Protective Role of *Elaeis guineensis* Leaves against Crude Oil Tainted Diet-induced Hematotoxicity in Wistar Rats

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**ABSTRACT**

**Background:**
Crude oil is a very toxic chemical. Recently, the search for protective substances is attracting attention. This study aimed to investigate the hematoprotective potentials of oil palm leaves against the toxicity induced by crude oil.

**Methods:**
Male Wistar albino rats (n=36) were divided into six groups of rats (n=6). Group 1 (controls) were fed with normal rat food. Groups 2 and 3 were fed with diets combined with a predetermined quantity of *Elaeis guineensis* (*E. guineensis*) leaves. Group 4 were given crude oil contaminated diet. Groups 5 and 6 were fed with tainted diet, mixed with a predetermined quantity of powdered *E. guineensis* leaves.

**Results:**
Pre-treatment of the diet with oil palm leaves restored lipid peroxidation, the activities of various types of superoxide dismutases (SODs), and catalase compared to those obtained for the control group. Treatment of crude oil-tainted diet with oil palm leaves significantly increased hemoglobin concentration and red blood cell indices, and significantly decreased white blood cell count compared to those noted for the rats fed crude oil-tainted diet.

**Conclusions:**
This study found that the treatment of crude oil contaminated diet with oil palm leaves reduced the hemotoxicity as experimented in Wistar albino rats.

**Keywords:**
Crude Oil; *Elaeis Guineensis* Leaves; Hemotoxicity; Oil-Tainted Rat Diet

**INTRODUCTION**

Free radicals are the most common reactive oxygen species in animals, the formation of which has been associated with crude oil (1). The generation of free radicals leads to the production of lipid peroxides, which inactivate antioxidant enzymes and induce oxidative stress (2). In fact, the disruption of antioxidant status in animals by crude oil has been established in the literature (3). Humans are exposed to crude oil during production, uses and illegal bunkering and refining (4,5).

It is not surprising that most inhabitants of crude oil producing communities in the world are at risk of health issues that are linked to oxidative stresses (6,7). Alterations in the levels of lipid peroxidation and the enzymatic and non-enzymatic antioxidants are reliable measures of assessing the oxidative stress in experimental animals (8,9). The association of crude oil-induced oxidative stress with hemotoxicity conditions has been suggested in the literature (10). Products of the *Elaeis guineensis* (*E. guineensis*) tree are associated with medicinal properties due to their phytochemical and antioxidant effects (11-15). These attributes have been linked to *E. guineensis* leaves as a functional animal food (16). The aim of this study was to investigate the ability of *E. guineensis* leaves to protect against hemotoxicity induced in rats whose diet was contaminated with crude oil.

**MATERIALS AND METHODS**

**Materials:** Oil palm leaves was obtained from oil palm plantation in Obiaruku, Delta State, Nigeria. It was identified by Dr. Harrison Erhenhi, Department of Botany, Delta State University, Abraka, Nigeria. Crude oil was obtained from the Department of Petroleum Resources (DPR), Warri, Nigeria. All reagents used were of analytical grade.
Male albino Wistar rats weighing 130–175g were obtained from a local animal dealer in Abraka and were identified by the Department of Anatomy, Delta state University, Abraka, Nigeria. The rats were kept in plastic cages and allowed to acclimatize for two weeks on grower’s feed. The rats were handled based on the guidelines for the use of experimental animals throughout the study (17).

**Methods:** The preparation of oil palm leaves powder and treatment of diet followed an earlier protocol (18). The male Wistar albino rats (n=36) were constituted into six groups of equal number of rats. Rats in group 1 (control) were fed with normal diet. Rats in groups 2 and 3 were fed with diets treated with a predetermined quantity of *E. guineensis* leaves. Rats in group 4 were fed with crude oil tainted diet (4.0 mL/100g). Rats in groups 5 and 6 were fed with the same tainted diet mixed with a predetermined amount of powdered *E. guineensis* leaves. All rats had access to water and food *ad libitum* throughout the four weeks of experiment. The feeds were prepared fresh daily and old feeds were discarded. At the end of the four weeks, the rats were sacrificed under chloroform anesthesia. Blood samples were collected in test tubes, and the lipid peroxidation activity assayed, by the protocol of Gutteridge and Wilkins (19). Total superoxide dismutase (SOD), copper/zinc superoxide dismutase (Cu/Zn SOD) and manganese superoxide dismutase (Mn SOD) activities were determined with an automated hematology analyzer (Mindray analyzer, BC-2300, K.P. Diagnostic & Instruments, India).

**Statistical Analyses:** All data were subjected to analysis of variance (ANOVA) and were expressed as means ± standard deviations (SD) with the significant differences among the treatments set at 5% confidence limit, i.e., (P<0.05).

**RESULTS**

As shown in Table 1, the lipid peroxidation significantly (P<0.05) increased in rats, fed with crude petroleum tainted diet compared to rats fed the normal diet. However, adding oil palm leaves to the diet returned the levels of lipid peroxidation to near the control levels. Crude oil tainted diet induced changes in the plasma total SOD, Cu/Zn SOD and Mn SOD (Table 1). However, pre-treatment of the rat food with oil palm leaves restored the activities of these enzymes to those noted for the control rats. Similarly, this trend was noted for the plasma catalase activity (Table 1), in which treatment of rat food with oil palm leaves maintained the catalase activity within the range noted for the control rats.

The hemoglobin level and red blood cell counts were significantly (P<0.05) decreased in rats, fed crude oil tainted diet compared to those noted for the control group. The white blood cell counts significantly (P<0.05) increased in rats fed the crude oil tainted food (Table 2). Treatment of crude oil-tainted diet with oil palm leaves significantly increased the hemoglobin concentration and red blood cell counts but significantly decreased the white blood cell counts (Table 2), to those noted for rats fed with crude oil-tainted diet.

**DISCUSSION**

Blood is an important means of transporting and supplying nutrients and oxygen to bodily tissues and organs in all animals and humans. More importantly, blood is in charge of the regulation of animal’s internal homeostasis and represents the first source for toxicological assessments (23). The induction of plasma...

**Table 1. Effect of *E. guineensis* leaves treatment of diet on plasma oxidative stress markers in Wistar rats.**

<table>
<thead>
<tr>
<th>GROUP (N=6 each)</th>
<th>Lipid peroxidation (nmol/ml)</th>
<th>Total SOD activity (Unit/ml)</th>
<th>Cu/Zn SOD activity (Unit/ml)</th>
<th>Mn SOD activity (Unit/ml)</th>
<th>Catalase activity (Unit/ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>0.73±0.16</td>
<td>8.62±1.83</td>
<td>6.36±0.13</td>
<td>1.71±0.13</td>
<td>4.80±0.81</td>
</tr>
<tr>
<td>Group 2</td>
<td>0.64±0.21</td>
<td>8.03±0.43</td>
<td>6.81±0.14</td>
<td>1.65±0.43</td>
<td>4.71±0.40</td>
</tr>
<tr>
<td>Group 3</td>
<td>0.62±0.083</td>
<td>8.55±0.55</td>
<td>6.74±0.16</td>
<td>2.55±0.31</td>
<td>4.66±0.22</td>
</tr>
<tr>
<td>Group 4</td>
<td>1.15±0.110</td>
<td>6.21±1.02</td>
<td>4.88±0.30</td>
<td>2.1±0.08</td>
<td>3.81±0.56</td>
</tr>
<tr>
<td>Group 5</td>
<td>0.62±0.13</td>
<td>7.43±1.00</td>
<td>6.05±0.24</td>
<td>1.77±0.23</td>
<td>4.22±0.26</td>
</tr>
<tr>
<td>Group 6</td>
<td>0.63±2.11</td>
<td>7.21±1.13</td>
<td>6.22±0.31</td>
<td>1.61±0.48</td>
<td>4.16±0.32</td>
</tr>
</tbody>
</table>

The results are expressed as mean ± standard deviation with n=6. Values not sharing a common superscript on the same vertical column differ significantly. SOD= superoxide dismutase; Cu/Zn SOD= copper/zinc superoxide dismutase; Mn SOD=Manganese superoxide dismutase.

**Table 2. Effect of *E. guineensis* leaves treatment of diet on hematological markers in Wistar rats.**

<table>
<thead>
<tr>
<th>Group (N=6 each)</th>
<th>Hb (mg/dl)</th>
<th>PCV (%)</th>
<th>RBC (x10^12/L)</th>
<th>WBC (x10^3/L)</th>
<th>MCV</th>
<th>MCH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>15.21±1.67</td>
<td>40.13 ± 0.63</td>
<td>10.48 ± 4.31</td>
<td>17.07 ± 5.77</td>
<td>4.52 ± 2.33</td>
<td>0.38 ± 0.05</td>
</tr>
<tr>
<td>Group 2</td>
<td>17.34±2.04</td>
<td>43.88 ± 1.65</td>
<td>13.71±2.62</td>
<td>18.02 ± 2.39</td>
<td>3.28 ± 0.56</td>
<td>0.40 ± 0.35</td>
</tr>
<tr>
<td>Group 3</td>
<td>19.61±0.89</td>
<td>46.13 ± 1.65</td>
<td>16.41±1.67</td>
<td>17.34 ± 0.88</td>
<td>2.84 ± 0.23</td>
<td>0.43 ± 0.02</td>
</tr>
<tr>
<td>Group 4</td>
<td>8.50±2.40</td>
<td>21.13 ± 4.19</td>
<td>5.39 ± 1.61</td>
<td>25.49 ± 3.90</td>
<td>4.40 ± 2.16</td>
<td>0.44 ± 0.21</td>
</tr>
<tr>
<td>Group 5</td>
<td>10.26±3.96</td>
<td>30.50 ± 4.20</td>
<td>6.35 ± 1.76</td>
<td>19.61 ± 1.70</td>
<td>5.26 ± 2.24</td>
<td>0.40 ± 0.20</td>
</tr>
<tr>
<td>Group 6</td>
<td>13.49±1.22</td>
<td>37.86 ± 6.56</td>
<td>9.50 ± 0.91</td>
<td>19.47 ± 1.06</td>
<td>4.07 ± 1.11</td>
<td>0.40 ± 0.19</td>
</tr>
</tbody>
</table>

The results are expressed as mean ± standard deviation with n=6. Superscripts values not sharing a common superscript on the same vertical column differ significantly. Hb = haemoglobin concentration; PCV = Packed cell volume; RBC = Red blood cell count; WBC = White blood cell count; MCV = Mean corpuscular volume; MCH = Mean corpuscular hemoglobin.
lipid peroxidation, the concomitant reduction in antioxidant enzymes by petroleum, and the treatment by antioxidant rich substances have been published elsewhere (24). The results of this study indicated that crude oil tainted diet altered plasma oxidative stress indicators. However, the addition of oil palm leaves in rat diet restored the indices to levels approaching those noted for the control group. Also, the protective properties of oil palm leaves has previously been documented (25). The increase in the oxidative stress status of the plasma during crude oil abuses and the resultant anemia have previously been reported by other studies (26, 27). The same could be mentioned of induction of disease processes by crude oil (28). This is the basis for the alteration of hematological indices in animals exposed to crude oil (29). It is on this premise that it is imperative to monitor the protective effects of oil palm leaves against hemotoxicity following the exposure of animal to foods contaminated with crude oil.

As seen in Table 2, the significant decrease in hematological indices in rats fed with crude oil contaminated diet as compared to that for the controls, supports the findings of previous studies on the hemotoxic effects of crude oil contaminations (30-32). The decreased hemoglobin concentration and related hematopoietic indices have been attributed to decreased hematopoiesis and enhanced hemolysis induced by hydrocarbons (33). The treatment of crude oil-contaminated diet with oil palm leaves significantly returned the hemoglobin concentration and red blood cell counts to values close to those noted in the control rats.

Unlike hemoglobin and red blood cell indices, we observed a significant increase (P<0.05) in the white blood cell (WBC) counts in rats fed with crude oil-contaminated food compared to those seen in the controls (Table 1). This observation was in agreement with the previous findings, suggesting that increases in WBC represent induction of a disease process (34). Moreover, oil palm leaves treatment of rat diet significantly decreased the WBC compared to the levels noted in rats fed with crude oil-tainted diet only. These observations, i.e., the positive alterations in hematological indices, suggest that oil palm leaves can protect against crude oil-induced hemotoxicity. The protective potential of the leaves against the toxicity was linked to the presence of polyphenolic compounds with the attendant antioxidant effects, which had been previously reported by another study (35).

CONCLUSIONS

This study discovered that the treatment of crude oil-tainted diet with oil palm leaves reduced the resultant and expected hemotoxicity in Wistar albino rats.

ACKNOWLEDGEMENTS

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CONFLICT OF INTERESTS

The author has no conflict of interest to declare.

REFERENCES


