Asian Journal of Biological Sciences

OPEN ACCESS

Hypolipidaemic Effects of Ethanol Leaf Extract of *Eucalyptus camadulensis* in Wistar Rats

[1]Dennis Amaechi, [1]Ameh Enyojo Mary, [1]Ini Patrick Ekpe, [1]Yisa Nma Benjamin, [1]Sunday Kaura, [2]Christy Chinyere Fredrick and [1]Nnolim Lucia Chidinma

[1]Department of Biochemistry, Medical Biochemistry, Veritas University Abuja, Abuja, Nigeria

[2]Department of Pathology and Forensic Medicine, College of Health Sciences, University of Abuja, Abuja, Nigeria

ABSTRACT

Background and Objective: Plants are a significant source of medicinal compounds that play a crucial role in global health and serve as an important potential source of treatments. Medicinal plants which are widely used across various health systems, serve not only to treat illnesses but also to maintain overall health. This research is aimed at investigating the hypolidaemic effects of ethanol leaf extract of *Eucalyptus camaldulensis* in Wistar rats. **Materials and Methods:** The study involved 40 rats divided into six groups, each given different doses of a plant extract. Biochemical analysis was performed using standard laboratory techniques and significant changes were considered acceptable at a $p<0.05$ level. **Results:** Administration of the extract resulted in no significant changes in TC, TG, LDL and VLDL concentrations in all experimental groups when compared to the control group. However, there was a significant increase ($p<0.05$) in HDL at 150 mg/kg (365.00±46.10) and 450 mg/kg (390.00±75.06). **Conclusion:** The ethanol leaf extract of *Eucalyptus camaldulensis*, particularly at doses of 150 and 450 mg/kg, significantly increased HDL levels in the Wistar rats. This suggests its potential as a rapeutichypolidaemic agent which may be responsible for reducing cardiovascular disease risk.

KEYWORDS

Cardiovascular diseases, lipid profile, lipid metabolism, bioactivity, blood lipids

INTRODUCTION

Plants are a significant source of medicinal compounds that play a crucial role in global health and serve as important potential sources of treatments. Medicinal plants which are widely used across various health systems, serve not only to treat illnesses but also to maintain overall health[1]. Because they are easily accessible, readily available and reasonably priced, 80% of people in underdeveloped nations have continued to use medicinal plants and plant products to treat main medical issues across time[2].

Plants can be categorized into "wild plant species", which thrive in natural or semi-natural ecosystems without human intervention and "domestic plant species", which have been cultivated through human activities like selection or breeding and require management to survive. Advancements in herbal medicine research have significantly enhanced our understanding of the pharmacological properties of many plants

ISSN: 1996-3351 (Print)
https://doi.org/10.3923/ajbs.2024.846.851

Received: 28 Aug. 2024
Accepted: 21 Sep. 2024
Published: 31 Dec. 2024

used in traditional medical systems. Consequently, plants are recognized as a primary source of medicines, available as both crude pharmaceuticals for the general populace and isolated active compounds administered in standardized doses[1]. The therapeutic efficacy of medicinal plants is directly related to the concentration of significant phytochemicals and Nigeria, for instance, is home to more than 300 recognized medicinal plants, whose uses vary based on culture, belief systems and other factors[3].

The *Eucalptus camaldulensis*, known as "red river gum" belongs to the *Eucalyptus* genus and is native to Australia, thriving particularly near inland waterways. It has been widely cultivated globally, including in Nigeria. *Eucalyptus camaldulensis*, with its evergreen leaves, can reach heights of 24-40 m and features a robust trunk with smooth, buff, or white-grey bark. Medicinally, *Eucalyptus camaldulensis* is used in various treatments. Its oil is utilized in Nigeria and other sub-Saharan African countries as a remedy for coughs and colds. A liquid concoction made by boiling its gum with sugar and water serves as a general anesthetic for toothaches and treats respiratory issues. Bark infusions are used as eye washes for ophthalmia and have shown effectiveness in treating diarrhea[4]. *Eucalyptus camaldulensis* is frequently utilized for its medicinal benefits in treating various ailments. The Igala people call it "Ogwuiba" meaning fever medicine, while in Northern Nigeria, it is known as "Zaity" and it is used to address a wide range of health issues[5].

The young shoots of *Eucalyptus camaldulensis* are crushed and used both topically and ingested to treat wounds and sores. Infusions made from these shoots address severe headaches, pains and snake bites and the plant is believed to effectively manage hypertension. Additionally, it has demonstrated antibacterial and antifungal activities[6]. Studies have shown that "red river gum" may have a positive effect on lipid profile and potentially reduce the risk of cardiovascular disease. The plant contains compounds such as terpenoids that have antioxidant and anti-inflammatory properties, which may help lower levels of LDL cholesterol and triglycerides in the blood. Additionally, the plant is reported to possess potential hypolipidemic and anti-hyperlipidemic properties[7].

Lipids are transported in the blood as lipoproteins. Lipid profile, also known as lipid panel, refers to the measurement of total cholesterol (TC), High-Density Lipoprotein Cholesterol (HDL-C), Low-Density Lipoprotein Cholesterol (LDL-C) and triglycerides (TG). This panel is used to detect hyperlipidemia, which encompasses various disturbances in cholesterol and triglyceride levels, many of which are recognized risk factors for cardiovascular disease and occasionally pancreatitis. High-Density Lipoprotein (HDL), a complex of fat and protein synthesized in the blood, is termed "good cholesterol" because it transports excess cholesterol from the bloodstream to the liver for detoxification, thereby being associated with a reduced risk of cardiovascular diseases. In contrast, Low-Density Lipoprotein (LDL), also a fat-protein complex formed in the blood, is known as "bad cholesterol" since it transports cholesterol from the bloodstream to the cells, with high LDL levels being linked to an increased risk of cardiovascular diseases[8]. This present work, therefore, is to evaluate the hypolipidaemic effects of the ethanol extract of *Eucalyptus camaldulensis* leaves in Wistar rats.

MATERIALS AND METHODS

Study area: This research was carried out at Department of Biochemistry, Veritas University, Abuja, Nigeria from October, 2024 to December, 2024.

Materials: The following materials were utilized for the experimental work: Wistar rats, weighing balance, distilled water, rubber cages, water bath, lancet, chloroform sample, filter paper, dissecting kit, refrigerator, syringes and needles, a pair of scissors and forceps obtained from the Department of Biochemistry Laboratory, Veritas University, Abuja, Nigeria, routine assay kits for high-density lipoprotein, total cholesterol were obtained from Dialab Production and laborinstriementen Gessellschaft M.b.H. A-1160

Table 1: Experimental design showing animal groupings and treatments

Groups	Number of rats	Group title	Treatment administered
Group A	7	Normal control	Feed and distilled water
Group B	7	Treatment group one	150 mg/kg b.wt., of *Eucalyptus camaldulensis* extract
Group C	7	Treatment group two	250 mg/kg b.wt., of *Eucalyptus camaldulensis* extract
Group D	7	Treatment group three	350 mg/kg b.wt., of *Eucalyptus camaldulensis* extract
Group E	7	Treatment group four	450 mg/kg b.wt., of *Eucalyptus camaldulensis* extract
Group F	7	Treatment group five	550 mg/kg b.wt., of *Eucalyptus camaldulensis* extract

Wien-panikengasse, Austria. Whereas sodium and potassium kits were obtained from Teco Diagnostics 1268N. Lakeview Ave. Anaheim, CA 92807, USA. dissecting board, blood sample, methylated spirit (ethanol), 1M of Sodium Hydroxide (NaOH), Dimethyl Sulphate Sulfoxide (DMSO) and 752W UV-Vis Grating Spectrophotometer obtained from the Department of Biochemistry Laboratory, Veritas University, Abuja, Nigeria.

Collection and preparation of plant sample: Fresh samples of *Eucalyptus camaldulensis* leaves were collected between October to December, from Zuma II in Bwari Area Council, Abuja, Nigeria. The plant specimen was identified and authenticated by an expert at the National Institute for Pharmaceutical Research and Development (NIPRD). The leaves were washed, air-dried and milled using a blender into powdered form, then sieved. A 600 g sample of the powder was soaked in 2,000 mL of 90% ethanol for 72 hrs in a storage container with daily vigorous shaking to enhance the extraction process. The mixture was then sieved using a muslin cloth and filtered through Whatman filter paper. The filtrate was evaporated to dryness on a rotary evaporator which was obtained from (RE-52A, Shangai Ya Rong Biochemistry Instrument Company, England) and further concentrated with a thermostatic water bath at 50°C. The resulting paste was collected, weighed, stored in sterile bottles and kept at 40°C until further use.

Experimental design: Forty-two adult male and female Wistar rats were used for the experiment. The rats were obtained from an animal farm in Kaduna State, Nigeria and housed in the Animal House of Veritas University Abuja for a two-week acclimatization period. During this period, the rats were fed standard rat feed and deionized water and maintained under standard laboratory conditions with a 12 hrs light/dark cycle, temperatures of 22-28°C and 40-50% relative humidity two days before the experiment commenced, the rats were randomly divided into six groups. Table 1 shows the experimental design, animal groupings and treatments. The first group served as the control, while the remaining groups were test groups receiving different doses of eucalyptus extract: 150, 250, 350, 450 and 550 mg/kg, respectively. Each test group contained seven animals, while the control group contained five animals. All groups were fed with Growers' feed mash (Top Growers Feed Ltd., Nigeria) and water.

Administration of extract: On the first day of the experiment, the rats were assigned to their respective groups ensuring that the body weight differences within and between groups did not exceed ±20% of the average weight of the sample population. The rats in the five test groups were orally administered specific doses of *Eucalyptus camaldulensis* extract using an oral gavage (orogastric tube), along with normal rat chow and deionized water daily. These treatments were conducted daily and observations were recorded for 21 days.

Sacrifice of animals: On day 22, the rats were anesthetized with chloroform 24 hrs after the last extract administration and humanely sacrificed. Blood was collected from the heart via cardiac puncture using a 2 mL syringe and placed into labeled plain bottles for lipid profile analysis. Each blood sample was centrifuged at 3,000 rpm for 15 min and the serum was collected into respective labeled bottles. The serum was refrigerated for subsequent biochemical analysis. The organs, including the liver, kidneys, pancreas and testes, were excised and preserved in 5% formaldehyde for histological examinations.

Statistical analysis: The results obtained from this study were analyzed by One-way Analysis of Variance (ANOVA), followed by Dunnett's multiple comparisons to evaluate the significance of the difference between the mean value of the measured parameters in the respective control and test groups using GraphPad Prism v8. A significant change was considered acceptable at $p<0.05$.

Ethical consideration: This research was approved by the Ethical Committee of Veritas University. This research was carried out following the guidelines for the use and care of laboratory animals of Veritas University and national law pertaining to the care of animals in research. The animals were handled in line with best practices.

RESULTS AND DISCUSSION

The results presented in Table 2 showed the effect of *Eucalyptus camaldulensis* on lipid profile which indicates changes in lipid profile parameters across different doses of *Eucalyptus camaldulensis* extract compared to the control group. The High-Density Lipoprotein (HDL) concentration in group B, 365.00±46.10 mg/dL shows a significant increase ($p<0.05$), compared to 243.42±34.98 mg/dL in the control group

The data revealed no significant changes in cholesterol, triglycerides, Low-Density Lipoprotein (LDL) and Very Low-Density Lipoprotein (VLDL) levels. No dose-dependent effect was observed. However, there was a significant increase ($p<0.05$) in HDL at 150 mg/kg (365.00±46.10) and 450 mg/kg (390.00±75.06).

Administration of the *Eucalyptus camaldulensis* extract resulted in no significant changes in TC, TG, LDL and VLDL concentrations in all experimental groups when compared to the control group. However, there was a significant increase ($p<0.05$) in HDL at 150 mg/kg. The results presented in Table 2 showed the effect of *Eucalyptus camaldulensis*on lipid profile which indicate changes in lipid profile parameters across different doses of *Eucalyptus camaldulensis* extract compared to the control group. The High-Density Lipoprotein (HDL) concentration in group B, 365.00±46.10 mg/dL shows a significant increase ($p<0.05$), compared to 243.42±34.98 mg/dL in the control group. Lipids and lipoprotein abnormalities play a major role in the progression of atherosclerosis and cardiovascular diseases[8,9]. A complete cholesterol test or lipid profile test measures the amount of "good" and "bad" cholesterol and triglycerides in the body. In this study, the impact of ethanol leaf extract of *Eucalyptus camaldulensis* was evaluated on the lipid profile of Wistar rats. The lipid profile parameters assessed include total cholesterol, triglycerides, HDL (High-Density Lipoprotein), VLDL (Very Low-Density Lipoprotein) and LDL (Low-Density Lipoprotein)[10].

According to Amaechi *et al.*[2] hypercholesterolemia has been identified as a primary risk factor in the development of CVD. Therefore, understanding how *Eucalyptus camaldulensis* affects these parameters can provide insights into its potential therapeutic benefits. This is a substantial finding as elevated HDL is associated with a decreased risk of atherosclerosis and CVD. Similarly, the HDL concentration in group E, 390.00±75.06 mg/dL shows a significant increase ($p<0.05$), compared to 243.42±34.98 mg/dL in the control group. This group demonstrated the highest HDL level among all groups, highlighting a potent effect of *Eucalyptus camaldulensis* at this concentration.

Other lipid parameters, such as total cholesterol, triglycerides, VLDL and LDL, did not exhibit significant changes across the treatment groups when compared to the control. The significant increase in HDL levels with 150 and 450 mg/kg doses of *Eucalyptus camaldulensis* is noteworthy. The HDL is known as "good cholesterol" because it helps remove excess cholesterol from the bloodstream and transport it to the liver for excretion. Higher HDL levels are protective against the development of atherosclerosis, a key factor in cardiovascular diseases[11-13].

Table 2: Effect of *Eucalyptus camaldulensis* on lipid profile

	Cholesterol (mg/dL)	Triglyceride (mg/dL)	HDL (mg/dL)	VLDL (mg/dL)	LDL (mg/dL)
Control	163.16±16.43	163.67±41.60	243.42±34.98	32.73±8.32	141.13±26.61
150 mg/kg	161.23±20.92	114.06±7.41	365.00±46.10*	22.81±1.48	222.27±33.04
250 mg/kg	138.77±12.92	261.56±68.54	273.33±2.36	52.31±13.71	216.31±17.49
350 mg/kg	103.29±23.20	214.84±29.99	305.00±8.66	42.97±6.00	265.15±17.20
450 mg/kg	193.20±50.34	196.88±30.89	390.00±75.06*	39.38±6.18	192.64±5.74
550 mg/kg	164.04±41.31	187.50±49.19	347.50±25.76	37.50±9.84	204.66±59.63

Data are represented as Mean±SEM, n = 7, *p<0.05 significantly different from distilled water, HDL: High-Density Lipoprotein, LDL: Low-Density Lipoprotein and VLDL: Very Low-Density Lipoprotein

The findings suggest that *Eucalyptus camaldulensis* extract can positively modulate lipid metabolism, particularly by raising HDL levels, which is beneficial in reducing cardiovascular risk. The lack of significant changes in other lipid parameters such as total cholesterol, triglycerides, VLDL and LDL indicates that the extract's primary beneficial effect might be specifically enhancing HDL levels.

CONCLUSION AND RECOMMENDATIONS

The ethanol leaf extract of *Eucalyptus camaldulensis*, particularly at doses of 150 and 450 mg/kg, significantly increased HDL levels in the Wistar rats. This suggests its potential as a therapeutic agent in improving lipid profiles and reducing cardiovascular disease risk. Further studies are needed to explore the mechanisms underlying these effects and to confirm the potential clinical benefits of *Eucalyptus camaldulensis* in lipid management and cardiovascular health.

SIGNIFICANCE STATEMENT

Cardiovascular Disease (CVD) is a leading cause of global mortality, responsible for 17.9 million deaths annually. Dyslipidemia, an abnormal lipid profile is a key modifiable risk factor of CVD. In Nigeria, the rising prevalence of CVD poses significant health challenges, yet specific data on dyslipidemia prevalence is limited. Evaluating lipid profiles is crucial for CVD prevention, but accessible and affordable treatment options are needed. On this note, this study aims to investigate the effects of ethanol extract of *Eucalyptus camaldulensis* leaves on the lipid profile of Wistar rats, potentially offering a natural and cost-effective alternative for managing dyslipidemia.

REFERENCES

1. Oladeji, O., 2016. The characteristics and roles of medicinal plants: Some important medicinal plants in Nigeria. Nat. Prod.: Indian J., Vol. 12.
2. Amaechi, D., E.O. Udosen, E.E. Edet, E.E. Asanga and I.E. Mbakwe, 2015. Lipid profile status of streptozotocin induced diabetic rats treated with ethanolic leaf extract of *Solenostemon monostachyus*. J. Med. Plants Res., 9: 289-293.
3. Amaechi, D., I.P. Ekpe, E.D. Edet and M.C. Madu, 2021. Hepatoprotective and hematological effects of *Solanum melongena* (garden egg), *Solannum lycopersicum* (tomato) and *Daucus carrots subsp. sativus* (carrot) extracts against lead induced toxicity in Wistar rats. Asian J. Biochem. Genet. Mol. Biol., 7: 10-18.
4. Amaechi, D., I.P. Ekpe, B.N. Yisa and T.F. Adamgbe, 2024. Phytochemical profiling (GC-MS) of the leaf extract of *Mangifera indica* and its hypolipidemic effect on serum lipid profile in streptozotocin-induced diabetic Wistar rats. Asian Sci. Bull., 2: 17-23.
5. Amaechi, D., B.N. Yisa, I.P. Ekpe, P.I. Nwawuba and A. Rabbi, 2022. Phytochemical screening, anti-obesity and hepatoprotective activities of ethanol leaf extract of *Jatropha tanjorensis* in Wistar rats. Asian J. Appl. Chem. Res., 12: 20-26.
6. Amaechi, D., E.A. Felix, I.P. Ekpe, G.E. Udosen and B.N. Yisa, 2020. The ameliorative effects of *Solanum melongena* (garden egg), *Solanum lycopersicum* (tomatoes) and *Daucus carrot sub.sativus* extracts on lipid profile against lead induced toxicity in Wistar rats. Eur. J. Pharm. Med. Res., 7: 70-73.

7. Ekpe, I.P., D. Amaechi and C.E. Obeleagu, 2020. Protective effect of *Solanum melongena* (garden egg), *Solanum lycopersicum* (tomatoes), *Daucus carota* subsp. sativus (carrot) extracts on some electrolytes and renal biomarkers of lead induced toxicity in albino wistar rats. World J. Adv. Res. Rev., 8: 386-391.
8. Ekpe, I.P., D. Amaechi, B.N. Yisa and O.G. Osarhiemen, 2021. Evaluation of the effects of aqueous fruit extract of *Tamarindus indica* on body weight, lipid profile, some electrolytes and urea of Wistar rats. J. Pharm. Res. Int., 33: 444-451.
9. Sharma, B. and N. Singh, 2012. Experimental hypertension induced vascular dementia: pharmacological, biochemical and behavioral recuperation by angiotensin receptor blocker and acetylcholinesterase inhibitor. Pharmacol. Biochem. Behav., 102: 101-108.
10. Ekpe, I., E.O. Udosen, D. Amaechi and B. Yisa, 2018. Impact of ethanolic extract of *Tecoma stans* and *Costus afer* leaves on lipid profile status of streptozotocin induced diabetic Wistar rats. Int. J. Sci., 7: 16-20.
11. Ekpe, I.P., D.A. Apata and D. Amaechi, 2021. Effects of methanol leaf extract of *Corchorus olitorius* on liver function and lipid profile in Wistar rats. Eur. J. Pharm. Med. Res., 8: 13-19.
12. Dennis, A., E.O. Udosen, V.S. Ekam and I.P. Ekpe, 2018. Effects of methanolic root extract of *Holarrhena floribunda* on the lipid profile and sex hormones in Wistar rats. Asian J. Res. Biochem., Vol. 3. 10.9734/ajrb/2018/v3i329829.
13. Kumar, M., R. Nagpal, R. Kumar, R. Hemalatha and V. Verma *et al*., 2012. Cholesterol-lowering probiotics as potential biotherapeutics for metabolic diseases. Exp. Diabetes Res., 10.1155/2012/902917.