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# **The Recovery of Waste Cooking Oil using Natural Antioxidants from Mangosteen Peel**

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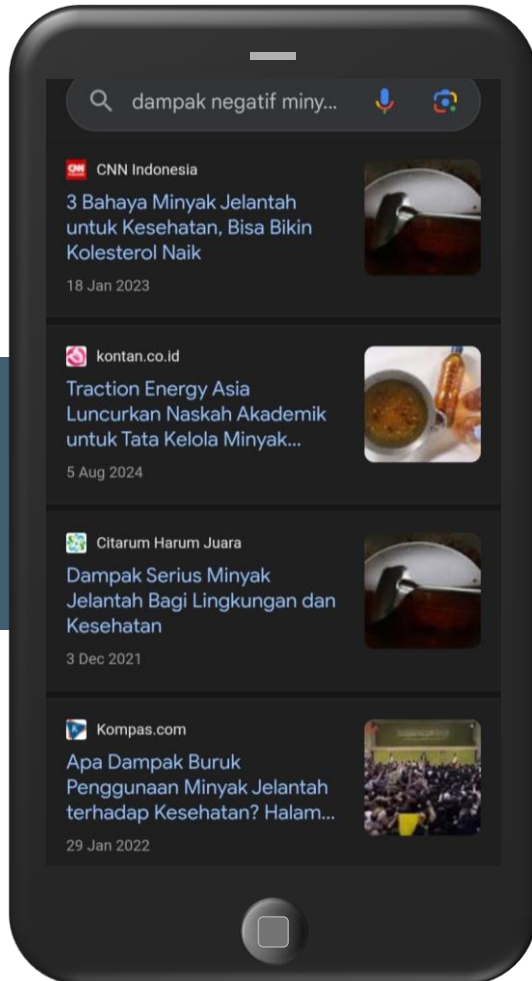
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INTRODUCTION

# IS WASTE COOKING OIL DANGEROUS??



## ISSUE WITH WASTE COOKING OIL

Waste cooking oil can cause several health risks such as carcinoma because it contains peroxide compounds and fatty acids that is alleviated due to auto-oxidation caused by reheating the oil over and over again.

## SIGNS OF DAMAGE IN WASTE COOKING OIL

**Peroxide Number:** The higher the peroxide number the greater damage of the waste cooking oil. The number shows the level of oxidation, with the safe limit as of <10 meq/kg.

**Acid Number:** Shows the amount of fatty acid; the higher the amount means the lower the quality of oil.

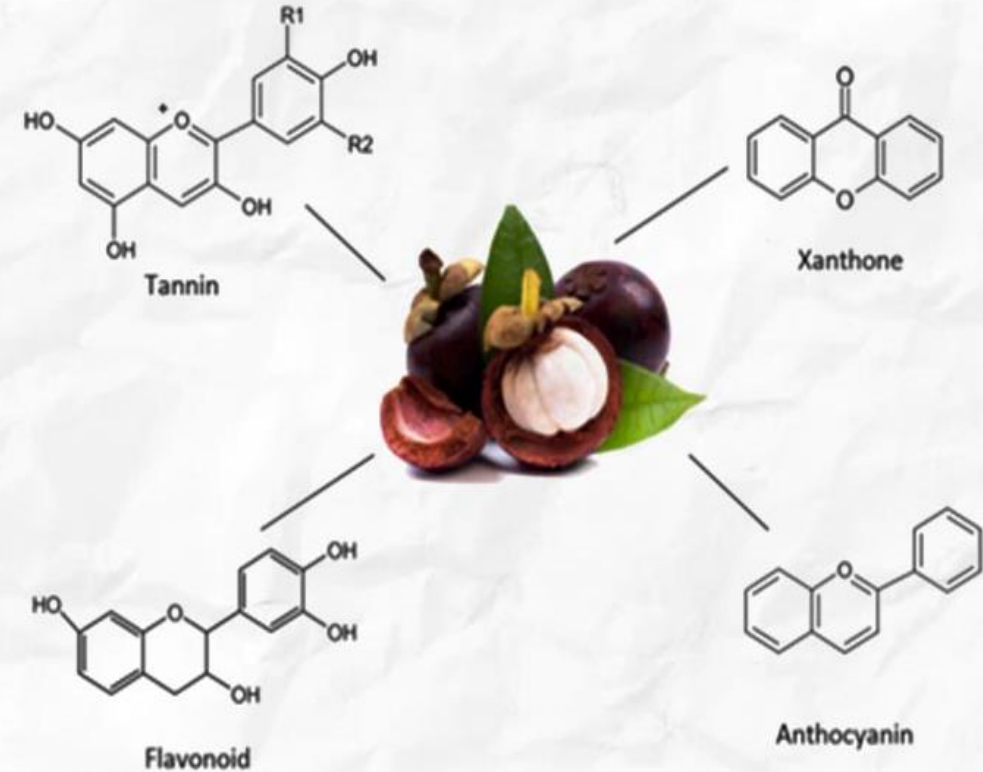
## Attempts to Lower The Peroxide Number from Previous Research:

- Soursop leaves 30% b/v for 7 days: Lowering the peroxide number from 20,67 mg O<sub>2</sub>/100g (Tupamahu et al., 2019).
- Papaya leaves 10% for 5 days: Lowering the peroxide number up to 52,16% (Wardoyo, 2018).
- Ajwa date seeds 10% b/v for 24 hours: Lowering the peroxide number up to 17,96% (Aslifa, 2017).

## THE POTENTIAL OF MANGOSTEEN PEEL

Mangosteen peel is rich on flavonoid, tannin, and xanthone (40 types), especially  $\alpha$ -manggestin, serving as antioxidant reducing the oxidation process and damage to waste cooking oil

### Beneficial Compounds in Mangosteen Peel



# PURPOSE OF THE STUDY

To test the effectivity of mangosteen peel extract to lower the peroxide number and acid in waste cooking oil, to provide health benefits through the recovery of waste cooking oil.





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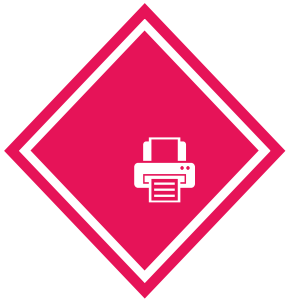
The research materials cover the mangosteen peel taken from Sumowono Region, Semarang. The waste cooking oil is taken from household waste in Semarang City. Chemical substances being used is ethanol, 2,2-Diphenyl-1-picrylhydrazyl (DPPH),  $\text{CHCl}_3$ , KI,  $\text{Na}_2\text{S}_2\text{O}_3$ , Diethyl Ether and NaOH from Merck (*pro analysis*).



**RESEARCHS**  
MATERIALS

# WORKING PROCEDURE

## Measurement of Antioxidant Activity



A total of 0.05 grams of mangosteen peel samples were carefully weighed, then dissolved into 1 mL of 70% ethanol using a test tube.



The mixture is then homogenized for 10 minutes at room temperature, and left for 12 hours in an airtight room. The sample is then centrifuged until a supernatant is obtained.



The supernatant obtained is then pipetted as much as 1 mL into the test tube and added 1 mL of DPPH and 3 mL of 70% ethanol, then mixed using a vortex for 1 minute.



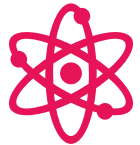
The samples were then incubated at an opaque room temperature for 30 minutes, then the absorbance was read using a spectrophotometer at a wavelength of 517 nm. The same treatment is done on the controls.



The activity of sample antioxidant was obtained by reducing the absorbance of the blanks against the sample, then compared with the absorbance of the blanks and expressed in % of RSA.



# Determining Peroxides Number



A total of 5 grams of waste cooking oil sample was put into Erlenmeyer



The sample was then added 30 mL of distilled water, and whisked until homogeneous



The number of peroxides obtained is expressed in mg O<sub>2</sub>/100g

Add 30 mL of solvents (CHCl<sub>3</sub> and CH<sub>3</sub>COOH) and 0.5 mL of saturated KI then let it sit for 30 minutes in a dark place



Next, it was titrated with Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> 0.01 N using the amylum indicator until the right blue color disappeared.





# Determining Acid Number

A total of 10 grams of waste cooking oil samples were dissolved using 25 mL of diethyl ether and 25 mL of 95% neutral ethanol.



A 1% PP indicator was added to the sample, then titrated using NaOH 0.1 N until a constant pink color is achieved.



The acid number of waste cooking oil is expressed in mg KOH/g



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RESULT AND DISCUSSION

# Antioxidant Activity

**Table 1 Mangosteen peel antioxidant activity**

Sample	antioxidant activity (% RSA)
1	36,61 ± 0,28
2	38,56 ± 0,11
3	35,28 ± 0,36
4	36,44 ± 0,09
5	37,95 ± 0,74
Average	36,97 ± 1,16

Mangosteen peel antioxidant activity in the research is determined by using free radical deterrence methods or commonly known as **DPPH assay**. **DPPH** method is the most simple and common analysis used to evaluate the antioxidant activity of plants.

The average value of antioxidant activity is influenced by several factors, such as the source of the plant, the level of ripeness of the fruit, and the extraction method used.



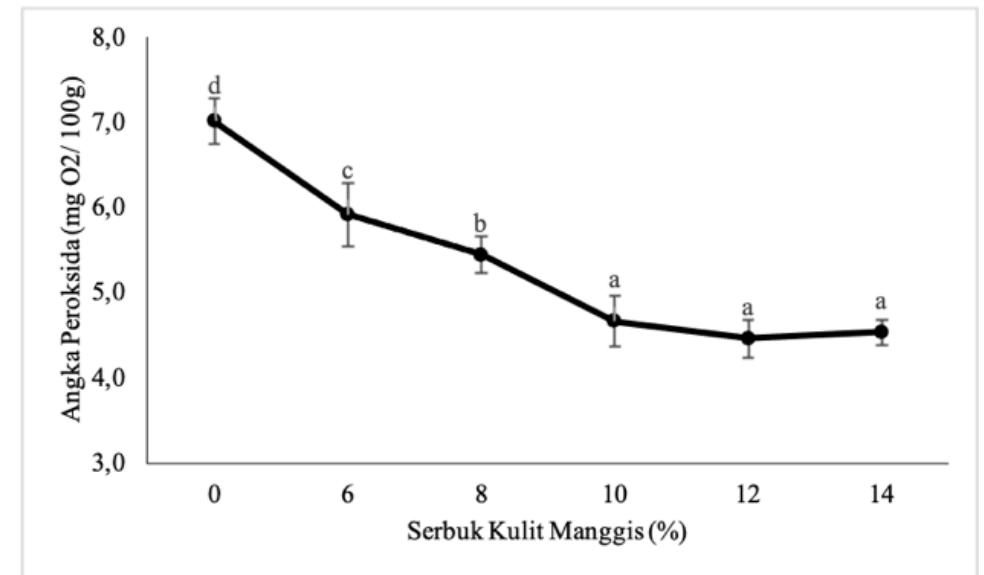
# Peroxides Number



Waste cooking oil has a high peroxide number (7.02 mg O<sub>2</sub>/100g), which indicates oxidation shown by a rancid smell and taste. This oxidation process is triggered by unsaturated chains in triglycerides which are accelerated by light, heat, heavy metals, and peroxide compounds (Ketaren, 2012; Nawar, 1996).

The addition of mangosteen peel powder as an antioxidant can significantly lowered the peroxide rate to 4.39–5.92 mg O<sub>2</sub>/100g. The xanthone in mangosteen peel functions as a powerful antioxidant, reducing oxidation and lowering the peroxide number in waste cooking oil. The more mangosteen peel powder added, the greater the decrease in the peroxide numbers.

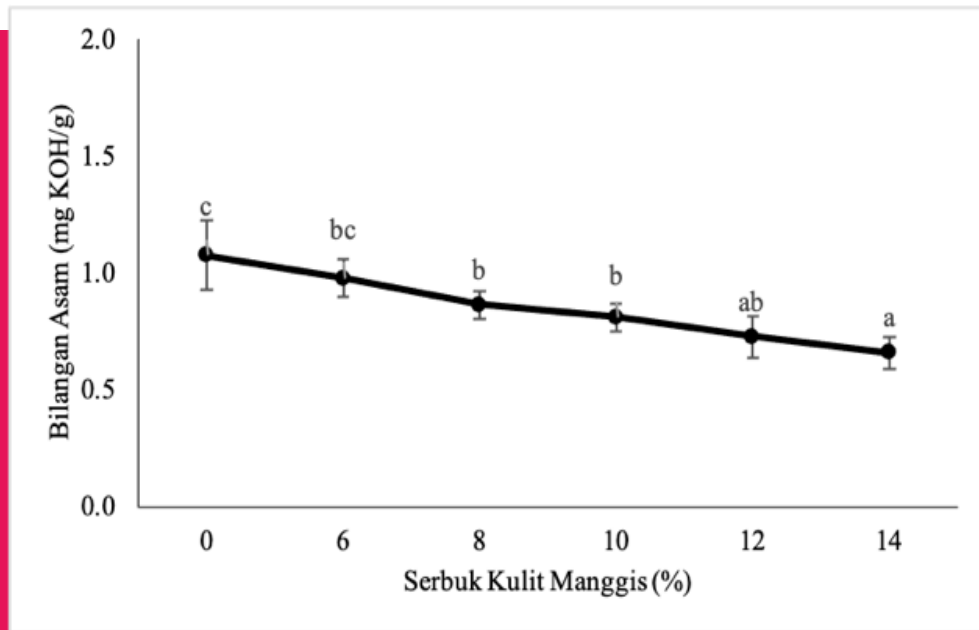
**Picture 1 Peroxides Number of Cooking Oil**





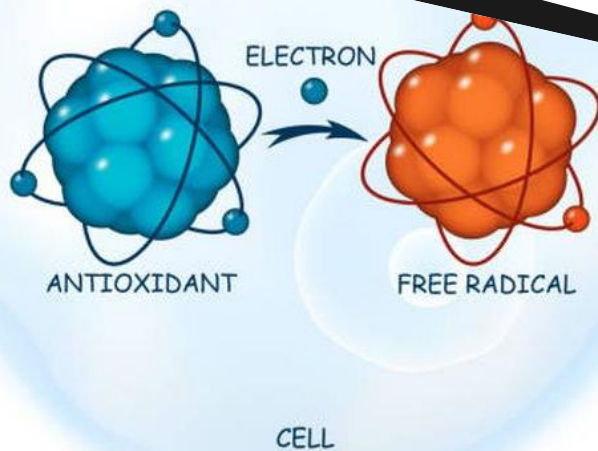
# Acid Number

**Picture 2 Acid Number of Cooking Oil**

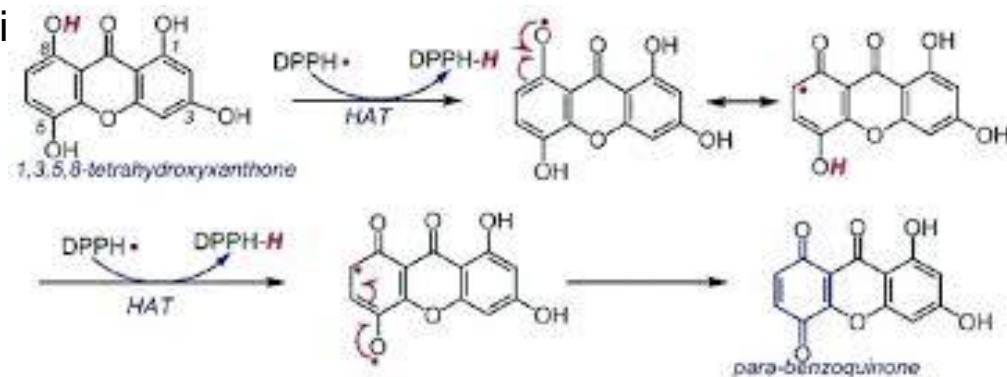


- Waste cooking oil has a high acid number (1.08 mg KOH/g), indicating a large content of free fatty acids due to the hydrolysis of triglycerides during repeated heating (Suroso, 2013; Widayat et al., 2006).
- The addition of antioxidants from mangosteen peel was able to reduce the acid number to 0.66–0.98 mg KOH/g, with an optimal decrease in the concentration of 14% of mangosteen peel. An increase in mangosteen peel extract was shown to significantly reduce the number of acids, inhibiting the formation of free fatty acids through reduced oxidation and hydrolysis of the oil (Marlina & Ratnawati, 2015).

# The Role of Antioxidants in Decreasing Peroxide and Acid Numbers



- **Natural Antioxidants:** Mangosteen peel extract contains xanthone compounds, tannins, and flavonoids working as natural antioxidants. These compounds inhibit the oxidation process by neutralizing free radicals, which helps to lower the peroxide and acid numbers in waste cooking oil.
- **Xanthone Antioxidant Mechanism:** Xanthone can act as a hydrogen donor for free radicals so that it can stop the oxidation chain reaction. This mechanism is important in reducing the damage of waste cooking oil and making





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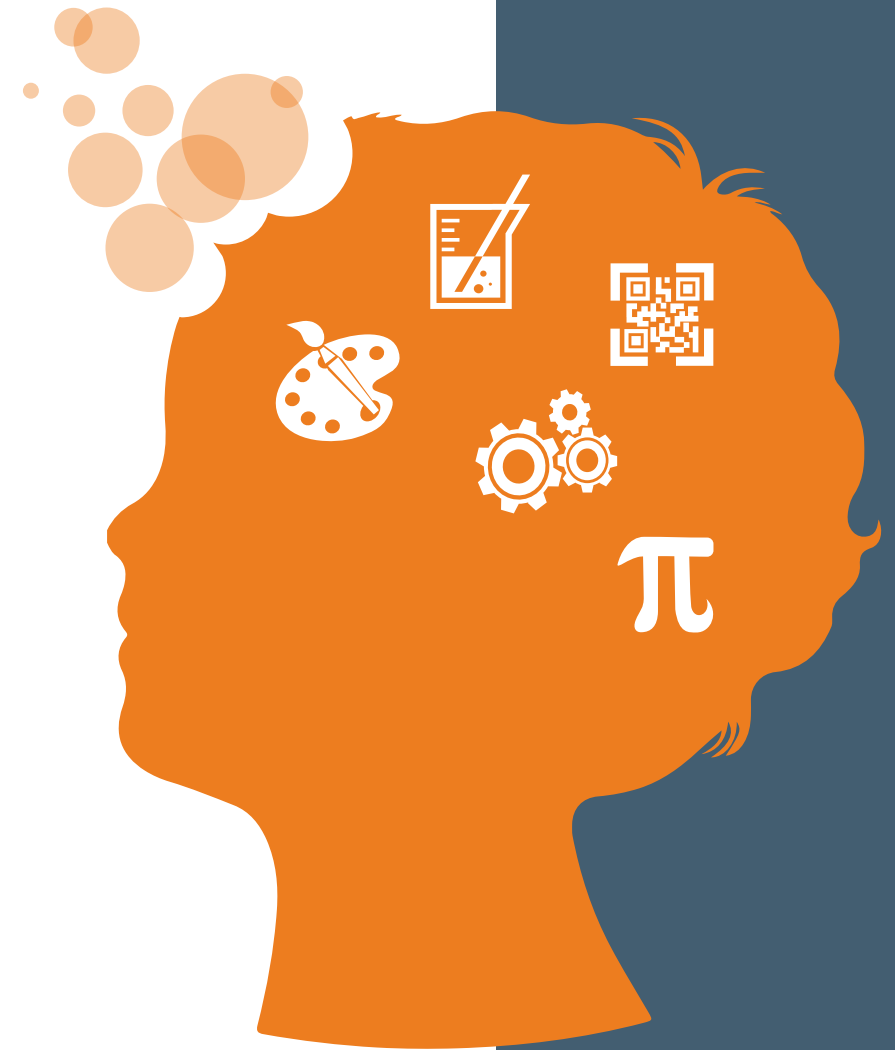


CONCLUSIONS



# CONCLUSION

Mangosteen peel powder contains antioxidant activity of 36.97 %RSA. The addition of mangosteen peel powder by 12% was able to significantly improve the quality of waste cooking oil through a decrease in peroxide number and acid number.



## Application of Recovered Waste Cooking Oil

### Soap and Detergent Production

Waste cooking oil contains fatty acids that are suitable for making soap through the saponification process, in which the oil is heated with an alkaline solution (usually NaOH or KOH) to produce soap and glycerin. With additional refining, waste cooking oil can be used to make hand soap, bath soap, or dish soap. Soap products from waste cooking oil are generally more affordable, environmentally friendly, and easy to produce by small industries and households.





## Application of Recovered Waste Cooking Oil

### Natural Cosmetics and Skin Care Products

In natural cosmetics, pure waste cooking oil can be further processed to produce glycerin, the basic ingredient of moisturizing products and beauty soaps. Proper processing can separate glycerin from unwanted components of the oil. Glycerin from waste cooking oil is often used as a moisturizer in cosmetic products and lotions, with hygienic processing that ensures it is free of contaminants.



## Application of Recovered Waste Cooking Oil

### Biodiesel Fuel

Waste cooking oil refined and converted into biodiesel is one of the most popular and sustainable ways of its utilization. This process involves transesterification, which is converting waste cooking oil into an alkyl ester, such as methyl ester. Biodiesel from waste cooking oil has been proven to have lower carbon emissions than diesel from fossil fuels, making it more environmentally friendly and at the same time supporting the reduction of greenhouse gas emissions. This biodiesel can be used in conventional diesel engines, both in the transportation sector and in power plant.



## Application of Recovered Waste Cooking Oil



### **Lubricants for Non-Food Machinery and Equipment**

After processing that removes harmful residues and contaminants, waste cooking oil can be used as a lubricant for machines that do not interact directly with food products, such as lubricants for chains, hinges, and agricultural tools. In some industries, it is used as a hydraulic lubricant or a more affordable cutting oil, although its lubricating properties are still less than synthetic lubricants.

## Application of Recovered Waste Cooking Oil

### Compost or Additive for Organic Compost

Waste cooking oil can be used in compost production after neutralizing the excessive free fatty acid. This oil can be an additive that increases the energy content in the compost, speeds up the composting process, and increases the content of beneficial soil microorganisms. Its use must be in limited quantities, so as not to create a hydrophobic layer in the soil that can inhibit water infiltration.





# Environmental and Economical Benefits of Using Recovered Waste Cooking Oil

## Environmental Benefits

- Reduce soil and water pollution.
- Prevents clogging of water lines.
- Reduces greenhouse gas emissions.
- Suppressing deforestation from the demand for new palm oil.
- Saving water resources and maintaining air quality.

## Economical benefits

- Economical raw materials for biodiesel.
- Opening opportunities for small and medium enterprises (soap, wax, biodiesel).
- Reduce waste disposal costs for industry.
- Providing additional income for the community.
- Increase the economic value of recycled products.
- Reduce household spending on certain products.
- Creating jobs in green industries.
- Supporting local and regional economies.
- Reduce dependence on petroleum.
- Potential to get incentives or subsidies from the government.





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