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Original Article

Analysis of Vitamin A Content and Antioxidant Test in Super and Bulk Olein

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Abstract: Cooking oil plays an important role in supporting the body's health. Cooking oil is required to contain vitamin A to support the government's program in addressing vitamin A deficiency in the Indonesian population. Cooking oil contains antioxidant compounds that inhibit or slow down oxidation reactions. This study aimed to analyze the vitamin A and antioxidant contents of super olein and bulk olein before and after fortification. The vitamin A content was measured using the High-Performance Liquid Chromatography (HPLC) method, yielding a result of <0.0015 mcg. The antioxidant test was conducted using the 2,2-Diphenyl-1-picrylhydrazyl (DPPH) method with ultraviolet-visible spectrophotometry (UV-Vis). The resulting antioxidant activity showed inhibition values of 23 % for bulk olein and 10 % for super olein.

Keywords: *antioxidant, DPPH, HPLC, olein, vitamin A*

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INTRODUCTION

Palm oil (*Elaeis guineensis* Jacq.) is a plant that produces vegetable oil, which is widely used in the household sector, food industry, cosmetics, and biofuels (biodiesel) [1]. Oil palm fruit weighs between 3 and 40 kg, with each cluster comprising 10-20 g of flesh, fruit, fiber, husk, and kernel [2], [3]. Palm oil is a major commodity in the Indonesian plantation sector, where Indonesia is the world's leading palm oil producer [4], [5]. Palm oil plants have many advantages, including the fact that the flesh and kernels of palm fruits can be extracted to produce cooking oil [6].

There are two important components in cooking oil: vitamin A, as a form of fortification in one of the food ingredients, and antioxidant compounds (such as tocotrienols, tocopherol, phytosterol, and coenzyme Q10). Vitamin A is a crucial nutrient with a significant role in human health. Vitamin A deficiency (VAD) is a serious nutritional issue in Indonesia. VAD can increase the risk of gastrointestinal infections, diarrhea, and measles and can lead to stunted growth in children [7]. According to Ayu, the prevalence of malnutrition and poor nutrition in Indonesia by 2023 is 21.5 % [8]. In the field of nutrition, antioxidants are known as nutrients that can improve and maximize the performance of the body's immune system [9].

Antioxidants are compounds that can slow down oxidative reactions. These reactions initiate a chain reaction to produce free radical compounds [10]. Antioxidant compounds are commonly utilized as free radical scavengers due to the growing public awareness of their role in inhibiting degenerative diseases such as heart conditions and aging symptoms [11], [12]. Antioxidants block free radical compounds within the body and in the environment [13]. In the cooking oil industry, antioxidant content is required to maintain the quality and shelf life of oils [14], [15].

The purpose of this study was to determine the vitamin A content to test the antioxidant properties of the material before fortification and to evaluate the antioxidant content of super olein and bulk olein. Super olein had a value of 60 or more in the iodine test. Therefore, super olein is clearer, more stable, and less prone to cloudiness than normal olein [16]. HPLC was used to determine the vitamin A content, and a DPPH spectrophotometer was used to determine the antioxidant compounds in the super and bulk oils before fortification.

MATERIALS AND METHODS

Equipment and Materials

The equipment used in this research included a UV-Vis spectrophotometer, High-Performance Liquid Chromatography (HPLC) instrument, cuvette, analytical balance, 50 mL measuring glass, 25 mL pipette, sample bottle, and a 100 mL Erlenmeyer flask. The materials utilized were super and bulk olein, hexane, and 1,1-diphenyl-2-picrylhydrazyl (DPPH).

Methods

The analysis of vitamin A content in super and bulk olein before fortification was conducted using HPLC at the Balai Besar Agro Industri (BBAI) Bogor. The oil samples were dissolved in HPLC solvents, applied directly to a C18 column, and subsequently analyzed by fluorescence detection [17]. Antioxidant testing was performed using the DPPH method. When preparing the blank solution, 1 ml of hexane was added to 3 ml of the DPPH solution. Next, the sample solution was prepared for examination with UV-Vis spectrophotometry. A DPPH solution with a concentration of 100 ppm was prepared by weighing 5 mg of DPPH dissolved in 50 ml of hexane solvent. Each sample of super olein and bulk olein was taken up to 1 ml.

Then, 3 ml of the DPPH solution was mixed with 2 ml of hexane and stirred until homogeneous. The blank and sample solutions were incubated in the dark at a temperature of 28°C for 30 min. The absorbance of each solution was measured at 510-525 nm. Antioxidant data analysis is performed using the formula:

$$\text{antioxidant capacity} = \frac{Ab - As}{Ab}\ x\ 100\ \% \quad (1)$$

Ab: The blank of absorbance

As: The sample of absorbance

RESULT AND DISCUSSION

Super olein (contains more unsaturated fatty acids) and bulk olein are two types of palm oil fractions obtained by the fractionation process, that is, the separation of palm oil into a liquid (olein) and a solid (stearin) fraction. The levels of vitamin A in super olein and bulk olein before fortification are shown in Table 1.

Table 1 Results of the Analysis of Vitamin A Content using HPLC

Super Olein (µg)	Bulk Olein (µg)	Condition
< 0,0015	< 0.0015	Before Fortification
63.3	63.3	Ready for Sale

Based on Table 1, it can be observed that the vitamin A content in bulk olein and super olein before fortification is less than 0.005 µg. These results do not meet the Indonesian National Standards (SNI). Determination of vitamin A levels is regulated by the Ministry of Industry's regulation on the mandatory implementation of frying oil standard No. 35/2015, which stipulates a minimum vitamin A level of 45 µg. Crude palm oil naturally contains high levels of carotenoids (pro-vitamin A) at around a wavelength of 500-700 ppm. Generally, carotenoids consist of pro-vitamin A compounds that are beneficial for reducing free radicals. Carotenoids are also used to address Vitamin A Deficiency (VAD) issues, but these carotenoids are damaged and lost during the processing of palm oil. The processing method involved is deodorization, which uses temperatures ranging from 240°C to 270°C. A high deodorization temperature causes carotenoid compounds to undergo decomposition or degradation [18]. Palm oil with a high vitamin A content can be obtained through its ability to undergo controlled and improved processes.

Antioxidant Test Results

Antioxidant activity testing was conducted at the Pharmacy Laboratory of the Sumatera Institute of Technology. Based on Table 2, the maximum wavelength used in the UV-Vis measurements was 515 nm.

Table 2. Absorbance measurement of wavelength

Wavelength (nm)	Absorbance
525	0.01065
523	0.00957
521	0.01015
519	0.01335
517	0.01019
515	0.01493
513	0.01027
511	0.01407
509	0.01133

The results indicate the percentage of antioxidant levels in super olein and bulk olein before fortification. Figure 1 presents the percentage inhibition of antioxidant activity.

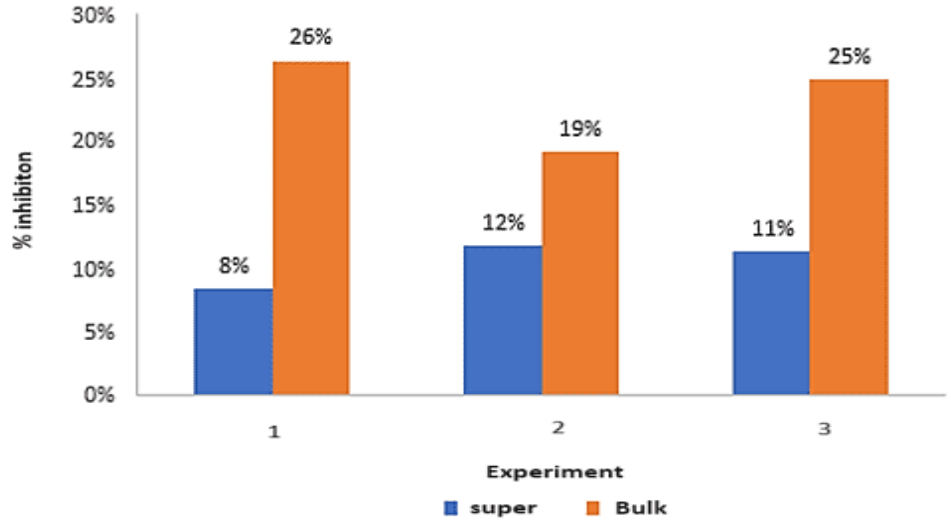

Figure 1. Results of percentage inhibition of antioxidant activity

Antioxidant activity was determined using the DPPH method. This test was conducted to quantitatively measure antioxidant activity by assessing the ability to capture free radical compounds to obtain percentage inhibition values [10]. The comparison between the results of antioxidant activity tests for super olein and bulk olein showed different percentage inhibitions. Super olein has a value of 10 %, whereas bulk olein has a value of 23 %. This indicates that the antioxidant activity of bulk olein is greater than that of super olein. Palm oil naturally contains antioxidants, such as carotenoids, but these carotenoids are damaged and lost during the high-temperature processing of palm oil into cooking oil. In this case, bulk olein processing has a shorter processing time, ranging from 5 to 6 h, compared to 7 to 8 h at room temperature for super olein. This is why the antioxidant activity of bulk olein is greater than that of super olein. However, both super- and bulk-palm cooking oils used for frying already contain relatively stable saturated fatty acids that are resistant to oxidation. Palm oil fortified with vitamin A also acts as an antioxidant, helping to maintain the stability of cell membranes against free radicals [19].

CONCLUSION

In conclusion, the vitamin A levels in both super olein and bulk olein are very low, below 0.005 IU/gram, and the antioxidant activity in bulk olein is higher than that in super olein, as bulk olein has the highest percentage inhibition at 23 %, while super olein has the highest percentage inhibition value at 10 %.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

AUTHOR'S CONTRIBUTION

Conceptualization, D.R.S, M.A.P.P, and Y.L.L.; validation, M.T.A, E.R.S., and D.D.; investigation, A.S. and .Y.F; writing—original draft preparation, D.R.S, M.A.P.P, and Y.L.L; writing—review and editing, D.D. and W.A.A; visualization, F.Y and R.Y; All authors have read and agreed to the published version of the manuscript.

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