TOXIC EFFECTS OF CHRONIC INHALATION OF FIREWOOD SMOKE: A BIOCHEMICAL STUDY IN SOME FOOD VENDORS IN AJEGUNLE

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INTRODUCTION

Forest resources particularly wood products are one of the environmental resources in Nigeria that are widely and rampantly used without a commensurate replacement. Kerosene, charcoal and gas are rarely used for cooking this probably may be due to the high purchase cost, a situation which has thus led to majority of food vendors in Ajegunle, Lagos state using firewood as an alternative for cooking [1]. Firewood is a wooden material which is either hard or soft and it is gathered as seasoned (dry) or unseasoned (fresh/wet). In 2002, it was reported by [2] that the smoke generated from firewood contain polycyclic aromatic hydrocarbons, fine tiny particles, gases and harmful substances such as toxic organic chemicals made up of both carbon and hydrogen e.g. acetaldehyde, acrolein, benzene and formaldehyde. This smoke according to [3] has the ability to penetrate deeply into the alveoli as well as remaining there for months thus capable of causing and/or influencing diseases and structural damage. This present study was initiated based on the rampant use of firewood by food vendors for cooking in Ajegunle and it is aimed at assessing the status of some plasma biochemical parameters in these food vendors who as at the time of conducting this research work had cooked with firewood for a period of 5-6 years.
MATERIAL AND METHODS

The consents of the one hundred apparently healthy subjects who were recruited for this study were sought and their approvals were obtained before the commencement of this research work. Fifty of these subjects which consisted of twenty five males and females respectively within the age range of 20-25 years who have used firewood for cooking consistently for a period of 5-6 years served as the experimental group while the remaining fifty which consisted of twenty five males and females respectively within the age range of 20-25 years who had not used firewood for cooking either before or during the course of this study served as the control group. 5ml blood specimen was collected from each of these recruited subjects (experimental and control groups) into different heparinized anticoagulated bottles via a standard venipuncture technique, the specimens were mixed gently and spun for 10 minutes using a Gullax Medical and Scientific Macro centrifuge Model 8000D England. The following biochemical parameters were quantitatively measured in the obtained plasma with S23A13192 model spectrophotometer using the specified methods: C-reactive protein (latex turbidimetry) as described by Spin-react Diagnostic kit manual, Spain [4-7], alanine aminotransferase (ALT) (colorimetric) as described in the manual of 11th February, 2009 revised edition of Randox Laboratories Limited, 55, Diamond Road, Crumlin, Country Antrim, BT294QY, United Kingdom [8,9], aspartate aminotransferase (AST) (colorimetric) as described in the manual of 5th January, 2007 revised edition of Randox Laboratories Limited, 55, Diamond Road, Crumlin, Country Antrim, BT294QY, United Kingdom [10,11], uric acid (enzymatic colorimetric) as described in the manual of 20th October, 2009 revised edition of Randox Laboratories Limited, 55, Diamond Road, Crumlin, Country Antrim, BT294QY, United Kingdom [12-14], urea (urease berthlhot) as described in the manual of 7th January, 2011 revised edition of Randox Laboratories Limited, 55, Diamond Road, Crumlin, Country Antrim, BT294QY, United Kingdom [15-18], creatinine (Jaffe reaction) previously described by Jaffe in 1886 and revised on the 15th September, 2010 by Randox Laboratories Limited, 55, Diamond Road, Crumlin, Country Antrim, BT294QY, United Kingdom [19,20], Cholesterol (enzymatic endpoint) as described in the manual of 22nd May, 2009 revised edition of Randox Laboratories Limited, 55, Diamond Road, Crumlin, Country Antrim, BT294QY, United Kingdom [21-24].

Statistical analysis: The results were expressed as mean and standard deviation, while the differences between the subjects used for the study were assessed using the student’s “t” tests, the results were considered statistically significant at $p \leq 0.05$.

RESULTS AND DISCUSSION

In this study comparison was made between the mean value of the plasma biochemical parameters in food vendors who by virtue of their occupation have consistently inhaled smoke generated from firewood for a period of 5-6 years (experimental group) via total body exposure and individuals who have not consistently inhaled smoke generated from firewood (control group) as shown in Table 1.

The percentage of food vendors in the experimental group with the values greater than the existing reference ranges maximum for the parameters measured are as shown in Table 2.

### Table 1: Results of the biochemical parameters measured in the control and experimental group

<table>
<thead>
<tr>
<th>Parameters measured</th>
<th>Control group (n=50)</th>
<th>Experimental group (n=50)</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crp (mg/l)</td>
<td>0.16 ± 0.04</td>
<td>20.50 ± 5.04</td>
<td>S</td>
</tr>
<tr>
<td>ALT (U/l)</td>
<td>7.20 ± 1.80</td>
<td>27.40 ± 4.22</td>
<td>S</td>
</tr>
<tr>
<td>AST (U/l)</td>
<td>7.00 ± 1.72</td>
<td>22.24 ± 3.82</td>
<td>S</td>
</tr>
<tr>
<td>Uric acid (µmol/l)</td>
<td>260.00 ± 6.40</td>
<td>261.00 ± 6.42</td>
<td>NS</td>
</tr>
<tr>
<td>Urea (mmol/l)</td>
<td>4.70 ± 1.54</td>
<td>4.71 ± 1.56</td>
<td>NS</td>
</tr>
<tr>
<td>Creatinine (mmol/l)</td>
<td>49.10 ± 2.70</td>
<td>49.20 ± 2.72</td>
<td>NS</td>
</tr>
<tr>
<td>Cholesterol (mmol/l)</td>
<td>3.02 ± 0.08</td>
<td>3.04 ± 0.09</td>
<td>NS</td>
</tr>
</tbody>
</table>

(a) Values are mean and S.D determination at $p \leq 0.05$ (b) NS represents not statistically significant (c) S represents statistically significant (d) n represents the number of subjects (e) Crp represents C-reactive proteins (f) ALT represents alanine aminotransferase (g) AST represents aspartate aminotransferase.

### Table 2: Percentage of the experimental group with values greater than the existing reference ranges maximum for the parameters measured

<table>
<thead>
<tr>
<th>Parameters measured</th>
<th>Reference ranges</th>
<th>N</th>
<th>Experimental group (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crp (mg/l)</td>
<td>≤ 6.0</td>
<td>50</td>
<td>56 (28.0)</td>
</tr>
<tr>
<td>ALT (U/l)</td>
<td>≤ 12.0</td>
<td>50</td>
<td>70 (35.0)</td>
</tr>
<tr>
<td>AST (U/l)</td>
<td>≤ 12.0</td>
<td>50</td>
<td>60 (30.0)</td>
</tr>
<tr>
<td>Uric acid (µmol/l)</td>
<td>(142-416)</td>
<td>50</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Urea (mmol/l)</td>
<td>(1.7-9.1)</td>
<td>50</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Creatinine (mmol/l)</td>
<td>(44-97)</td>
<td>50</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Cholesterol (mmol/l)</td>
<td>≤5.17</td>
<td>50</td>
<td>0 (0.0)</td>
</tr>
</tbody>
</table>

(a) N represents the number of subjects in the experimental group, values are in percentages, while number of subjects in the experimental group with values greater than the existing reference ranges maximum are in parenthesis (b) Crp represents C-reactive proteins (c) ALT represents alanine aminotransferase (d) AST represents aspartate aminotransferase.

The result from this research work showed that the mean value of plasma C-reactive protein was significantly higher statistically ($p \leq 0.05$) in the food vendors (experimental group) as compared with the control group as shown in Table 1, this result went further to reveal 56% of the experimental group as having plasma C-reactive protein concentration greater than the existing reference range maximum of 6mg/l as shown in Table 2. It is however, presumed that the inhalation of harmful toxic organic chemicals in the firewood smoke may have influenced systemic inflammation with the resultant release of inter leukin-6 and other cytokines which subsequently would have triggered the synthesis of C-reactive protein.
protein by the liver. It is thus confirmed from this work that food vendors who have inhaled firewood smoke via total body exposure for a period of 5-6 years are prone to elevated plasma C-reactive protein concentration.

Enzymes are proteins that are capable of catalyzing specific biochemical reactions with their levels averagely constant in apparently healthy individuals [25]. The result from this research work showed that the mean values of plasma alanine aminotransferase (ALT) and plasma aspartate aminotransferase (AST) were significantly higher statistically (p ≤ 0.05) in the food vendors (experimental group) as compared with the control group as shown in Table 1. 70% and 60% of the food vendors (experimental group) had plasma alanine aminotransferase and plasma aspartate aminotransferase concentrations greater than the existing reference range maximum of 91 U/l and 97 mg/dl respectively as shown in Table 2. This finding is presumed to be as a result of hepatoocyte damage caused by the inhalation of the harmful toxic organic chemicals in firewood smoke which in turn has led to the leakage of these enzymes from the intracellular compartment with subsequent elevation in the plasma.

The mean values of plasma uric acid, plasma urea, plasma creatinine and plasma cholesterol in the food vendors (experimental group) were not statistically significant (p = 0.05) as compared with that of the control group as shown in Table 1. However, this research work further revealed that the plasma urea and plasma creatinine concentrations in the food vendors (experimental group) with values greater than the existing reference range maximum of 9.1 mmol/l and 97 mg/dl respectively were 8% and 4% respectively, a finding which is quite insignificant.

The findings from this research work as applied to the mean values of plasma uric acid, plasma urea, plasma creatinine and plasma cholesterol have shown that the plasma concentrations of these biochemical parameters are not elevated in food vendors who by virtue of their occupation have inhaled firewood smoke via total body exposure for a period of 5-6 years.

CONCLUSION:

In conclusion, this research work has revealed that inhalation of firewood smoke via total body exposure for a period of 5-6 years may trigger gradual inflammatory condition with subsequent damage to hepatic organ due to the bioaccumulation of harmful and toxic chemical compounds in the smoke.

RECCOMENDATIONS

It is therefore recommended that:

i. The use of firewood as an alternative to cooking should be prevented as much as possible.

ii. Food vendors cooking with firewood smoke should embark on routine plasma C-reactive protein, plasma alanine aminotransferase (ALT) and plasma aspartate aminotransferase (AST) investigations with the aim to reverse the concentrations of these biochemical parameters to normal concentrations should there be any elevation.

REFERENCES


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