Comparative effects of the leaves of *Vernonia amygdalina* and *Telfairia occidentalis* incorporated diets on the lipid profile of rats

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The study compared the effects of the leaves of *Vernonia amygdalina* (VA) and *Telfairia occidentalis* (TO) incorporated diet on the lipid profiles of rats. The rats were fed for 28 days on diets specially formulated to contain 5, 15 and 30% by weight respectively of the leaves of each plant while the control group was fed standard rat diet. The serum total cholesterol (TC), triacylglycerol (TG), high-density lipoprotein cholesterol (HDL-C) and low-density lipoprotein cholesterol (LDL-C) were determined on blood samples collected on the 28th day using standard methods. The results showed that at the 5 and 15% treatments, TO significantly lowered the serum TC level relative to the effect of VA (P<0.05). The results also showed that the effects of VA and TO on TG and LDL-C were similar. For HDL-C, the TO diet preparation induced a significantly higher serum HDL-C level relative to the effect of the VA diet at the 15% treatment. Overall, the incorporation of *V. amygdalina* and *T. occidentalis* in diet preparations were anti-lipidaemic where TO showed a greater effect compared to the VA diet preparation.

**Key words:** *Vernonia amygdalina*, *Telfairia occidentalis*, lipid profile.

INTRODUCTION

Hypercholesterolaemia is recognized as an important risk factor in the development of coronary artery disease (Wald and Law, 1995; Nagra et al., 2003). The clinical manifestation of cholesterol build-up in arteries servicing the heart muscle cause more death and disability than all types of cancer combined (Lloyd-Jones et al., 2009; Daniels et al., 2009). This is an important outcome for a common polycyclic lipid with the humble function of maintaining the permeability and fluidity of cell membranes. Other lipid related risk factors, which have also been implicated in the development of chronic artery disease (CAD), include increased serum triacylglycerols, low density lipoprotein-cholesterol (LDL-C) and low level of high density lipoprotein-cholesterol (HDL-C) (Durrington et al., 1988; Lamendala, 2000). The treatment of hypertension has failed to show definitive effect on the incidence of coronary heart disease, which has aroused interest in lipid metabolism in hypertensive therapy (Karim et al., 2004). A number of African indigenous plants have been credited with a lot of chemotherapeutic potentials (Farombi, 2003).

*Vernonia amygdalina* (Compositae) also called bitter leaf in Nigeria because of its bitter taste, is a shrub that grows predominantly in Tropical Africa. The leaves have found relevance in traditional folk medicine as an antihelmint, a laxative herb and an antimalarial as they are known as quinine substitute (Farombi, 2003). *V. amygdalina* is a common polycyclic lipid with the humble function of maintaining the permeability and fluidity of cell membranes. Other lipid related risk factors, which have also been implicated in the development of chronic artery disease (CAD), include increased serum triacylglycerols, low density lipoprotein-cholesterol (LDL-C) and low level of high density lipoprotein-cholesterol (HDL-C) (Durrington et al., 1988; Lamendala, 2000). The treatment of hypertension has failed to show definitive effect on the incidence of coronary heart disease, which has aroused interest in lipid metabolism in hypertensive therapy (Karim et al., 2004). A number of African indigenous plants have been credited with a lot of chemotherapeutic potentials (Farombi, 2003).

*Telfairia occidentalis* (Cucurbitacea) leaves and young shoots are frequently eaten as a potherb (Tindal, 1968; Okigbo, 1977; Okoli and Mgbeogu, 1983). The root and leaves have been shown to contain highly toxic alkaloids and saponins (Alada, 2000). In Nigeria, the herbal preparation of the plant has been employed in the treatment...
of sudden attack of convulsion, malaria and anaemia (Gbile, 1986).

Following the recorded pharmacological outcomes of the leaves of these plants, the present study was designed to compare the effect of the two diet preparations on the lipid profile of rats.

MATERIALS AND METHODS

Animals

20 albino rats (Wistar strain) that weighed between 93-120 g were used as the experimental animals. The rats were kept in cages for two weeks to acclimatize, and were allowed free access to food and water ad libitum. The protocol was in line with the guidelines of the National Institute of Health (NIH) (NIH Publication 85-23, 1985) for laboratory animal care and use. The experimental animals were randomly distributed into four groups of five animals each. Group 1 rats were fed standard rat diet (Vital Feeds, Nigeria), and served as the control, while groups 2, 3 and 4 were fed on diets that contained 5, 15 and 30% by weight of V. amygdalina leaves respectively for 28 days. The protocol was repeated with T. occidentalis leaves for another set of rats.

Feed formulation

The leaves of V. amygdalina and T. occidentalis were purchased from a local market in Anyigba, Kogi State, Nigeria. The botanical identification and authentication were confirmed at the Department of Biological Sciences, Kogi State University, Anyigba. The leaves were dried at room temperature for 2 weeks to a constant weight and then powdered in a mortar. The standard rat diet was similarly milled. The feed for each leaf type was mixed with the standard rat diet to contain 5, 15 and 30% by weight of the leaves for groups 2, 3 and 4 respectively.

Sample collection

Overnight, prior to treatment, the animals were starved of food. Blood was collected from the ocular median-cantus vein of the rats with the aid of capillary tubes, transferred to test tubes, allowed to clot and subsequently centrifuged to obtain the serum component used for lipid analysis.

Lipid analysis

The lipid profiles were determined using kits manufactured by TECO Diagnostics Lakeview Ave, Anaheim, CA, USA. Serum total cholesterol (TC) was determined by the method of Aliain et al. (1974), while triacylglycerols was determined by the method of Burstein et al. (1980). The lipoproteins, very low-density lipoprotein (VLDL) and HDL were precipitated using phosphotungstic acid and magnesium chloride. After centrifugation, the supernatant contained the high-density lipoprotein cholesterol (HDL-C) fraction which was assayed for cholesterol by the method of Grove (1979). The low-density lipoprotein cholesterol (LDL-C) was calculated using the method of Friedewald et al. (1972).

Statistical analyses

Data collected were subjected to analysis of variance (ANOVA). In order to test whether or not significant differences existed between groups, the mean values with the paired t-test was analyzed. The mean ± SD of each parameter was taken for each group. Test probability value of P< 0.05 was considered significant. The analyses were carried out on SPSS for Windows version 10.

RESULTS

The effect of V. amygdalina and T. occidentalis diet preparations on the serum total cholesterol and triacylglycerols concentrations is shown in Table 1. There was a significant decrease in the effect of the vegetable leaves on the serum cholesterol and triacylglycerols levels relative to the control (P<0.05). The results showed that there was a significant difference in the effect of the two vegetable leaves even at the same concentrations (P<0.05) on serum cholesterol of the animals. For serum triacylglycerols, there was no significant difference between the effect of V. amygdalina and T. occidentalis diet preparations (P>0.05).

Table 2 depicts the effects of V. amygdalina and T. occidentalis diet preparations on the serum LDL-C and HDL-C (mg/dl). From the results, there was a significant decrease on the serum LDL-C concentration relative to the control (P<0.05) while there were no significant differences (P>0.05) between the effect of V. amygdalina and T. occidentalis diet preparations at the various levels of treatment. The results also showed that the T. occidentalis diet induced a relatively lower serum LDL-C at the 5 and 15% treatments while V. amygdalina produced a lower LDL-C at the 30% treatment. The results also showed that there was a significant increase in the serum HDL-C levels of both V. amygdalina and T. occidentalis diet preparations (P<0.05) relative to the control. From the results, the T. occidentalis diet preparation induced a significantly higher serum HDL-C concentration relative to V. amygdalina diet preparation.

DISCUSSION

Cholesterol is an essential substance involved in many cellular functions, including the maintenance of membrane fluidity, production of vitamin D on the surface of the skin, production of hormones and possibly helping cell connections in the brain (Champe and Harvey, 1994; Adaramoye et al., 2005; Daniels et al., 2009). It is of vital necessity that the body cells should have adequate supply of cholesterol. However, when cholesterol levels rise in the blood, they can have deleterious consequences. In particular, cholesterol has generated considerable notoriety for its causative role in atherosclerosis, the leading cause of death in developed countries around the world (Stamler et al., 2000; Daniels et al., 2009). Great efforts have been put into reducing the risk of cardiovascular diseases through the regulation
of cholesterol, thus the therapeutic benefits of plant foods have been the focus of many extensive dietary studies (Yokozawa et al., 2006; Zhang et al., 2007). For centuries, traditional plant remedies have been used in the treatment of illnesses (Akhtar and Ali, 1984) but only a few have been evaluated scientifically. Therefore, the effects of the diet preparations of *Vernonia amygdalina* and *Telfairia occidentalis* leaves on the lipid profile of rats were studied and compared.

From the results obtained in the study, it is apparent that the two diet preparations lowered the serum cholesterol levels of rats though the *T. occidentalis* diet induced a higher effect at lower concentrations. Adaramoye et al. (2007) had shown that *T. occidentalis* has hypolipidaemic effect in rats fed cholesterol rich diet while Nwanjo (2005) showed that the administration of aqueous leaf extract of *V. amygdalina* induced hypoglycaemic, hypolipidaemic and antioxidant effects in rats. Ahmed-Raus et al. (2001) suggested that the mechanism of this hypcholesterolaemic action may be due to the inhibition of the absorption of dietary cholesterol in the intestine or stimulation of the biliary secretion of cholesterol and cholesterol excretion in faeces.

Triacylglycerols are partly taken up with the diet and partly synthesized in the liver (Anderson et al., 1991). Dietary cholesterol has been shown to reduce fatty acid oxidation, which in turn, increases the levels of hepatic and plasma triacylglycerols (Fungwe et al., 1993). There is evidence that shows that high triacylglycerols are associated with coronary atherosclerosis (Bainton et al., 1994; Cullen, 2003). The results from this study showed that there was no significant difference on the triacylglycerols lowering effects of both diet preparations.

The link between increased levels of low density lipoprotein-cholesterol (LDL-C) in the blood and atherosclerosis is incontrovertible (Cullen, 2003). There is also very strong evidence that this link is causal; lowering of LDL-C by drugs, in particular statins, reduces the morbidity and mortality from cardiovascular disease in general and chronic heart disease in particular (Blakenhorn et al., 1993; Hodis et al., 1994). The mechanisms that manage and utilize LDL are tightly controlled systems evolved to distribute cholesterol through the circulatory system and its cells that require extracellular cholesterol. Unfortunately, LDL-C does not always reach its most appropriate destination, but rather accumulates in artery walls causing atherosclerosis, the leading cause of death and disability in the developed world (Yusuf et al., 2001). For this reason, the quantity of circulating LDL-C is a well-known risk factor for heart disease, and is the primary focus of most lipid lowering therapies (NCEP, 2001). The pathogenicity of LDL and likelihood of atherosclerotic development are heavily influenced by genetic composition of gene products involved with LDL metabolism. Patients with genetic defects that cause severely elevated LDL have familial hypercholesterolaemia, which affects approximately 1:500 people (Koivisto et al., 1993), and is the consequence of mutations.

### Table 1. Effects of *Vernonia amygdalina* and *Telfairia occidentalis* diet preparations on the serum total cholesterol and triacylglycerols (mg/dl).

<table>
<thead>
<tr>
<th>Treatment group</th>
<th>Total cholesterol (mg/dl)</th>
<th>Triacylglycerol (mg/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><em>V. amygdalina</em></td>
<td><em>T. occidentalis</em></td>
</tr>
<tr>
<td>Control</td>
<td>133.80 ± 5.95</td>
<td>133.80 ± 5.95</td>
</tr>
<tr>
<td>5%</td>
<td>118.35 ± 5.95&lt;sup&gt;a&lt;/sup&gt;</td>
<td>115.55 ± 4.89&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>15%</td>
<td>112.55 ± 4.42&lt;sup&gt;b&lt;/sup&gt;</td>
<td>110.65 ± 4.69&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>30%</td>
<td>101.92 ± 3.24&lt;sup&gt;b&lt;/sup&gt;</td>
<td>103.99 ± 2.81&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Results are mean ±SD. Values with different alphabetical superscripts for the same parameter in a row are significant with respect to each other (P<0.05). Values with the superscript * in a column are significant with respect to the control (P<0.05).

### Table 2. Effects of *Vernonia amygdalina* and *Telfairia occidentalis* diet preparations on the serum LDL-C and HDL-C (mg/dl).

<table>
<thead>
<tr>
<th>Treatment group</th>
<th>LDL-C (mg/dl)</th>
<th>HDL-C (mg/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><em>V. amygdalina</em></td>
<td><em>T. occidentalis</em></td>
</tr>
<tr>
<td>Control</td>
<td>127.33 ± 5.64</td>
<td>127.33 ± 5.64</td>
</tr>
<tr>
<td>5%</td>
<td>124.44 ± 3.81&lt;sup&gt;b&lt;/sup&gt;</td>
<td>120.49 ± 2.68&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>15%</td>
<td>116.72 ± 2.03&lt;sup&gt;b&lt;/sup&gt;</td>
<td>115.30 ± 3.68&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>30%</td>
<td>104.66 ± 3.84&lt;sup&gt;b&lt;/sup&gt;</td>
<td>103.99 ± 5.34&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Results are mean ±SD. Values with different alphabetical superscripts for the same parameter in a row are significant with respect to each other (P<0.05). Values with the superscript * in a column are significant with respect to the control (P<0.05).
in the low density lipoprotein receptor (LDLR) and other genes. The results showed that both preparations significantly lowered the serum LDL-C concentrations relative to the control. However, both diet preparations could not induce a significant effect when compared at equal concentrations.

Beyond the role of LDL-C in the development of atherosclerosis, growing evidence suggests that high density lipoprotein cholesterol (HDL-C) is a powerful predictor of cardiovascular disease (CVD). Indeed, epidemiological, mechanistic and intervention studies suggest that low HDL-C is a major CVD risk factor and that increasing HDL-C plasma levels may be beneficial, particularly in patients with low HDL-C levels (Phillips, 2007). The results from the study showed that the treatment with *V. amygdalina* and *T. occidentalis* diets led to a significant increase in serum HDL-C, showing their protective role in CVD. The comparison of their effects showed that *T. occidentalis* diet preparation induced a significant increase in serum HDL-C compared to *V. amygdalina* diet preparation at the 15% concentration. The protective role of HDL-C against CVD has been suggested to occur in several ways (Nofer et al., 2002). Particles of HDL prevent coronary artery disease by serving as transport particles for excess cholesterol to the liver, where it is converted into bile acids and excreted. In humans, HDL levels are a very well known measure of cardiac health due to their strong inverse relationship with coronary artery disease (Wilson et al., 1988; Stamler et al., 2000). The principal HDL pathway, termed reverse cholesterol transport (RCT) is a major component of lipid homeostasis. Genetic variation in the RCT pathway contributes greatly to phenotypic variations in humans (O’Connell et al., 1988).

Results from this study confirm that *V. amygdalina* and *T. occidentalis* have lipid lowering effects which may be beneficial to people at risk of CVD. *V. amygdalina* and *T. occidentalis* were found to be effective in lowering the levels of serum cholesterol, triacylglycerols and LDL-C, thereby, showing their hypocholesterolaemic property. In conclusion, the results from the study showed that the *T. occidentalis* diet preparation had more anti-lipidemic property than the *V. amygdalina* diet preparation. These leaves could be beneficial to people at high risk of cardiovascular disease.

**REFERENCES**


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