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Effect of *Justicia Carnea* Leaf Extract on Plasma and Fecal Lipid Profile in High-Fat Diet Fed Wistar Rats

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Abstract

The preference for high-fat diets has increased the risk of developing cardio-metabolic metabolic disorders. The aim of this study was to examine the effect of Justicia carnea (JC) leaf extract on plasma and fecal lipid profile [total cholesterol (TC), triglyceride (TG), high density lipoprotein (HDL), low density lipoprotein (LDL)] in high-fat diet fed wistar rats. The study involved a total of thirty wistar rats separated into six groups of five rats each. Group 1 served as control while groups 2 to 6 were fed with high-fat diet (HFD) throughout the period of the experiment. Group 2 remained untreated, Groups 3, 4 and 5 received respectively 200mg/kg, 500mg/kg and 1000mg/kg of JC extract. Group 6 received 10mg/kg of simvastatin. The animals were fed with the extract for twenty-eight days and thereafter plasma and fecal samples were collected to determine the lipid profile. Daily administration of 200mg/kg of JC caused a significant reduction in the plasma levels of total cholesterol (TC) but significant increase in fecal total cholesterol (FTC). The higher doses also showed a similar pattern but not significantly. Administration of 500mg/kg of JC caused significant increase in plasma TG and HDL compared to the HFD only group. All three doses of JC caused significant reduction in LDL. Conclusively, the results from the present study suggest that JC could possess plasma lipid lowering property and also enhanced fecal excretion of cholesterol. This effect could be possibly due to decreased absorption of lipids and increased fecal excretion of lipids.

Key words: *Justicia carnea, plasma, fecal, lipid profile*

Introduction

The rising trend in the incidence of cardio-metabolic disorders even in developing countries is typically due to the preference for high-fat diets (Jeong *et al*., 2005; Oggioni *et al*., 2015; Zong *et al*., 2016; Houston 2018). These high-fat diets are mainly flour or margarine-based highly processed foods sold in the increasing number of fast-food outlets. In many food cultures, fats serve as cooking medium and to a large extent determines the palatability or otherwise of certain foods. High content of dietary fat induces changes in lipid metabolism resulting in excessive fat accumulation in nearly all the tissues of the body including brain, liver, heart, peripheral nerves,

spleen and bone marrow (Buettner *et al*., 2006). Therefore, consumption of high-fat diets over a prolonged period could initiate disorders related to lipid metabolism such as increased visceral fat, hyperlipidemia and insulin resistance (Gao *et al*., 2015; von Frankenberg *et al*., 2017; Guo *et al*., 2022). These disorders are associated with complications including stroke, coronary heart disease, microvascular disease and sudden cardiac arrest. Studies suggest a strong correlation between high dietary intake of industrially produced trans-fatty acids and high risk of cardiovascular disease (Bendsen *et al*., 2011). The synthetic medications available in treating these disorders can only ameliorate the complications so that prevention becomes the most vital aspect of managing cardiovascular disorders. Preventive measures such as lifestyle and dietary modifications are often recommended by physicians and dieticians in different countries (Siervo *et al*., 2015; Samadian *et al*., 2016; Ozemek *et al*., 2018) but these cardiovascular disorders have continued unabated. Since it is almost impracticable to avoid consumption of high-fat diet in many cultures, it would therefore be appropriate to include some natural products that may have the potential to reduce effectiveness of these dietary fats (Ogan *et al*., 2022; Obia *et al*., 2024). Unprocessed plant products are easily available in many food cultures and have also been used for treatment of certain medical conditions.

Justicia carnea is an edible flowering plant with common names; flamingo flower, Brazilian plume flower and Jacobina. In Nigeria it is popularly referred to as "hospital too far" or "Jesus leaf'' because it is believed in many cultures to cure a number of ailments including anemia Onyeabo *et al*., 2017; Nji *et al*., 2020; Iwetan *et al*., 2022). The use of medicinal plants for the treatment of induced fat disturbances remains greatly unexplored and might be a strategic key in the development of effective drugs safe for man's consumption (Boqué *et al*., 2012).

The aim of this research was to evaluate the effect of the hydro-methanolic leaf extract of *Justicia carnea* on plasma and fecal lipid profile in high-fat diet fed wistar rats.

Materials and Methods

The study involved 30 male wistar rats weighing 200 to 240g and separated into six groups of five rats each. Ethical approval was obtained from the Research Ethics and Management Committee of the university of Port Harcourt with approval number; UPH/CEREMAD/REC/MM82/030. *Justicia carnea* leaves were bought from Epie community in Bayelsa State and was sent to the Plant Science and Biotechnology Department of the University of Port Harcourt for identification and authentication. Thereafter the leaves were processed to prepare the extract used for the study. The groups include;

Group 1 served as control (Normal animal feed and water).

Group 2 (High fat diet and water)

Group 3 (High fat diet + 200mg/kg of body weight of extract)

Group 4 (High fat diet + 500mg/kg body weight of extract)

Group 5 (High fat diet + 1000mg /kg body weight of extract).

Group 6 (High fat diet + 10mg/kg body weight of Simvastatin).

The animals were fed with the extract for 28 days and thereafter the animals were sacrificed (after anesthesia) and plasma samples collected via cardiac puncture to determine the plasma lipid profile (total cholesterol, triglyceride, high-density lipoprotein and low-density lipoprotein). Fecal pellets from the dissected colon were collected to determine the fecal lipid profile.

Statistical package for social sciences (SPSS) version 22.0 was used for data analysis. Results were presented in tables and graphs. Continuous variables were expressed as mean ± standard error of mean, discrete variables were expressed as percentages. Statistical difference was determined using analysis of variance (ANOVA) and at $p < 0.05$

RESULTS AND DISCUSSION

Table 1: Effect of *Justicia Carnea* leaf extract on Plasma lipid profile

Group	TC (mmol/l)	TG (mmol/l)	HDL (mmol/l)	LDL (mmol/l)
Control	2.50 ± 0.07	0.79 ± 0.05	1.10 ± 0.05	1.76 ± 0.07
High fat diet (HFD)	2.60 ± 0.05	0.72 ± 0.07	1.08 ± 0.09	1.84 ± 0.09
HFD + 200mg/kg	2.16 ± 0.06[ab]	0.96 ± 0.01[b]	1.21 ± 0.10	1.40 ± 0.04[ab]
HFD + 500mg/kg	2.40 ± 0.05	1.00 ± 0.04[ab]	1.66 ± 0.12[ab]	1.19 ± 0.05[ab]
HFD + 1000mg/kg	2.42 ± 0.10	0.74 ± 0.05	1.39 ± 0.19	1.38 ± 0.13[ab]
HFD + 10mg/kg of simvastatin	2.32 ± 0.08[b]	0.84 ± 0.10	1.36 ± 0.15	1.34 ± 0.10[ab]

Total cholesterol (TC), Triglyceride (TG), High-density lipoprotein (HDL), low-density lipoprotein (LDL).

[a]; Significantly different compared to control group

[b]; Significantly different compared to HFD only group

Table 2: Effect of *Justicia carnea* leaf extract on the Fecal lipid profile of high-fat diet fed wistar rats.

Group	FTC (mmol/l)	FTG (mmol/l)	FHDL (mmol/l)	FLDL (mmol/l)
Control	2.62 ± 0.06	1.14 ± 0.16	1.49 ± 0.03*	1.64 ± 0.10
High fat diet (HFD)	2.46 ± 0.14	1.07 ± 0.18	1.13 ± 0.04	1.82 ± 0.14
HFD + 200mg/kg	2.92 ± 0.16*	0.93 ± 0.08	1.43 ± 0.08*	1.91 ± 0.18#
HFD + 500mg/kg	2.74 ± 0.11	1.06 ± 0.10	1.36 ± 0.10	1.85 ± 0.06
HFD + 1000mg/kg	2.84 ± 0.25	1.15 ± 0.06	1.60 ± 0.08*	1.77 ± 0.25
HFD + 10mg/kg of simvastatin	2.56 ± 0.12	0.90 ± 0.08	1.51 ± 0.13*	1.47 ± 0.07

Fecal total cholesterol (FTC), Fecal triglyceride (FTG), Fecal high-density lipoprotein (FHDL), Fecal low-density lipoprotein (FLDL).

* Significantly different compared to HFD only group.

Significantly different compared to group 6.

The present study evaluated the effects of leaf extract of *Justicia carnea* (JC) on the plasma and fecal lipid profile of high-fat diet fed wistar rats. Results suggest that the leaf extract had plasma lipid lowering effect as well as enhanced fecal excretion of cholesterol. Daily administration of 200mg/kg of JC caused a significant reduction in the plasma levels of total cholesterol (TC) but significant increase in fecal total cholesterol (FTC). The gut can process cholesterol in three ways, absorption, metabolism by gut microflora and excretion (Lichtenstein 1990). When large amount of cholesterol is absorbed, only little will be excreted in feces and vice versa. Cholesterol in the feces is derived mainly from unabsorbed dietary cholesterol and biliary secretions into the intestine (Lin *et al*., 2017; Grefhorst *et al*., 2019; Chen *et al*., 2022). The reduction in plasma TC occurring together with increase in fecal total cholesterol during concurrent administration of the extract and high-fat diet could strongly suggest that it possibly impairs the absorption of cholesterol. Impaired cholesterol absorption when consumed with other plant products have been reported in previous studies (Plösch *et al*., 2006; Kris-Etherton *et al*., 2018). One or more of the phytochemical components of JC such as the phenols, tannins, terpenoids, alkaloids (Arthur *et al*., 2022) could play an important role in enhancing lipid excretion. Increased fecal excretion of cholesterol reduces the risk of cholesterol-associated disorders and could position this wonder plant as a potential anti-obesity and anti-hyperlipidemic agent which will require receptor-targeted studies to validate. We can therefore infer that addition of moderate amounts of JC leaf to high-fat diets could be beneficial in lowering the plasma cholesterol concentration. In higher concentrations of 500mg/kg and 1000mg/kg, JC leaf extract reduced the plasma TC and also increased fecal concentration of total cholesterol but in a manner that is not significantly. The lipid lowering effect of JC is therefore best obtained at lower doses.

For the triglycerides (TG), plasma levels increased significantly with the administration of 200mg/kg and 500mg/kg of the JC leaf extract compared to the HFD only group without corresponding significant changes in the fecal concentrations. Although the HDL concentrations increased slightly with the administration of three doses of JC leaf extract, the increase was only significant with the 500mg/kg group. Fecal excretion of HDL increased significantly in the 200mg/kg and 500mg/kg groups but not in the 1000mg/kg group. Low-density lipoprotein (LDL) is known as the ‘bad’ cholesterol and often associated with increased risk of cardiovascular disorders. All three doses of the extract caused significant lowering of the plasma LDL in a similar way manner as the standard drug used in the experiment. Thus, the extract might have a protective effect on the heart and possibly reducing the risk of cardiovascular diseases (Ray *et al*., 2023). However, the fecal excretion of LDL was unaffected by the extract.

Conclusively, moderate administration of *Justicia carnea* leaf extract together with high-fat diet significantly improved plasma total cholesterol while increasing the fecal loss of total cholesterol. Therefore, moderate consumption of *Justicia carnea* leaf might potentially reduce the risk of cardiovascular disease in individuals who consume high-fat diet.

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