Effects of Aqueous Extracts of Petals of Red and Green *Hibiscus sabdariffa* on Plasma Lipid and Hematological Variables in Rats

Lawrence A. Olatunji¹, Joseph O. Adebayo¹, Oladapo B. Oguntoye¹, Nafisat O. Olatunde¹, Victoria A. Olatunji², and Ayodele O. Soladoye¹

Departments of ¹Physiology and Biochemistry and ²Anatomy, College of Medicine, University of Ilorin, Ilorin, Kwara State, Nigeria

Abstract

The effects of administrating aqueous extracts of the petals of red and green *Hibiscus sabdariffa* (1.0 and 1.5 mg/kg body weight) on hematological and plasma lipid variables were examined in rats. Animals were randomly divided into group A (control), groups B and C (treated with 1.0 and 1.5 mg/kg body weight, respectively, of the extract of petals of red *Hibiscus sabdariffa*), and groups D and E (treated with 1.0 and 1.5 mg/kg body weight, respectively, of the extract of petals of green *Hibiscus sabdariffa*). The chronic administration of both extracts for 28 days resulted in significant decreases in the plasma total cholesterol levels at 1.5 mg/kg body weight (p < 0.05) while the extracts led to significant decreases in LDL-cholesterol levels at both 1.0 and 1.5 mg/kg body weight only (p < 0.05). In contrast, the administration of the extracts did not have any significant effect on HDL-cholesterol, triglycerides, hematocrit, hemoglobin, red blood cell count, white blood cell count, and platelet count values when compared with the controls (p > 0.05). These results indicate that the lowered plasma total cholesterol concentrations induced by aqueous extracts of either red or green *Hibiscus sabdariffa* petals is strongly associated with decreased LDL-cholesterol concentrations. Thus, both extracts could exert similar cardiovascular protective effects.

Keywords: Aqueous extracts, green petals, *Hibiscus sabdariffa*, plasma cholesterol, red petals.

Introduction

Plasma lipid disorders are characterized by elevated plasma levels of LDL-cholesterol, triglycerides, and by a decreased level of HDL-cholesterol. Epidemiological studies demonstrate that cardiovascular disease is the leading cause of death. It results from a variety of risk factors such as heredity, smoking, high blood cholesterol, glucose intolerance, obesity, and high blood pressure that are substantially influenced by dietary factors. These constitute important risk factors for cardiovascular disease that are modifiable (Stamler et al., 1986). In addition, a number of dietary factors alter lipoprotein profiles and have a significant effect on initiation and progression of cardiovascular disease (Paolisso et al., 2000).

A large body of evidence suggests that extract of petals of red *Hibiscus sabdariffa* has a blood-pressure-lowering effect in humans (Haji-Fara & Haji-Tarkhani, 1999) and in animals (Adegunloye et al., 1996; Onyenekwe et al., 1999). The mechanisms responsible for the blood-pressure-lowering effect of *Hibiscus sabdariffa* have not been fully elucidated.

The petals of *Hibiscus sabdariffa* are consumed more than any other part of the plant. The aqueous extract of the petals of red *Hibiscus sabdariffa* is consumed as a drink while the petals of green *Hibiscus sabdariffa* is consumed as a vegetable in Nigeria. The current study was, therefore, undertaken to determine the effects of aqueous extracts of the petals of red and green *Hibiscus sabdariffa* on lipid and hematological parameters in rats.

Materials and Methods

Animals and assay kits

Thirty albino rats (*Rattus novergicus*) weighing between 150 and 200 g obtained from the Animal Breeding Unit...
of the Department of Biochemistry, University of Ilorin, Ilorin, Nigeria, were used for this study. The lipid assay kits were supplied by Randox Laboratory Ltd. (Co. Antrim, UK). All other reagents were of analytical grade and were prepared in all glass-distilled water.

Plant extracts

Fresh samples of the red petals of *Hibiscus sabdariffa* were collected from Maiduguri, Borno state, Nigeria, while those of the green *Hibiscus sabdariffa* were collected from Ogbomoso, Oyo state, Nigeria. Prof. F.A. Oladele of the Department of Botany, University of Ilorin, Ilorin, Nigeria, botanically authenticated the samples. The petals of both types were dried at room temperature separately. The aqueous extracts of the petals were prepared as described by Adegunloye et al. (1993) and Obiefuna et al. (1993). This was then filtered and the residue was discarded. The filtrate was subsequently evaporated to dryness. The resulting powder of either extract was scrapped from the crucible and stored in capped bottles until needed (Adegunloye et al., 1993; Obiefuna et al., 1993). The extracts of *Hibiscus sabdariffa* (2.5 g) was dissolved in 500 ml of distilled water to make a stock solution of 5 mg/ml.

Administration of aqueous extracts of petals of *Hibiscus sabdariffa*

The rats received standard feed and were allowed access to water *ad libitum*. Animals were randomly divided into five groups of six rats each. They were treated for 28 days accordingly: Group A received an appropriate volume of distilled water on a daily basis, serving as the controls. Group B received 1.0 mg/kg body weight/day of the aqueous extract of petals of red *Hibiscus sabdariffa*. Group C received 1.5 mg/kg body weight/day of the aqueous extract of petals of red *Hibiscus sabdariffa*. Group D received 1.0 mg/kg body weight/day of the aqueous extract of petals of green *Hibiscus sabdariffa*. Group E received 1.5 mg/kg body weight/day of the aqueous extract of petals of green *Hibiscus sabdariffa*.

Blood collection

The rats were sacrificed by cervical dislocation at the end of the experimental period. The jugular vein was exposed and cut with a sterile scalpel blade and the rats were bled into EDTA-coated specimen bottles. Plasma was obtained from a portion of the blood sample by centrifugation at 3000 rpm for 5 min. All plasma samples were stored in refrigerator at 4°C before analysis (Soladoye et al., 1998).

Sample analysis

All hematological parameters were determined by an automated hematological analyzer, SYSMEX KX-21 (SYSMEX Corporation, Japan), using whole blood samples. Plasma total cholesterol concentration was determined by enzymatic analysis (Allain et al., 1974), and plasma triglyceride concentration was determined by the Hantzch condensation reaction (Carr et al., 1993). HDL-cholesterol concentration was estimated using the precipitation method of Warnick et al. (1982), and LDL-cholesterol concentration was calculated using Friedewald’s formula (Friedwald et al., 1972).

Statistical analysis

Data are presented as mean ± SEM, and statistical significance was determined using the Student’s *t*-test. Probability level of *p* < 0.05 was considered statistically significant.

Results

Effects of aqueous extracts of petals of red and green *Hibiscus sabdariffa* on plasma lipid and lipoprotein concentrations

Chronic administration of 1.5 mg/kg body weight of extracts of both red and green *Hibiscus sabdariffa* for 28 days (groups C and E) resulted in significant decreases in the plasma total cholesterol levels (*p* < 0.05) when compared with the control value, whereas the administration of the lower dose of 1.0 mg/kg body weight of both extracts (groups B and C) did not produce any significant change (*p* > 0.05; Table 1) compared with the control value. On the other hand, administration of either extract led to significant decreases in plasma LDL-cholesterol levels in all the experimental groups compared with the control values (*p* < 0.05; Table 1). However, administration of both extracts at either dose did not produce any significant effect on plasma HDL-cholesterol and triglycerides levels (*p* > 0.05; Table 1).

Effects of aqueous extracts of petals of red and green *Hibiscus sabdariffa* on hematological variables

The results show that administration of both extracts of red and green petals of *Hibiscus sabdariffa* did not result in any significant change in all hematological variables observed in this study (*p* > 0.05; Table 2).

Discussion

In this study, we demonstrated that aqueous extracts of the petals of both red and green *Hibiscus sabdariffa* decrease plasma total cholesterol and LDL-cholesterol levels. Decreased plasma LDL-cholesterol concentration has been associated with reduced risk for cardiovascular disease (Stamler et al., 1986). The potential use of
aqueous extracts of petals of red and green *Hibiscus sabdariffa* for human consumption becomes significant especially in the countries where there is high prevalence of elevated plasma cholesterol among the population.

Previous studies have demonstrated that aqueous extract of petals of *Hibiscus sabdariffa* has blood-pressure-lowering effect in rats (Adegunloye et al., 1996; Onyenekwe et al., 1999) and in humans (Haji-Faraji & Haji-Tarkha, 1999). However, mechanisms responsible for this effect are not clear, although reduced vascular resistance due to enhanced endothelial function and inhibition of Ca$^{2+}$ influx have been proposed in rats (Obiefuna et al., 1993; Owolabi et al., 1995). However, diminished endothelium-dependent vasodilatation has been observed in both clinical and experimental hypercholesterolemia (Creager et al., 1992; Cooker et al., 1997). Hence, Treasure et al. (1995) reported that agents that have the ability to lower cholesterol would reduce vascular resistance by improving endothelial function. The finding in this study that administration of aqueous extracts of *Hibiscus sabdariffa* lowers plasma cholesterol is in consonance with previous studies (EL-saadany et al., 1991). Furthermore, the observation in the current study that administration of the extracts of *Hibiscus sabdariffa* did not have any significant effect on plasma HDL-cholesterol level is comparable with other studies that demonstrated that intake of some dietary plants lower plasma LDL-cholesterol levels without affecting plasma HDL-cholesterol levels (Ulrich, 1987).

The significant decrease in plasma LDL-cholesterol level after the administration of the extracts may be due to alterations in the small intestine, which might increase hepatic LDL-receptor and decrease conversion of VLDL to LDL (Vidal-Quintanar et al., 1997). Because there is no corresponding decrease in plasma HDL-cholesterol levels, the decreased plasma total cholesterol concentration observed in this study is attributed to decreased plasma level of LDL-cholesterol.

The non-significant effect of the administration of the extracts at both doses on all hematological parameters (Table 2) indicates that the consumption of aqueous extracts of either the red or green *Hibiscus sabdariffa* petals at 1.0 and 1.5 mg/kg body weight may not cause any significant deleterious effect on red blood cells, white blood cells, and platelets. The absence of any significant change in hematocrit value in the current study also suggests that the observed decrease in plasma cholesterol concentration induced by the extracts is neither due to hemodilution nor increased plasma volume. Hence, body fluid balance might have been preserved in these animals.

In conclusion, chronic administration of aqueous extract of either red or green *Hibiscus sabdariffa* lowers plasma LDL-cholesterol level without affecting HDL-cholesterol level. In addition, the potential use of either red or green *Hibiscus sabdariffa* as a cholesterol-lowering agent for human consumption deserves further consideration.

### Table 1. Effect of administration of aqueous extracts of red and green petals of *Hibiscus sabdariffa* on some plasma lipid variables in rats.$^a$

<table>
<thead>
<tr>
<th>Variables</th>
<th>A (Control)</th>
<th>B (1.0 mg/kg)</th>
<th>C (1.5 mg/kg)</th>
<th>D (1.0 mg/kg)</th>
<th>E (1.5 mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total cholesterol (mmol/l)</td>
<td>3.58 ± 0.49</td>
<td>2.66 ± 0.51$^{**}$</td>
<td>1.85 ± 0.29$^*$</td>
<td>2.49 ± 0.19$^{**}$</td>
<td>1.84 ± 0.27$^*$</td>
</tr>
<tr>
<td>LDL-cholesterol (mmol/l)</td>
<td>2.23 ± 0.24</td>
<td>1.33 ± 0.18$^*$</td>
<td>1.21 ± 0.24$^*$</td>
<td>1.10 ± 0.04$^*$</td>
<td>1.06 ± 0.11$^*$</td>
</tr>
<tr>
<td>HDL-cholesterol (mmol/l)</td>
<td>1.21 ± 0.23</td>
<td>0.80 ± 0.13$^*$</td>
<td>1.11 ± 0.31$^{**}$</td>
<td>1.15 ± 0.10$^*$</td>
<td>1.01 ± 0.19$^{**}$</td>
</tr>
<tr>
<td>Triglycerides (mmol/l)</td>
<td>0.58 ± 0.03</td>
<td>0.63 ± 0.04$^{**}$</td>
<td>0.52 ± 0.04$^{**}$</td>
<td>0.65 ± 0.08$^{**}$</td>
<td>0.76 ± 0.11$^{**}$</td>
</tr>
</tbody>
</table>

$^a$Data are expressed as mean ± SEM for 6 rats per group. ns, not significantly different at p < 0.05 compared with controls; $^*$significantly different at p < 0.05 compared with controls.

### Table 2. Effect of administration of aqueous extracts of red and green petals of *Hibiscus sabdariffa* on some hematological variables in rats.$^a$

<table>
<thead>
<tr>
<th>Variables</th>
<th>A (Control)</th>
<th>B (1.0 mg/kg)</th>
<th>C (1.5 mg/kg)</th>
<th>D (1.0 mg/kg)</th>
<th>E (1.5 mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hematocrit (%)</td>
<td>42.6 ± 0.8</td>
<td>46.0 ± 1.5$^{**}$</td>
<td>45.6 ± 1.2$^{**}$</td>
<td>41.8 ± 1.9$^{**}$</td>
<td>40.2 ± 2.4$^{**}$</td>
</tr>
<tr>
<td>Hemoglobin (g/l)</td>
<td>15.5 ± 0.4</td>
<td>16.6 ± 0.2$^{**}$</td>
<td>15.9 ± 0.4$^{**}$</td>
<td>15.3 ± 0.6$^{**}$</td>
<td>14.9 ± 0.4$^{**}$</td>
</tr>
<tr>
<td>Red blood cell count ($\times 10^{12}$/l)</td>
<td>5.1 ± 0.2</td>
<td>5.3 ± 0.2$^{**}$</td>
<td>5.2 ± 0.2$^{**}$</td>
<td>5.0 ± 0.3$^{**}$</td>
<td>4.8 ± 0.3$^{**}$</td>
</tr>
<tr>
<td>White blood count ($\times 10^{9}$/l)</td>
<td>8.9 ± 0.7</td>
<td>8.2 ± 0.4$^{**}$</td>
<td>8.7 ± 0.6$^{**}$</td>
<td>9.4 ± 0.6$^{**}$</td>
<td>8.3 ± 0.6$^{**}$</td>
</tr>
<tr>
<td>Platelet count ($\times 10^{9}$/l)</td>
<td>42.6 ± 0.8</td>
<td>46.0 ± 1.5$^{**}$</td>
<td>45.6 ± 1.2$^{**}$</td>
<td>41.8 ± 1.9$^{**}$</td>
<td>40.2 ± 2.4$^{**}$</td>
</tr>
</tbody>
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$^a$Data are expressed as mean ± SEM for 6 rats per group. ns, not significantly different at p < 0.05 compared with controls.
References


