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# Effect of Different Vegetable Oils (Red Palm Olein, Palm Olein, Corn Oil and Coconut Oil) on Lipid Profile in Rat

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## ABSTRACT

*The objective of the study was to evaluate the effects of different vegetable oils [red palm olein (RPO), palm olein (PO), corn oil (CO) and coconut oil (COC)] on lipid profile in rat. Sixty six Sprague Dawley male rats were randomly divided into eleven groups of* 6 *rats per group and were treated with* 15% *concentrations of RPO, PO, CO and COC for* 4 *and* 8 *weeks. Rats in control group were given normal rat pellet only while in treated groups* 15% *of additional vegetable oils were given. The results at* 4 *weeks showed a decline in Low Density Lipoprotein Cholesterol (LDL-C) values at RPO and PO groups whereas in CO and COC groups the LDL-C were increased compared to the control group. The High Density Lipoprotein Cholesterol (HDL-C) values increased in RPO and PO groups whereas it was declined in CO and COC groups compared to the control group. At* 8 *weeks, there was no significant difference* ($P \geq 0.05$) *in HDL-C of rats treated with vegetable oils compared to the control group. However, the LDL-C in RPO and PO was significantly decreased* ($P \leq 0.05$) *in the LDL-C and there was no significant difference* ($P \geq 0.05$) *for CO and COC groups compared to the control groups. The mean value of the LDL-C after 8 weeks in the control group, RPO, PO, CO, and COC groups were* 66.1 mg/dl, 31.9 mg/dl, 41.1 mg/dl, 50.41 mg/dl *and* 54.31 mg/dl *respectively. There was significant decreased* ($P \leq 0.05$) *in the total cholesterol (TC) in RPO group for* 4 *weeks compared to the control group while the TC in PO, CO and COC were within the normal range. The results of TC in all treated rats for* 8 *weeks were within the normal range. There was no significant difference in TC of rats treated with vegetable oils compared to the control group. Triglycerides (TG) in all treated rats for* 4 *weeks were within the normal range whereas the TG in RPO, PO and CO groups for* 8 *weeks were significant increase* ($P \leq 0.05$) *compared to the control group but there was no significant difference between the control group and COC group.*

**Keywords:** *Red Palm Olein, Palm Olein, Corn Oil, Coconut Oil, Total Cholesterol, Triglyceride, High Density Lipoprotein Cholesterol, Low Density Lipoprotein Cholesterol*

## 1. Introduction

Vegetable oil is very common, affordable and used by majority of people across the globe especially in the tropics. Its use as antidote to prevent some oxidative stress related diseases and a complication is advocated [1]. Vegetable oils in particular are natural products of plant origin consisting of ester mixtures derived from glycerol with chains of fatty acid contain about 14 to 20 carbon atoms with different degrees of unsaturation [2]. Palm oil contains approximately an equal amount of saturated and unsaturated fatty acids. Amongst the former, palmitic and stearic acid account for 45% and 5% of the total fatty acids, respectively. Palm oil has a wide range of applications and it is commonly fractionated into olein and stearin [3]. The different properties of palm oil and it's fractions allow the products to be used for different purposes [4]. Palm olein, a liquid fraction obtained from the refining of palm oil, is rich in oleic acid (42.7% - 43.9%), $\beta$-carotene and vitamin E (tocopherols and tocotrienols) [5]. It is rich in tocotrienol which has been reported to be natural inhibitors of cholesterol synthesis. Tocopherols are very important minor components of oils and fats because of their antioxidant properties. [6]. Red Palm Oil (RPO) contains 50% saturated fatty acids, 40% monounsaturated fatty acids and 10% polyunsaturated fatty acids. The RPO is the only vegetable oil with a balanced composition of saturated and unsaturated fatty acids both in the processed and unprocessed forms [7]. It contains carotenoids, phosphatides, sterols, tocopherols and trace metals. They have shown to be effective against oxidative stress *in vitro* and *in vivo* [8].

Red palm oil (RPO) is the oil obtained before refining. The characteristic colour of RPO is due to the abundance of carotenoids (500 - 700 mg/L) in the crude oil [9]. Most of the $\beta$-carotene is destroyed during processing the oil in palm oil refineries [7]. The carotenoids, together with vitamin E, ascorbic acid, enzymes and proteins, are members of the biological antioxidant network converting highly reactive radicals and free fatty peroxyl radicals to less active species [10] thus, protecting against oxidative damage to cells. Besides providing high energy density in the diet, $\beta$-carotene is the most abundant carotenoids which can be converted to vitamin A; which is important in the visual process. In addition, it is an antioxidant that destroys singlet oxygen and free radicals [11].

Red Palm Oil is also a rich source of vitamin E, which is about 559 to 1000 ppm. Vitamin E acts as a potent antioxidant serving to protect cellular membranes from free radical-catalyzed lipid peroxidation [11]. Atherosclerotic lesions in man and in animals appear to be related to elevated plasma Total Cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), decreased high-density lipoprotein cholesterol (HDL-C) and excess fat consumption [12,13]. Coconut oil is commercially a major source of lauric acid [14]. Coconut oil contains approximately 90% saturated fats. Saturated fats are known to contribute to coronary artery disease (CAD) [15]. Coconut oil contains medium chain fatty acids such as lauric (C-12), caprylic (C-10) and myristic (C-14) acids. Of these three, coconut oil contains 40% lauric acid, which has the greater antiviral activity of these three fatty acids [16]. Corn oil provides essential fatty acids, mostly linoleic acid. Linoleic acid is necessary for the integrity of the skin, cell membranes, and the immune system, and for synthesis of eicosanoids. Eicosanoids are necessary for reproductive, cardiovascular, renal, gastrointestinal functions, and resistance to disease and it is highly effective for lowering serum cholesterol, primarily low-density-lipoprotein cholesterol [17]. Corn oil is a good source of essential fatty acids and its nutritional properties are excellent and the fatty acids found in corn oil are palmitic acid, stearic acid, oleic acid, linoleic acid, and linolenic acid [18].

The total cholesterol, LDL-cholesterol, HDL-cholesterol and triglycerides are collectively called blood lipids. Their levels could be modified by the type and amount of fat in the diet [19,20]. Therefore the the main objective of this work was to compare the effect of four vegetable oils (red palm olein, palm oil, corn oil and coconut oil) added to commercial pallet on lipid profile of rats fed until 8 weeks of growth.

## 2. Material and Methods

### 2.1. Instruments

A Reflotron (ROCHE, 10007908, germany) was used for the measurement of blood lipid profile. A centrifuge (KUBOTA 2010, Malaysia) with speed 3000 r.p.m at room temperature for 10 min was used to separate the plasma from the whole blood.

### 2.2. Experimental Diets

The evaluated RPO samples consist of carotino. It is provided by Carotino SDN BHD company and and palm olein (Seri Murni), corn oil and coconut oil were obtained commercially. The test diet was prepared by mixing vegetable oils with normal commercial rat pellet to contain 15% of the vegetable oils. The 15% diet was prepared by adding 15 g RPO, PO, CO or COC to 85 g rat pallet, and mixed manually and the diets were then left to absorb the vegetable oils at room temperature overnight and stored at 20˚C before the feeding trial was conducted.

### 2.3. Animals

Sixty six Sprague Dawley male rats each weighing between 170 - 250 g and approximately 80 days old were obtained from the animal house of the Faculty of Science and Technology, Universiti Kebangsaan Malaysia. The rats were fed ad libitum with commercial rat's food containing 15% vegetable oils. At the end of the experiment, after 8 weeks, all the rats were fasted for one day and killed with chloroform.

### 2.4. Statistical Analysis

Results were expressed as mean values ± SEM (n = 6). Means of six samples were compared by analysis of variance (ANOVA). Significant differences between means were determined by Tukey's least different significant difference ($p \leq 0.05$). The software used was MINITAB® (14.20).

## 3. Results

### 3.1. Body Weight

**Figure 1** shows the effect of vegetable oils on body weight of rats. The body weight increased in each group (4 and 8 weeks) compared with $T_0$ group. The body weight increased in each group after 4 and 8 weeks com-

 

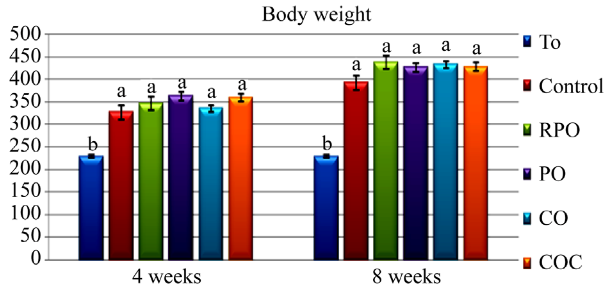


**Figure 1. Body weight (g) in rats fed different vegetable oils for 4 and 8 weeks. Bars are mean ± SEM (n = 6), significantly increase (P < 0.05) in all treated groups compared to the control group.**

pared with $T_0$ group.

## 3.2. Determination of Total Cholesterol

**Figure 2** shows the results of TC in blood samples of rats that were treated with 15% of vegetable oils for 4 and 8 weeks of treatment. After 4 weeks of treatment, there was significant decrease ($P \leq 0.05$) in the TC level in RPO group compared to control group while the TC in PO, CO and COC groups were within the normal range. There was no significant different ($P \geq 0.05$) compared to the control group. However, there was significant decrease ($P \leq 0.05$) in the TC level in all treated groups of vegetable oils (RPO, PO, CO and COCO) after 8 weeks.

## 3.3. Determination of Triglycerides

**Figure 3** shows the results of TG with 15% of vegetable oils for different times of treatment. After 4 weeks of treatment the results in this group had triglycerides values within the normal range compared to the control group and at 8 weeks. There was significant increase ($P \leq 0.05$) in triglyceride level with RPO, PO and CO treated groups compared to the control group but there was no significant difference ($P \geq 0.05$) in COC group compared to the control group.

## 3.4. Determination of HDL-C and LDL-C

The results of HDL-C and LDL-C with 15% of vegetable oils for different times of treatment are summarized in **Figures 4** and **5**. For HDL-C the results showed that after 4 weeks of treatment with vegetable oils there was no significant difference in RPO and PO groups compared to the control group but there was significant decrease ($P \leq 0.05$) in CO and COC groups compared to the control group. The results of LDL-C showed that there was significant decrease ($P \leq 0.05$) in RPO group compared to the control group but there was significant increase ($P \leq 0.05$) in COC group while there was no significant difference in PO and CO compared to control group. At 8 weeks, the results of HDL-C showed no significance difference ($P \geq 0.05$) between control group and vegetable oils. The results of LDL-C showed that there was significant decrease ($P \leq 0.05$) in RPO, PO and CO groups while there was no significant difference in COC group compared to the control group.

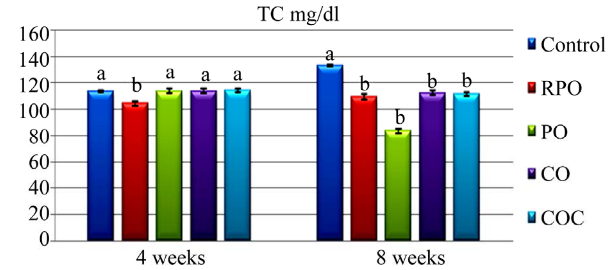


**Figure 2. Total cholesterol (mg/dl) in rats fed different vegetable oils for 4 and 8 weeks. Bars are mean ± SEM (n = 6), at 4 weeks, significantly decrease (P < 0.05) in RPO group, no significantly different (P > 0.05) in PO, CO, COC groups compared to the control group. At 8 weeks significantly decrease (P < 0.05) in all treated groups compared to the control group.**

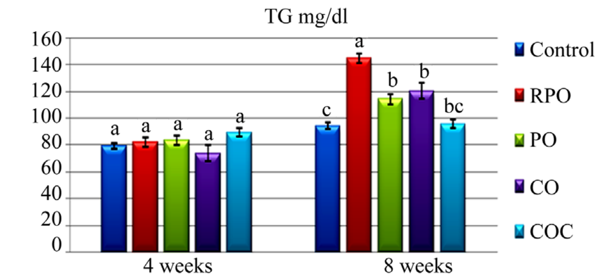


**Figure 3. Triglycerides (mg/dl) in rats fed different vegetable oils for 4 and 8 weeks. Bars are mean ± SEM (n = 6), at 4 weeks, no significantly different (P > 0.05) in all treated groups compared to the control group. At 8 weeks, significantly increase (P < 0.05) in RPO, PO, CO groups compared to the control group.**

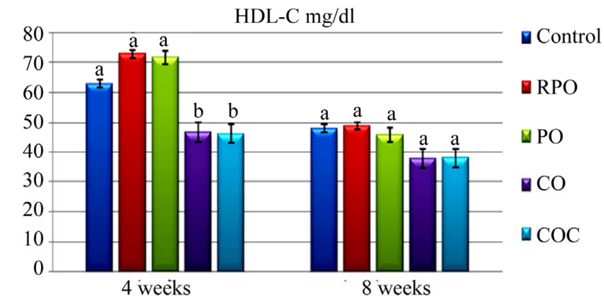


**Figure 4. HDL-C (mg/dl) in rats fed different vegetable oils for 4 and 8 weeks. Bars are mean ± SEM (n = 6), at 4 weeks, significantly decrease (P < 0.05) in CO and COC groups, no significantly different (P > 0.05) in RPO and PO, CO, COC groups compared to the control group. At 8 weeks no significantly different (P > 0.05) in all treated groups compared to the control group.**

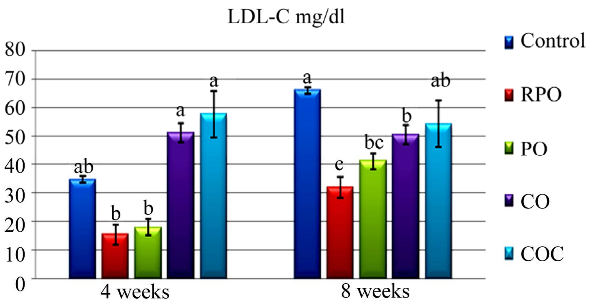


**Figure 5. LDL-C (mg/dl) in rats fed different vegetable oils for 4 and 8 weeks. Bars are mean ± SEM (n = 6), at 4 weeks, significantly decrease (P < 0.05) in RPO group, no significantly different (P > 0.05) in PO and CO groups, significantly increase (P < 0.05) in COC group compared to the control group. At 8 weeks, significantly decrease (P < 0.05) in RPO, PO and CO groups, no significantly different (P > 0.05) in COC group compared to the control group.**

## 4. Discussion

This study was designed to investigate the effects of diet containing different vegetable oils as red palm olein, palm oil (olein), corn oil and coconut oil on lipid profile. The results showed that after 4 weeks under sedentary conditions, *ad libitum* feeding of RPO there was significant difference (P ≤ 0.05) in the TC level while PO, CO and COC groups were within the normal range compared to the control group. Studies have demonstrated that RPO supplementation has beneficial or neutral effects on plasma total cholesterol [1]. This because RPO is rich in antioxidant particularly *β*-carotene and vitamin E [7]. Red palm oil contains the highest concentration of tocotrienols compared with other vegetables [21]. At 8 weeks, there was significant decrease (P ≤ 0.05) in level of the TC with all treated groups of vegetable oils compared to control group. However, the results obtained suggested that vegetable oils did not cause an increase in plasma TC after 4 or 8 weeks. Corn oil contains relatively high concentration of polyunsaturated fatty acids (PUFA) [22]. In addition to a lowering of saturated fat intake an increase in unsaturated fats, such as linoleic acid generally has been recommended due to the ability of polyunsaturated fatty acids (PUFA) to reduce serum cholesterol, a risk factor for heart disease [23].

After 4 weeks the results of TG with 15% of vegetable oils for different times of treatment had triglycerides values within the normal range compared to the control group and at 8 weeks. There was significant increase (P ≤ 0.05) in RPO, PO and CO groups but there was no significant difference (P ≥ 0.05) in COC group compared to the control group. However, this may explain that the long time of treatment with vegetable oils contains palmatic acids may lead to increase in plasma TG. Nimal and Sarwar (2004) reported that increasing fat intakes increases the concentration of triglycerides in blood plasma. Diets high in trans fatty acids have been linked to increases in blood triglycerides [24].

HDL-C and LDL-C with 15% of vegetable oils for different times of treatment showed that after 4 weeks of treatment there was no significant difference (P ≥ 0.05) in RPO and PO groups but there was significant decrease (P ≤ 0.05) in CO and COC groups in HDL-C level compared to the control group. However, the results of HDL-C at 8 weeks showed no significance difference (P ≥ 0.05) between control group and treated groups. The LDL-C results at 4 weeks showed that there was significant decrease (P ≤ 0.05) in RPO group but there was significant increase in COC group and there was no significant difference in PO and CO compared to control group. However, at 8 weeks the results of LDL-C showed that there was significant decrease (P ≤ 0.05) in RPO, PO and CO groups while there was no significant difference (P ≥ 0.05) in COC group compared to the control group. It seems probable that palm olein is rich in natural antioxidants such as tocopherols and tocotrienols. However, the unbleached palm oil, so-called red palm olein is rich in α- and β-carotenes high content of the tocotrienols which have been shown to exhibit good antioxidant properties [25,26].

The combined effect of the properties of carotenoid, tocopherols, tocotrienols and 50% instauration of the fatty acids confer on palm oil a higher oxidative stability as compared to other vegetable oils [27]. Studies have shown that diets rich in saturated fatty acids (SFA) increased the LDL-C [28]. The higher the level of LDL cholesterol, the greater the risk of atherosclerotic heart disease conversely and the higher the level of HDL cholesterol the lower the risk of coronary heart disease [29,30].

## 5. Conclusions

Treatment with different vegetable oils (RPO, PO, CO and COC) did not affect the total cholesterol level after 4 weeks while there was decreased in TC level after 8 weeks. However, there was an increased in TG level with RPO, PO and CO after 8 weeks of treatment. Additionally, the results in HDL-C and LDL-C showed that lower HDL-C level in CO and COC groups while LDL-C level decreased in RPO and PO groups after 4 weeks. There was a decreased in LDL-C level with RPO, PO and CO groups but not in COC group after 8 weeks. Therefore, the study indicated that red palm olein lead to an increase in HDL-C and a decrease in LDL-C.

## 6. Acknowledgements

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