COMPARATIVE EFFECTS OF PALM KERNEL OIL, OLIVE OIL, CRUDE OIL AND HONEY ON LIPID PROFILE, BODY WEIGHT AND HEARTS OF MALE ALBINO RATS

Chinedu Imo* and Oluwafemi David Sunday

Department of Biochemistry, Faculty of Pure and Applied Sciences, Federal University Wukari, Nigeria.

*Corresponding Author: Dr. Chinedu Imo
Department of Biochemistry, Faculty of Pure and Applied Sciences, Federal University Wukari, Nigeria.

ABSTRACT
Comparative effects of palm kernel oil, olive oil, crude oil and honey on lipid profile, body weight and hearts of male albino rats was evaluated in this study. This is because they are widely used for various reasons in traditional medicine. Thirty-five male albino rats were used and randomly placed into five groups. Six animals were placed in each group. They were administered the corresponding chemical substances for twenty-one days before being sacrificed. Their body weights were recorded before and after administration of the substances. Their blood samples and hearts were collected for biochemical and histological analysis respectively. Total cholesterol reduced non-significantly (p>0.05) in groups 2 and 3, but increased non-significantly (p>0.05) in groups 4 and 5 compared to the control. Triglycerides increased non-significantly (p>0.05) in groups 2 and 3, but increased significantly (p<0.05) in groups 4 and 5 compared to the control. HDL reduced non-significantly (p>0.05) in groups 2 and 4, but increased non-significantly (p>0.05) in groups 3 and 5 compared to the control. LDL reduced non-significantly (p>0.05) in groups 3 and 5, but increased non-significantly (p>0.05) in groups 2 and 4 compared to the control. Weight difference after the administration of the chemicals increased non-significantly (p>0.05) in group 2, but decreased significantly (p<0.05) in group 3, and non-significantly (p>0.05) in groups 4 and 5 compared to the control. Photomicrograph from heart section of normal rat showed normal features of the cardiac tissue with unremarkable muscles fibres within which are seen bare nucleated cells and endothelial cells at the periphery. Photomicrograph from heart section of all rats administered the chemical substances showed normal features of the cardiac tissue. No pathological changes were seen/identified in them when compared to cardiac tissue of normal control. Crude oil and palm kernel oil may mildly influence lipid profile negatively. Administration of olive oil and honey improved the synthesis of HDL, though they also encourage the synthesis of triglycerides. Olive oil could be used for body weight reduction or control, while honey and palm kernel oil may cause an increase in body weight. The long-term intake of crude oil may lead to set back in growth and improvement of body weight. Administration of the chemical substances as used in this study may show no pathological changes in cardiac tissues.

KEYWORDS: Body weight, crude oil, honey, olive oil, palm kernel oil, lipid profile.

INTRODUCTION
Palm kernel oil is an edible oil extracted from the kernels of the fruits of tropical palm tree (Elaeis guineensis Jacq.).[1-2] Palm kernel oil does not contain the same nutritional advantages as other vegetable oils. These oils have high energy contents. Palm kernel oil is underutilized as edible oil in Nigeria. The consumption of palm kernel oil as a source of dietary fat does not pose any additional risks for coronary artery disease when consumed in realistic amounts as part of a healthy diet.[3] Sutapa and Analava[3] reported that oxidized palm kernel oil induces reproductive toxicity and organ toxicity particularly of the kidneys, lungs, liver and heart. Olive oil is a source of at least 30 phenolic compounds, among which is elenolic acid, a marker for maturation of olives. Olive oil is composed mainly of the mixed triglyceride esters of oleic acid and palmitic acid and of other fatty acids, along with squalene and sterols. The composition varies by cultivar, region, altitude, time of harvest, and extraction process. A 2014 meta-analysis concluded that increased consumption of olive oil was associated with reduced risk of all-cause mortality, cardiovascular events and stroke, while monounsaturated fatty acids of mixed animal and plant origin showed no significant effects.[4] Another meta-analysis in 2018 found high-polyphenol olive oil intake was associated with improved measures of total cholesterol, HDL.
cholesterol, malondialdehyde, and oxidized LDL when compared to low-polyphenol olive oils.\textsuperscript{[5]}

Crude oil consists of mainly carbon (83-87\%) and hydrogen (12-14\%) having complex hydrocarbon mixture like paraffins, naphthenes, aromatic hydrocarbons, gaseous hydrocarbons (from CH\textsubscript{4} to C\textsubscript{8}H\textsubscript{16}).\textsuperscript{[6]} Besides, crude oil also contains small amount of non-hydrocarbons (sulphur compounds, nitrogen compounds, oxygen compounds) and minerals. Depending on predominance of hydrocarbons, crude oil: also known as petroleum is classified as paraffin base, intermediate base or naphthenic base. In Nigeria, crude oil is mostly found in the riverine areas. Most of the compounds in crude oil are known to be toxic to different biomass in the ecosystem when exposed to at a given lethal dose.\textsuperscript{[7],[8]}

Honey is a supersaturated sugar solution, created by bees, and used by humans as a sweetener or additive. It has been reported to contain concentrated aqueous solution of inverted sugars and complex mixture of other saccharides, proteins, enzymes, amino acids, organic acids, polyphenols, and carotenoid like substances, vitamins and some minerals.\textsuperscript{[9]} When honey is orally consumed, its carbohydrate is reported to be easily digested and absorbed in human to generate energy requirements of about 303 kcal/100 g.\textsuperscript{[10]} Manyi-Loh et al.\textsuperscript{[11]} reported that the therapeutic potential of honey could be attributed to the several scientific reports of its antimicrobial, anti-inflammatory and anti-oxidant properties, including its immune system boosting capacity.

Lipid profile or lipid panel is the collective term given to the estimation of total cholesterol, high-density lipoprotein cholesterol, low-density lipoprotein cholesterol, and triglycerides. An extended lipid profile may include very low-density lipoprotein. This is used to identify hyperlipidemia (various disturbances of cholesterol and triglyceride levels), many forms of which are recognized risk factors for cardiovascular disease and sometimes pancreatitis. There is need for documented information on the comparative effects of crude oil, palm kernel oil, olive oil and honey on lipid profile, body weight and heart due to their wide use in traditional medicine for various purposes. This warrants research into the present study.

**MATERIALS AND METHODS**

**Chemical substances used**

Four chemical substances were used in this study. Palm kernel oil, olive oil, crude oil and honey were obtained from Umuahia, Wukari, Port Harcourt and Kurmi L.G.A. of Taraba State, Nigeria respectively.

**Experimental animals**

A total of 30 healthy male albino rats of 7 weeks of age were used in this study. The albino rats were purchased at National Veterinary Research Institute (NVRI) Vom, Plateau State, and transferred to the animal house, Department of Biochemistry, Federal University Wukari, Nigeria. The animals were allowed to acclimatize for fourteen days prior to the experiment. They were allowed to have access to feed and water \textit{ad libitum} throughout the experimental period. Standard laboratory protocols for animal studies were followed and all methods were performed in accordance with the relevant guidelines and regulations.

**Experimental design**

The 30 male albino rats were placed (randomly) into 5 different groups of 6 rats each. Group 1 albino rats served as normal control and did not received any chemical substance. The test albino rats were placed in groups 2, 3, 4 and 5, and were administered palm kernel oil (5 ml/kg bw), olive oil (5 ml/kg bw), crude oil (5 ml/kg bw) and honey (5 ml/kg bw) respectively for 21 consecutive days prior to animal sacrifice. The chemical substances were administered to the experimental rats once daily through oral route.

**Body-weight determination**

The weight of the rats before and after the administration of selected chemical substances was determined using electronic weighing scale.

**Blood collection**

Following the administration of the chemical substances to the test rats, all the rats were starved overnight, anaesthetized with the use of chloroform and sacrificed by cervical dislocation. Blood samples of the rats were collected through cardiac puncture and dispensed into plain sample tubes. The blood samples were allowed to stand for about fifteen minutes to clot and thereafter centrifuged at 4000 rpm for 10 minutes. The serum was aspirated using Pasteur pipette and dispensed into clean tubes for the biochemical analysis. The liver of all the rats were harvested for histological analysis.

**Biochemical and histological analysis**

Serum biochemistry was carried out on each blood sample. The concentrations of HDL, total cholesterol and triglycerides were determined using Reflotron Plus. The LDL was calculated using the formulae: \(\text{LDL} = \text{Total cholesterol} – \text{HDL} – (\text{Triglycerides}/5).\)

The hearts of the rats in all the groups were harvested and fixed in 10\% formalin. They were processed using an automatic tissue processor and embedded in paraffin wax, and sections cut using a rotary microtome. The heart sections were stained using haematoxylin and eosin. The sections were examined and photomicrographs of the heart sections taken (Magnification: x200).

**Statistical analysis**

The results of the biochemical analysis and body weight were analyzed statistically using One-Way Analysis of Variance with the use of Statistical Package for Social
Chinedu et al. European Journal of Biomedical and Pharmaceutical Sciences

www.ejbps.com 86

Sciences, version 21. The means of the group results were compared for significance at p≤0.05. The final group results were presented as mean ± SD (n=6).

RESULTS

The result of the biochemical analysis and body weight are presented in the tables below:

Table 1: Concentrations of lipid profile indices in rats administered palm kernel oil, olive oil, crude oil and honey (mmol/L).

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Group 1 (Normal control)</th>
<th>Group 2 (Palm kernel oil: 5 ml/kg bw)</th>
<th>Group 3 (Olive oil: 5 ml/kg bw)</th>
<th>Group 4 (Crude oil: 5 ml/kg bw)</th>
<th>Group 5 (Honey: 5 ml/kg bw)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total cholesterol</td>
<td>2.61 ± 0.03a</td>
<td>2.60 ± 0.02a</td>
<td>2.56 ± 0.06a</td>
<td>2.62 ± 0.03a</td>
<td>2.69 ± 0.15a</td>
</tr>
<tr>
<td>Triglycerides</td>
<td>0.87 ± 0.12a</td>
<td>0.94 ± 0.24a</td>
<td>0.89 ± 0.04a</td>
<td>1.39 ± 0.11b</td>
<td>1.64 ± 0.24b</td>
</tr>
<tr>
<td>HDL</td>
<td>0.90 ± 0.39b</td>
<td>0.58 ± 0.16a</td>
<td>1.14 ± 0.25a</td>
<td>0.62 ± 0.18a</td>
<td>1.09 ± 0.17b</td>
</tr>
<tr>
<td>LDL</td>
<td>1.29 ± 0.43b</td>
<td>1.56 ± 0.18b</td>
<td>1.11 ± 0.23bb</td>
<td>1.36 ± 0.22bb</td>
<td>0.85 ± 0.20b</td>
</tr>
</tbody>
</table>

Result represent mean ± standard deviation of group serum result obtained (n=6).

Mean in the same row having different letters of the alphabet are statistically significant (p<0.05).

Total cholesterol reduced non-significantly (p>0.05) in groups 2 and 3, but increased non-significantly (p>0.05) in groups 4 and 5 compared to the control. Triglycerides increased non-significantly (p>0.05) in groups 2 and 3, but increased significantly (p<0.05) in groups 4 and 5 compared to the control. HDL reduced non-significantly (p>0.05) in groups 2 and 4, but increased non-significantly (p>0.05) in groups 3 and 5 compared to the control. LDL reduced non-significantly (p>0.05) in groups 3 and 5, but increased non-significantly (p>0.05) in groups 2 and 4 compared to the control.

Table 2: Weight of rats before and after administration of palm kernel oil, olive oil, crude oil and honey.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Group 1 (Normal control)</th>
<th>Group 2 (Palm kernel oil: 5 ml/kg bw)</th>
<th>Group 3 (Olive oil: 5 ml/kg bw)</th>
<th>Group 4 (Crude oil: 5 ml/kg bw)</th>
<th>Group 5 (Honey: 5 ml/kg bw)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial (g)</td>
<td>156.00 ± 32.24</td>
<td>164.50 ± 22.89</td>
<td>213.83 ± 27.35</td>
<td>174.50 ± 60.59</td>
<td>170.17 ± 41.69</td>
</tr>
<tr>
<td>Final (g)</td>
<td>170.50 ± 33.52</td>
<td>185.50 ± 29.77</td>
<td>203.33 ± 20.11</td>
<td>175.67 ± 40.18</td>
<td>182.50 ± 47.84</td>
</tr>
<tr>
<td>Weight difference (g)</td>
<td>14.50 ± 7.31ab</td>
<td>21.00 ± 13.11ab</td>
<td>-10.50 ± 9.63a</td>
<td>1.17 ± 22.71abc</td>
<td>12.33 ± 9.63abc</td>
</tr>
<tr>
<td>Percentage increase/decrease (%)</td>
<td>9.29</td>
<td>12.77</td>
<td>4.91</td>
<td>0.67</td>
<td>7.25</td>
</tr>
</tbody>
</table>

Result for initial, final and weight difference represent mean ± standard deviation of group result obtained (n=6).

Mean in the same row for weight difference, having different letters of the alphabet are statistically significant (p<0.05).

Weight difference after the administration of the chemicals increased non-significantly (p>0.05) in group 2, but decreased significantly (p<0.05) in group 3, and non-significantly (p>0.05) in groups 4 and 5 compared to the control.

Photomicrographs of the heart sections are presented below:

Figure 1: Photomicrograph from heart section of normal rat (group 1) showing normal features of the cardiac tissue with unremarkable muscles fibres within which are seen bare nucleated cells and endothelial cells at the periphery.
Figure 2: Photomicrograph from heart section of rat administered palm kernel oil (group 2) showing normal features of the cardiac tissue. No pathological changes seen/identified compared to cardiac tissue of normal control.

Figure 3: Photomicrograph from heart section of rat administered olive oil (group 3) showing normal features of the cardiac tissue. No pathological changes seen/identified compared to cardiac tissue of normal control.
Figure 4: Photomicrograph from heart section of rat administered crude oil (group 4) showing normal features of the cardiac tissue. No pathological changes seen/identified compared to cardiac tissue of normal control.

Figure 5: Photomicrograph from heart section of rat administered honey (group 5) showing normal features of the cardiac tissue. No pathological changes seen/identified compared to cardiac tissue of normal control.

DISCUSSION
It is well known that the world today is challenged with various cardiovascular diseases which some of the key manifestations include coronary heart diseases, stroke and hypertension.\(^{12}\) It is therefore important to ascertain the effects of various chemical substances used by human on the lipid profile, heart and body weight.

The serum concentrations of the lipid profile parameters of this study is shown in table 1. There was no significant alteration of cholesterol levels in all the test animals administered the different chemical substances when compared with the cholesterol level of the normal control animals. The result showed that olive oil may cause very mild excretion of or reduction in serum cholesterol level. Reduction of cholesterol level has a positive impact in the animal’s body system, especially against cardiovascular diseases. This is because atherosclerosis can be caused by deposition of cholesteryl esters (when they are transported in the blood vessels) thereby leading to the narrowing and hardening of the vessels.\(^{13-14}\) Imo et al.\(^{15}\) reported that reduction of the total cholesterol, triglycerides, LDL concentrations and increase in HDL concentration prevents the incidence that may lead to hyperlipidemia or atherosclerosis. None of the chemical substances showed
the ability to induce hypercholesterolemia. The histological examination result of the heart sections of the animals is in tandem with this result. Hypercholesterolemia has been associated with cardiovascular disease.

Administration of olive oil and palm kernel oil did not show a significant increase in triglycerides levels, which is in tandem with the result of cholesterol. However, administration of crude oil and honey caused a significant increase (p<0.05) in triglycerides levels when compared with the control. Elevated concentrations of plasma lipids have been reported as risk factors in cardiovascular problems and the important lipids whose elevations are implicated such problems are cholesterol and triglycerides.\textsuperscript{16, 17} Though the administration of honey and crude oil did not cause an increase in cholesterol level, but ability to cause a significant increase in triglycerides level in the test rats when compared with the control showed they may possess the ability to induce cardiovascular risk. The increase observed in the rats administered crude oil and honey may also be an indication of varying responses towards the synthesis of triglycerides in the liver of the rats. It is also possible that crude oil and honey may contain certain compounds that may possess such ability. It is important that further research be carried out to evaluate this view and the mechanism by which crude oil and honey were able to cause the significant increase in triglycerides levels.

HDL reduced non-significantly (p>0.05) in groups 2 and 4, but increased non-significantly (p>0.05) in groups 3 and 5 compared to the control. HDL is a lipoprotein (a combination of fat and protein) found in the blood. It is called “good” cholesterol because it removes excess cholesterol from the blood and takes it to the liver. A high HDL level is related to low risk of heart and blood vessel disease. The increased HDL levels in the animals administered olive oil and honey showed they may possess compounds that may promote synthesis of HDL and therefore, may help transport excess cholesterol out of the blood. This will help prevent conditions such as hypercholesterolemia. On the other hand, crude oil and palm kernel oil may not possess such ability regarding synthesis of HDL, hence may not handle cholesterol out of the blood when compared with olive oil and honey. Low serum concentrations of HDL-cholesterol are associated with increased risk for coronary heart disease. Group 2 and 4 animals may experience such risk as a result of the low HDL level. LDL reduced non-significantly (p>0.05) in groups 3 and 5, but increased non-significantly (p>0.05) in groups 2 and 4 compared to the control. The result of LDL agreed with the result of HDL. This means that administration of palm kernel oil and crude oil may possess the ability to transport more cholesterol into the blood and may also pose a cardiovascular disease risk. This therefore calls for caution in the prolong (regular) use of crude oil and palm kernel oil in traditional medicine. Ezekwesili et al.\textsuperscript{17} reported that any attempt to lower LDL concentration and increase HDL concentration is considered as one of the strategies which may delay the on-set of chronic disorders that are associated with hyperlipidemia in humans. However, comparing the results of cholesterol and LDL, especially in the groups administered palm kernel oil and crude oil, it is possible that the test animals may have alternative mechanisms for cholesterol removal from the blood.

Photomicrograph from heart section of normal rat (figure 1) showed normal features of the cardiac tissue with unremarkable muscles fibres within which are seen bare nucleated cells and endothelial cells at the periphery. Photomicrographs from heart section of the test rats administered palm kernel oil, olive oil, crude oil and honey (figure 2-5) showed normal features of the cardiac tissue. No pathological changes were seen/identified when compared to the cardiac tissue of normal control. This means that the administration of the chemical substances as used in this study may not cause any remarkable histological alteration in the heart.

From the observation made on the weights of the albino rats before and after the administration of the selected chemical substances, administration of palm kernel oil and honey encouraged body weight gain. Olive oil discouraged body weight gain when compared with the normal control animals. It is also obvious that crude oil did not encourage proper body weight gain. It is therefore possible that olive oil and crude oil interfered with certain processes of growth and development in the test animals. Palm kernel oil and honey may encourage growth and development of rats. It is possible that palm kernel oil contains chemical constituents that may promote processes that may lead to growth and development than the other chemical substances when compared with the control. This study results therefore showed that olive oil could be used for weight control, honey and palm kernel oil may help in the increment of the body weight, while long-term intake of crude oil may lead to set back in growth and development of the body.

CONCLUSION
Crude oil and palm kernel oil may mildly influence certain lipid profile parameters negatively. Administration of olive oil and honey improved HDL synthesis, though they also improved the synthesis of triglycerides. Olive oil could be used for body weight reduction or control while honey and palm kernel oil may cause an increase in body weight. The long-term intake of crude oil may lead to set back in growth and improvement of body weight. Administration of the chemical substances as used in this study may show no pathological changes in cardiac tissues.

COMPETING INTERESTS
The authors declare that they have no competing interests.
REFERENCES