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Impact of Palm Oil Tainted Feed on Liver and Kidney Health in Wistar Rats: A Sub Chronic Study

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Background: Palm oil is an edible vegetable oil obtained from the mesocarp (reddish pulp) of the fruit of the oil palm trees. The present study evaluated the effects of sub-chronic consumption of palm oil-tainted feed (POTF) on hepatorenal parameters in male Wistar rats.
Methods: Twenty-five (25) male Wistar rats with an average weight of 150±15g were used for the study. They were randomly selected into 5 groups of 5 rats each. Group 1 controlled and accessed only normal feed and water *ad libitum*. Groups 2 and 3 were fed with 10% and 20% POTF and water *ad libitum* respectively. Groups 4 and 5 were fed with 10% and 20% POTF + 0.02mg/ml and 0.04mg/ml of simvastatin respectively, and water *ad libitum* respectively. After 60 days of exposure/consumption of the POTF; blood samples were obtained from the study animals via cardiac puncture after proper sedation. The obtained data were analyzed with IBM SPSS version 25.

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Results: The serum level of a liver enzyme-alanine transaminase (ALT) had no significant (P>0.05) change in all the test groups (groups 2, 3, 4, and 5) when compared to the control group. The level of aspartate transaminase (AST) was found to be significantly (p<0.05) raised in test group 3 when compared to that of group 1 (control). The alkaline phosphatase (ALP) level was significantly (p<0.05) reduced in test group 3 but markedly (p>0.05) elevated in test group 4 when compared to group 2. The serum levels of total protein, albumin, and total bilirubin indicated no significant (P>0.05) difference except for conjugated bilirubin which was significantly (p<0.05) reduced in test group 2.

Conclusion: Except for greater doses, which can have some potentially harmful consequences, mild sub-chronic POTF consumption (10%) in the study animals did not negatively impact any liver enzymes or certain renal indices in the study models.

Keywords: Sub-chronic consumption; palm oil tainted feed; hepatorenal parameters; moderate use of safe; annatural palm oil.

1. INTRODUCTION

The diet pattern across different populations has been linked to the trend of disease prevalence [1,2]. More so, a healthy dietary pattern is related to reducing the risk of chronic metabolic disease; thus, there is a great need for a better understanding of such benefits [3]. An effective approach to achieving this target is putting up efficient checks on the dietary patterns and their relationship with multiple chronic metabolic disorders; as this can be of great benefit to the populace [4].

Elaeis guineensis, a species of palm commonly called oil palm (also known as African oil palm or macaw-fat), it is an age-long trendy food for many West African populations. Again, it is one of the most popular and easy to get, cooking oils used for many delicacies in virtually every home in our population [5,6]. The plant has several local names like “epo pupa” in Yoruba, the Hausa of Northern Nigeria called it “*jar mai or man ja*” and the Igbo called it “*Nkwu or nmanu nri*” etc.

The plant is known to be rich in beta-carotene and contains saturated (and even unsaturated fats) and some other nutrients like vitamin E and beta-carotene [6,7].

Even though palm oil and palm kernel oil, are recorded to contain high levels of saturated fatty acids—roughly 50% and 80%, respectively and a source of dietary fat; consuming it as part of a healthy diet does not increase the risk of coronary artery disease [8].

There have been inconsistent reports about the effects of diets rich in palm oil on the increase in risk of cardiovascular diseases (CVDs)/coronary heart diseases (CHDs) in humans [9]. For instance, saturated fats, reported to be contained in palm oil, are known to possess the potential to raise total cholesterol, which includes low-density lipoprotein cholesterol (LDL-C), which is more dangerous [10,11]. Elevations in LDL-C level are also associated with plaque formation in arteries which is largely contributory to CVD/CHD conditions [12,13].

It therefore calls for the need for further evaluations to unravel the actual relationship between continuous and increasing use of palm oil and CVDs. The current study therefore investigated the possible effect of sub-chronic consumption of palm oil on hepatorenal parameters in Wistar Rats.

2. MATERIALS AND METHODS

About (25) male Wistar rats with a weight of 150±15 grams were procured from the Animal House of the Department of Pharmacology, Faculty of Basic Medical Sciences, University of Port Harcourt. The animals were separated into 5 groups of 5 rats and then housed in well-aerated standard top wire-gauzed plastic cages with sawdust beddings. They were maintained at room temperature under the 12-hour light/dark cycle. The animals were allowed two weeks of acclimatization to their new handling and housing and they accessed their differently formulated feeds and water both in this period and through the treatment interval.

2.1 Experimental Protocol

Group 1 served as the control group and the animals were allowed access to 100 grams of normal rat feed and water.

Group 2 were fed with 100 grams of rat feed tainted with 10% palm oil and water.

Group 3 was fed with 100 grams of rat feed tainted with 20% palm oil and water.

Group 4 was fed with 100 grams of rat feed tainted with 10% palm oil, water, and 0.02mg/ml of simvastatin.

Group 5 was fed with 100 grams of rat feed tainted with 20% palm oil, water, and 0.04mg/ml of simvastatin.

It is noteworthy that, 10% and 20% gram weight of the palm oil were mixed with 90% and 80% gram weights of the normal rat feed respectively to constitute the 10% and 20% of palm oil tainted feed (POTF).

2.2 Harvest of Samples from the study Models

After sixty (60) days of exposure to the different levels of POTF, blood samples were obtained from the study animals through cardiac puncture after proper sedation using 80% trichloromethane (chloroform). The sample was immediately moved into properly labeled lithium heparin bottles and presented for the designated laboratory screening.

2.3 Determination of Liver Enzymes and Other Biochemical Parameters Levels

The Randox assay guides and spectrophotometric detection technique (i.e. automated clinical chemistry analyzer) were used to determine the serum concentrations of ALT, AST, ALP, bilirubin, total protein, and albumin [14,15,16].

2.4 Method of Data Analysis

The numerical data from the present study were subjected to statistical analyses using analyses of variance and Post Hoc tools of the IBM Statistical Product and Service Solutions (SPSS) 21.0V software. The data were presented as Mean ± Standard error of the mean. Variances between means were determined using Analysis of variance (ANOVA) and post-test using LSD multiple comparison tool and Dunnett at 95% probability.

3. RESULTS

The data in Table 1 displays the effect of sub-chronic consumption of palm oil on some hepatorenal parameters in male Wistar rats [17].

The variation in the level of alanine transaminase (ALT) did not show any significant ($p>0.05$) changes when all test groups were compared to the control group and among themselves. For the effect of the sub-chronic consumption of palm oil on aspartate transaminase (AST), only the animals that consumed 20% (group 3) indicated a raised level when compared to that of the animals in the control group. Considering the changes in alkaline phosphatase (ALP) levels following the sub-chronic consumption of palm oil, there appears to be a general reduction in ALP levels when compared to that of control. The aforementioned reductions were seen to be significant in group 2 (treated with 10% of palm oil). On the other hand, the 10% palm oil + simvastatin treated animals (group 4) revealed a significantly elevated ALP level when compared to that of 10% of palm oil treated animals (group 2).

The result on total protein changes indicated that the sub-chronic consumption of palm oil in the study animals did not elicit any significant ($p>0.05$) effect on them. Similarly, the changes in albumin and total bilirubin levels as recorded in the present study revealed no—significant ($p>0.05$) change for all test groups when compared to group 1 and among themselves. Meanwhile, for the conjugated bilirubin changes, there were significant ($p<0.05$) reductions in group 2 (10% palm oil-treated animals) and elevation in group 5 (20% palm oil + simvastatin-treated animals).

4. DISCUSSION

Some schools of thought think that the continuous consumption of palm oil may not possess any adverse effects on the hepato-renal system, heart and blood vessels, or ischemia injuries and plaque buildup [18,19], others hold that palm oil consumption may relatively increase LDL cholesterol, and other adverse biological alterations [20,21]. This controversy prompted the focus of the present study, which has made relevant findings that are discussed in the following paragraphs.

Table 1. Effect of sub-chronic consumption of palm oil tainted feed (POTF) on hepatorenal parameters in male Wistar rats

Groups and Treatment	ALT $(i\mu/L)$	AST $(i\mu/L)$	ALP $(i\mu/L)$	Total Protein (g/L)	Albumin (g/L)	Total Bilirubin $\mu mo/L$	Conjugated Bilirubin $\mu mo/L$
Group 1: Control	5.60 ± 0.98	7.60 ± 0.60	32.20 ± 2.52	64.20 ± 13.68	41.40 ± 2.77	18.84 ± 12.54	4.90 ± 0.65
Group 2: 10% PALM OIL SC	4.80 ± 0.80	11.20 ± 2.24	21.60 ± 3.35 [a]	66.60 ± 7.01	44.00 ± 4.06	5.34 ± 0.98	2.38 ± 0.60 [a]
Group 3: 20% PALM OIL SC	4.80 ± 0.80	15.0 ± 2.75 [a]	29.40 ± 3.93	72.20 ± 5.60	42.60 ± 0.87	5.40 ± 0.90	4.28 ± 0.85
Group 4: 10% PALM OIL SC + SIMV	6.40 ± 0.98	10.80 ± 1.65	32.20 ± 1.71 [b]	43.20 ± 11.12	42.60 ± 1.43	5.54 ± 1.24	3.50 ± 0,76
Group 5: 20% PALM OIL SC + SIMV	5.60 ± 0.98	12.00 ± 2.96	23.80 ± 4.21	38.00 ± 13.80	42.60 ± 2.38	6.16 ± 0.99	4.58 ±0.72 [b]

Values represent mean ± SEM, n=5; [a] Significant at p<0.05 when compared to Group 1; [b] Significant at p<0.05 when compared to group 2; [c] Significant at p<0.05

A major outcome of the present study indicated a stable or normal level of ALT but a marked increase in AST level of the 20% POTF fed group. Of course, the evaluation of ALT level is considered a very reliable enzyme marker with high specificity in diagnosing liver toxicity [22]. This finding, thus, indicates that the consumption of the POTF in the study models may not have adversely affected the normal function of the hepatocytes. The raised level of AST in the 20% POTF group could be a pointer consumption amount of POTF that may result in damage to extra-hepatic tissues or hemolysis; this outcome validates the earlier submissions of Gowda et al., [23] and Kalas et al., [24], as AST level can be marked influenced by extra-hepatic toxicities; especially, seeing here that the ALT level was unaffected.

Another important serum analyte is alkaline phosphatase (ALP) which has a correlation with the presence of bone, liver, and other diseases when it is elevated in the serum [25]. The depression in ALP level, which is rare, could indicate a lack of zinc, malnutrition, pernicious anemia, thyroid disease, etc., and can affect bones and teeth [26,27]. Thus the marked depression in ALP level in the POTF group of animals in the present study is a pointer to a possible adverse effect of increasing POTF consumption. Therefore, while further in-depth study may be required to establish this interesting finding of the present study on the possible ALP depressive effects of the consumption of POTF in the study models, there is a need for caution in increasing the use of palm oil as indicated in the study models.

Plasma proteins are known to be majorly synthesized in the liver [28,29,30], thus, the marginal effects of consumption of POTFs on the study models' total protein and albumin levels, buttresses the earlier result on ALT in the present study. Therefore the moderate consumption of POTFs in the study animals may not have elicited any severe effects on the hepatorenal system.

The present study also found generally reduced levels of conjugated bilirubin in virtually all rats that fed on the POTFs; this was relatively significant when group 2 (that fed on 10% Palm oil tainted group) values were compared to that of the control group.

Due to bilirubin's hydrophilicity and large molecular size, it is easily reabsorbed via the intestinal walls, but the process of its conjugation prevents the intestinal mucosa from passively reabsorbing it. The conjugation, therefore, aids in removing the potentially harmful metabolic waste products [31,32]. Now, because the heme oxygenase in Kupffer cells is responsible for the synthesis of bilirubin [33]; it is suggestive to state that the consumption of increasing doses of POTF may have altered the function of the Kupffer cells. This finding also indicates that further study to evaluate the possible difference in the effects of palm consumption on hepatocytes and Kupffer cells of the liver may be necessary.

5. CONCLUSION

The present study found that except for higher doses, that may elicit some possible unbeneficial effects, mild sub-chronic consumption of POTF in the study animals may not result in any adverse alterations in both liver enzymes and some renal indices in the study models. It is therefore suggestive to state that, continuous use of palm oil should consider moderate use of safe and natural palm oil to prevent any negative health effects.

CONSENT

It is not applicable.

ETHICAL APPROVAL

Ethical authorization was sought and obtained from the Ethical Committee of the Department of Human Physiology, Faculty of Basic Medical Sciences, University of Port Harcourt. The study models were handled in line with the recommendations of the US National Institute of Health (NIH) guidelines for the care and use of laboratory animals in experimental research [17].

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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