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Turmeric Extract As An Antioxidant In Repeatedly Used Cooking Oil

Andi Abriana, Eva Johannes

ABSTRACT: One of the natural antioxidant sources is turmeric olant from zingiberaceae family that contains curcumin. Curcumin is an important component isolated from turmeric (Curcuma longa), that is used as traditional medicines and food additive substance. This study was aimed to examine the use of turmeric as an antioxidant in repeatedly used cooking oil and to find out the mechanism by which the turmeric extract inhibits the formation of trans fatty acid in repeateadly used cooking oil. This study was an experimental study in which the turmeric extract was obtained by maceration. The obtained turmeric extract was then added into cooking oil that will be used later to fry repeatedly for 10 times. Frying treatments consisted of frying without turmeric extract addition (control) and frying with turmeric extract addition at concentrations of 0.02%, 0.03%, and 0.04%. The samples of the used cooked oil were collected at frying 1, frying 5, and frying 10 and analyzed for their trans fatty acid content by gas chromatography. Study findings indicate that turmeric extract addition into cooking oil reduced the formation of trans fatty acid and extended the use time of cooking oil. According to trans fatty acid content analysis, the best treatment was the addition of turmeric extract at concentration of 0.03%.

Keywords: Turmeric extract, antioxidant, cooking oil, repeated frying.

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INTRODUCTION

Fried foods are the kind of foods that contains fat and cholesterol that frequently induce the development of various diseases such as coronary diseases and others. Consuming fried foods commonly sold in streets and many places is risky. Fried foods are commonly fried with repeatedly used cooking oil at high temperature and in long time (deep frying). Chemically, cooking oil that has been used repeatedly is very different from fresh palm oil that has not been used for frying. In palm oil there are about 45,5% of saturated fatty acid dominated by palmitatefattyc acid and about 54.1% of unsaturated fatty acid dominated by oleic fatty acid. Whereas in palm oil that has been used repeatedly the fatty acid (trans fatty acid) is much more higher than the saturated fatty acid. Trans fatty acid is very harmful to health because it can induce various diseases such as cardiac diseases and stroke [1]. Some of the fried foods that contain trans fatty acid are fried bananas, fried cassavas, croquette, fried fermented soybeans, and powdered fried chickens that are fried with repeatedly used cooking oil. It is these types of food that contribute to high trans fatty acid intake. The formation of trans fatty acid by partial hydrogenation in vegetable oil that contain unsaturated fatty acid if through heating process with high temperature. Frying using heated fat or oil at high temperature of 150°C – 190°C is one of food serving technique that becomes popular because ot can provide better color, taste, and texture for frieds. Two methods of frying are practicted, namely (1) Shallow frying and (2) Deep frying. Shallow frying uses pan (pan frying) and the fied foods are only partly submerged in the oil.

In deep frying technique, the fried foods are submerged completely in the oil and the oil temperature can reach 200-205°C, that it needs oil in high number. Deep frying technique causes changes in stability and quality, taste, color, and texture of the fried foods and their nutrient contents. Comercially, this process is widely applied particularly for industrial scale production of various products such as fried potatoes, seafood, egg rolls, and chicken patties. Frying process with deep frying technique enables heat transfer during the rpocess from the hot oil into cool foods. It is this feature that makes this process fast. The fried foods have delicious taste, layered by crispy surface, interested color, and the oil absorption by the fried product will result in the desired mouthfeel, easily reconstructed, and free from harmful microorganisms [2,3,4,5]. However, it is associated to health risk because the repeatedly used cooking oil will subject to oxidation that produce peroxide groups and cyclic monomer. According to [1], in addition to harfmul effect by peroxide group to health, the use of repeatedly used cooking oil also produces aldehyde-type acrolein that produce itchiness in throat. Curcumin is an antioxidant with concentrated yellow collor isolated from turmeric, known effective as food composition because beside it slows down the food degradation, it is also effective in inhibiting the formation of lipid peroxide compared to synthetic antioxidant such as BHT [6]. The presense of antioxidant in fat will reduce the oxidation process rate, by scavenging the free radicals and change them into non-reactive "second hand" radicals that are not harmful to health [7]. This study was conducted to determine the effect of turmeric extract as natural oxidant on the extension of use time of repeatedly used cooking oil.

METHOD

This study was conducted from March 2014 to September 2014, using experimental method with the following steps:

Turmeric extraction: 1 kg of turmeric was selected and cleansed initially. After that the turmerics were peeled and chopped and then dried under sun light for 1 week. After dried, the turmerics were crushed by using blender, weighted, and 500 g of fine turmerci powder were stored in closed container. Turmerics were extracted by maceration using ethanol (1:1) for 24 hours, and then filtered by

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buchner filter to separate the residue and its supernatant. Maceration was performed three times. The result of the maceration, in the form of supernatant, was dried by using evaporator in order that the ethanol liquid was separated from its macerate. 50 mg of thick macerated was obtained.

Food frying: The food materials used in this study were bananas (saba banana) and cooking oil. Frying was performed without the addition of turmeric extract (control) and with the addition of turmeric extract at concentrations of 0.02%; 0.03%, and 0.04%. Frying process was started by adding 3.5 liters of fresh cooking oil into frying pan, the pan was heated up to 180°C. The food materials were fried for 10 minutes and it was attempted to not frequently stir the frieds to reduce convection flow from oil and oxidation reaction due to aeration process. Frying was performed up to 10 times. The samples of cooking oil were collected in frying 1, 5, and 10 (each 100 mL) to analyze the trans fatty acid content.

Trans Fatty Acid Mesurement: Identification of trans fatty acid composition was performed in cooking oil that had been used to fry bananas with the samples were collected at frying 1, 5, and 10. Analysis of trans fatty acid was performed by gas chromatography (GC) to separate it formcis and trans fatty acid configurations. Components were separated by evaporation, carried by inerg gas and passed through a column or stationary phase in the form of solid or liquid substances that is not easy to evaporate that attached to inert supporting substance with the following ways:

a. Sample preparation (hydrolisis and esterification). First, oil sample was weighed in a teflon closed tube, and added with 1 mL of 0.5 N NaOH in methanol and heated with water bath for 20 minutes.
b. 2 mL of BF_3 16 % and 5 mg/ml of internal standard were added and heated again for other 20 minutes. After cooling down, 2 mL of saturated NaCl and 1 mL of hexane was added. Hexane layer was separated and added into a tube containing 0.1 g of anhydrous Na_2SO_4 and kept for 15 minutes. Liquid phase was separated in injected into gas chromatogprahy.
c. Analysis of fatty acid components, as FAME by gas chromatography, cyanoprilmethilsil column (capillary column). The instrument conditions were adjusted as following: column dimension (length= 60 m; Ã depth = 0,25 mm, 0,25 Î ¼ Film Tickness); flow rate of N_2 : 20 mL/min; lajualir H_2:30 mL/min; flow rate of air: 200 â€ "250 mL/min; injector tempareture: 200°C; detector temperature: 230°C; column temperature: temperature program (column temperature: initial 190°C, stationary 15 min, end 230°C stationary 20 min and rate 10°C/min; ratio = 1:8; inject volume: 1 ¼ L; linear velocity: 20 cm/sec.
d. Analysis was started from solvent injection (1 µL) into column to obtain baseline values, and then continued by injecting 5 µL of FAME standard solution. When all peaks had been out, sample was injected in the volume of 5 µL. Retention time and sample peak were measured for each component and compared to standard and calculated with the following formula:

$$C_x = \frac{A_x . R\ C_s}{A_s}$$

Note:
C_x : Concentration of component x
C_s : Concentration internal standard
A_x : Area of component x peak
A_s : Area of internal standar peak
R : Response

Data Analysis: Data were anlyzed by using SPSS version 17 with contrast further test.

RESULTS AND DISCUSSION

Frying Without Turmeric Extract Addition (Control)

The frying of food materials with cooking oil without the addition of turmeric extract (control). Study findings indicate that the more frequent the use, the higher the trans fatty acid concent in repeateadly used cooking oil. (Figure 1). According to [8], unsaturated fatty acid level is increasing with the use frequency of the repeatedly used cooking oil.

Frying with Turmeric Extract Addition

The frying of foods with addition of turmeric extract at the concentrations of 0.02%, 0.03%, and 0.04% in the used cooking oil indicated that in frying 10 there was a decrease in trans fatty acid content. This means that the addition of turmeric extract in cooking oil reduces the formation of trans fatty acid. Analysis of trans fatty acid content in the used cooking oil without addition of turmeric extract (control) indicated higher trans fatty acid content at frying 10; whereas the used cooking oil with addition of turmeric extract at concentration of 0.02%, 0.03% and 0.04% indicated reduction trans fatty acid content at frying 10 (Figure 1). This was related to curcumin that inhibit the auto-oxidation rate by modifying the lipid radical into more stabil form, that commonly inhibit the fat oxidationreaction[9]. According to [10], turmeric extract is an antioxidant with good reactivity and has the potential to be used as natural antioxidant ini food industry. According to [11], turmeric extract added into cooking oil can reduce trans fatty acid content, because the turmeric extract is capable of inhibiting oxidation reaction in the oil that the trans fatty acid formation is slowed down significantly ($P<0.05$). The presence of antioxidant added into the repeatedly used cooking oil can decelerate the oil oxidation rate during frying and contrbute to sensoric acceptance of fried foods. The findings of this study are supported by the statement of [12] that the addition of antioxidant in cooking oil determine the stability of oxidation during frying; and according to Tuba and [13], curcumin is effective to be used as antioxidant because it can scavenge free radical by donating H atom from phenolic as its active group. According to [11], the use of antioxidant initially reduces the oxidative stability loss during frying, and the reduces heat degradation under the commonly used frying conditions.

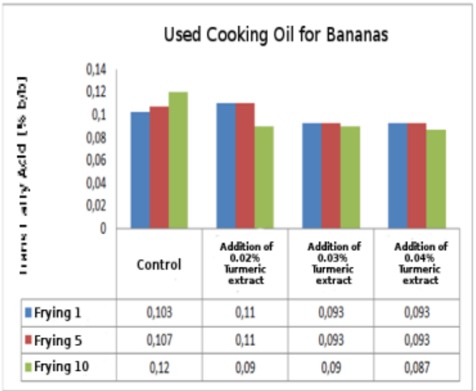

Figure 1. *The results of trans fatty acid analysis in cooking oil that was used to fry bananas*

When compared to analysis results of trans fatty acid concent with addition of turmeric extract at concentrations of 0.02%, 0.03%, and 0.04%, it can be seen that the higher the concentration of the added turmeric extract, the lower the trans fatty acid content. The addition of turmeric extract at concentrations of 0.03% and 0.04% were not significantly different and according to organoleptic test against cooking oil and fried food colors with addition of 0.03% and 0.04% turmeric extract, it was shown that the addition of 0.04% turmeric extract resulted in very yellow color of cooking oil and the fried foods; whereas the addition of 0.03% turmeric extract resulted in less yellow color of cooking oil and the color of the fried foods is not significantly different from normal color of the fried foods. According to follow-up test by contrast test (Table 1), it was shown that the control treatment and turmeric extract addition treatment at all concentrations were different significantly. This indicates that turmeric extract can be used as an antioxidant in repeatedly used cooking oil and can inhibit the formation of trans fatty acid in repeated frying and extend the use time of cooking oil. This is in accordance to [13] that the presence of antioxidants in cooking oil is very important in stabilizing the complex frying system and improve the appearance and lifetime of fried foods. The best treatment for repeatedly used cooking oil is the addition of turmeric extract at concentration of 0.03%.

Table 1. The results of follow-up test for trans fatty acid content in used banana cooking oil

Frying repetition	Control	Addition of 0.02% turmeric extract (% b/b)	Addition of 0.03% turmeric extract (% b/b)	Addition of 0.04% turmeric extract (% b/b)
Frying 1	0.103^{ns}	0.11^{**}	0.093^{**}	0.093^{**}
Frying 5	0.107^{ns}	0.11^{**}	0.093^{**}	0.093^{**}
Frying 10	0.12^{ns}	0.09^{**}	0.09^{**}	0.087^{**}

^{ns}) not significantly different **)very significantly different

CONCLUSION

The addition of turmeric extract at the concentrations of 0.02%, 0.03%, and 0.04% reduces the formation of trans fatty acid in repeatedly used cooking coil, and extends the use time of cooking oil. The best result was obtained with addition of 0.03% turmeric extract.

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