**Moringa oleifera** Attenuates Crude Oil Contaminated Diet Induced Biochemical Effects in Wistar Albino Rats

**Achuba FI**, **Ubogu LA**, **Ekute BO**

1Department of Biochemistry, Delta State University, PMB 1, Abraka, Nigeria.  
2Department of Food Science, Delta State Polytechnic, Ozoro, Nigeria  
3Chemistry Unit, School of Science and Technology, National Open University of Nigeria, 14/16 Ahmadu Bello Way, Victoria Island, Lagos, Nigeria

**Article Information**  
Received 10 August 2016  
Received in revised form 29 October 2016  
Accepted 30 October 2016

**Keywords:** Liver, kidney, crude oil, Moringa oleifera, lipid profile, protein profile

**Abstract**  
The ability of *Moringa oleifera* leaves to protect against crude oil-contaminated diet imposed alterations in biochemical parameters of wistar albino rats was investigated. Exposure of rats to crude oil contaminated diet resulted in hepatic injury as evidenced by significant (P<0.05) increase in the activities of serum hepatic enzymes, aspartate aminotransferase (AST), alanine aminotransferase (ALT), alkaline phosphatase (ALP) and acid phosphatase (ACP). Serum urea, creatinine and potassium ion also significantly increased. Moreover, serum sodium, calcium, chloride and bicarbonate ions significantly (P<0.05) decreased in rats exposed to crude oil contaminated diet, indicating impaired kidney function. Similarly, exposure of rats to crude oil contaminated diet significantly increased serum total cholesterol (TC), triacylglyceride (TAG) and low-density lipoprotein (LDL) but significantly decreased high-density lipoproteins (HDL) when compared to the control. Moreover, the values of serum total protein, albumin and globulin significantly reduced in rats exposed to crude oil contaminated diet compared with values in rat fed uncontaminated diet. However, supplementing crude oil contaminated diet with *Moringa oleifera* significantly maintained serum levels of hepatic enzymes, urea, creatinine and electrolytes close to values obtained in control rats and significantly improved lipid profile and serum proteins. Rats fed *Moringa oleifera* treated diets exhibited reduced TC, TAG and LDL and a higher HDL compared to rats fed crude oil contaminated diet. Besides, rats fed *Moringa oleifera* treated diet had significantly higher total protein, albumin and globulin as compared with rats fed crude oil contaminated diet. Thus, this study exhibits the protective effect of *Moringa oleifera* supplemented diet against the adverse biochemical effects that were mediated by crude oil.

**1 Introduction**  
The exposure of vast majority of the inhabitants of Niger Delta region of Nigeria to crude oil and its refined products has been a reoccurring decimal due to incessant oil spills, unguarded disposal of used and unused petroleum products by automobile mechanics and proliferation of sales outlets. Moreover, the illicit use of crude oil in folkloric medicine in the Niger-delta region of Nigeria for the treatment of various ailments has ignorantly exposed the people to toxic effect of petroleum products. Petroleum pollution has been shown to cause toxicological effects in animals. In addition, recent studies have shown petroleum hydrocarbons to cause significant degenerative changes in the structural integrity of hepatic and renal cells. *Moringa oleifera* is very important for its medicinal value, hence it is employed for the treatment of different ailments. In fact, *Moringa oleifera* is seen among Nigerian populace as a magic plant that cures various ailments as well as a nutritional supplement. Moreover, *Moringa oleifera* preparation is reported to possess antibiotic, anti-inflammatory,
hypocholesterolemic, anti-anaemic and hypoglycaemic activities\(^\text{22}\). Previous studies have shown *Moringa oleifera* to confer protection on toxic chemical induced hepatic damage\(^\text{21}\).

It has been scientifically proved that *Moringa oleifera* imparts significant hypolipidaemic effect\(^\text{23}\). In addition, Mehta et al\(^\text{24}\) reported significant decrease in total cholesterol, low-density lipoproteins, triacylglyceride and phospholipid in hypercholesterolaemic rabbits. Besides, pretreatment with *Moringa* leaf extracts in cadmium exposed rats resulted in a significant decrease in the levels of total cholesterol, triglyceride, HDL, LDL and VLDL as compared to the untreated control group Chatterjee et al\(^\text{25}\). Thus, we planned to evaluate the protective effect of *Moringa oleifera* supplemented diet against the adverse biochemical consequences that was mediated by crude oil.

2 Materials and Methods

2.1 Materials

The crude oil used during this study was obtained from Nigerian National Petroleum Corporation (NNPC), Port Harcourt, Nigeria. Other reagents are high-quality analytical grade. The moringa leave used was obtained from Abraka and was duly identified by the Department of Botany, Delta State University, Abraka, Nigeria.

2.2 Experimental animals

Sixty male albino wistar rats were obtained from the animal house, Department of Anatomy, Delta state University, Abraka. The experimental rats were housed in clean wooden cages and left to acclimatize for two weeks on grower’s mash and water. The rats were weighted after the acclimatization period, and their weights ranged between 130 – 175g.

2.3 Experimental design

Sixty adult male albino rats were randomly divided into five groups with twelve in each group. Rats in group 1 were the control, and were fed with grower’s mash only. Rats in group 2 were fed with grower’s mash plus 5 g *Moringa oleifera* leaves per 100 g of feed. Rats in groups 3 were fed with crude oil contaminated grower’s mash (5 ml/100 g of feed) while rats in groups 4 and 5 were fed with crude oil contaminated grower’s mash (5 ml/100 g of feed) plus 10 g *Moringa oleifera* per 100 g of feed respectively.

The rats in all the groups were given free access to clean drinking throughout the four (4) months the experiment lasted. The feeds for all the groups were prepared fresh daily and stale feed remnants were regularly discarded.

2.4 Collection of blood samples

At the end of the experiment, the rats were sacrificed and the required organs and tissues removed. A set of 5 ml sterile syringes with the needle were used for collection of blood from the vena cava into properly labeled plain sample bottles.

2.5 Determination of serum electrolytes, enzyme activities and metabolite concentrations

Serum creatinine was determined by Jaffe-slot alkaline picate colorimetric method as described by Cheersbrough\(^\text{26}\). The urea was determined using Randox kits. The Bicarbonate ion (HCO\(_3^-\)) was determined by titration method as described by Ochei and Kalhatkar\(^\text{27}\). The sodium ion (Na\(^+\)) and potassium ion (K\(^+\)) were determined by the use of 410 clinical flame photometer made by Sherwood scientific. Calcium was determined by the method specified in Cyaman assay kit.

Serum Chloride was determined by the colorimetric method. Serum alanine aminotransferase (ALT) and aspartate aminotransferase (AST) activities were determined by the colorimetric method of Reitman and Frankel as described by Ochei and Kolhatkar\(^\text{27}\). Serum ALP activity was determined in accordance to the principle of Tietz\(^\text{28}\) as described by Ochei and Kolhatkar\(^\text{27}\). Acid phosphate was determined by method described in agape kit.

2.6 Determination of serum lipid and protein profiles

Serum total cholesterol (TC), triacylglyceride (TAG) and high-density lipoproteins (HDL) were determined using Randox kit purchased from Randox Laboratory Limited (Antrim, Uk, BT29 4QY). The low-density lipoprotein (LDL) was then evaluated from; LDL= TC- TAG/2.2- HDL.

Serum total protein and albumin were determined using Randox kit. Serum globulin was estimated from the difference of total protein and albumin (Globulin Gb, Total protein - Tp, Albumin - Alb). Serum bilirubin was determined by the Jendrassik and Grof bilirubin method as described by Cheerbrough\(^\text{26}\).

2.7 Statistical analysis

All the results were expressed as means ± SD and all data were analyzed using Analysis of variance (ANOVA). Significant differences between the control and treatment means were determined at 5% (P < 0.05) confidence level using Duncan’s Multiple Range Test\(^\text{29}\).

3 Results

Table 1 shows a significant increase in the activities of AST, ALT, ALP and ACP in rats fed crude oil contaminated diet as compared to the values obtained in rats from the control and *Moringa oleifera* alone groups. Supplementation of crude oil contaminated diet significantly decreased the activities of AST, ALT, ALP and ACP compared to control.

The result (Table 2) displayed that the total cholesterol, triacylglyceride and low-density lipoproteins significantly
decreased in rats fed feed plus 5g of moringa compared to the values obtained in rats fed uncontaminated diet (control). However, high-density lipoprotein significantly increased in rats fed with feed that was treated with *Moringa oleifera* alone relative to rats in the control group. A significant increase (P<0.05) in total cholesterol, triacylglyceride and low density lipoproteins in rats fed crude oil contaminated diet as compared to the control rats was observed (Table 2). Conversely, high density lipoprotein value in rates fed crude oil contaminated diet significantly decreased as compared to the value in control rats. However, supplementation of crude oil contaminated diet with *Moringa oleifera* restored the values of TC, TAG, LDL and HDL close to the values obtained in control rats.

Table 1: Effect of *Moringa oleifera* on the activities of hepatic enzymes in wistar albino rats fed crude oil contaminated diet

<table>
<thead>
<tr>
<th>Groups</th>
<th>AST U/L</th>
<th>ALT U/L</th>
<th>ALP U/L</th>
<th>ACP U/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group1 (Control)</td>
<td>60.2±11.1a</td>
<td>60.00±23.5a</td>
<td>49.50±9.40a</td>
<td>70.25± 12.01a</td>
</tr>
<tr>
<td>Group 2 (Feed + 5g)</td>
<td>53.50±9.5b</td>
<td>52.25±25.0b</td>
<td>23.25±2.50b</td>
<td>83.75±7.80c</td>
</tr>
<tr>
<td>Group 3 (Crude+feed)</td>
<td>93.00±11.4c</td>
<td>92.75±19.1c</td>
<td>66.75±15.88c</td>
<td>107.00±7.39d</td>
</tr>
<tr>
<td>Group 4 (Crude+feed+5 gm)</td>
<td>72.00± 5.66d</td>
<td>82.50±9.19d</td>
<td>52.50± 3.54a</td>
<td>89.50 ± 4.95d</td>
</tr>
<tr>
<td>Group 5 (Crude + feed+10 gm)</td>
<td>62.00 ± 9.49a</td>
<td>56.75±21.20b</td>
<td>51.00±12.57c</td>
<td>79.00±10.92c</td>
</tr>
</tbody>
</table>

Results are expressed in mean ± standard deviation. Values sharing different superscript across a column differ significantly. The mean difference is significant at the P<0.05 level, n = 12 for all groups.

Table 2: Effect of *Moringa oleifera* on protein profile and serum bilirubin of wistar albino rats fed crude oil contaminated diet

<table>
<thead>
<tr>
<th>Groups</th>
<th>Total Protein g/dl</th>
<th>Albumin g/dl</th>
<th>Globulin g/dl</th>
<th>Total Bilirubin nmol/L</th>
<th>Conjugated Bilirubin nmol/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1 (Control)</td>
<td>171.25±63.67a</td>
<td>67.75±19.38a</td>
<td>103.50±44.58a</td>
<td>17.75±5.32a</td>
<td>19.00 ± 7.57a</td>
</tr>
<tr>
<td>Group2 (Feed + 5g)</td>
<td>101.00± 7.44b</td>
<td>46.00±3.56b</td>
<td>95.00±6.48a</td>
<td>18.75±14.25a</td>
<td>17.50 ± 4.93a</td>
</tr>
<tr>
<td>Group3 (Feed +Crude )</td>
<td>93.75 ± 8.54c</td>
<td>38.50± 9.33c</td>
<td>55.25±16.09b</td>
<td>24.75±12.84b</td>
<td>14.75 ± 6.85c</td>
</tr>
<tr>
<td>Group4 (Crude +Feed+5g)</td>
<td>133.00±22.63c</td>
<td>49.50±2.12c</td>
<td>83.50±20.51c</td>
<td>20.50 ± 9.19c</td>
<td>18.00 ± 8.49c</td>
</tr>
<tr>
<td>Group5 (Frude+Feed+10g)</td>
<td>139.75±58.28c</td>
<td>60.00±14.10c</td>
<td>79.75±44.43c</td>
<td>20.25±15.69c</td>
<td>21.75 ± 7.14c</td>
</tr>
</tbody>
</table>

Results are expressed in mean ± standard deviation. Values sharing different superscript across a column differ significantly. The mean difference is significant at the P<0.05 level, n = 12 for all groups.

Table 3 demonstrated that exposure of rats to crude oil contaminated diet caused a significant increase in the values of serum urea, creatinine and potassium ion relative to values in rats fed uncontaminated diet. Conversely, exposure of rats to crude oil-contaminated diet significantly decreased serum sodium, chloride, bicarbonate and calcium ions compared with the values obtained for the control group.

Rats in all the groups did not differ significantly in uric acid levels. Although supplementation of crude oil contaminated diet with *Moringa oleifera* did not significantly alter serum calcium ion, it did decrease serum urea, creatinine and potassium ions as well as significantly increased serum sodium, chloride, bicarbonate and calcium ions as compared to the values obtained for rats in crude oil protocol.

The result (Table 4) displayed that the total cholesterol, triacylglyceride and low-density lipoproteins significantly decreased in rats fed feed plus 5g of moringa compared to the values obtained in rats fed uncontaminated diet (control).
Table 3: Effect of *Moringa oleifera* on serum urea, creatinine, uric acid and electrolytes in wistar albino rats fed crude oil contaminated diet

<table>
<thead>
<tr>
<th>Groups</th>
<th>Na⁺ (mM/L)</th>
<th>K⁺(mM/L)</th>
<th>Cl⁻ (mM/L)</th>
<th>HCO₃⁻ (mM/L)</th>
<th>Ca²⁺ (mM/L)</th>
<th>Urea (nmol/L)</th>
<th>Creatinine (nmol/L)</th>
<th>Uric Acid (nmol/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1 (Control)</td>
<td>153.00±6.63ᵃ</td>
<td>7.25±1.32ᵃ</td>
<td>85.00±4.40ᵃ</td>
<td>26.00±4.08ᵃ</td>
<td>6.36±10.43ᵃ</td>
<td>18.20±3.20ᵃ</td>
<td>253.25±39.74ᵃ</td>
<td>1.06±0.20</td>
</tr>
<tr>
<td>Group 2 (feed+ 5g)</td>
<td>149.00±2.58ᵃ</td>
<td>6.85±0.29ᵃ</td>
<td>85.00±6.65ᵃ</td>
<td>24.00±3.92ᵃ</td>
<td>1.16±0.31ᵇ</td>
<td>17.18±3.44ᵇ</td>
<td>229.25±64.68ᵇ</td>
<td>1.07±0.19ᵇ</td>
</tr>
<tr>
<td>Group 3 (Crude + Feed)</td>
<td>142.25±3.59ᵇ</td>
<td>8.88±0.91ᵇ</td>
<td>79.00±6.22ᵇ</td>
<td>19.50±2.65ᵇ</td>
<td>0.82±0.33ᵇ</td>
<td>24.15±2.49ᵇ</td>
<td>347.00±91.74ᵇ</td>
<td>1.17±0.08ᵃ</td>
</tr>
<tr>
<td>Group 4 (Crude + Feed+ 5g)</td>
<td>148.00±7.07ᵃ</td>
<td>6.70±0.71ᵃ</td>
<td>91/00±1.41ᵃ</td>
<td>24.00±5.66ᵃ</td>
<td>0.93±0.24ᵇ</td>
<td>21.70±6.22ᵇ</td>
<td>287.00±19.80ᵇ</td>
<td>1.23±0.38ᵇ</td>
</tr>
<tr>
<td>Group 5 (Crude+Feed +10g)</td>
<td>148.25±12.63ᵃ</td>
<td>5.85±0.35ᵇ</td>
<td>91.25±14.25ᵃ</td>
<td>24.00±3.56ᵃ</td>
<td>1.10±0.22ᵇ</td>
<td>18.65±3.07ᵇ</td>
<td>245.25±39.15ᵇ</td>
<td>0.99±0.25ᵃ</td>
</tr>
</tbody>
</table>

Results are expressed in mean ± standard deviation. Values sharing different superscript across a column differ significantly. The mean difference is significant at the P<0.05 level, n = 12 for all groups.

Table 4: Effect of *Moringa oleifera* on lipid profile of wistar albino rats fed crude oil contaminated diet

<table>
<thead>
<tr>
<th>Sample</th>
<th>TotalCholesterol (mg/dL)</th>
<th>Triacylglyceride (mg/dL)</th>
<th>HDL (mg/dL)</th>
<th>LDL (mg/dL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group1 (Control)</td>
<td>5.98 ± 3.36ᵃ</td>
<td>0.66 ± 0.28ᵃ</td>
<td>0.23 ± 0.18ᵃ</td>
<td>1.04 ± 0.19ᵃ</td>
</tr>
<tr>
<td>Group 2 (Feed +5g)</td>
<td>2.54 ± 1.01ᵇ</td>
<td>0.17 ± 0.07ᵇ</td>
<td>1.01 ± 0.14ᵇ</td>
<td>0.76 ± 0.20ᵇ</td>
</tr>
<tr>
<td>Group 3 (Crude)</td>
<td>4.67 ± 1.29ᶜ</td>
<td>0.59 ± 0.95ᶜ</td>
<td>0.08 ± 0.02ᶜ</td>
<td>1.31 ± 0.40ᶜ</td>
</tr>
<tr>
<td>Group 4 (Crude +Feed +5g)</td>
<td>2.75 ± 0.49ᵇ</td>
<td>0.28 ± 0.14ᵇ</td>
<td>1.07 ± 0.64ᵇ</td>
<td>0.64 ± 0.07ᵇ</td>
</tr>
<tr>
<td>Group5 (Crude+Feed +10g)</td>
<td>2.53 ± 1.02ᵇ</td>
<td>0.21 ± 0.17ᵇ</td>
<td>1.11 ± 0.47ᵇ</td>
<td>0.57 ± 0.22ᵇ</td>
</tr>
</tbody>
</table>

Results are expressed in mean ± standard deviation. Values sharing different superscript across a column differ significantly. The mean difference is significant at the P<0.05 level, n = 12 for all groups.

However, high-density lipoprotein significantly increased in rats fed with feed that was treated with *Moringa oleifera* alone relative to rats in the control group. A significant(P<0.05) increase in total cholesterol, triacylglyceride and low density lipoproteins in rats fed crude oil contaminated diets compared to the rats in control group was observed (Table 4). Conversely, high density lipoprotein value in rates fed crude oil contaminated diet significantly decreased as compared to the values in control rats. However, supplementation of crude oil contaminated diet with Moringa oleifera restored the values of TC, TAG LDL and HDL close to the values obtained in control rats.

4 Discussions

The liver is the organ responsible for the metabolism and detoxification of chemical compounds. Besides, the kidney plays the dominant role in the body homeostasis, and works synergistically with the liver to complete the process of xenobiotics detoxification. Therefore, the toxicity of crude oil on living systems could be investigated by simultaneous evaluation of the biochemical and / or functional changes in the liver and kidney. The observed significant (P<0.05) increase in the activities of AST, ALT, ALP and ACP in rats fed crude oil contaminated diet as compared to the control (Table 1) agrees with the results of previous studies on crude petroleum and...
refined petroleum products\textsuperscript{9}, \textsuperscript{31}, \textsuperscript{32},\textsuperscript{13}. The elevated levels of serum marker enzymes indicate cellular leakage due to damage of the structural integrity of the liver\textsuperscript{23}, \textsuperscript{34}, \textsuperscript{35}. The decrease in the activities of AST, ALT, ALP and ACP in rats fed crude oil contaminated diet supplemented with \textit{Moringa oleifera} indicates protective effect of \textit{Moringa oleifera} on the hepatocytes (Table 1). This agrees with previous studies on the hepatoprotective effect of \textit{Moringa oleifera} on chemically induced hepatic damage\textsuperscript{21, 22}. \textit{Moringa oleifera} is reported by many authors to be richly endowed with antioxidant chemicals (such as quercetin), potent antioxidant vitamins (such as C and E) and antioxidant micronutrients such as selenium\textsuperscript{36}-\textsuperscript{37}. This explains the potency of \textit{Moringa oleifera} against crude oil mediated toxicity. The protective effect of vitamins C and E, palm oil and honey against crude oil induced heamatoxicity was earlier reported\textsuperscript{38, 12, 15}. Moreover, previous studies have shown the elevation of antioxidant enzymes and organ biomarkers upon treatment with either \textit{Moringa oleifera} or its phytochemical isolates\textsuperscript{39, 37}. The reduction of the activities of the hepatic maker enzymes by \textit{Moringa oleifera} despite exposure of rats to crude oil contaminated diet may be attributed to the stabilizing ability of the cell membrane and thereby preventing enzyme leakages\textsuperscript{32}.

That the liver integrity has been compromised by the ingestion of crude oil contaminated diet is indicated by the decrease in the levels of macromolecules such as total protein, albumin, globulin and conjugated bilirubin as well as the significantly higher level of total bilirubin (Table 2). This observation is in tandem with the results from previous studies\textsuperscript{40, 31}. The decreases in the levels of these macromolecules indicate that the metabolic function of the liver has been compromised. This is because one of the metabolic functions of the liver is the biosynthesis of these metabolites before they are released into the general blood circulation\textsuperscript{26}. Moreover, lower level of globulins may suggest reduced immunity since globulins are important for immunological responses\textsuperscript{27}. Further, the alterations in levels of total- and conjugated bilirubin in rats fed crude oil contaminated diet suggests liver damage as the liver is the organ that conjugates and excretes bilirubin. However, feeding rats with crude oil contaminated diet that was supplemented with \textit{Moringa oleifera} significantly increased total protein, albumin, and globulin and conjugated bilirubin (Table 2). \textit{Moringa oleifera} augmented diet also decreased total bilirubin. Albumin is used as an indicator of liver impairment, reduced absorption or protein loss\textsuperscript{41}. \textit{Moringa oleifera} may have induced the repairing effect on the liver due to its constituent essential amino acid such as methionine and cysteine and thus boosting the total protein and albumin levels\textsuperscript{42}

The significant (P<0.05) increase in serum urea, creatinine and potassium ion as well as significant (P<0.05) decrease in serum sodium, chloride, bicarbonate and calcium ions observed in rats fed crude oil contaminated diet compared to the control indicates compromised kidney function\textsuperscript{27, 26} (Table 3). The present findings agree with earlier reports by Ovuru et al\textsuperscript{40} and Achuba and Ogwumu\textsuperscript{14} on crude oil toxicity and diesel toxicity, respectively. Nonetheless, augmentation of crude oil contaminated diet with \textit{Moringa oleifera} significantly improved the values of these kidney function markers in a close similitude with the values obtained in control rats. This again indicates the protective role of \textit{Moringa oleifera} against crude oil mediated nephrotoxicity.

Fluctuations in lipid profile are vital in monitoring the cases of cardiovascular disorders\textsuperscript{12}. As observed in this study (Table 4), consumption of crude oil contaminated diet caused a significant (P<0.05) increase in the levels of some of the lipids (TC, TAG and LDL) in the exposed rats. This agrees with the findings of Achuba and Otuya\textsuperscript{8} and Ujowundu et al\textsuperscript{31}. Although both research submitted decreased levels of TAG following exposure of animals to crude oil contaminated diets, Achuba and Otuya\textsuperscript{8} reported a significant increase in TC and LDL while Ujowundu et al\textsuperscript{31} reported a significant increase in LDL. Previous report indicated that increase in total cholesterol alongside a corresponding decrease in high density lipoproteins is a primary risk factor for coronary heart disease\textsuperscript{44}. The increased levels of serum TAG is an indicator of liver toxicity\textsuperscript{44} and high serum TAG with decreased absorption of fatty acids by the adipose tissue is linked with low high density lipoproteins, insulin resistance and increased risk of atherosclerosis\textsuperscript{44}.

Previous studies have reported the hypolipidaemic effect of \textit{Moringa oleifera}\textsuperscript{24}. In this study, supplementation of crude oil contaminated diet resulted in significant restoration of lipid profile close to control values (Table 4). \textit{Moringa oleifera} may have improved the lipid profile of rats due to its antioxidant properties. Achuba and Otuya\textsuperscript{31} had earlier found antioxidants such as vitamins C and E to improve lipid profile in rabbits fed crude oil contaminated diet. In fact, the lipid profile of all \textit{Moringa oleifera} groups was better than that observed in the control group (Table 4).

5 Conclusion

The result of this investigation suggests that crude oil contaminated diet ingestion could compromise the integrity of the liver and kidney as well as predispose subjects to cardiovascular disease as evidenced by adverse alterations in the lipid profile of rats. However, supplementations of diet with \textit{Moringa oleifera} could ameliorate the adverse alterations in the biochemical parameters induced by crude petroleum.

6 Conflict of interests

The authors declare that there is no conflict of interest

7 Author’s contributions

This work was carried out in collaboration between all authors. Author FIA designed the study. Authors LAU and BOE wrote the
protocol. Author FIA reviewed the experimental design and wrote the first draft of the manuscript. All authors managed the analyses of the study. Authors LAU and BOE performed the statistical analysis. All authors read and approved the final manuscript.

8 References


Moringa oleifera,
Amic rabbits. Journal d Practice. Tara Mecgraw, FN, Igwe CU, Agha NC, Igwe; al

UK J Pharm & Biosci, 2016: 4(5); 76