Palm Oils Consumption Modulates Serum SGPT and SGOT in Rats Fed a High-Fat Diet

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Abstract. In this study we investigated the effect of three kinds of palm oil product (refined bleached deodorized palm oil (RBDPO), red palm oil (RPO) and palm kernel oil (PKO)) on the serum glutamic oxaloacetic transaminase (SGOT), serum glutamic pyruvic transaminase (SGPT), and liver color of rats in fed high-fat diet, and compare it with beef tallow and corn oil. Growing male SD rats were fed a high-fat diet (20% fat) for 13 weeks, divided into 2 groups (with and without azoxymethane (AOM)). Dietary corn oil showed the lowest serum SGOT and SGPT ($p < 0.05$) both in the AOM and Non-AOM groups. Beef tallow diet caused the highest level of serum SGOT and SGPT followed by PKO, RPO, and RBDPO respectively ($p < 0.05$). The serum SGOT and SGPT were not affected by the AOM treatment. Although the liver color from the AOM group was relatively darker than the non-AOM group, in general the fat sources did not have a significant effect on liver color.

Keywords rat · palm oil · fat · SGOT · SGPT · liver color

1. Introduction

Palm oil has become the most important vegetable oil in the world and is widely used in the food processing industry [1]. The fatty acid composition of palm oil is mainly composed of palmitic acid (44%) and oleic acid (39%), with the total saturated fatty acids and unsaturated fatty acids similar in percentage (49% and 49%) [2]. Although the consumption of palm oil often causes concern because of its composition, currently there is no scientific evidence (experimental or epidemiological) to warrant associating palm oil consumption with a higher cancer incidence or mortality risk in humans [3]. Nevertheless, the health benefits of red palm oil in animal and human studies have been reviewed, including improvement in cardioprotective effects in ischemic heart disease, antiatherogenic, antihemorrhagic, antihypertensive, and anticancer properties [4].

Animal models (rat and/or mouse) have been widely used in studies involving high-fat diets, including the organ-specific pathologies associated with exposure to a maternal high-fat diet [5]. The application of a high-fat diet in rats has been developed for the induction of non-alcoholic fatty liver disease [6]. Serum SGOT and SGPT has been considered as a marker for fatty liver disease, with high levels of serum SGOT and SGPT resembling the development of the disease.

The effects of the type of fat sources in the diet to the serum SGOT and SGPT is a question that remains to be answered, especially regarding the palm oils. The present study was conducted to compare the serum SGOT and SGPT of rats fed with 3 different types of palm oil sources (RBDPO, RPO and PKO) and also compared with beef tallow and corn oil.

2. Materials and methods

2.1. Animal and experimental protocols

Male Sprague Dawley rats (3 weeks old) were provided by The Center for Food and Nutrition Studies Laboratory Animal Center, Universitas Gadjah Mada and housed in individual cages in a room with a temperature of 25-26 degrees Celsius and relative humidity of 50-60 percent, with a 12-hour light-dark cycle. The rats were fed a pellet meal for one week before the start of the experimental diet and were randomly allocated to one of five groups. Animal care is carried out following the "Guide for the Care and Use of Laboratory Animals" created by Universitas Gadjah Mada and authorized by the same university's Medical and Health Research Ethics Committee. Rats were divided into 5 groups ($n = 6$), and each group fed by the following experimental diets (*ad libitum*): 20% beef tallow, 20% corn oil, 20% RBDPO, 20% RPO, and 20% PKO. The composition of the experimental diets was presented in Table 1. AOM (Sigma, St. Loius, MO) was administered with oral gavage in saline at 15 mg/kg body, twice at 2nd and 3rd week. Thirteen weeks after feeding the diets, animals were killed by decapitation with anesthesia of diethyl ether, and the whole blood collected from the abdominal aorta. Blood samples were centrifuged at 2000 x g for 20 min to obtain serum samples, and stored at –70˚C.

2.2. Determination of Serum SGOT and SGPT

Serum SGOT levels were measured using Diasys ASAT (GOT) FS quantification kit following the manufacturer's instructions (DiaSys Diagnostic Systems GmbH, Holzheim, Germany). Serum SGPT levels were measured using Diasys ALAT (GPT) FS quantification kit following the manufacturer's instructions (DiaSys Diagnostic Systems GmbH, Holzheim, Germany).

Table 1. Compositions of the diets

Ingredient (w/w %)	Beef Tallow	Corn Oil	RBDPO	RPO	PKO
Casein	20.00	20.00	20.00	20.00	20.00
Corn starch	39.95	39.95	39.95	39.95	39.95
AIN-93 vitamins	1.00	1.00	1.00	1.00	1.00
AIN-93 minerals	3.50	3.50	3.50	3.50	3.50
Cellulose	5.00	5.00	5.00	5.00	5.00
Sucrose	10.0	10.0	10.0	10.0	10.0
L-Cystine	0.30	0.30	0.30	0.30	0.30
Choline	0.25	0.25	0.25	0.25	0.25
Beef tallow	20.00	-	-	-	-
Corn Oil	-	20.00	-	-	-
RBDPO	-	-	20.00	-	-
RPO	-	-	-	20.00	-
PKO	-	-	-	-	20.00

Abbreviations used: RBDPO, refined bleached deodorized palm oil; RPO, red palm oil; PKO, palm kernel oil.

2.3. Smartphone Setup

A smartphone (Model iPhone 11 Pro Max, Apple Inc., California USA) was used by holding (handheld) it vertically just above the rat organ at a distance about 20 cm. The main camera (wide angle) and native camera application were used for image acquisition. The camera settings as follows: camera capture most compatible format, ISO auto, shutter speed auto, aperture lens auto, white balance auto, exposure program normal, metering mode pattern, no flash, daylight conditions, resolution 4032x3024 pixels, color space RGB, with the images saved in jpeg.

2.4. Image Analysis

The Adobe Photoshop CC 2019 Software for Mac (Adobe Systems Inc., San Jose, California) was used to obtain the color parameters from the digital images of rat organ surfaces. The images were open in photoshop with image mode Lab Color chosen. The software was capable of displaying the color parameters *L* *, *a* *, *b* *, a model commonly used in food research [7]. The measurement or color analysis of the sample was based on what has been suggested by Papadakis *et al*. [8]. One of the tools in Photoshop used in this research was the Magic Wand Tool and Quick Selection Tool. With these tools, we can choose the field of images that we want to be analyzed further. We can select the dark or bright surface part of the sample with the Magic Wand Tool, for which we can then measure *L* *, *a* *, *b* *, and the percentage of the color surface differences. The selected image range was controlled with the tolerance value of the Magic Wand Tool, which is used for this research value 50.

2.5. Statistical analysis

To compare mean values, one-way ANOVA was used to compare between different groups of fat sources (beef tallow, corn oil, RBDPO, RPO, and PKO). The Tukey-Kramer post hoc test was conducted when a significant effect was found by one-way ANOVA. Data analysis was performed using SPSS Statistics for Mac (version 26.0; IBM SPSS Statistics, SPSS Inc., Chicago, USA). Differences were considered as differently significant at $p < 0.05$.

3. Results and discussions

The levels of serum SGOT and SGPT in five groups of rats fed with high-fat diets which different in fat sources were shown in Table 2. Dietary corn oil showed the lowest serum SGOT and SGPT ($p < 0.05$) both in the AOM and Non-AOM groups. Beef tallow diet caused the highest level of serum SGOT and SGPT followed by PKO, RPO, and RBDPO respectively ($p < 0.05$).

The disorder of liver function can be evaluated through biomarkers such as serum SGOT and SGPT. Found mainly in the liver, the enzyme GOT (also known Aspartate Aminotransferase/AST) and GPT (also known as Alanine Aminotransferase/ALT) catalyze the conversion of 〈-keto acids into amino acids by transfer of amino groups. As a liver specific enzyme, GPT/ALT is only significantly elevated in hepatobiliary diseases. While the increased GOT/AST levels can occur in the connection with damages of heart or skeletal muscle as well as of liver parenchyma. Under normal conditions, the level of SGOT and

SGPT were maintained within a certain range. Therefore, the increase and/or high level of SGOT and SGPT could indicate liver tissue damage or infection occurrence. In acute hepatotoxicity, the levels of liver enzymes usually increased, but with prolonged intoxication because of the damage to the liver the levels could be decreased [9].

Figure 1 showed the image of the rat's liver after we applied the selection (magic wand) tool in the image editor (Adobe Photoshop). The liver color in five groups of rats fed with high-fat diets which different in fat sources were shown in Table 3. Although the liver color from the AOM group was relatively darker than the non-AOM group, in general the fat sources did not have a significant effect on liver color.

Table 2. Effect of the experimental diets on serum SGOT and SGPT in rats

Groups	Beef Tallow	Corn Oil	RBDPO	RPO	PKO
Serum SGOT (U/L)					
AOM	57.0 ± 0.7^{a}	38.8 ± 0.3^{d}	40.6 ± 0.6^{cd}	43.0 ± 0.7^{bc}	44.5 ± 0.9^{b}
Non-AOM	58.6 ± 0.4^{a}	38.6 ± 0.6^{c}	41.0 ± 0.2^{ab}	43.2 ± 0.3^{b}	43.2 ± 0.7^{b}
Serum SGPT (U/L)					
AOM	36.3 ± 0.6^{a}	18.9 ± 0.3^{d}	21.9 ± 0.5^{c}	23.8 ± 0.5^{c}	26.7 ± 0.3^{b}
Non-AOM	37.1 ± 0.4^{a}	19.7 ± 0.2^{d}	22.6 ± 0.2^{cd}	24.4 ± 0.5^{bc}	26.9 ± 1.4^{b}

Data are expressed as means ± S.E.M., $n = 3$. ^{a,b,c,d} Values in a row not sharing a superscript are significantly different at $p < 0.05$. Abbreviations used: RBDPO, refined bleached deodorized palm oil; RPO, red palm oil; PKO, palm kernel oil.

Table 3. The L^*, a^*, and b^* mean values of the liver of rats fed with beef tallow, corn oil, RBDPO, RPO and PKO

Groups	Beef Tallow	Corn Oil	RBDPO	RPO	PKO
L^*					
AOM	19.30±1.52	18.97±5.65	17.79±0.79	20.70±6.50	18.61±2.54
Non-AOM	24.91±3.37	22.06±0.62	24.02±9.38	25.19±0.99	20.50±1.75
a^*					
AOM	20.49±2.32	22.08±4.39	18.72±1.36	24.73±4.30	21.74±3.34
Non-AOM	23.74±2.36	21.75±1.80	22.70±7.47	27.29±1.13	24.72±1.29
b^*					
AOM	9.44±0.03	8.90±2.85	6.76±1.30	10.35±2.47	9.36±2.83
Non-AOM	12.50±3.19	10.12±1.49	10.59±6.58	11.74±1.02	10.90±2.69

Data are expressed as means ± S.E.M., $n = 3$. ^{a,b,c,d} Values in a row not sharing a superscript are significantly different at $p < 0.05$. Abbreviations used: RBDPO, refined bleached deodorized palm oil; RPO, red palm oil; PKO, palm kernel oil.

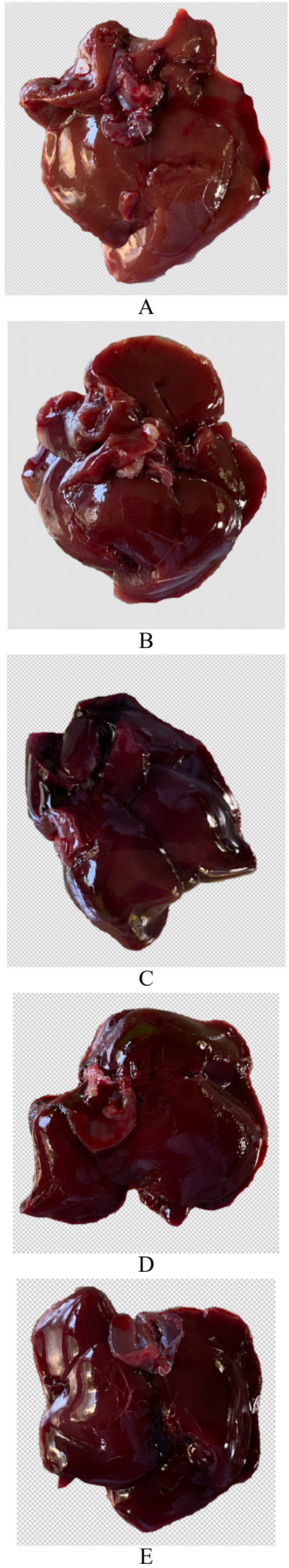

Figure 1. The liver image after we applied Magic Wand Tool and/or Quick Selection Tool in Photoshop for the Lab color analysis (AOM group, A: beef tallow; B: corn oil; C: RBDPO refined bleached deodorized palm oil; D: RPO, red palm oil; and E: PKO, palm kernel oil)

4. Conclusion

Dietary corn oil showed the lowest serum SGOT and SGPT both in the AOM and Non-AOM groups. Beef tallow diet caused the highest level of serum SGOT and SGPT followed by PKO, RPO, and RBDPO respectively. In general, differences in fat sources (beef tallow, corn oil, palm oil) did not have a significant effect on liver color.

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