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EFFECT OF *CORCHORUS TRILOCULARIS* ON SERUM LIPID AND GLUCOSE IN WISTAR RATS

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ABSTRACT

Dyslipidemia is a major risk factor for cardiovascular and coronary heart diseases (CHD) which causes morbidity and mortality in patients with diabetes mellitus because of disturbance in lipoproteins metabolism. During therapeutic management, great attention is paid on lowering blood glucose level and lipid profile of the patients. This study aimed to evaluate the hypolipedemic and hypoglycemic potentials of Corchorus trilocularis (CT) in diet-induced hyperlipedemic wistar rats. Twenty four rats were divided into six equal groups (4 rats each): Group I was normal control, group II was hyperlipidemic control, group III was standard control treated with 500mg/kg of metformin, groups IV, V and VI were treated with various concentrations of the aqueous extract of leaves of C. trilocularis for four weeks after confirmation of hyperlipidemia induced with High Fat Diet (HFD). Mean serum Triglycerides and Fasting Blood Sugar levels were significantly lower ($p<0.05$) in animals treated with aqueous extract of the leaves of C. trilocularis from various groups in a dose dependent manner. Although no significant difference ($P>0.05$) was found in mean serum Total Cholestrol, HDL Cholestrol, and LDL levels, animals in group IV were found to have lower serum LDL and T. Cholestrol levels as well as higher serum HDL level than those in groups I,II and III. The C. trilocularis aqueous extract showed serum lipid profile and hypoglycemic reduction properties and hence may reduce the tendency of cardiovascular risks.

Key words: Hyperlipidemia, Diabetes, Corchorus trilocularis, Metformin, HFD

INTRODUCTION

Diabetes mellitus is one of the chronic diseases that frequently cause significant morbidity and mortality. Its complications have become a serious issue for public health. Although multiple factors including hyperglycemia, hyperlipidemia, and inflammation all contribute pathogenic effects to various vascular complications in diabetes, hyperglycemia plays a critical role in the widespread cellular damage. Diabetes mellitus requires continuous medical care with multifactorial risk-reduction strategies (Diabetes Care, 2020).

Plants still represent a large untapped source of structurally novel compounds that might serve as lead for the development of novel drugs. Herbal medicines are safer than synthetic medicines because the phytochemicals in the plant extract target the biochemical pathway (Dhanalakshmi *et al*., 2014). Several such herbs have shown anti-diabetic and antilipedemic activities.

Corchorus trilocularis (CT) is one of the most common plants in tropical Africa, tropical and sub-tropical Asia and Australia (Chaudhari *et al*., 2012). It is locally called *Lalo* or *Turgunnuwa* in Hausa Land and commonly known as Wild jute. It has been reported that many species from *CT's* family possess cholesterol lowering activity, anti-inflammatory and demulcent properties (Dhanalakshmi *et al*., 2014). Study carried out by (Choudhary *et al*., 2013) on acute oral toxicity showed the *Corchorus trilocularis* is safe.

Lifestyle-related diseases such as diabetes mellitus and hyperlipidemia are increasing, probably with the increased availability of our food style and associated excessive energy intake (environmental factor) or due to genetic factor (Omae *et al*., 2006). The problems of cost and failure of medication and use of traditional herbs without scientific backing, necessitate investigation of traditional herbs effects scientifically on diseases causing mortality. In this research *Corchorus trilocularis,* was studied for hypolipidemic and hypoglycemic effect on diet-induced hyperlipidemic rats.

MATERIALS AND METHODS

Materials

Sample collection and identification

Corchorus trilocularis was obtained from the garden of School of Legal Studies Kano, Nigeria. The plant was identified as *Corchorus trilocularis* by botanist at Herbarium unit, Bayero University, Kano. The sample was deposited with accession Number BUKHAN 0501 for reference.

Formulation of High Cholesterol Diet

Animals were turned hyperlipidemic by feeding them with high-fat diet (HFD), for 7 days. The HFD contained cholesterol powder (100g), coconut oil (1L), egg yolk supplement (35 pieces) and normal rat feed. The mixture was pounded, molded and allowed to dry (Balzan *et al.*, 2013).

Preparation of Plant Extract

The plant leaves were gently but thoroughly washed in tap water two times and completely air dried at room temperature for 2 weeks. The dried leaves were pulverized into fine powder using mortar and pestle. The powdered sample (130 g) was poured into bottle containing 660ml of distilled water and shaked well. The mixture was left for 24 hours after which it was filtered using a piece of clean white cotton gauze. The filtrate was evaporated to complete dryness at 50 ºC. The dried extract was weighed (10g) and stored in air- and water-proof containers kept in a refrigerator at 4ºC. From this stock, fresh preparation was made whenever required (Choudhary *et al.*, 2013).

$$\text{Volume of extract administration} = \frac{\text{weight of rat (kg)} \times \text{dosage (mg/kg)}}{\text{Concentration of extract (mg/ml)}}$$

Experimental animals

The study was conducted on healthy albino rats of both sexes weighing between 150-180g were purchased from Vom Research institute of Jos, Plateau State Nigeria. The animals were housed in well-ventilated cages in the animal house of Biological Science Department of Bayero University Kano. They were allowed to acclimatize for one week prior to the experiment and had access to food and clean water.

Principle of laboratory animal care and ethical guidelines for investigation of experimental pain in conscious animals were observed during experimentation.

Methods

Experimental Design and Grouping

Twenty four (24) male albino rats weighted 150g – 180g were used for this study. They were divided into six groups of four rats each. Group I was normal control group that received distilled water and normal rat's feed. Group II, III, IV, V and VI were induced with hyperlipidemia by feeding them with high cholesterol diet for one week. Group II were test control group (hyperlipidemic rats without treatment). Group IV, V and VI were orally administered with 100mg/kg, 200mg/kg and 400mg/kg of aqueous extract of *Corchorus trilocularis* respectively (Choudhary *et al.,* 2013) for four weeks. Group III were orally administered with 500mg/kg twice daily of metformin drug for four weeks. This dose selection was based on dosage calculation and preparation of stock solution (Muhammad *et al.*, 2011). At the end of four weeks the animal were sacrificed. Blood samples were used for analysis of serum Cholestrol (Trinder, 1969), serum triglycerides (Fossati, and Principle, 1982), serum HDL-cholesterol (Richmond, 1973) and Fasting Blood Glucose levels using glucose oxidase method (Weisman and Klien, 1958).

Statistical Analysis

The results were expressed as mean ± standard deviation: difference between the groups was analyzed by one-way analysis of variance (ANOVA) using Graphad instat software. P-Values < 0.05 was considered statistically significant

RESULTS

The results of the rats' body weight in this research are presented in table 1. At the start of the experiment, the initial body weight of the rats of the six groups did not significantly differ. During the experimental period, the body weight was stable and steadily increases in each group after HFD induction for one week. At the end of the experiment, the body weight did not differ among the groups. The groups treated with metformin and *C. trilocularis* extract for four weeks showed insignificant ($p > 0.05$) decrease in body weight compare to hyperlipidemic control.

Table 1: Body weight changes in control and hyperlipidemic rats orally treatment with aqueous extract of *Corchorus trilocularis* for four weeks.

GROUPS (g)	INITIAL WEIGHT	WEIGHT AFTER TWO WEEKS INDUCTION	WEIGHT AFTER FOUR WEEKS TREATMENT
I (Normal)	160±1.10	170±1.50	190±1.62
II (HFD)	180±3.84	215±1.43	220±0.92
III(Metformin)	170±6.35	210±6.07	200±3.10
IV(100mg/Kg)	150±3.75	200±3.12	195±2.14
V(200mg/Kg)	160±1.32	220±3.18	215±6.13
V (400mg/Kg)	160±1.41	220±1.84	210±5.10

Data are presented as Mean±SD; n=4

The results of analysis of lipid profile are presented in table 2. After one week of hyperlipidemic induction followed by four weeks of treatment with metformin and with different doses of aqueous extract of Corchorus trilocularis, it is found that; Total cholesterol serum level in group II rats has increased compared to group I. Group III has decreased compare to group II. Group IV, V and VI have decreased compared to group II. Group VI has decreased more than group V followed by group IV when compared to group II and group III except group IV. The differences in all comparison are not significant (p>0.05). For triglycerides serum level, there was an increase in group II rats compared to group I. Group III has decreased compare to group II. Group IV, V and VI have decreased compared to group II. Group V has decreased more than group IV followed by group VI when compared to group II and group III. The differences in all comparison are significant at p <0.05. For HDL serum level, there is decrease in group II rats compared to group I. Group III has increased compare to group II. Group IV has increased but not group V and VI compared to group II and group III. The differences in all comparisons are not significant (p> 0.05). For serum LDL cholesterol level, there was significant (p <0.05) reduction in groups III, IV, V and VI when compared with group II.

Table 2: Serum lipid profile of control and hyperlipidemic rats orally treated with aqueous extract of Corchorus trilocularis for four weeks.

GROUPS m	TCHOL (mg/dl)	TRIG (mg/dl)	HDL-C (mg/dl)	LDL-C (mg/dl)
I (Normal)	43.15±1.10	86.87±1.66	29.58±5.45	3.80±4.67
II (HFD)	46.70±3.84	197.70±1.90[a]	27.66±7.56	20.50±4.56[a]
III(Metformin)	43.47±6.35	120.50±0.52[b]	28.79±7.96	9.43±1.71[b]
IV (100mg/Kg0	44.33±3.75	82.37±1.50[c]	24.04±10.32	7.40±9.16[c]
V(200mg/Kg)	42.03±1.32	52.97±0.81[d]	26.17±18.79	6.94±0.22[d]
VI (400mg/Kg)	41.50±1.41	39.80±0.81[e]	29.43±3.81	1.14±17.70[e]

Values are mean ± standard deviation, (n= 4). Different superscript letters in the same column are statistically significant. [a]is significantly higher ($p < 0.05$) compared to group I. [b c d]and [e] represent significant reduction ($p < 0.05$) respectively, when compared to untreated control (group II) rats.

Table 3 shows the effect of oral administration of Corchorus trilocularis on fasting blood glucose concentrations of diabetic rats at the interval of fourteen (14) and twenty eight (28) days of oral treatment. Seven days after induction of hypercholesterolemia with HFD, the blood glucose levels of group III and test groups (groups IV-VI) increased significantly (p<0.05). Significant difference was observed in fasting blood glucose of the experimental rats following fourteen (14) days of oral administration of C. trilocularis. However, blood glucose level of all test groups (groups III, IV, V and VI) and standard drug treated group (group III) decreased significantly (p<0.05) after 4 weeks of extract administration when compared with blood glucose levels after 2 weeks of the of extract administration.

Table3: Blood glucose level (mg/dl) of control and hyperlipidemic rats orally treated with aqueous extract of Corchorus trilocularis for four weeks.

GROUPS	FBS AFTER ONE WEEK HFD (mg/dl)	FBS AFTER TWO WEEKS (mg/dl)	FBS AFTER FOUR WEEKS (mg/dl)
I(Normal)	81.0±10.23[a]	81.50±5.32[a,b]	84.64±10.07
II (HFD)	81.50±12.44[b]	86.00±14.76[a,d]	88.33±11.06
III(Metformin)	93.00±5.48	84.00±10.44[e,f,g]	72.33±15.50[*]
IV(100mg/Kg)	96.00±6.63[a,b,c]	101.00±14.02[a,b]	94.67±12.50[*]
V(200mg/Kg)	82.50±4.80[c]	106.75±2.75[a,b,c,e]	94.00±12.03*
VI(400mg/Kg)	83.25±10.50	100.50±5.67[b,d,f]	82.00±9.35[*]

Results are expressed as mean ± SD. Values in the same column bearing similar superscripts are significantly different at $p<0.05$. * indicates significant reduction at $p<0.05$ after four weeks when compared with after 2 weeks of treatment.

DISCUSSION

Induction of high fat diet in the rats increased the body weights of the rats. Both the standard drug, metformin (500mg/kg) and the aqueous extract of leaves of *C. trilocularis* at their various doses (100mg/kg, 200mg/kg and 400mg/kg) have insignificant differences in reductive effect of the body masses of experimental rats. In this study, it was observed that aqueous extract of leaves of *C. trilocularis* at various doses (100mg/kg, 200mg/kg and 400mg/kg) is more effective than metformin in decreasing total cholesterol, triglyceride (significantly) and LDL serum level as well as hyperlipidemia. Also the extract at high dose (400mg/kg) is more effective than metformin in increasing HDL serum level as well as decrease in hyperlipidemia. Increase in serum HDL is desirable because HDL take away cholesterol from peripheral cells into the liver, and thereby reducing the risk of cardiovascular diseases. Very low level or absence of LDL serum level is likely due to the efficient mechanism for clearance of chylomicrons and VLDL remnant from circulation due to the interaction of remnant with specific hepatic receptor and lack of the cholesteryl ester transfer reaction in rats (Olagunjub, 2009). Several phytonutrients including flavonoids, steroids, glycosides, diterpenes and fatty acid ester compounds present in the leaves of *C. trilocularis* Dhanalakshmi *et al*., 2014) as present in the seeds *C*. papaya reduces total cholesterol and triglycerides in high-fat diet fed rats by interfering with their biosynthesis as reported in previous studies (Adeneyea *et al*., 2009). Decrease in hyperlipidemia in turn, decreases the risk of diabetes and cardiovascular diseases. It is well established that there is a strong link between diabetes mellitus, dyslipidemia, obesity and ischemic heart disease (NCEP, 2002). Several reports indicated that hyperlipidemia causing diabetes is due to the high triglyceride and reduction in triglycerides reduces hyperlipidemia as well as diabetes. Reports that, the lipid abnormality most closely associated with insulin resistance and hyperinsulinemia is hypertriglyceridemia (Amuamuta, 2014), and that, dyslipidaemia in diabetic patients is characterized by elevated triglyceride levels and decreased HDL cholesterol levels, triglycerides are considered to have atherogenic properties (Ademuyiwa *et al*., 2005) are among the several reports.

Furthermore, *CT* could have acted through the inhibition of rate limiting enzyme, HMG-CoA reductase, in the biosynthesis of cholesterol. HMG-CoA reductase catalyses the conversion of HMG-CoA to mevalonic acids (Rang *et al*., 2007). The reversible and competitive inhibition of HMG-CoA reductase leads to decreased hepatic cholesterol synthesis, up regulation of LDL receptor synthesis and increased LDL-C clearance from the plasma into liver cells (Rang *et al*., 2007; Khanna *et al*., 2002).

Previous study reported some phytocomponents to elicit a wide range of biological activities which include hypoglycemic (Subbram, 1997). The presence of these phytocomponents in the extract in high concentrations could account for these observed biological effects, particularly hypoglycemic effect. This extract can therefore be used not only to control glucose homeostasis in diabetes but to control dyslipidemia and obesity alike. It is well established that there is a strong link between diabetes mellitus, dyslipidemia, obesity, hypertension and ischemic heart disease.

CONCLUSION

In this study, *Corchorus trilocularis* had lipid-lowering actions by decreasing serum triglycerides, total cholesterol and LDL – cholesterol levels as well as increasing serum HDL- cholesterol level. This could serve as an experiment-based evidence to support that *Corchorus trilocularis* may have potential as a therapy for reducing blood lipid levels and

lowering hyperlipidemic effects. The extract was also found to possess some hypoglycemic activity by significantly lowering blood glucose concentration, thus supporting the traditional claim and thus may reduce the risk of cardiovascular diseases.

REFERENCES

Ademuyiwa, O, Ugbaja Rn, Idumebor F. and Adebawo O.(2005) Plasma lipid profiles and risk of cardiovascular disease in occupational lead exposure in Abeokuta, Nigeria. *Lipids Health Dis*, 4:19.

Adeneyea, J.A., Olagunjub, O. and Homis, A. (2009). "Preliminary hypoglycemic and hypolipidemic activities of the aqueous seed extract of Carica papaya Linn. in Wistar rats." *Biology and Medicine*, 1-8.

Amuamuta, A. (2014). "A Review on Risk Factors/Indicators and Effects of Hyperlipidemia." *Middle-East Journal of Scientific Research*, 886-893.

Balzan, S., Harnendes, A., Reichert, C.L., Donaduzzi, C. (2013). "Lipid-lowering effects of standardized extracts of Ilex." *Fitoterapia,* **115-122**.

Chaudhari, R.L., Mahajan, M.A., Chaudhari, R.Y., Bhangal, J.O. (2012). "Pharmacological evidence of Corchorus trilocularis (L.) leaves in alloxan induced diabetic rats." *American journal of pharmtech research*, 681-686.

Choudhary, S.B., Sharma, H.K., Karmakar, P.G., Kumar, A.A., Saha, A.R., Hazra, P. and Mahapatra, B.S. (2013). "Nutritional profile of cultivated and wild jute (Corchorus) species." *Australian journal of crop science*, 1973-1982.

Dhanalakshmi, R., Manavalan, R. and Khanna, S. (2014). "Bioactive Compounds in Leaves of Corchorus trilocularis L." *Pharmaceutical Technology*, 1991-1998.

Diabetes Care (2020). Standards of Medical Care in Diabetes. American Diabetes Association. *The journal of clinical and applied research and education,* 43(Supplement 1): S1-S2. (https://doi.org/10.2337/dc20-Sint)

Fossati, P., and Principle, L. (1982). Serum triglycerides determined colorimetrically with an enzyme that produces hydrogen peroxide. *Clinicl Chemistry* 28: 2077

James, C., Lann, E. and Best, T. (2010). "Hyperlipidemia." *International Jornal of Medicine*, 21-27.

Khanna, A.K., Rizvi, F. And Chander,R. (2002) Lipid lowering activity of Phyllanthus niruri in hyperlipidemic rats. *Journal of Ethnopharmacology*.;82(1):19-22.

Mocelin, R., Marcona, M., Santoa, G.D., Zanatta, L., Sachetta, A., Schonella, A.P., Bevilaquab, F., Giachinib, M. and Silavanna, D.P. (2015). "Hypolipidemic and antiatherogenic effects of Cynara scolymus in cholesterol-fed rats." *Brazilian journal of pharmacognosy*, **22-30**.

Muhammad, A.K., Eftakhar, M. and Teherippana, R. (2011). "The effect of administration of metformin on lipid profile changes and insulin resistance in patients with polycystic ovary syndrome." *Middle East Fertility Society Journal*, 172-177.

National Cholesterol Education Program (NCEP).(2002): Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III), Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) final report, Circulation. 2002; 106: 3143421.

Omae, T., Shimamoto, C., Hiraike, Y., Kanemitsu, N., Iwakura, K., Nakanishi, Y. and Katsu, K. (2006). "Hyperlipidemia and Fat Absorption in Model Rats with Type 2 Diabetes Mellitus." *American Journal of Medicine,* **211-222.**

Olagunjub, A.A. (2009). "Preliminary hypoglycemic and hypolipidemic activities of the aqueous seed extract of Carica papaya Linn. in Wistar rats." *Biology and Medicine*, 1-12.

Richmond, W. (1973). Preparation and properties of a cholesterol oxidase from Nocardia sp. and its application to the enzymatic assay of total cholesterol in serum..*Clinical Chemistry*. **19: 1350-56.**

Rang, H.P., Dale M.M., Ritter J.M. and Moore R.K. (2007). Pharmacology 6th edition, Edinburgh Churchill livingstone.

Subbram, N. R. (1997). Medicinal plants and intellectual property right In: International workshop on medicinal plants and their bioactivity, screening and evaluation center for science and technology of the nonaligned and other developing country. p 1-5.

Trinder, P. (1969). Cholesterol enzymatic end point manual.Ann. *Clinical Biochem*.6:24-27.

Weisman, M. and Kliem, B. (1958). Evaluation of glucose determination in untreated serum sample. *Clinical chemistry* 4: 420-422.