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Renal and Hepatocellular Effects of Chronic Red Palm Oil Consumption

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ABSTRACT

The effect of chronic consumption of red palm oil on renal and hepatic toxicity on albino wistar rats was evaluated. The design consisted of 5 study groups of 8 rats each. Group A were fed on rat chow supplemented with 10% oxidised palm oil, group B received rat chow supplement with 10% freshly prepared palm oil, while group C were fed on rat chow supplemented with 20% oxidised palm oil, group D were fed with rat chow supplemented with 20% freshly prepared palm oil and only rat pellets were given to group E which served as the control. The feeding lasted for a period of three months (90 days) after which blood and tissues were obtained for evaluation of renal and hepatic indices. ALP activity in groups A, B, C and D were significantly ($p < 0.05$) higher compared to the control. However, the serum ALT activities showed a significant ($p < 0.05$) decrease in group A, B and C compared to the control. Moreso, AST activities of group A, C and D recorded significant ($p < 0.05$) decrease while that of group B showed a significant ($p < 0.05$) increase compared to the control. However, the renal total protein of group A, B and D showed significant ($p < 0.05$) decrease while the renal total cholesterol of group C showed a significant ($p < 0.05$) increase and that of group D showed a significant ($p < 0.05$) decrease compared to the control. Nevertheless, the renal triacylglyceride of the entire treated groups compared well to each other except for group D which showed significant ($p < 0.05$) decrease compared to the control. Finally, this study showed that palm oil - depending on the source - especially oxidized palm oil may have some deleterious effects on hepatic and renal tissues and is a called for concern.

Keywords: *Renal, Hepatic, chronic consumption, red palm oil.*

1. INTRODUCTION

Oils are important nutrients and energy source that are composed of triacylglycerols. Dietary triacylglycerols are composed of fatty acids that may vary in their chain length, degree of unsaturated, isometric orientation of double bonds and position within the triacylglycerols molecule [1]. There is a growing importance of oils and fats in human nutrition. The period during which dietary lipids were considered only as a means of making food tastier, as a source of energy and vehicle for fat soluble vitamins has now come to an end. The type of food we eat is a key factor that affects as much as it defines the health of all people; hence the saying "you are what you eat". This suggests that our health to a large extent is under our control and we can abuse our bodies by what we eat [2]. Cooking oil is purified fat of plant or animal origin which is liquid at room temperature. In Nigeria palm oil is a major cooking oil. Palm oil and palm kernel oil are derived from oil palm fruit. Palm oil is derived from the mesocarp of the palm fruit. It is processed by pressing and crushing the fruits which retains its deep orange colour due to the presence of carotenoids [3]. In Africa, oil palm plant (Elaeis guineensis) has remained a domestic plant supplying a need for oil and vitamin A in the diet. Palm oil is reported to contain a reasonable concentration of saturated fatty acids. It contains palmitic acid as the main saturated fatty acids and this have been reported by some to contribute to the risk of atherosclerosis [4]. Some researchers argue that the major reason for the high incidence of heart disease, obesity couple with increased organs weight, hypertension, diabetes, premature ageing and some forms of cancer is the profound imbalance between dietary intake of omega -3- fatty acids and omega h-6- fatty acids [5]. While the metabolic products of omega -6- fatty acids promote inflammation, blood clothing and tumor growth, the omega -3- fatty acids act in an entirely opposite manner [5]. Our ancestors evolved on a diet with a ratio of omega -6- fatty acids to omega -3- fatty acids of about 1:1, [5]. This has now massively changed to one which is close to 20:1 due to changing dietary habits over the last few centuries, which indeed is a course for concern [5]. Several studies have incriminated dietary intake of cholesterol and saturated fatty acid from red palm oil, in the incidence of obesity and CHD. It has been shown that plasma cholesterol levels in the body are dependent on the dietary intake of the

animals, thus atherosclerosis and coronary heart disease (CHD) are seriously associated with dietary intake of fat. There are rising concern that palm oil consumption might have contributed to the 20th century episodes of obesity and coronary heart diseases [6]. Virtually, ubiquitous among most developed nations, atherosclerosis was much less prevalent in central and South America, Africa and Asia who consumed this oil, though this trend is gradually changing. Various oils are used as food and have different effects on man. In developing countries, people consume this oil without any knowledge of the contribution of the oil to the overall wellbeing of the individual. Palm oil is a component of both local and processed food and as a source of dietary fats. Since the prelude to the emergence of cardiovascular diseases, fatty liver and change in other vital biochemical indices is hyperlipdeamia which could arise due to increased saturated fatty acid composition of the oil which may trigger an overhaul in the system. It now becomes necessary to investigate how this oil could affect the functionality of vital organs like the liver and kidney via fluctuation of some biochemical indices.

2. MATERIALS AND METHODS

Chemicals

0.1M phosphate buffer, 10% buffered formaldehyde, ethanol (70, 90 and 95%), Chloroform ether, 50% dimethylsulphoxide (DMSO).

Animals

Thirty mature rats of the albino wistar strain weighing 180-200g were used for this study. The rats were obtained from the Department of Pharmacology, Faculty of Basic Medical Sciences, and University of Calabar. The animals were kept in the Biochemistry animal house and were allowed acclimatization period of one week after which they were reweighed and housed in plastic cages with plastic bottom and wire-mesh top (North Kent Co. Ltd), under controlled environmental conditions of temperature (28±20C), relative humidity (50±5%) and a 12 hour light/dark cycle. The animal facility was adequately ventilated and the animals maintained regularly on the commercial rat chow obtained from Pfizer Nig. Ltd Aba. Tap water and food were provided ad-libitum throughout the experimental period. The animals were randomly allocated into five (5) distinct groups of six rats per group.

Feed Constitution

Group A were fed on rat chow supplemented with 10% oxidized palm oil. Group B were fed on rat chow supplemented with 10% freshly prepared palm oil. Group C were fed on rat chew supplemented with 20% oxidized palm oil, Group D were fed on rat chow supplemented with 20% prepared fresh palm oil and Group E which is the control, the rat were fed with the rat pellets. The feeding lasted through 3 months (90 days) period.

Collection of Tissue Samples for Analysis

Twelve hours after last feeding, the animals were anesthetized under chloroform vapour, and then dissected. The kidneys where excised and the whole blood was collected from the heart by cardiac puncture. The blood was put into plain samples tubes. Sera were obtained from the clotted blood into plain sample tubes by allowing standing for 2 hours at room temperature to clot before centrifugation at 3000rpm for 10 minutes using a bench top centrifuge, MSE England to separate cells from serum and the serum used for Biochemical Assays. The kidney was homogenized using laboratory mortar and pistil and then centrifuge to obtain the supernatant for the renal tissue assay.

3. BIOCHEMICAL ASSAYS

All Biochemical assays were carried out using DIALAB kits and an AJ-1222 Semi-auto Biochemistry Analyzer (Easy way medical equipment Ltd England).

Statistical Analysis

Data obtained was expressed as Mean ± Standard Deviation and analyzed using the Analysis of Variance ‘ANOVA; f-ratio’ [7] and student‘t’ test where applicable. Values at $P < 0.05$ were considered significant.

4. RESULTS

The effect of different percentage of oxidized palm oil and freshly prepared palm oil on serum liver enzyme concentration presented on table 1 showed that the ALP activities of groups A, B, C, and D recorded a significant ($p < 0.05$) increase compared to the control group. Moreso, the AST activities of the groups A, C, and D showed a significant decreased ($p < 0.05$) compare to the control group while that of group B showed a significant increased ($p < 0.05$) compared to the control group. However, the ALT activities of groups A, B and C showed significant decrease ($p<0.05$) while that of group D compared favorably to the control subjects. Table 2 showed a presentation of the lipid profile of kidney. Triacylglycerol (TG) and Total Cholesterol (TC) of the kidney tissue showed no significant difference ($p > 0.05$) compared to the control group. However, the TC of group D of the kidney tissue (27.35±0.84) showed a significant decreased ($p < 0.05$) while that of group C (76.65±3.80) showed a significant ($p < 0.05$) increased compared to the control (48.85±14.60). Moreso, the renal total protein levels of all experimental groups showed significant ($p < 0.05$) decrease except for group C which compared well to the control. However, similar trend was observed for renal creatinine levels. Also, Table 3 showed Liver Lipid Profile and liver tissue Enzymes Concentration. Statistical evaluation indicates that the ALT, ALP and AST

activities compare well to the control except for AST and ALP of group D that showed significant increase ($p < 0.05$) compared to the control. Also, the hepatic TG and TC levels in all experimental groups showed no significant ($p < 0.05$) changes.

5. DISCUSSION

Palm oil is the major source of world supply of oils and fat. Palm oil contains an equal proportion of saturated and unsaturated fatty acid, with about 44% palmitic acid, 55 stearic acid (both saturated), 40% oleic acid monounsaturated) [8]. Many health authorities state that palm oil promotes heart diseases and even hepatic liver, citing research and meta studies that date back to 1970 [9]. In our study, the effect of 3 months administration of oxidized palm oil and freshly prepared palm oil at different percentage levels on serum and tissue (liver, kidney, and heart) lipid profile, total protein, enzyme levels as well as albumin, creatinine and urea concentrations were evaluated. Significant decrease was observed in the organ lipid profile for TC and TG of the treatment groups compared to the control subjects. These might simply indicates that both oxidized palm oil and freshly prepared palm oil do not have adverse effects on the organ lipid profile. This is in agreement with the report of [10] who suggested that a covering of drop in lipid profile occur following increased day of administration of fresh palm oil, indicating that a transient increase occurs at the first day of administration, but gradually falls as the days increase. Total protein measurement can reflect nutritional and metabolic status and may be use to screen for and help to diagnose disease of hepatic or renal origin, including many other pathological conditions [11]. From result of our study, statistical evaluation showed that, total protein level of groups A, B, and D of the kidney was significantly lower compared to the control group. These decrease may have resulted from increased protein utilization by the body for building new protoplasm during cell division and multiplication [11]. Aspartate aminotransferase (AST), Alanine aminotransferase (ALT) are more reliable markers in determining the integrity of the liver, while alkaline phosphate is a group of enzymes that are primarily found in the liver and bones. An elevated level of these markers into the serum indicates injuries to the liver [12]. The observed significant increase in the activities of serum ALP, AST and ALT of group C which was given 20% oxidized palm oil may therefore be indication that oxidized palm oil may have a deteriorative effects on the integrity of the hepatocytes. On the other hand, the liver tissue AST, ALT and ALP showed no significant changes in other experimental groups which indicate that freshly prepared palm oil may have hepato-protective function.

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Table 1: Serum Enzyme Concentration of the Liver

	ALP(iU/L)	ALT(iU/L)	AST(iU/L)
Group A	127.59	104.16	199.93
	±2.82*	±0.83*	±1.15*
Group B	228.83	142.92	303.09
	±30.29*	±0.62*	±2.90*
Group C	101.13*	132.01	143.56

	±5.52	±1.06*	±2.07*
Group D	129.99 ±6.17*	153.94 ±0.78	170.57 ±5.47*
Group E (Control)	78.84 ±2.56	150.43 ±2.58	225.77 ±13.49

*P<0.05 vs control

Table 2: Renal Creatinine, Total Proteins, Triglyceride and Total Cholesterol Concentration

	Creatinine(mg/dL)	TP (g/dL)	TG(mg/g)	TC(mg/g)
Group A	2.20 ±0.32*	1.28 ±0.25*	23.49 ±0.78	37.44 ±1.66
Group B	4.92 ±0.81	2.75 0.35*	38.72 ±4.82	65.09 ±5.10
Group C	5.95 ±1.88	8.15 ±0.61	38.79 ±4.67	76.65 ±3.80*
Group D	2.88 ±0.16*	4.52 ±1.20*	16.90 ±1.55*	27.35 ±0.84*
Group E (Control)	6.56 ±0.94	7.48 ±0.51	31.08 ±0.61	48.85 ±14.60

*P<0.05 vs control

Table 3: Liver Lipid Profile and Enzymes Concentration

	TG (mg/G)	TC(mg/G)	ALP(U/L)	AST(U/L)	ALT(U/L)
Group A	31.64 ±3.32	88.72 ±6.12	25.84 ±3.27	143.50 ±16.51	178.00 ±8.37
Group B	29.61 ±4.29	43.88 ±5.53	43.50 ±0.54	169.00 ±21.73	168.50 ±8.62
Group C	26.64 ±3.49	51.26 ±9.61	413.26 ±240.07	434.75 ±149.25*	226 ±36.77*
Group D	36.11 ±0.53	76.13 ±17.02	82.98 ±24.44	167.75 ±8.25	122.50 ±11.21
Group E (Control)	25.64 ±3.09	72.44 ±8.28	133.38 ±14.00	212.25 ±10.83	136.00 ±5.77

*P<0.05 vs control