found in anti-tumor and anti-cancer drugs. Schizophyllan also known as β- (1-3) -D-glucan originate from the fungus that had a higher value in medical field and can increase anti-aging activities (Rathore, Prasad & Sharma, 2017). Other than that, it is said to be helpful in increasing the body immune system as well as anti-inflammatory, anti-bacteria, anti-parasites and help in protecting the skin.

The study found that the average protein content in split gill mushroom is 16% and fat content is 2%. The amino acid content is 34% lower than that of whole egg protein, with limited amino acid methrone (Khairul et al., 2017). The actual protein digestion (TDP) is around 53% for *Schizophyllum commune.* Oleic acid and linoleic acid make up 72-77% of total fat different mineral content may depend on habitat and variation. It is also related to the metabolism of fats and sugars in the human body. In addition, it also contains ergothioneine which is a natural antioxidant that can help protect the cells in the body. According to studies, split gill mushrooms were able to control hypertension and reduce cardiovascular disease (Abdullah, 2015). The high nutritional value of mushroom is the choice of entrepreneur in increasing the value of quality of split gill mushroom to the production of products such as dish soap, cosmetic product and food product (Ma et al., 2018).

There for, the combination between waste cooking oil and an extract from *Schizophyllum commune* are a best combo to produce a quality of soap. This study aims to produce an eco-friendly solid dishwashing soap made from waste cooking oil (WCO) and evaluate the efficacy of solid dishwashing soap based on physicochemical and sensory evaluation.

## 2.0 Material and Methods

Solid dishwashing soap infused with *Schizophyllum commune* extracted made from waste cooking oil were started by collected and pre-treatment of waste cooking oil. Next, dried the mushrooms using “tuff oven” followed by grinding process using hand grinder and ethanol extraction was processed from split gill mushrooms using rotary evaporator. Then, optimization of soap was made and a sample of the solid dishwashing soap from waste cooking oil was sent to Bio Synergy Laboratories to analyze the physiochemical evaluation of our solid dishwashing soap. A total of 79 random respondents among students of Polytechnic Jeli, Kelantan were selected to answer the question and evaluated the solid dishwashing soap infused with *Schizophyllum commune* extracted in terms of its texture, aroma, foam and packaging of the product (Figure 1).

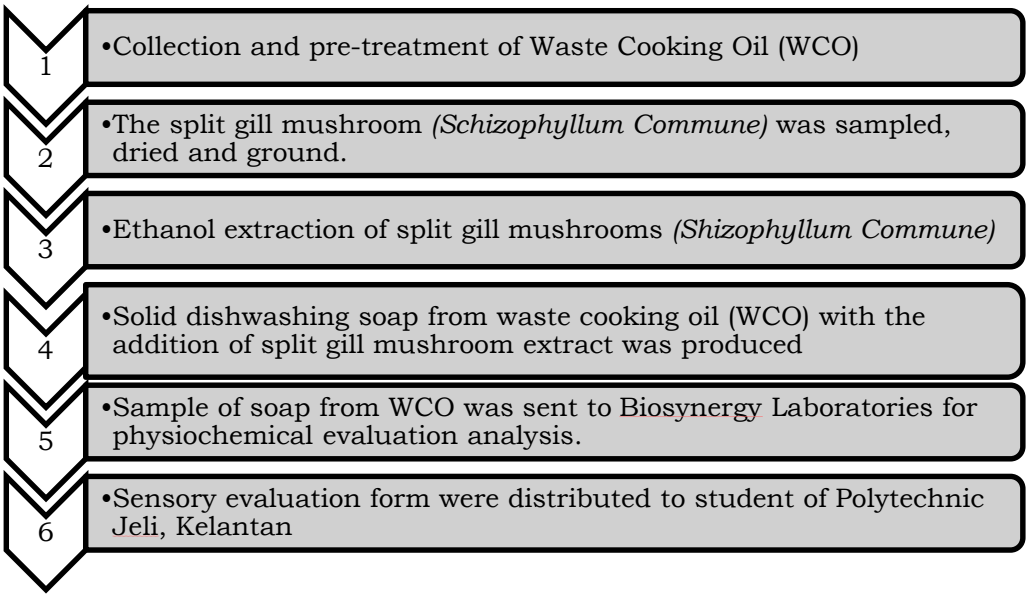



**Figure 1:** Preparation of Solid dishwashing soap from waste cooking oil (WCO) with the addition of split gill mushroom extract

### 2.1 Collection and pre-treatment of Waste Cooking Oil (WCO)

The sample of WCO was collected from various places such as households and cafeterias. WCO was filtered as preliminary treatment using a 250 µm metal strainer to remove food residue substances (Cárdenas et al., 2021). These filtration processes were repeated a few times. The filtrated WCO was heated to 60°C for three minutes to remove any water excess substances (Cárdenas et al., 2021). It was allowed to cool at room temperature for 24 hours. Then this filtrated WCO was poured into an airtight container for further usage.

### 2.2 Split gill mushroom (*Schizophyllum commune*) drying

Split gill mushrooms were purchased from nearby wet markets. After washing properly to remove any debris, it was dried using a tuff oven at 50°C for 48 hours (Wongaem et al., 2021). Then the dried split gill mushroom was grinded using a hand grinder until it turns to powder form. The ground of split gill mushroom was filtered using a sieve number 250µm and kept in a Durran bottle for subsequent use.

### 2.3 Ethanol extraction of split gill mushroom (*Schizophyllum commune*) (Kong et al., 2010)

For the maceration process, 25 g of split gill mushroom powder was added to 250 ml of 70% ethanol at room temperature (Kong et al., 2010). Then, the solution was shaken for 24 hours using an orbitary shaker at 150 rpm. The aqueous suspensions were filtered using Whatman No.1 filter paper. Extract of split gill mushroom was evaporated under reduced pressure using a rotary evaporator at 50°C for dryness (Auta, Naman & Hosea, 2018). .The evaporated split gill mushroom extract was stored in Durran bottle at room temperature.

### 2.4 Production of solid dishwashing soap from waste cooking oil with split gill mushroom (*Schizophyllum commune*) extract addition

Sodium hydroxide (NaOH) pellets weighing 26.58 g were added slowly to 62.02 g of water while continuously mixing the solution with a stirrer (Burleson et al, 2017). The NaOH solution was allowed to cool down to 40°C. Exactly 200 g of oil was heated to 40 °C and the NaOH solution was added slowly to the oil (Antonic et al., 2020). A stirrer was used to stir the mixture for approximately fifty minutes until it reached the trace stage then add soap colorant. The soap Mixture was poured into a steel pot for heating on a low flame. After ten minutes of heating, the soap mixture started to bubble over, the soap mixture was stirred gradually to avoid flooding the mixture. After twenty-five minutes of heating, the mixture reached the gel phase and started thickening (Antonic et al., 2020). Heating was continued for about fifteen minutes until the soap mixture became clear and translucent and add on split gill mushroom extract with berries essential oil. The soap was then transferred to a plastic container and left for curing for 24 hours (Sanaguano at al., 2018).

### 2.5 Evaluation of physicochemical properties of schizocomm solid dishwashing soap

A sample of solid dishwashing soap was analyzed by using standard procedures. Evaluated parameters were total fatty matter (TFM), total alkalinity (as $CaCO^3$), free fatty acid, free alkali (as NaOH), moisture content and pH value (AOAC, 2010).

### 2.6 Evaluation of sensory properties of schizocomm solid dishwashing soap

The sensory survey was conducted to determine the acceptability and feedback of SchizoComm solid dishwashing soap in terms of aroma, texture, foam, and product packaging from respondent. Questionnaires were distributed to 79 random students at Politkenik Jeli, Kelantan. Result from the questionnaire has been analyzed using SPSS (Mann- Whitney U test) to compare the significantly different between the two products which are sample A (SchizoComm solid dishwashing soap) and sample B (commercial dishwashing soap).

## 3.0 Result and Discussion

The production of solid dishwashing soap with split gill mushroom was successful.

### 3.1 Analysis of physicochemical properties of schizocomm solid dishwashing soap

Results of the physicochemical analysis are shown in Table 1:

**Table 1:** The results of physicochemical properties of SchizoComm solid dishwashing soap.

| Parameter | Results |
|---|---|
| Total Fatty Matter | 77.4% |
| Total Alkalinity (As $CaCO_3$) | 8.0% |
| Free Fatty Acid | 0.15% |
| Free Alkali (as NaOH) | <0.05% |
| Moisture Content | 1.9% |
| pH Value | 10.34 |

Total fatty matter and alkalinity are the most important characteristics describing the quality of soap and it showed that the total fatty matter must exceed 75% to get the best grade, quality and gentle to skin. The SchizoComm solid dishwashing soap is categorized under grade 1 based on a total fatty matter value that was 77.4%. Fatty substances inside soap become a measure of the suitability of the soap to the skin, producing foam which is many and most importantly to cleanse the skin better and softer. The total alkali content in this soap was 8.0% and it is higher compared to the standard value of the commercial washing soap in the range of 3-5%. According to Betsy et al, (2013), soaps with a high total fatty matter and a low alkali content have good quality.

The result for the Free Fatty acid (FFA) in the solid dishwashing soap was 0.15%. The free fatty acid content (FFA) or neutral fat is one of the most important criteria in the refining of edible oil. FFA is often used as an indicator of oil quality and suitability for human consumption (Antonić et al., 2020). In soap making, the fatty acids contained in the oil form alkaline salts which build up the soap structure. FFA added as natural additives can improve the fragrance, moisturisation, foam formation, or foam quality, reduce the odor and color stability in commercial soap.

The Free alkali (as NaOH) was found in this SchizoComm solid dishwashing soap was very low values namely <0.05%. In the current analysis, the free alkali was revealed to be between 0.00% and 0.62% for toilet soaps and between 0.14% and 0.99% for laundry soaps (Ashrafy et al., 2016). The free alkali is the amount of alkali that is free to counteract the soap and prevent it from becoming oily. It is indicating the abrasiveness of a soap. High amount of this substance in bath soap causes skin itching and on laundry soap causes the fabric to be damaged.

Moisture content is a parameter used to assess the shelf life of a product. There are no specific requirements for moisture content according to the national standard. It should be neither too high nor too low. The percentage moisture content of the solid dishwashing soap was found 1.9%. The lower moisture content in the present study could be due to a different formulation for soap making and the absence of substances or additives that

bind the water and support the moisturising effect (Antonić et al., 2020). The high moisture content promotes hydrolysis and changes in the soap itself. Some of the best soap manufacturers declare a maximum moisture content of 14% in their products (Betsy et al., 2013).

The pH of the SchizoComm solid dishwashing soap was found 10.34 and when compared to other studies, similar results showed for pH when testing soaps made from used cooking oils ranging from 9.96 to 11.30 (Sanaguano et al., 2018). The higher pH values indicate that the soaps analysed are corrosive to the skin. The use of high pH soap causes the pH of the skin to rise, leading to dehydration and alteration of the bacterial flora and ultimately to the development of skin diseases caused by microbes. On the other hand, most commercial soaps tested had a pH between 9 and 10 (Tarun et al., 2014).

### 3.2 Analysis of sensory properties of SchizoComm solid dishwashing soap

The results of the Mann-Whitney U-test analysis showed that there were significant differences in respondents' preference between SchizoComm solid dishwashing soap and commercial soap ($U = 2116.5$, $p < 0.05$) (Table 2 b.). By comparing the mean values of ranks between the two groups of respondents in the ranks table in the Mann-Whitney U-test results below, it is observed that the value mean rank of respondent's preference for SchizoComm solid dishwashing soap (mean = 92.21) over the mean respondents of commercial soap products (mean = 66.79) (Table 2 a.).

**Table 2:** Test results showed that there was a significant difference between the two groups of respondents on ($p \leq 0.05$)

**NPar Tests**

**Mann-Whitney Test**

a.

**Ranks**

| | Product | N | Mean Rank | Sum of Ranks |
|---|---|---|---|---|
| SensoryAll | SchizoComm | 79 | 92.21 | 7284.50 |
| | Commercial Product | 79 | 66.79 | 5276.50 |
| | Total | 158 | | |

b.

**Test Statistics[a]**

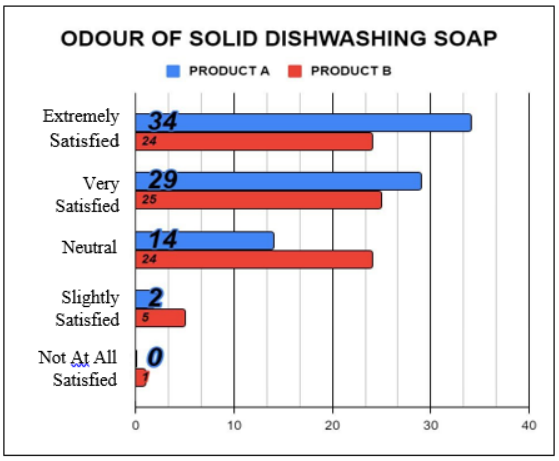
| | SensoryAll |
|---|---|
| Mann-Whitney U | 2116.500 |
| Wilcoxon W | 5276.500 |
| Z | -3.507 |
| Asymp. Sig. (2-tailed) | <.001 |

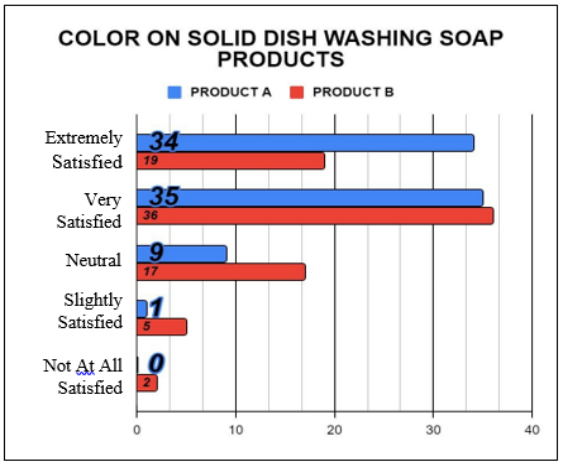
a. Grouping Variable: Product

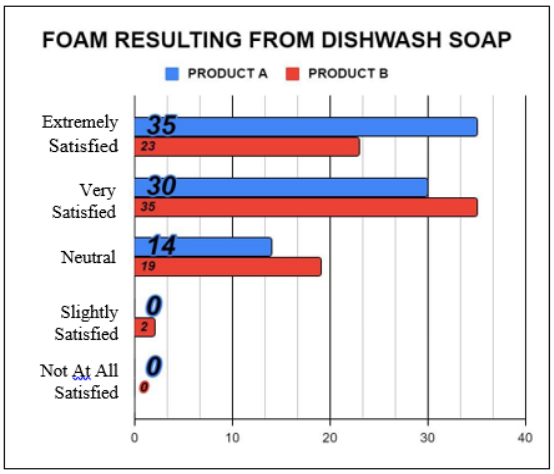
The graph below showed that respondents had a relatively strong satisfied for the product attributes of SchizoComm solid dishwashing soap (A) over the commercial soaps (B) in term of odor, color, moisture, foam, moisture, cleaning level and price (Figure 2). The appearance of the SchizoComm solid dishwashing soap, which is pink in colour with the addition of berry essential oil, which give a fragrant smell and reduce the smell of used cooking oil when it is used, were the most preferred soap. The added odour and color do not affect the function of the soap, but can increase consumer attraction and

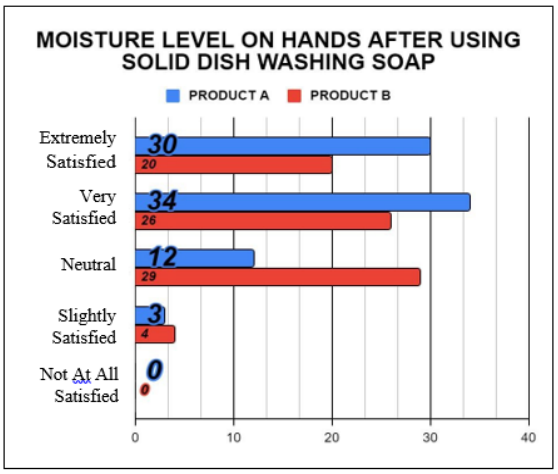
buying interest.

The majority of respondents like SchizoComm solid dishwashing soap that produce a lot of foam. According to Sany and Fahmi (2019), foaming on a soap is influenced by several factors, namely the presence of active ingredients such as surfactants, foam stabilisers and soap making materials such as the type of oil used. The test of moisture level is done by trying to wash hand with the soap. The respondents were preferred the SchizoComm solid dishwashing soap because it contain bioactive compounds such as β-1,3 and β-1,6 beta-glucan (Schizophyllan) which is really good at retaining moisture and soften the skin. The cleaning level of SchizoComm solid dishwashing soap was greatly affects the use of soap. This is because a lot of foam produced soap is one of the main properties that take part in soap cleaning properties. SchizoComm solid dishwashing soap is cheaper when compared to the price of other commercial soaps because using wasted cooking oil as as a low-cost raw material in the production of soap.



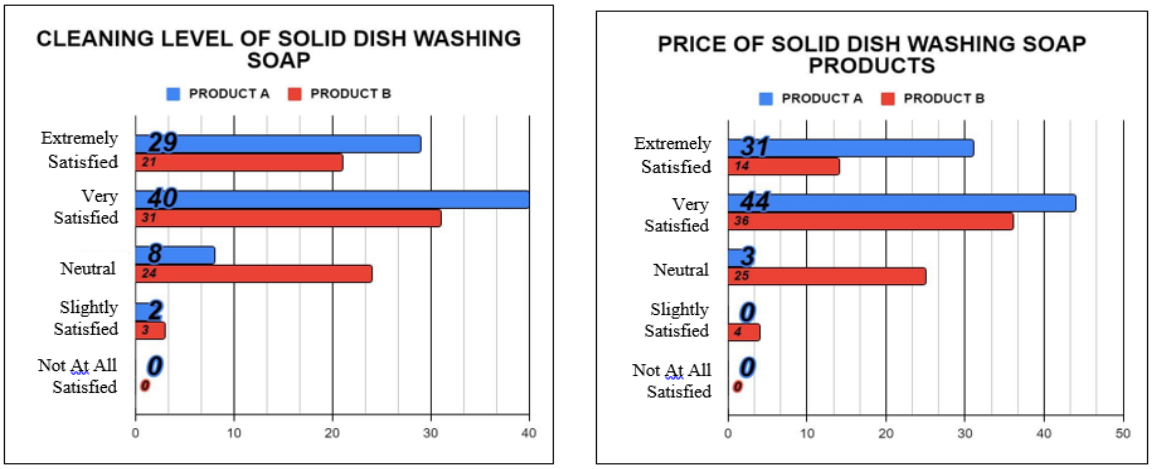



**Figure 2:** Bar chart of differences in respondents' satisfaction on the attributes of SchizoComm solid dishwashing soap (product A) and commercial soap (product B).

## 4.0 Conclusion

In this study, the use of waste cooking oil (WCO) as the main ingredient to produce solid dishwashing soap could provide a sustainable alternative to prevent improper disposal of WCO. The physiochemical evaluation shows that the SchizoComm soap is under Grade 1 based on the total fatty matter (TFM) which is better in quality in terms of cleaning and lathering characteristics. The sensory results from the respondents indicated this soap is well received in term of in terms of odour, colour, foam, cleaning, moisture, and price and has the potential to be commercialized.

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