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Methanolic Extract of *Musa sapientum* (L var. *paradisiaca*) Sucker Improves Lipid Profiles in Alloxan Induced Diabetic Rats

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ABSTRACT

Alterations in plasma lipid profiles are common occurrences in diabetes. There is also a positive correlation between the risk of developing ischaemic heart disease and raised plasma cholesterol and LDL-cholesterol. *Musa sapientum* sucker extract has proven to be an effective antidiabetic agent by lowering blood sugar level and improve the islets of Langerhans. In this study, effect of different concentrations of methanolic extracts of *Musa sapientum* sucker on plasma lipid profile were assessed in alloxan induced diabetic rats. Total plasma cholesterol, HDL cholesterol and triglyceride were determined using enzymatic kits, while plasma LDL cholesterol, VLDL cholesterol, atherogenic and coronary risk indices were calculated. The extract at 5 mg and 10 mg/kg/body weight/day reduced significantly ($p<0.05$) the total plasma cholesterol, very low density lipoprotein cholesterol and plasma triglyceride. Administration of the extract also reduced significantly ($p<0.05$) the atherogenic and coronary risk indices. However, a significant increase ($p<0.05$) was observed in plasma HDL cholesterol. The result of the study indicates that *Musa sapientum* sucker extract was effective in improving plasma lipid profile associated with cardiovascular risk factors in alloxan induced diabetic rats.

Key words: *Musa sapientum*, lipid profile, cardiovascular disease, diabetes, atherosclerosis

INTRODUCTION

Diabetes mellitus is a non communicable disease, which is considered one of the five leading causes of death in the world (Kumar *et al*., 2007). It is a complex disease associated with myriad of debilitating complications among which cardiovascular diseases are on a resounding note. About 70 to 80% of death in diabetic patients are due to vascular diseases (Chattopadhyay and Bandyopadhyay, 2005).

Cardiovascular diseases (CVD) contributed to one third of all global death with developing countries, low income and middle income countries accounting for 86% of disability-adjusted life years (WHO/FAO, 2003). Some of the risk factors implicated in cardiovascular disease are: total plasma cholesterol (Richard *et al*., 1989; Mazier and Jones, 1991), Plasma triglycerides (Austin *et al*., 2000; Van Lennep *et al*., 2002), plasma LDL cholesterol (Singh *et al*., 2007), plasma

VLDL cholesterol (Rosenfeld *et al*., 1987; Yla-Herttuala *et al*., 1989), plasma HDL cholesterol, (APCSC, 2004; Barter, 2005), coronary risk index (Alladi *et al*., 1989) and atherogenic risk index (Abbot *et al*., 1988).

Musa sapientum belongs to the family Musaceae (Dhanabal *et al*., 2005). It is one of the plants whose usefulness in ethnopractice has been well documented (Mallick *et al*., 2006; Pari and Umamaheswari, 2000; Best *et al*., 1984; Kalash *et al*., 1993). Different parts of *Musa sapientum* extract has been reported to posses anti diabetic activity. Study on the antidiabetic effect of the plant has been focused on the flower and fruits (Singh *et al*., 2007; Lewis *et al*., 1999).

Previous reports have also indicated that cardiovascular diseases induced by hyperglycaemia are associated with alteration in serum lipid profile (Laakso, 1996; Steiner, 1999; Massing *et al*., 2001). Hence, if these risk factors are not controlled in diabetic subjects, cardiovascular disease is imminent. In our previous study, we reported that methanolic extract of *Musa sapientum* sucker possess anti-hyperglycemic activity (Salau *et al*., 2010) and thus could serve as a good phytomedicine for diabetic treatment. In this study the effects of methanolic extract of *Musa sapientum* sucker on plasma lipid profile changes in alloxan induced diabetic rats was investigated with a view to finding its possible effects on cardiovascular disease induced by hyperglycemia.

MATERIALS AND METHODS

Plant materials and preparation of extracts: Ten kilogram of fresh *Musa sapientum* sucker was harvested from a local garden in Ikenne, Ogun State, Nigeria in 2008. The plant was identified and authenticated at the Forestry Research Institute, Ibadan, Nigeria where a voucher number FHI 108349 was assigned. Samples of the plant were deposited at the Herbarium. The sucker was cleaned and rinsed in water to remove dirt. It was then dried at room temperature for 24 h. The sucker was thereafter cut into pieces and air dried (24-25°C). Exactly 200 g of the pulverized sucker was soaked in 70% methanol for 48 h. The extract was filtered and then concentrated with rotary evaporator. The concentrated extract was then dried at room temperature. The dried product was kept in a hermetically sealed container and stored in a desiccator. The required dose of the extract was reconstituted in water daily and administered to the rats. The yield of the extract was 2.61%.

Experimental subject and management: Forty rats (male and female) weighing between 160-185 g were obtained from physiology Department, University of Ibadan Nigeria. The rats were acclimatized for two weeks in an individual metabolic cage and later divided randomly into four groups. They were all allowed access to food and clean drinking water ad libitum. The care of the animals was in accordance with the US Public Health Service Guidelines (NRC, 1999) and approved by the Olabisi Onabanjo University College of Health Sciences and Animal ethics Committee.

Induction of diabetes: After the initial acclimatization period, 8 of the rats were randomly selected into a group labeled G1 (normal control). Alloxan (180 mg kg^{-1} b.wt. i.p.) was then administered into all other rats. Exactly 72 h after alloxan administration, fasting blood glucose level of all the rats were determined. Rats with fasting blood glucose level ≥300 mg dL^{-1} were then randomized into 3 groups of 8 rats each. The groups were labeled G2-G4 and treated as follow:

G2: Diabetic control: Administered with normal saline
G3: Test group 1: Administered with 5 mg kg^{-1} b.wt. of sucker extract
G4: Test group 2: Administered with 10 mg kg^{-1} b.wt. of sucker extract

All administration was done orally as a single dose using an oral intubator. Treatments were carried out for 8 weeks after which the rats were fasted over night; blood was then withdrawn by cardiac puncture into lithium heparinized bottle after anesthesia. The blood was centrifuged at 3,000 rpm for twenty minutes and the plasma was collected.

Biochemical analysis: Plasma cholesterol, HDL cholesterol and Plasma triglycerides were determined by enzymatic method using Randox kits. LDL cholesterol was obtained by deduction using Friedwald equation. Atherogenic index was calculated using the formula of Abbot *et al.* (1988). Coronary risk index was determined the by method of Alladi *et al.* (1989). VLDL cholesterol was estimated by dividing plasma triglyceride by 5.

Statistical analysis: The data were analyzed using one-way ANOVA. Level of significance was assessed using Duncan Multiple Range Test (DMRT) at $p<0.05$ (SPSS 14.0 software was used for data analyses).

RESULTS

The result of the plasma lipoprotein indicates that alloxan administration significantly increased ($p<0.05$) plasma total cholesterol level above the normal control value (Table 1). Treatment with methanolic sucker extract at the two tested doses brought the total cholesterol level to the pretreatment level. No significant variation ($p>0.05$) was observed in the total plasma cholesterol level at the two tested doses. Triglyceride level was also observed in the study to increase with alloxan treatment. When the extracts were administered to the diabetic rats (G3 and G4) the triglyceride level was reduced significantly ($p<0.05$) below the pretreatment level. The triglyceride level of 67.65±4.03 mg dL^{-1} observed in rats treated with 10 mg kg^{-1} which was significantly ($p<0.05$) lower than that observed in rats treated with 5 mg kg^{-1} dose. No significant difference ($p>0.05$) was observed in HDL cholesterol level of untreated diabetic rats and those treated with the extract at the two tested doses; however a significant increase ($p<0.05$) was observed in the HDL cholesterol when compared with the normal control (G1). No significant variations ($p>0.05$) were observed in the HDL cholesterol levels at the two treated doses. A significant increase in plasma LDL cholesterol from 38.92±2.25 mg dL^{-1} in the normal control to 80.83±0.43 mg dL^{-1} was observed after alloxan administration. Treatment with the extract however, brought the LDL cholesterol level to the pretreatment level. The observed LDL cholesterol of 39.80±4.23 mg dL^{-1} in

Table 1: Effect of *Musa sapientum* sucker extract on plasma lipids in normal and alloxan-induced diabetic rats

	Lipid (mg dL^{-1})				
Group	Total cholesterol	Triglycerides	HDL-cholesterol	LDL-cholesterol	VLDL-cholesterol
G1	84.55±1.65^{a}	103.85±3.72^{a}	24.98±1.168^{a}	38.92±2.25^{a}	20.71±0.74^{a}
G2	135.82±0.81^{b}	140.29±1.39^{b}	26.80±0.75^{ab}	80.83±0.43^{b}	28.07±0.28^{b}
G3	86.15±5.56^{a}	79.66±4.56^{c}	30.31±2.51^{b}	39.80±4.23^{a}	15.84±0.90^{c}
G4	77.83±3.22^{a}	67.65±4.03^{d}	29.90±1.68^{b}	34.20±2.26^{a}	13.46±0.82^{d}

Mean±SEM for 8 rats per group, Values within a column with different superscripts are significantly different at $p<0.05$ (DMRT)

Table 2: Effect of *Musa sapientum* sucker extract on risk indices in normal and alloxan-induced diabetic rats

Group	Coronary risk index	Atherogenic risk index
G1	3.50±0.18[a]	1.66±0.15[a]
G2	5.14±0.11[a]	3.02±0.08[b]
G3	2.93±0.23[b]	1.39±0.19[a]
G4	2.62±0.17[b]	1.18±0.12[a]

Values are Mean±SEM for 8 rats per group, Values within a column with different superscripts are significantly different at $p<0.05$ (DMRT)

rats treated with 5 mg kg^{-1} dose of the extract was not different ($p>0.05$) from the value of 34.20±2.26 mg dL^{-1} observed in the group treated with 10 mg kg^{-1} dose. VLDL cholesterol was also observed to be significantly raised ($p<0.05$) with alloxan administration whereas treatment with the extract reduced the VLDL level to values lowered than the normal control value.

The results of the effect of treatment on coronary and atherogenic risk indices are shown in Table 2. Administration of alloxan increased both the coronary and atherogenic risk indices significantly ($p<0.05$). Treatment with *Musa sapientum* sucker extract at the two tested doses however lowers the coronary risk index (5.4±0.11 to 2.93±0.23) and atherogenic risk index (3.02±0.08 to 1.39±0.19). The atherogenic risk indices at the two tested doses (1.39±0.19) and (1.18±0.12) were not different from the normal control group (1.66±0.15), however, the coronary risk index was observed to be lower (2.62±0.17) than the value in the normal control group (3.50±0.18). No significant difference ($p>0.05$) was however observed in these parameters at the two tested doses.

DISCUSSION

Many investigators have reported on the effect of plant extracts on serum lipids. Karimi and Hayatghaibi (2006) reported whole hemp seed, significantly reduced serum LDL. Chattopadhyay and Bandyopadhyay (2005) reported the effect of *Azadirachta indica* leaf extract on serum lipid profile of streptozotocin-induced diabetic rats. The extracts significantly reduced total cholesterol, LDL and VLDL cholesterol while HDL cholesterol remained unchanged. Ethanolic and methanolic extracts of *Musa sapientum* sucker extracts have been reported to possess anti-hyperglycaemic effect in alloxan induced diabetic rats (Salau *et al*., 2010; Gorinstein *et al*., 2007). Alterations in plasma lipid profiles are common occurrence in diabetics, which are likely to increase cardiovascular disease (Pari and Umamaheswari, 2000; Kalash *et al*., 1993; Steiner, 1999), thus improvement in plasma lipid profiles could be considered as beneficial in the treatment of the disease. This study shows that methanolic extract of *Musa sapientum* improves lipid profile in alloxan induce diabetic rats.

The preliminary phytochemical analysis of *Musa sapientum* revealed the presence of saponins, saponin-glucosides, tannins, alkaloids and indole alkaloids. It is opined that these compounds, either singularly or synergistically might be responsible for the moderating effect observed in the lipid profile. One of the plausible mechanisms could be as a result of normalization of blood glucose via restoration of pancreatic integrity which was adversely affected by alloxan (Salau *et al*., 2010). Thus, it can be opined from the findings in the present study that the raised levels of total plasma cholesterol, plasma triglycerides, LDL and VLDL cholesterols that were associated with diabetes could be lowered with methanolic extract of *Musa sapientum* suckers. Similarly, this study indicates that increase in HDL cholesterol occurs along with concomitant decreases on other plasma lipoproteins when diabetics are treated with *Musa sapientum* extract. This is indicative of

cardioprotective effects (Rosenfeld *et al*., 1987; Mazier and Jones, 1991; Oke *et al*., 1999; Austin *et al*., 2000; Van Lennep *et al*., 2002) hence, present results suggest that administration of *Musa sapientum* sucker extract in diabetics has cardioprotective effect. The result of this study also suggests that the antihyper-triglyceridaemic effect of the extract might not be dose dependent with respect to total cholesterol, HDL cholesterol, LDL cholesterol, coronary and atherogenic indices.

CONCLUSION

The present study indicates that *Musa sapientum* suckers contain compounds that have a protective mechanism against the development of atherosclerosis through lipid profiles moderation. Our investigation thus suggest that methanolic extracts of *Musa sapientum* suckers may be helpful in controlling hyperlipidaemia as well as atherosclerosis in Insulin Dependent Diabetes Mellitus (IDDM).

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