

Prophylactic Potential of *Corchorus olitorius* Leaves against Experimentally-induced Dyslipidaemia

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Background: Our literature searches revealed that no study has examined the ameliorative impact of *Corchorus olitorius* leaves on dyslipidaemia caused by potassium bromate (KBrO₃). Therefore, the purpose of this study was to determine whether *C. olitorius* leaves could prevent KBrO₃-induced dyslipidaemia.

Methodology: Fresh *Corchorus olitorius* (jute) plants were gathered from the Institute of Agricultural Research and Training, Moor Plantation, Nigeria. Using a soxhlet system and 95% ethanol as the solvent, they were extracted. For the experiment, 24 male Wistar rats were used. They were allowed to be used to a lab environment for seven (7) days before the experiment. They were divided into groups A, B, C, and D at random. Group A received oral distilled water as the

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control group. In addition to the 100 mg/kg body weight of potassium bromate given to groups B, C, and D, animals in groups C and D also received 100 and 200 mg/kg body weight of *C. olerius*, respectively. Oral gavage was used to administer *C. olerius* extract and freshly made potassium bromate to rats every day for 28 days. Twenty-four hours after the last treatment, the animals were killed under gentle sedation with diethyl ether. Blood was drawn by puncturing the heart. Also taken from the animals was their heart.

Results: In comparison to the untreated group, the research animals given KBrO_3 had considerably higher plasma levels of total cholesterol, triglycerides, LDL, VLDL, and the CHD risk ratio, whereas their levels of HDL and the HDL/LDL ratio were much lower. When compared to the control group, treatment with KBrO_3 significantly decreased cardiac levels of total cholesterol, HDL, and HDL/LDL ratio, while increasing levels of triglycerides, LDL, and VLDL as well as the CHD risk ratio. *C. olerius* reduced these abnormalities in a dose-dependent manner.

Conclusion: *Corchorus olerius* leaves were found to have hypolipidaemic effect against Potassium bromate-induced dyslipidaemia, increase HDL and reduce cardiovascular disease ratio.

Keywords: Cardiovascular diseases; *Corchorus olerius* leaves; dyslipidaemia; lipid profile.

1. INTRODUCTION

According to researches, medicinal plants are utilized worldwide to treat chronic illnesses [1, 2]. Several plant species in Nigeria have reportedly been utilized to cure a variety of illnesses, including dyslipidemia and its consequences [3]. Numerous kinds of medicinal plant leaves that are utilized in traditional lipid dysfunction control and therapy across the globe have been studied [4,5]. The hypoglycaemic and hypolipidaemic effects of plant leaves used in the treatment of diabetes are caused by the presence of phytochemicals and other bioactive components in those leaves [6]. Momo et al. [7] found that traditional leafy vegetables may improve blood lipid levels and improve carbohydrate metabolism, which may help prevent and control dyslipidemia. The health advantages of underutilized indigenous leaves with reference to lipid regulation, however, are still poorly understood [3]. *Corchorus olerius* is one of these plants.

The vegetable plant *Corchorus olerius* L., also referred to as "Jute mallow" is a member of the Malvaceae family, which was once known as the Tiliaceae. It is a tall, annual plant that grows well in many types of soil [8]. The second most extensively farmed vegetable fiber is jute, which comes from the *Corchorus* plant [9,10]. The leaves of *C. olerius* are a traditional vegetable in Egypt and are widely used in the cuisines of Southern Asia, Africa, and the Middle East. When cooked, it takes on a mucilaginous texture. The dried leaves are used to make herbal tea, while the seeds are utilized as a flavoring agent [11]. *C. olerius* leaves are frequently used as a

vegetable in Nigerian cuisine, particularly among South-Westerners, while making the stew-based meal known as "ewedu". It is prepared as stew and is referred to as krain krain (or crain crain) in Sierra Leone. *C. olerius* is referred to as "saluyot" in the Philippines and is eaten as a leafy vegetable with bamboo shoots [11,12]. The therapeutic qualities of *C. olerius* leaves have been discussed in numerous papers [13,14]. Our literature searches revealed that no studies have examined its ameliorative impact on dyslipidemia caused by potassium bromate (KBrO_3). Therefore, the purpose of this investigation was to determine whether *C. olerius* leaves could prevent KBrO_3 -induced dyslipidemia.

2. MATERIALS AND METHODS

2.1 Extraction of Plant Materials

Fresh *Corchorus olerius* (jute) plants were harvested from the Institute of Agricultural Research and Training, Moor Plantation, Ibadan, Nigeria. Carefully separating the leaves from the stem, the damaged ones were discarded. To get rid of contaminants, they were thoroughly washed under running water. In an open laboratory setting, they were allowed to air dry for 14 days at room temperature before being ground into powder with an electric blender. The extraction was performed using a soxhlet device and ethanol as the solvent in accordance with the procedures outlined by Airaodion et al. [15,16]. After the procedure was complete, the ethanol was evaporated in a rotary evaporator at 35°C , yielding 2.28 g for a 9.12% yield as a percentage. Until it was needed, the extract was kept in the refrigerator.

2.2 Experimental Animals

The experiment involved twenty-four (24) mature male Wistar rats (*Rattus norvegicus*) weighing between 140 and 160 g. They were allowed to be used to a laboratory environment for seven (7) days before the test. The rats were kept in cages made of wire mesh, and they had unrestricted access to commercial rat food and water. The animals were housed at regular temperatures and humidity levels with 12-hour light and dark cycles. The Declaration of Helsinki and the rules set by the Committee for the Control and Supervision of Experiments on Animals were followed in conducting this investigation. Additionally, NIH policy was followed when doing animal experiments [17]. They were divided into groups A, B, C, and D at random. Group A received oral distilled water, served as the control group. In addition to the 100 mg/kg body weight of potassium bromate given to groups B, C, and D, animals in groups C and D also received 100 and 200 mg/kg body weight of *C. olitorius*, respectively. Oral gavage was used to administer *C. olitorius* extract and freshly made potassium bromate to rats every day for 28 days. Twenty-four hours after the last treatment, the animals were killed under gentle sedation with diethyl ether. Blood was drawn by puncturing the heart.

2.3 Preparation of Organ Homogenate

The animals were quickly dissected and the heart was extracted. Then, 10% of each organ homogenate was created in 6.7 mM potassium phosphate buffer using a Teflon homogenizer (pH 7.4). The homogenate was centrifuged at 10,000 rpm for 10 minutes at 40 °C to separate

the homogenate into a clear supernatant that could be kept in the freezer for additional analysis.

2.4 Determination of Lipids

Lipids were isolated and quantified using the techniques previously reported [18,19]. Coronary heart disease (CHD) risk ratio was determined as the ratio of total cholesterol to high density lipoprotein.

2.5 Statistical Analysis

Graph Pad Prism was used to perform a variance analysis on the data. The outcomes were shown as Mean±Standard Deviation (SD). The means were compared using both Tukey's post hoc analysis and one-way analysis of variance (ANOVA). At $P \leq 0.05$, differences between means were deemed statistically significant.

3. RESULTS

In comparison to the untreated group, the research animals given $KBrO_3$ had considerably higher plasma levels of total cholesterol, triglycerides, LDL, VLDL, and the CHD risk ratio, whereas their levels of HDL and the HDL/LDL ratio were much lower (Table 1). When compared to the control group, treatment with $KBrO_3$ significantly decreased cardiac levels of total cholesterol, HDL, and HDL/LDL ratio, while increasing levels of triglycerides, LDL, and VLDL as well as the CHD risk ratio. *C. olitorius* reduced these abnormalities in a dose-dependent manner.

Table 1. Effect of *C. olitorius* on the plasma lipid profile of potassium bromate-induced dyslipidaemia

Lipid Profile	Control	$KBrO_3$ Only	$KBrO_3$ + 100 mg/kg <i>C. olitorius</i>	$KBrO_3$ + 200 mg/kg <i>C. olitorius</i>	p-value
TC (mg/dL)	148.32±8.25	232.42±12.35	218.34±12.32	173.83±8.83	0.01
TG (mg/dL)	96.46±6.22	171.37±8.26	154.82±6.89	114.27±8.17	0.00
HDL-C (mg/dL)	49.46±3.26	32.28±5.36	33.73±4.18	45.21±3.25	0.02
LDL-C (mg/dL)	47.24±1.48	74.26±3.17	69.27±5.55	52.64±3.73	0.03
VLDL-C (mg/dL)	19.29±1.72	34.27±3.44	30.96±3.24	22.85±1.84	0.02
HDL:LDL ratio	1.04±0.06	0.43±0.01	0.48±0.02	0.85±0.03	0.01
CHD risk ratio	2.30±0.35	7.20±0.27	6.47±1.01	3.84±0.41	0.01

Values are presented as Mean±SD, where n = 6.

Legend: TC = Total Cholesterol, TG = Triglyceride, HDL-C = High Density Lipoprotein Cholesterol, LDL-C = Low Density Lipoprotein Cholesterol, VLDL-C = Very Low Density Lipoprotein Cholesterol, CHD = Coronary Heart Disease

Table 2. Effect of *C. oltorius* on the heart lipid profile of potassium bromate-induced dyslipidaemia

Lipid Profile	Control	KBrO ₃ Only	KBrO ₃ + 100 mg/kg <i>C. oltorius</i>	KBrO ₃ + 200 mg/kg <i>C. oltorius</i>	p-value
TC (mg/dL)	116.46±3.38	81.20±7.82	83.27±3.33	89.37±3.25	0.03
TG (mg/dL)	136.28±3.01	159.77±9.32	157.45±3.33	152.28±4.24	0.03
HDL-C (mg/dL)	58.29±2.15	38.31±2.94	43.93±2.00	52.24±2.78	0.01
LDL-C (mg/dL)	46.86±2.02	59.20±3.22	55.28±1.93	51.38±2.45	0.03
VLDL-C (mg/dL)	27.25±2.46	31.95±3.24	31.49±2.31	30.45±2.46	0.04
HDL:LDL ratio	1.24±0.03	0.64±0.02	0.79±0.01	1.01±0.01	0.02
CHD risk ratio	2.00±0.10	2.11±0.09	1.90±0.05	1.71±0.07	3.24

Values are presented as Mean±SD, where n = 6.

Legend: TC = Total Cholesterol, TG = Triglyceride, HDL-C = High Density Lipoprotein Cholesterol, LDL-C = Low Density Lipoprotein Cholesterol, VLDL-C = Very Low Density Lipoprotein Cholesterol, CHD risk ratio = Coronary Heart Disease Risk Ratio

4. DISCUSSION

Jute leaf is a green leafy vegetable that is frequently consumed and used in traditional medicine to treat different ailments [20]. At the moment, dietary control is still one of the best ways to prevent and treat chronic degenerative diseases like type 2 diabetes and cardiovascular conditions [21,22]. The current study examined the levels of lipidaemia in various experimental groups. Animals exposed to KBrO₃ alone had significantly higher plasma levels of triglycerides (TG), total cholesterol (TC), and low density lipoprotein cholesterol (LDL-C), whereas their levels of high density lipoprotein cholesterol (HDL-C) were much lower when compared with those in the untreated group. An increasing body of research shows that while high HDL-C is cardioprotective, elevated plasma triglyceride concentrations, LDL-C, and ratios of TG/HDL-C and TC/HDL-C are markers of increased cardiovascular (CV) risk. The increased plasma triglyceride concentration seen in the group treated with KBrO₃ may have resulted from either excessive generation or underutilization of triglycerides [23].

It is generally known that plasma insulin plays a significant part in lipid metabolism. Although plasma insulin was not assessed in this research, it may be hypothesized that the treatment with both extracts resulted in decreased insulin secretion from pancreatic cells, which may have contributed to the raised triglyceride and LDL-C levels in this study [24]. It was noted that TC/HDL-C (CHD risk) ratio greater than 5 is the most potent independent predictors of the onset of coronary artery disease [25,26]. In this study, KBrO₃ exposure increased the CHD risk ratio from 2.30 to 7.20 in the

plasma of experimental rats. This is an indication that KBrO₃ intoxication could greatly lead to coronary artery disease.

Compared to animals treated with only KBrO₃, those concurrently given *C. oltorius* leaf extract and KBrO₃ showed lower plasma and cardiac triglyceride concentrations. This suggested that *C. oltorius* leaves might have hypolipidaemic properties. A high triglyceride level has been linked to insulin insufficiency, which leads to improper glucose use and a hyperglycemic state in animals [27]. Fatty acids from adipose tissue may also be mobilized and transported to the liver [28]. The decreased plasma and cardiac triglyceride concentrations in the rats treated with 100 and 200 mg/kg body weight of *C. oltorius* may have also been caused by improved blood plasma glucose uptake and utilization, which decreased triglyceride biosynthesis and possibly decreased the mobilization of fatty acids from adipocytes. Furthermore, enhanced glucose utilization and a resulting decreased fat mobilization may be responsible for the stability of plasma triglyceride and cholesterol levels in rats after administration of the leaf extracts [7,29]. This suggests that the plant extracts might help to lessen the problems that frequently accompany with diabetes, like hyperlipidemia and hypercholesterolemia.

The elevated plasma cholesterol seen in this study could have been attributed to stimulation of HMG-CoA synthase, the rate-limiting enzyme in cholesterol biosynthesis. A decrease in the activity of acyl-CoA: cholesterol-O-acyltransferase (ACAT), the enzyme that esterifies cholesterol in body cells, may also be the cause of the KBrO₃-treated rats' blood cholesterol buildup [30]. A spike in the efflux of

cholesterol from the liver into the blood could have also been the cause of the elevated plasma cholesterol [31]. By blocking the production of cholesterol in the liver or limiting the quantity of cholesterol taken into the bloodstream through the gastrointestinal tract, *C. olitorius* leaves most likely decreased the concentration of circulating plasma cholesterol.

Furthermore, compared to rats treated with KBrO_3 alone, rats concurrently given *C. olitorius* leaves saw a substantial reduction in plasma LDL-cholesterol levels. This implies that the leaves of *C. olitorius* may have hypocholesterolemic properties. Through their well-established effects on cellular antioxidant state and inflammation, flavonoids may have a favorable impact on health [32]. According to earlier research, drugs with hypocholesterolemic action may impair insulin production in dyslipidaemic rats, which could prevent the LDL-receptors from absorbing circulating plasma LDL-cholesterol [33]. Additionally, the fact that animals treated with 100 and 200 mg/kg body weight of *C. olitorius* leaves had higher plasma HDL cholesterol levels than animals treated with only KBrO_3 supports the claim made by Airaodion et al. [34] that consuming foods high in phytochemicals has protective effects on lipid profiles and cardiovascular diseases (CVD). According to this study's findings, *Corchorus olitorius* leaves have hypolipidaemic effects against KBrO_3 -induced dyslipidemia. These findings are in line with those of Airaodion et al. [13], who examined the hypoglycemic and hypolipidaemic effects of methanolic extract of *Corchorus olitorius* leaves in albino rats. This could be because alkaloids, saponins, flavonoids, and polyphenols are present, which are known to lower plasma lipid levels in animals. The animals' dramatically elevated plasma levels of high-density lipoprotein cholesterol may have been caused by the significantly reduced total cholesterol levels sequel to administration of *C. olitorius* leaves in this study.

A highly ideal biochemical condition for the prevention of atherosclerosis and ischemic situations is a significant reduction in total cholesterol and an increase in HDL-C levels [35]. High levels of HDL-C protect against cardiovascular diseases by removing cholesterol atheroma from arteries and transporting it back to the liver for excretion or reutilization [36,37]. The fact that plasma HDL-C levels rose in animals that received KBrO_3 and *C. olitorius* leaf extract at the same time suggests that the

vegetable had an influence on raising HDL-C levels.

Although the study did not examine the impact of KBrO_3 on glucose concentration, it is probable that KBrO_3 increased blood glucose levels. According to several researches, experimentally-induced diabetes is associated with dyslipidemia. A recognized consequence of diabetes mellitus known as hyperlipidaemia is characterized by increased levels of phospholipids, cholesterol, and other lipoproteins [38]. According to reports, the increased mobilization of free fatty acids from peripheral fat depots as a result of the hormone sensitive lipase's inhibition is what causes elevated plasma lipid levels in people with diabetes [39]. The extra fatty acids produced are converted into phospholipids and cholesterol, which are then released into the blood as lipoproteins along with extra triacylglycerols that were produced concurrently in the liver. As a result, it is possible to interpret the marked hyperlipidemia seen in KBrO_3 -exposed rats as the result of unchecked actions of lipolytic hormones in fat depots [40]. Concurrent administration of *C. olitorius* leaves and KBrO_3 reduced each of these effects.

The chemical analysis of *C. olitorius* leaves revealed that they contain phenolic, glycoside, and flavonoid compounds [41]. Therefore, the hypolipidaemic effect of *C. olitorius* leaves observed in this study may be caused by these chemical constituents. These results raise the possibility that *C. olitorius* leaves may inhibit platelet aggregation and increase vasodilatation, acting as a significant protective factor in preventing the onset and progression of vascular complications brought about by the hyperlipidaemic state. Studies have actually demonstrated that polyphenolic compounds, which are present in some plant foods, can inhibit the formation of thrombi [42,43]. There have also been reports of a number of other plants and extracts having antihyperlipidaemic and insulin-stimulating properties [44–46]. Metabolites like glycosides, alkaloids, and flavonoids have been discovered to be present in the majority of plants with these properties [47–49].

5. CONCLUSION

The study showed that KBrO_3 caused increased levels of triglycerides, LDL, VLDL and also increase CHD risk ratio and reduced HDL. *Corchorus olitorius* was found to reduce this lipid abnormality induced by KBrO_3 .

CONSENT

It is not applicable.

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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