Effect of “Reed A Dream” Insecticide on Selected Biomarkers of Kidney, Liver and Lipid Profile in Wistar Rats

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Abstract

This study investigated the effect of “Reed A Dream” (RD) insecticide on selected biomarkers of kidney, liver and lipid profile in Wistar rats. Twenty five (25) rats of both sexes (weighing 50-114g) were divided into 5 groups comprising of control (0.5mL water), N-hexane only (0.5mL), RD(50% vol/vol) + N-hexane, RD(25% vol/vol) + N-hexane, and RD(12.5% vol/vol) + N-hexane labelled groups 1-5 respectively. After 2 weeks of oral daily administration, animals were sacrificed; blood, liver, kidney and heart tissues were taken for biochemical and histopathological investigations respectively. A non-significant decreased (p≥0.05) in plasma concentration of total protein, aspartate aminotransferase (AST), alanine aminotransferase (ALT), alkaline phosphatase (ALP) in groups 3-5; a significant decrease (p≤0.05) in albumin (groups 3-5); a non-significant increased in creatinine, gamma glutamyltranspeptidase (GGT) in groups 3-4 when compared with control group; a significant increased (p≤0.05) in urea in groups 3-5 when compared with control group. Histology of the liver tissue (group 3) revealed central vein with mild congestion, kidney tissue (groups 3-5) showed visible congestion of glomerulus and heart tissue (group 3-5) showed interstitial deposition of collagens compared with control group. RD insecticide on oral exposure caused acute nephrotoxicity and mild hepatotoxicity in Wistar rats.

Key words: Reed A Dream, insecticide, kidney, liver, toxicity
Introduction

The use of insecticides in homes to control crawling and flying insects have been a practice for decades. In Africa where malaria due to mosquitoes bite is a public health concern, governments, non-governmental organizations (NGOs), international donors and individuals have through various programmes devised means of combating mosquitoes, which include distribution of insecticide treated nets, environmental spraying of insecticides, encouraging communities to clear their surrounding bushes, cleaning water drainage and stagnant water which serve as home for mosquitoes. In Nigeria, some families preferred the use of either powdered, liquid or aerosolized insecticides in their homes. There is now increasing concern over the persistent exposure of humans to these insecticides which can possibly result in insecticide poisoning [1]. According to Ki-Hyun [2], the most severe form of pesticide poisoning may arise from oral exposure. Oral exposure to insecticides could be either by accident, carelessness or for intentional reasons [2, 1]. Gilden [4] stated that the most prevalent incidence of unintentional oral intake occurred during the process of moving pesticides from their initially marked vessel to an unlabeled one or packaging for foodstuff.

In considering intentional ingestion of insecticides, there are reported cases in Nigeria for instance where young people have committed suicide by ingesting insecticide [5, 6]. In addition, children are at risk of insecticide toxicity if insecticide is kept in drink bottle or after drinking water from insecticide-tainted bottle [6]. Workers handling insecticides or equipments containing insecticides for Agricultural application as reported by the United State Environmental Protection Agency (USEPA) [7] can also ingest insecticides if proper hand washing is not done before eating.

Additionally, in animal studies, Albert et al. [8] reported progressive increased in mortality of albino rats exposed to “Raid” aerosolized insecticide as the concentration increases. They also discovered that Raid pesticide may bio-accumulate, and that the sequence of bio-accumulation of the insecticide in tissues is lipid > muscle > liver > brain. According to Albert et al. [8], the indicators of toxicity indicated no significant impact in the brain, but substantial reductions in glucose-6-phosphatase and lactic acid dehydrogenase levels in muscle and liver. They however, conclude that Raid insecticide can inhibits several critical metabolic processes as a result of the insecticide constituents accumulating in the tissues. The severity of any effect from exposure to insecticides depends on the concentration, route of exposure, ease of absorption, metabolic fate, and persistency of exposure [2, 6]. Although, there three established major routes of human exposure to insecticide; skin, oral ingestion,
and inhalation. The effect may be acute, showing immediately after the exposure, or chronic, showing only after prolonged use [7]. In Nigeria, some of the major factors leading to a preponderance of adverse health impact associated with insecticides use is the fact that the most-deadly insecticides are used because they are cheaper than newer safer insecticides, poor legislation and lack of enforcement on available legislation, improper and safe application, lack of adequate information, knowledge, and awareness of the inherent danger of persistent exposure to insecticides, have shown the need for more studies which could guild the regulatory authorities in the country to better formulate policies that could properly regulate the sale and usage of these insecticides in homes.

The insecticide ‘‘Reed A Dream’’ (RD) (Manufactured by Yuanlong (Fujian) Commodities, China and marketed in Nigeria by Cu-Bas International Nigeria Limited) is used in most part of Nigeria to control insects like mosquitoes, cockroaches, flies and other crawling insects in many homes, especially in major cities in the country. However, there have not been documented toxicity and safety studies of this insecticide on direct exposure or contamination of food in homes. The effect of persistent exposure to insecticide can be more severe in children who could easily ingest insecticide when not properly stored or indiscriminately used in the home, which is a major concern as insecticides have been reported to have adverse effect on human health [4]. More so, there are rising cases of suicide by ingestion of insecticides among teenagers in some cities in Nigeria. Thus, there is need for independent studies to ascertain the safety of this insecticide as used in homes. Hence, this study investigated effect of RD insecticide on selected biomarkers of kidney, liver and lipid profile in Wistar rats.
Materials and Methods

Test facility

Twenty-five Wistar rats of both sexes weighing 50-114 g were divided into five groups of five rats each and maintained at the Department of Biochemistry, University of Port Harcourt animal breeding facility. The rats were fed standard rat food and given free access to water. Protocols defining animal usage were followed in line with the World Medical Association (WMA) [9] handbook on the care and use of laboratory animals.

Source of animals and insecticide

The University of Port Harcourt' Department of Biochemistry's animal breeding facility provided the Wistar rats used for this study. Commercially grade RD aerosolized insecticide was purchased from a grocery store in Choba, Rivers State, Nigeria.

Test procedure

300ml of RD aerosolized insecticide was trap in 300ml N-hexane to give 1:1 dilution (50% vol/vol). From the initial dilution, a 1:2 (25% vol/vol) and 1:4 (12.5% vol/vol) dilution of RD to N-hexane were prepared and orally administered to animals. Group 1-5 animals were given water and rats chow only, N-hexane only, 50% vol/vol, 25% vol/vol and 12.5 % vol/vol RD insecticide respectively.

Analytical procedure

The plasma obtained from different treatments after sacrificed was subjected to biochemical analysis using Spectrumlab 23A. Urea and creatinine concentration were determined following the method described by Fawcett and Scott [10] and Spencer [11] respectively. Magnesium and Potassium ion, albumin, total bilirubin, Tietz [12] method was used to determine high density lipoprotein cholesterol (HDL-C) and triglyceride concentrations, while Hochstrasser and Skeggs [13] method was used to determine chloride ions concentration. Trinder's approach [14] was used to detect sodium ion concentration. The concentrations of total protein and bilirubin were determined using Nowotny's technique [15]. The activities of transaminases (ALT and AST) were determined using the Reitman and Frankel method [16], ALP and GGT, and total cholesterol were determined using the Plummer [17], Theodorsen and Stromme [18], and Allain et al. [19] methods, respectively. Friedewald et al. [20] were used to estimate low density lipoprotein-cholesterol (LDL-C). To
avoid post-mortem deterioration, liver, kidney, and heart tissues were obtained immediately after sacrifice for histopathological examination using Windsor [21] procedure.

Data analysis

Statistical analysis was performed using SPSS version 20.0 (IBM, U.S.A). The data were analysed using one-way analysis of variance (ANOVA) and significant differences were determined using least significant difference (LSD) for Post Hoc test of multiple comparisons at p ≤ 0.05. The mean and standard error of the mean (M ± SEM) were used to report the results.

Results

Table 1 shows a significant increase (p ≤ 0.05) in plasma urea concentration in the RD (50 percent vol/vol) + N-hexane, RD(25 percent vol/vol) + N-hexane, and RD(12.5% vol/vol) + N-hexane test groups when compared to the control group; a significant increase (p 0.05) in plasma creatinine concentration in the RD(12.5% vol/vol) + N-hexane test group when compared with control group. Electrolyte concentrations (Mg²⁺, Cl⁻, and Na⁺) increased albeit not significantly.

Total protein (Table 2) showed decreased (p≥0.05) in the RD (50% vol/vol) + N-hexane, RD(25% vol/vol) + N-hexane, and RD(12.5% vol/vol) + N-hexane test groups; a significant decreased in albumin concentration in the RD (50% vol/vol) + N-hexane, RD(25% vol/vol) + N-hexane, and RD(12.5% vol/vol) + N-hexane test groups; significant increased (p ≤ 0.05) in total bilirubin concentration in the RD (50% vol/vol) + N-hexane, RD(25% vol/vol) + N-hexane, and RD(12.5% vol/vol) + N-hexane test groups when compared with control group. AST, ALT and ALP activities of the RD (50% vol/vol) + N-hexane, RD(25% vol/vol) + N-hexane and RD(12.5% vol/vol) + N-hexane test groups showed non-significant decrease (p≥0.05) compared with control group. However, GGT activity were non-significantly increased in the RD (50% vol/vol) + N-hexane and RD(25% vol/vol) + N-hexane test groups while a non-significant decreased was observed in the RD(12.5% vol/vol) + N-hexane test group when compared with the control group.

Table 3 revealed a non-significant increased (p≥ 0.05) in HDL-C levels in the RD (50% vol/vol) + N-hexane and RD(25% vol/vol) + N-hexane test groups; a non-significant decreased (p ≥ 0.05) in LDL-C, triglyceride and cholesterol levels in the RD (50% vol/vol) +
N-hexane, RD(25% vol/vol) + N-hexane, and RD(12.5% vol/vol) + N-hexane test groups in relation to control group.

Effect of RD insecticide on liver, heart and kidney weight of Wistar albino rats (Table 4) indicated significant increased \((p \leq 0.05)\) in liver weight in RD(50% vol/vol) + N-hexane (1:1 dilution) test group; significant decreased \((p \leq 0.05)\) in kidney and heart weight in RD(12.5% vol/vol) + N-hexane (1:4 dilution) test group compared with control group.
Table 1: Plasma concentration of urea, creatinine, Mg\(^2+\), K\(^+\), Cl\(^-\) and Na\(^+\) in Wistar albino rats orally exposed to RD insecticide

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Urea (mmol/L)</th>
<th>Creatinine (mmol/L)</th>
<th>Mg(^2+) (g/dL)</th>
<th>K(^+) (mmol/L)</th>
<th>Cl(^-) (mmol/L)</th>
<th>Na(^+) (mmol/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (Normal food &amp; Water)</td>
<td>1.79±0.21</td>
<td>116.89±5.77</td>
<td>2.22±0.11</td>
<td>5.49±0.30</td>
<td>97.54±5.44</td>
<td>153.47±1.25</td>
</tr>
<tr>
<td>N-Hexane Only (0.5 mL)</td>
<td>4.90±1.20</td>
<td>132.70±6.09</td>
<td>2.40±0.12</td>
<td>5.68±0.70</td>
<td>99.79±8.81</td>
<td>154.04±0.32</td>
</tr>
<tr>
<td>RD(50% vol/vol) + N-Hexane (1:1 dilution)</td>
<td>4.17±0.44(^a)</td>
<td>138.56±12.35</td>
<td>2.41±0.16</td>
<td>5.12±0.93</td>
<td>105.78±8.92</td>
<td>153.11±2.14</td>
</tr>
<tr>
<td>RD(25% vol/vol) + N-Hexane (1:2 dilution)</td>
<td>4.73±1.20(^a)</td>
<td>142.33±12.78</td>
<td>2.14±0.09</td>
<td>4.87±0.54</td>
<td>105.94±7.55</td>
<td>160.49±4.88</td>
</tr>
<tr>
<td>RD(12.5% vol/vol) + N-Hexane (1:4 dilution)</td>
<td>3.36±0.87</td>
<td>154.75±10.53(^a)</td>
<td>2.36±0.08</td>
<td>5.61±0.63</td>
<td>101.27±7.97</td>
<td>153.81±3.30</td>
</tr>
</tbody>
</table>

Values are reported as Mean± Standard Error of Mean (M±SEM) (n =5), \(^a\) superscripts indicates statistical significance difference (p≤ 0.05) when compared with control and between treatment groups.
Table 2: Plasma concentration of total protein, bilirubin, albumin, AST, ALT, ALP and GGT in Wistar albino rats orally exposed to RD insecticide

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Total Protein (g/L)</th>
<th>Albumin (g/L)</th>
<th>Total Bilirubin (mmol/L)</th>
<th>AST (U/L)</th>
<th>ALT (U/L)</th>
<th>ALP (U/L)</th>
<th>GGT (U/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (Normal food &amp; Water)</td>
<td>61.06±12.01</td>
<td>41.74±2.55</td>
<td>2.77±0.79</td>
<td>147.11±8.64</td>
<td>46.89±13.18</td>
<td>43.26±7.96</td>
<td>18.05±1.37</td>
</tr>
<tr>
<td>N-Hexane Only (0.5 ml)</td>
<td>37.42±13.56</td>
<td>25.19±4.32</td>
<td>4.32±1.24</td>
<td>138.32±3.20</td>
<td>21.51±1.66</td>
<td>25.28±2.35</td>
<td>17.70±0.85</td>
</tr>
<tr>
<td>RD(50% vol/vol) + N-Hexane (1:1 dilution)</td>
<td>54.95±6.13</td>
<td>31.98±2.11(^a)</td>
<td>5.05±1.46(^a)</td>
<td>130.78±10.63</td>
<td>22.60±2.43(^a)</td>
<td>25.73±4.68(^a)</td>
<td>20.88±2.40</td>
</tr>
<tr>
<td>RD(25% vol/vol) + N-Hexane (1:2 dilution)</td>
<td>34.01±5.99</td>
<td>26.47±2.94(^a,b)</td>
<td>13.14±5.68(^a,b)</td>
<td>100.73±3.45(^a,b)</td>
<td>22.15±2.81(^a)</td>
<td>26.71±5.44(^a)</td>
<td>18.39±3.12</td>
</tr>
<tr>
<td>RD(12.5% vol/vol) + N-Hexane (1:4 dilution)</td>
<td>40.25±8.89</td>
<td>35.93±3.39(^b)</td>
<td>8.33±2.58(^a)</td>
<td>111.09±8.39(^a,b)</td>
<td>22.41±2.27(^a)</td>
<td>23.94±3.35(^a)</td>
<td>16.42±1.06</td>
</tr>
</tbody>
</table>

Values are reported as Mean± Standard Error of Mean (M±SEM) (n =5). \(^a,b\)superscripts indicates statistical significance difference (\(p\leq 0.05\)) when compared with control and between treatment groups.
### Table 3: Lipid profile of Wistar albino rats orally exposed to RD insecticide

<table>
<thead>
<tr>
<th>Treatments</th>
<th>HDL-C</th>
<th>LDL-C</th>
<th>Triglyceride</th>
<th>Total cholesterol</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(mmol/L)</td>
<td>(mmol/L)</td>
<td>(mmol/L)</td>
<td>(mmol/L)</td>
</tr>
<tr>
<td>Control (Normal food &amp; Water)</td>
<td>1.78±0.06</td>
<td>0.73±0.13</td>
<td>1.63±0.09</td>
<td>3.25±0.10</td>
</tr>
<tr>
<td>N-Hexane only (0.5 mL)</td>
<td>1.54±0.17</td>
<td>0.58±0.17</td>
<td>1.13±0.17</td>
<td>2.64±0.31</td>
</tr>
<tr>
<td>RD(50% vol/vol) + N-Hexane (1:1 dilution)</td>
<td>1.82±0.48</td>
<td>0.54±0.12</td>
<td>1.41±0.43</td>
<td>3.01±0.75</td>
</tr>
<tr>
<td>RD(25% vol/vol) + N-Hexane (1:2 dilution)</td>
<td>1.87±0.44</td>
<td>0.36±0.13</td>
<td>1.18±0.27</td>
<td>2.70±0.45</td>
</tr>
<tr>
<td>RD(12.5% vol/vol) + N-Hexane (1:4 dilution)</td>
<td>1.78±0.17</td>
<td>0.48±0.23</td>
<td>1.10±0.15</td>
<td>2.74±0.39</td>
</tr>
</tbody>
</table>

Values are reported as Mean± Standard Error of Mean (M±SEM). n =5.
Table 4: Weight of liver, heart and kidney of Wistar albino rats orally exposed to RD insecticide

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Liver (g)</th>
<th>Kidney (g)</th>
<th>Heart (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (Normal food &amp; Water)</td>
<td>4.88±0.06</td>
<td>0.44±0.02</td>
<td>0.52±0.06</td>
</tr>
<tr>
<td>N-Hexane only (0.5 mL)</td>
<td>4.60±0.31</td>
<td>0.54±0.02</td>
<td>0.46±0.02</td>
</tr>
<tr>
<td>RD(50% vol/vol) + N-hexane (1:1 dilution)</td>
<td>5.12±0.39&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.54±0.04&lt;sup&gt;a,b&lt;/sup&gt;</td>
<td>0.42±0.05</td>
</tr>
<tr>
<td>RD(25% vol/vol) + N-hexane (1:2 dilution)</td>
<td>4.70±0.18</td>
<td>0.32±0.05&lt;sup&gt;a,b,c&lt;/sup&gt;</td>
<td>0.34±0.04&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>RD(12.5% vol/vol) + N-hexane (1:4 dilution)</td>
<td>4.22±0.39&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.48±0.02&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.46±0.06</td>
</tr>
</tbody>
</table>

Values are reported as Mean± Standard Error of Mean (M± SEM). n =5. <sup>a,b,c</sup> superscripts indicates statistical significance difference (p≤ 0.05) when compared with control and between treatment groups.
Plate 1: Photomicrograph liver sections. (A) control (Normal food & Water) (B) N-Hexane Only (0.5 ml). (C) RD(50% vol/vol) + N-Hexane. (D) RD(25% vol/vol) + N-Hexane and (E) RD(12.5% vol/vol) + N-Hexane (H&E X100).

Plate 1(A) and (B) showed central vein (CV) of normal hepatocytes architecture. Plate 1(C) showed central vein with mild liver congestion. Plate 1(D) indicates severe liver congestion and enlarged central vein. Plate 1(E) showed hepatic artery (ha), bile duct (bd), portal vein (pv), hepatocytes (ha) with enlarged fat vacuoles (fv).
Plate 2: Photomicrograph of kidney sections. (A) Control (Normal food & water) (B) N-Hexane only (0.5 ml) (C) RD(50% vol/vol) + N-Hexane (D) RD(25% vol/vol) + N-Hexane and (E) RD(12.5% vol/vol) + N-Hexane (H&E X400).

Plate 2 (A) and (B) showed normal architecture of glomerulus (G), tubules and blood vessels of kidney histology. Plate 2 (C), (D) and (E) arrows indicates visible congestion of glomerulus while asterisks (*) showed areas of tubular necrosis.
Plate 3: Photomicrograph of heart sections. (A) Control (Normal food & water) (B) N-Hexane only (0.5 ml) (C) RD(50% vol/vol) + N-Hexane (D) RD(25% vol/vol) + N-Hexane and (E) RD(12.5% vol/vol) + N-Hexane (H&E X400).

Plate 3 (A) and (B) arrows showed the nucleus of normal heart histology. Plate 3 (C) arrows showed myofibres. Plate 3 (D) showed interstitial deposition of collagens (cd). Plate 3(E) arrows showed nucleus and blood vessels (bv).
Discussion

Insecticides are insect-controlling agents that are either chemical or biological in nature [1]. Pyrethroid insecticides are synthetic organic chemicals derived from chrysanthemum flowers, and they are widely used as home and commercial pesticides [22]. Reed A Dream aerosolised insecticide active ingredients according to the manufacturer are d-t-tetramethrin (0.2%), d-t-Phenothrin (0.2%) and d-t-allethrin (0.2%) which are classified as pyrethroids [23].

Exposures to pyrethroids in adult humans have been reported by the United State Centre for Disease Control (CDC) [24] to result in skin irritation, dizziness, twitching, and nervous disorders. However, dose range at which symptoms occur differs for the different pyrethroids. Also, exposure to pyrethroid-based insecticide have been reported in several animal studies [25, 26] to cause change in physiological activities of the exposed animals, and these changes have been reported by Donald and Michael [26] to affect protein, important enzymes, and other biomolecules in several animals.

The results of our investigation (Table 1) demonstrated significant elevation of plasma urea in the test groups, similar to Kingsley et al. [27] findings of substantial increased in urea concentrations in wistar rats subjected to dichlorvos-based pesticide preparations in South-Eastern Nigeria. Although poor urea clearance alone may not be definitive indicator of abnormal glomerular filtration rate, since overproduction can be influenced by a variety of non-renal variables such as nutrition and urea cycle enzymes [28]. Additionally, elevated urea levels have been found to develop during late pregnancy [29] or as a result of consuming a high-protein diet [28]. Our findings also revealed a significant elevation in plasma creatinine concentration in test groups when compared to control group, in a manner that conforms to Kingsley et al. [27] findings. Creatinine is a derivative of creatinine-phosphate in muscle [28, 29], and it is fairly constant. It is a definitive indicator of renal function [29]. The compound is cleared from the circulation by the kidneys [30]. Elevated creatinine levels found in this study suggest poor clearance by the kidneys, implying that RD insecticide may have caused impaired kidney function.

Furthermore, our study found non-significant increases in electrolytes (Mg^{2+}, Cl^-, and Na^+) concentration in test groups, which agrees with Malekirad et al. [31], who reported that individuals who are directly exposed to a wide range of insecticides have elevated urea, creatinine, electrolytes, and albumin, as well as plasma aminotransferases. Tierney et al. [32] describe electrolytes as positively and negatively charged ions present in cells and
extracellular fluids such as blood plasma. Mg$^{2+}$, Cl$^-$, and Na$^+$ elevations seen in this study further indicate poor renal function since these ions are measured to assess renal, endocrine, and acid-base balance. They and are also components of the general metabolic processes [33].

Total protein in test groups (Table 2) showed non-significant decreased similar to Pieper et al. [33] report, which could imply damage to hepatocytes membrane by RD active compounds thereby interfering with protein synthesis in the liver. Albumin concentration in test groups was significantly increased in conformity with Green and Flamm [34]. Albumin has been reported by Green and Flamm [34] to be a biomarker of synthetic function and it is a valuable guide to the severity of chronic liver disease. This study finding also agreed with Malekirad et al. [31] who reported a significant increased in albumin in people that are occupationally exposed to insecticides.

Total bilirubin concentrations were significantly higher in the test groups. This rise might be attributed to hepatocyte dysfunction, blockage of biliary excretion into the duodenum in haemolysis, errors in hepatic absorption or conjugation of bilirubin pigment, as seen in Gilbert's disease, as described by Mansour et al. [35]. The activities of AST, ALT, and ALP were not significantly increased in the test groups. However, GGT activity was non-significantly elevated in the test groups. GGT is a microsomal enzyme found in many organs, including the liver, and its activity can be induced by pharmaceuticals or other xenobiotics [29]. If ALP is normal, elevated GGT levels is useful guide to hepatocytes toxicants [29].

Our study finding on lipid profile (Table 3) showed non-significant increased in HDL-C levels in test groups, a non-significant decrease in LDL-C, triglyceride and cholesterol levels in test groups when compared with control group. These finding suggest that RD insecticide may not have significant influence on lipid profile in animals. The animals' nutrition may have contributed to the non-significant rise in HDL-C seen in this study. HDL is produced in the liver, the intestines, and during lipolysis of triglyceride-rich lipoproteins [36, 37]. HDL is measured in Clinical Chemistry by its cholesterol level (i.e HDL-C). High HDL-C plasma concentrations have been linked to a decreased risk of cardiovascular disease [38, 39]. Pamela et al. [38] stated that deficiencies or imbalances of lipid metabolism can lead to atherosclerosis and obesity.
There was also significant increased in liver weight in the RD (50% vol/vol) + N-hexane (1:1 dilution) test group; significant decreased in kidney and heart weight in RD(12.5% vol/vol) + N-hexane (1:4 dilution) test group compared with control group. Mansour et al [35] reported similar finding with five different insecticides (Abamectin, Carbosulfan, Fenpropathrin, Methomyl and Profenofos). Jayusman et al. [40] have also reported on the effects of sub-lethal dosages of the insecticides phorate and fenitrothion in animal tests, suggesting that RD pesticide has a harmful effect on important internal organs.

The photomicrograph results in plate 1-3 showed histological changes similar to Idowu et al. [41] findings, corroborating the biochemical results discussed above, and also aligned with Mansour et al. [35], who reported degenerative changes and granularity of hepatocytes with Kupffer cell activation, shrinking Bowman's capsule, degenerative changes of epithelium lining renal tubules, and necrotic effects associated with desquamation of epithelium lining tubules in the liver and kidney tissues of rats exposed to insecticide preparations.

**Conclusion**

This study has established that “Reed A Dream” insecticide on oral exposure caused acute nephrotoxicity and mild hepatotoxicity in Wistar rats. Therefore, whenever this insecticide is to be unavoidably used in homes to control insects, precaution must be emphasized to avoid oral ingestion.

**Ethical Approval**

The research design was approved by the Department of Biochemistry Faculty of Science, University of Port Harcourt Research Ethics Committee (Approval number UPH/BCHREC/2022/001).

**Funding**

This research was self-funded only, as part of ongoing research on toxicity of insecticides used in Nigeria.
Authors’ Contributions

Joshua D. initiated and carried out the investigation, analyzed, and presented data. Peters D. E. and Ikewuchi J. C. designed the experiment, supervised and provided reagents for the study. All authors drafted, revised, and approved the initial and final manuscript.

Competing Interest

We state unequivocally that there is no conflict of interest.

References


[41] Idowu ET, Oмотayo AI, Otubanjo OA. Evaluation of the toxicity of a mixture of dichlorvos and formaldehyde used for mosquito control in Nigeria. *Nigeria J Parasitol*. 2016;37(1):16. [https://doi.org/10.4314/nipar.v37i1.4](https://doi.org/10.4314/nipar.v37i1.4)