The Effect of Raja Banana Peel Extract on Acid and Peroxide Numbers in Bulk Frying Oil

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Abstract. Bulk frying oil has been generally under the standardised quality in SNI 3555-1998 since it is not packed and is easy to be oxidised. The research was to apply raja banana peel extract that contained natural oxidant such as flavonoid to enhance the quality of bulk frying oil. The raja banana peel extract was obtained by maceration method using methanol and ethyl acetate. The weight of extract applied to the bulk frying oil was 1; 1.5; 2; 2.5 grams, with stirring time for about 40 minutes. The samples were then analysed to identify the contents of both acid and peroxide numbers. The best result was attained by applying 2.5 grams of the extract with 40 minutes of stirring time, which resulted in the acid number of 0.27938 meq/kg and peroxide number of 1.99668 meq/kg.

1. Introduction
Frying oil has been proven essential for Indonesian due to the increase in its demand, which causes higher price periodically. Consequently, people with low economic income instead choose bulk frying oil since it is more affordable for them. However, the quality of the existing bulk frying oil is distant from its standard, which is more of bad quality and not hygiene. Since the package is not fulfilled the packaging standard, bulk frying oil is more natural to be oxidised that further produces bad smell.

There are various ways to enhance the quality of bulk frying oil. The previous study found that mangosteen (Garcinia mangostana L.) peel extract was additionally used to improve iodide numbers because it contained a natural substance named xanthone. Besides, the addition of antioxidant that can adjourn or prevent free radicals oxidation in lipid oxidation obtained from Raja banana (Musa paradisiaca sapientum) peel extract. Raja banana peel contained a beneficial natural antioxidant, of which the antioxidant substance was called flavonoid [9]. However, this present research used Raja banana peel extract to regenerate the quality of bulk frying oil on acid, iodide, and peroxide numbers. Moreover, the use of Raja banana peel as the main ingredient of the extract, at the same time, responded to the application of the recycle process to decrease banana peel waste. This research also proved that Raja banana peel waste could be processed into different benefits, not only becoming an animal feed.

2. Literature Reviews
2.1 Frying Oil
Frying oil consists of fat originated from the purification process of plant’s or animal’s part, or from a synthetic method that is further purified and used to fry foods [12]. Good frying oil is that by
Indonesian National Standards (SNI). Table 1 shows the standard of frying oil regarding SNI 3555-1998.

Table 1. Standardised Frying Oil according to SNI 3555-1998

| No. | Aspects to Test | Unit       | Requirement |
|-----|----------------|------------|-------------|
| 1   | Color          | -          | Yellow      |
| 2   | Smell and taste| -          | Normal      |
| 3   | Acid number    | Meq/kg     | Max. 0.3    |
| 4   | Iodide number  | Meq/kg     | <5          |
| 5   | Peroxide number| Meq/kg     | Max. 2      |
| 6   | Water          | %          | 0.3         |

A good frying oil should consist of more unsaturated fatty acids than the saturated ones [12]. The fatty acids contained in a frying oil determine its oil quality because the acids define chemical properties and oil stability [6]. Table 2 shows different fatty acids contained in vegetable oil [3].

Table 2 Fatty Acids Composition based on Three Types of Vegetable Oil

| Fatty Acids | Number of Atom C | Palm Oil (%) | Oil Core (%) | Coconut Oil (%) |
|------------|------------------|--------------|--------------|-----------------|
| Saturated Fatty Acids: |
| Octanoate | 8                | -            | 3-4          | 5.5-9.5         |
| Decanoate | 10               | -            | 3-7          | 4.5-9.5         |
| Laurate   | 12               | 0-0.3        | 46-52        | 44-52           |
| Myristate | 14               | 0.9-2.5      | 14-17        | 13-19           |
| Palmitate | 16               | 40-46        | 6.5-9        | 7.5-10.5        |
| Stearate  | 18               | 3.6-5.7      | 1.2-5        | 1.0-3.0         |
| Unsaturated Fatty Acids: |
| Oleat      | 18               | 39-45        | 13-19        | 5-8             |
| Linoleate  | 18               | 7-12         | 0.5-2.0      | 1.5-2.5         |
| Linolenate | 18               | 1            | 1-5          | -               |

2.2 Antioxidant

An antioxidant is a molecule that can postpone, decelerate, or prevent other particles oxidation process [10]. It can decelerate oxidation reaction or stop the chain reaction of the free radicals from oxidised oil (absorption of free radicals) [7]. There is four reaction mechanism including:

1. Releasing hydrogen from antioxidant
2. Releasing electron from antioxidant
3. Adding fat to the aromatic ring on antioxidant
4. Creating complex compounds between fat and aromatic ring from antioxidant.

The following states the reaction stages of fat or oil oxidation:

Lipid Radical Initiation: \( \text{RH} + \text{O}^\cdot - \text{O}^\cdot \rightarrow \text{R}^\cdot + \text{OOH} \)

Peroxide formation: \( \text{R}^\cdot + \text{O}^\cdot - \text{O}^\cdot \rightarrow \text{ROO}^\cdot \)
\( \text{ROO}^\cdot + \text{RH} \rightarrow \text{ROOH} + \text{A}^\cdot \)

Propagation: \( \text{ROOH} \rightarrow \text{RO}^\cdot + \text{OH}^\cdot \)

Termination: \( \text{RO}^\cdot + \text{X} \rightarrow \text{inactive product} \)

The addition of antioxidants can stop oxidation reactions because the stable energy compounds are accommodated by antioxidant. The following example shows the mechanism of adding an antioxidant to the oil oxidation process:

\( \text{RH} + \text{AH} \rightarrow \text{RH} + \text{A}^\cdot \)
\( \text{ROO}^\cdot + \text{RH} \rightarrow \text{ROOH} + \text{R} \)
The addition of antioxidant (AH) with low lipids concentration can prevent oil oxidation reactions that block the oxidation reaction at the initiation and propagation stages [5].

Raja banana (Musa paradisiaca sapientum) is included in Musaceae family that has many benefits, not only the flesh but also the peel. Banana peel has high nutrition especially for Raja banana peel [1]. Table 3 and 4 show the nutrition, vitamin, and antioxidant consisted in Raja banana peel. Meanwhile, Table 5 shows the test result of antioxidant content in Raja banana peel extract.

| Parameter                     | Concentration (%) |
|-------------------------------|-------------------|
| Organic material              | 91.50 ± 0.05      |
| Protein                       | 0.90 ± 0.25       |
| Crude lipid, Carbohydrate, Crude fiber | 1.70 ± 0.10      |
| Organic material              | 59.00 ± 1.36      |
| Protein                       | 31.70 ± 0.25      |

| Components                    | Concentration (%) |
|-------------------------------|-------------------|
| Vitamin E (mg/kg)             | 1.07 ± 0.06       |
| Saponin (g/100 g)             | 0.12 ± 0.01       |
| Flavonoids (mg/100 g)         | 5.27 ± 0.47       |

| Seconder Metabolite           | Result (mgr/gr)   |
|-------------------------------|-------------------|
| Flavonoid                     | 90.56             |
| Saponin                       | -                 |

Generally, antioxidant compounds have a similar core structure covering the benzene ring that consists of hydroxide or amino [7]. Flavonoid is a natural antioxidant included in the phenolic compound cluster that can give one or more hydrogen atoms to free radicals caused by an oxidation process so that free radicals’ activities can be oppressed [8].

3. Methods
This research began with analysing the quality of bulk frying oil regarding the acid, peroxide, and iodide numbers. Afterwards, making Raja banana peel extract was conducted by using the maceration method equipped with methanol solvent and ethyl acetate. Figure 1 shows the procedure of employing the maceration method while Figure 2 depicts free radicals absorption utilizing the addition of a natural antioxidant.
4. Results And Discussion
Revealing acid, peroxide, and iodide numbers were significant to investigate the quality of frying oil. This research aimed at examining how Raja banana peel was able to regenerate the quality of bulk frying oil since it contained flavonoid as many as 90.56 mgr./gr. [3].
Table 6 Analysis Results of Bulk Frying Oil

| Parameter          | SNI               | Result     |
|--------------------|-------------------|------------|
| Acid number        | Max. 0.3 meq/kg   | 0.71836    |
| Iodide number      | <5 meq/kg         | 1.76192    |
| Peroxide number    | Max. 2 meq/kg     | 2.12660    |

In the beginning, this research made *Raja* banana peel extract and analysed bulk frying oil to reveal whether its quality met the SNI 3555-1998 or not. Table 6 shows that the analysis results of bulk frying oil did not achieve the standardised quality of SNI 3555-1998 so that the addition of antioxidant was necessary to regenerate the quality.

**Figure 3.** The relationship between the weight of Raja banana peel extract with the acid number

The acid number in the bulk frying oil showed that the oxidation process caused the present free fatty acids. By the high acid number contained, the frying oil’s quality decreased or was damaged. According to Table 6, the acid number of the bulk frying oil remained unstandardized namely SNI + 0.71836 meq/kg. After being given *Raja* banana peel oil amounted to 1 gram, the acid number decreased up to 0.333 meq/kg. Figure 3 confirms the more the peel given to the bulk frying oil; the more decreased the acid number. For instance, 2.5 grams of Raja banana peel extract could decrease 61.2% of the acid number.

Besides the acid number, it was also essential to look at the peroxide number. This number was to determine the degree of the damaged oil or the fat. Unsaturated fatty acids might bind oxygen in the double bond that produced peroxide. Figure 4 shows the relationship between *Raja* banana peel extract and the various exciting time variables.

**Figure 4.** The relationship between the weight of Raja banana peel extract and peroxide number
Analysis result portrayed that the initial peroxide number of bulk frying oil before the addition of Raja banana peel extract was 2.12660 meq/kg. However, when 1 gram of Raja banana peel extract was added to the bulk frying oil, there was a decrease of the peroxide number amounting 2.0764 meq/kg. That is, the addition of Raja banana peel extract could decrease the peroxide number contained in bulk frying oil. The created peroxide compounds could be oppressed by using natural antioxidant from Raja banana peel extract. For instance, 2.5 grams of the extract could decrease the peroxide number from 2.12600 meq/kg to 1.9966 meq/kg. Thus, the decrease was about 6.24%.

The decrease of the acid and peroxide numbers were caused by the activity of antioxidant produced by Raja banana peel extract. Phenolic compounds contained in the extract could oppress the creation of free fatty acids caused by the oxidation process. The phenolic compounds also could prevent the oxidation process by using atom H that bonded peroxide groups, which resulted in more stable compounds.

5. Conclusion
The addition of Raja banana peel extract on bulk frying oil can enhance the oil quality. The best result is by giving 2.5 grams of Raja banana peel extract with the acid number 0.27938 meq/kg or decreased peroxide up to 1.997 meq/kg.

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