



## COMPARATIVE STUDIES ON THE EFFECT OF EXTRACTS OF *Cymbopogon citratus* (LEMON GRASS) ON THE LIPID PROFILES OF WISTAR ALBINO RATS

Adegbeji J. Ademuyiwa\*<sup>1</sup>, Usunobun Usunomena<sup>2</sup>, Anyanwu, G. Olubunmi<sup>3</sup>,  
Onoagbe O. Iyere<sup>4</sup>

<sup>1</sup>Department of Science Laboratory Technology, Rufus Giwa Polytechnic, Owo, Ondo State, Nigeria.

<sup>2</sup>Department of Biochemistry, Benson Idahosa University, Benin City, Edo State, Nigeria.

<sup>3</sup>Department of Biochemistry, Bingham University, Karu, Nasarawa State, Nigeria.

<sup>4</sup>Department of Biochemistry, University of Benin, Benin City, Nigeria.

Article Received on  
11 Aug. 2016,

Revised on 31 Aug. 2016,  
Accepted on 21 Sep. 2016

DOI: 10.20959/wjpr201610-5863

### \*Corresponding Author

**Dr. Adegbeji J. Ademuyiwa**

Department of Science  
Laboratory Technology,  
Rufus Giwa Polytechnic,  
Owo, Ondo State, Nigeria.

### ABSTRACT

Plants of medicinal properties have been recognized to have therapeutic effects as well as toxic side effects. The present study aimed to investigate the effect of aqueous and ethanolic extracts of *Cymbopogon citratus* on the lipid profiles of normal rats. The lipid profiles of rats treated with both ethanolic and aqueous extracts of lemon grass as observed in table 3. The Total cholesterol, Triglycerides, High density lipoprotein (HDL) and low density lipoprotein (LDL) levels of the ethanolic extracts were observed to be significantly lowered when compared with the aqueous extract and the control normal rats. The results of the study also showed that the level

of the LDL-Cholesterols in both ethanolic and aqueous extracts were decreased but not significantly ( $p < 0.05$ ) different when compared with the control group and the level of the HDL-Cholesterol in the treated groups. Thus, blood serum cholesterol level was found to be down regulated in this study. Findings in this study showed that this plant did not exert oxidative damage; in some instances, particularly in the liver, kidney and pancreas as well as its relative safety and possible use for weight gain.

**KEYWORDS:** medicinal plants; lipid profiles; *Cymbopogon citratus*; rats; oxidative status.

## INTRODUCTION

*Cymbopogon citratus* commonly called lemon grass is an aromatic, perennial grass belonging to the family gramineae (Ebomoyi 1986). It is a tropical plant, grown as an ornamental in many temperate areas with maximum a height of about 1.8m and its leaves 1.9cm wide covered with a whitish bloom (Gbile 1986). In certain medications, it is used for mental illness. It is an antifungal, antitoxicant and deodorizing agent (Gbile 1986). One of the main constituents of the many different species of lemongrass (genus *Cymbopogon*) is citral (3,7-dimethyl-2,6-octadien-1-ol) (Balbaa & Johnson 1955, Banthorpe et al 1976).

Lipid profile or *lipid panel* is a panel of blood tests that serves as an initial broad medical screening tool for abnormalities in lipids, such as cholesterol and triglycerides. The results of this test can identify certain genetic diseases and can determine approximate risks for cardiovascular disease, certain forms of pancreatitis, and other diseases (Sidhu & Naugler 2012). Cardiovascular disease (CVD) is a class of diseases that involve the heart or blood vessels (Sutcliffe et al 2013). Cardiovascular disease includes coronary artery diseases (CAD) such as angina and myocardial infarction (commonly known as a heart attack) (Sutcliffe et al 2013). Other CVDs are stroke, hypertensive heart disease, rheumatic heart disease, cardiomyopathy, heart arrhythmia, congenital heart disease, endocarditis, aortic aneurysms, peripheral artery disease and venous thrombosis (Sutcliffe et al 2013, Sutcliffe et al 2013). A triglyceride (triacylglycerol) is an ester derived from glycerol and three fatty acids (Nelson & Cox, 2000). As a blood lipid, it enhances the bidirectional transference of adipose fat and blood glucose from the liver (Lampe et al 1983). Cholesterol is a sterol (or modified steroid) (Olson 1998) and an essential structural component of animal cell membranes that is required to establish proper membrane permeability and fluidity (Lecerf & de Lorgeril 2011). Low density lipoprotein (LDL) molecules are the major carriers of cholesterol in the blood, and each one contains approximately 1,500 molecules of cholesterol ester (Javitt 1994). These plaques are the main causes of heart attacks, strokes and other serious medical problems, leading to the association of so-called LDL cholesterol (actually a lipoprotein) with "bad" cholesterol (Hanukoglu & Jefcoate 1980). Also, high density lipoprotein (HDL) particles are thought to transport cholesterol back to the liver for excretion or to other tissues that use cholesterol to synthesize hormones in a process known as reverse cholesterol transport (RCT) (Wolkoff & Cohen 2003).

The purpose of this study, therefore, is to carry out the biochemical studies on the effects of *Cymbopogon citratus* (lemon grass) on the lipid profile of wistar albino rats.

## MATERIALS AND METHODS

*Cymbopogon citratus* was harvested and collected freshly from a native farms and authenticated in Environmental Biology Laboratory, Department of Science Laboratory Technology, Rufus Giwa Polytechnic, Owo.

### Preparation of plant extract

The fresh plant was washed, chopped into pieces and air-dried at room temperature. The dried plant part was milled into powder and weighed. The Plant powder was divided into two groups. One portion was soaked in 90% absolute ethanol to obtain the ethanolic extract and the other group in distilled water to obtain the aqueous form separately in a container for 72 hours with intermittent shaking. Then, it was filtered through a muslin cloth and later Whatman No. 1 filter paper. The resulting filtrate was evaporated under reduced pressure using a rotary evaporator and there after freeze dried to get powder form of both ethanolic and aqueous extracts. The yield was stored in a refrigerator (4°C) till when needed (Onoagbe & Esekheigbe 1999).

### Experimental animal

Male albino rats (Wistar strain) weighing between 109-170g, purchased from the central animal house of University of Ibadan were used for the study.

**Acclimatization:** 15 days prior to dosing.

**Identification of animals:** By cage number.

**Diet:** Pelleted feed

**Water:** Potable drinking water

**Housing & Environment:** 4 animals each in a group.

**Determination of the weight of animals:** Weights of animals were taken using an electronic weighing balance every 7 days to verify the change in weight over the period of administration.

**Animal ethics**

All of the animals received humane care according to the criteria outline in the Guide for the Care and the Use of Laboratory Animals prepared by the National Academy Science and published by the National Institute of Health (USA).

**Experimental design**

Twelve male Albino rats were randomly, equally divided and assigned to either control or experimental groups. The control group received 2ml distilled water while the experimental rats group received oral doses of 200mg/kg for both the ethanolic and aqueous extracts of *Cymbopogon citratus* dissolved in 2ml distilled water through a stainless steel intra-gastric intubation and administered for 30 days. Here, lipid profiles were determined and recorded.

**Chemicals and reagents preparation**

All chemicals were of an analytical grade and are supplied from sigma chemical co. USA. Distilled water was used in all biochemical assays.

**Biochemistry assays for lipid profiles**

Triacylglycerol (TAG) was determined after enzymatic hydrolysis with lipases, glycerol kinase and glycerol phosphate oxidase. The indicator is a quinoneimine formed from H<sub>2</sub>O<sub>2</sub>, 4-aminophenazone and 4-chlorophenol under the catalytic influence of peroxidase. The intensity of the colour formed at 500nm is proportional to the level of TAG in the sample (Trinder 1969).

The cholesterol was determined after enzymatic, hydrolysis (by cholesterol esterase) and oxidation (by cholesterol oxidase). The indicator quinoneimine is formed from hydrogen peroxide and 4-amino antipyrine in the presence of phenol and peroxidase, which is photometrically determined at 500nm (Trinder 1969).

Low density lipoproteins (LDL) fractions are precipitated quantitatively by the addition of phosphotungstic acids in the presence of magnesium ions. After centrifugation, the cholesterol concentration in the HDL fraction, which remains in the supernatant, is determined. The absorbance is measured at 500nm (Trinder 1969).

Low Density Lipoprotein (LDL- cholesterol) (Trinder 1969).

### Statistical analysis

The experimental results were expressed as the mean  $\pm$  S.E.M. Statistical significance of difference in parameters amongst groups was determined by One way ANOVA followed by Duncan's multiple range test.  $P < 0.05$  was considered to be significant.

## RESULTS AND DISCUSSION

**Table 1: Effects of oral administration of ethanolic and aqueous extracts of *Cymbopogon citratus* on the weight of normal rats.**

	Control	Ethanolic extract	Aqueous extract
<b>Initial weight (g)</b>	115 $\pm$ 1.92 <sup>a</sup>	130 $\pm$ 1.71 <sup>b</sup>	135 $\pm$ 1.50 <sup>c</sup>
<b>Final weight (g)</b>	129 $\pm$ 1.71 <sup>a</sup>	150 $\pm$ 1.50 <sup>b</sup>	149 $\pm$ 1.70 <sup>c</sup>

Values are expressed as means  $\pm$  SEM of four independent experiments. Means in the same column not sharing the same letter(s) are significantly different ( $p < 0.05$ ).

**Table 2: Effects of oral administration of ethanolic extracts of *Cymbopogon citratus* on the weight of organs in normal rats.**

Group (mg/kg)	Liver (g)	Kidney (g)	Heart (g)	Pancrease (g)	Spleen(g)
<b>Control</b>	5.98 $\pm$ 0.82 <sup>b</sup>	0.95 $\pm$ 0.05 <sup>a</sup>	0.43 $\pm$ 0.05 <sup>a</sup>	0.40 $\pm$ 0.02 <sup>ab</sup>	0.79 $\pm$ 0.03 <sup>b</sup>
<b>Ethanolic extract (200mg/kg)</b>	3.71 $\pm$ 0.57 <sup>a</sup>	0.90 $\pm$ 0.08 <sup>a</sup>	0.41 $\pm$ 0.03 <sup>a</sup>	0.36 $\pm$ 0.04 <sup>a</sup>	0.64 $\pm$ 0.04 <sup>a</sup>
<b>Aqueous extract (200mg/kg)</b>	5.12 $\pm$ 0.86 <sup>b</sup>	1.45 $\pm$ 0.42 <sup>b</sup>	0.45 $\pm$ 0.04 <sup>a</sup>	0.45 $\pm$ 0.50 <sup>b</sup>	0.70 $\pm$ 0.04 <sup>a</sup>

Values are expressed as means  $\pm$  SEM of four independent experiments. Means in the same column not sharing the same letter(s) are significantly different ( $p < 0.05$ ).

**Table 3: The Effects of Ethanolic and Aqueous Extracts of *Cymbopogon citratus* on Serum Lipid Profiles in normal rats.**

Group	TotalCholesterol (mmol/l)	Triglycerides (mmol/l)	HDL (mmol/l)	LDL (mmol/l)
<b>Control</b>	30.54 $\pm$ 2.79 <sup>a</sup>	29.21 $\pm$ 6.09 <sup>a</sup>	36.18 $\pm$ 3.01 <sup>a</sup>	15.60 $\pm$ 1.34 <sup>a</sup>
<b>Ethanolic extract (200mg/kg)</b>	28.82 $\pm$ 4.83 <sup>a</sup>	19.89 $\pm$ 3.99 <sup>a</sup>	42.03 $\pm$ 0.27 <sup>a</sup>	14.91 $\pm$ 3.42 <sup>a</sup>
<b>Aqueous extract (200mg/kg)</b>	29.22 $\pm$ 2.41 <sup>a</sup>	21.05 $\pm$ 2.82 <sup>a</sup>	41.90 $\pm$ 0.63 <sup>a</sup>	16.11 $\pm$ 0.42 <sup>a</sup>

Values are expressed as means  $\pm$  SEM of four independent experiments. Means in the same column not sharing the same letter(s) are significantly different ( $p < 0.05$ ).

**HDL**- High Density Lipoprotein, **LDL**- Low Density Lipoprotein.

The lipid profiles of rats treated with both ethanolic and aqueous extracts of lemon grass as observed in table 3. The Total cholesterol, Triglycerides, High density lipoprotein (HDL) and low density lipoprotein (LDL) levels of the ethanolic extracts were observed to be

significantly lowered when compared with the aqueous extract and the control normal rats. The results of the study also showed that the level of the LDL-Cholesterols in both ethanolic and aqueous extracts were decreased but not significantly ( $p < 0.05$ ) different when compared with the control group and the level of the HDL-Cholesterol in the treated groups. Thus, blood serum cholesterol level was found to be down regulated in this study.

## DISCUSSION

To determine the safety of drugs and plant products for human use, toxicological evaluations are carried out on various experimental animals to predict toxicity and to provide guidelines for selecting a 'safe' dosage in humans. The highest overall concordance of toxicity in animals with humans is with hematological, gastrointestinal and cardiovascular adverse effects (Olson et al 2000).

The animal body and organ weights of the test group increased steadily after 28 days administration of extracts, likewise that of the control (Table 1 & 2). However, the weights of the animals, at the last day, for both ethanolic and aqueous extracts were shown to be significantly higher than that of the control. Any increase in the body weight is probably due to protein anabolic effect and reversal of gluconeogenesis and glycogenolysis by the improvement of insulin secretion as a result of insulinotropic effect of *C. citratus* extracts (Kim et al 2006). Another possible reason of the increase in body weight may be the presence of 30-60% of tannins in the leaves of *C. citratus* (Pande et al 1980).

The lipid profiles of rats treated with both ethanolic and aqueous extracts of lemon grass were also observed (Table 3). The Total cholesterol, Triglycerides, High density lipoprotein (HDL) and low density lipoprotein (LDL) levels of the ethanolic extracts were observed not to be significant but lowered when compared with the aqueous extract and the control normal rats. The results of the study also showed that the level of the LDL-Cholesterols in both ethanolic and aqueous extracts showed no significant difference but lowered when compared with the control group and the level of the HDL-Cholesterol in the treated groups. Thus, blood serum cholesterol level was found to be down regulated in this study. It is known that high blood cholesterol levels and hyper-lipidemia can be the consequence and frequently associated with diabetes (Ravi et al 2005, Emeka & Funmilayo 2011). The concomitant protein stabilization and the elevation in the serum cholesterol levels are considered an added value of this plant protective mechanism. These events and together with the hypoglycemic properties of this plant indicated that it can be considered as a preventive factor for long-term complications of

diabetes. These findings are in agreement with other cholesterol modulating effects of several other plants (Momo et al 2006). The reduction of this lipid profile in rats after treatment can be attributed to their promotion in utilization glucose reflected by a decrease in blood glucose and elevated insulin levels and hence depressed mobilization of fat (Momo et al 2006). Therefore we can speculate that this plant extracts may be helpful in reducing the complications of hyperlipidemia and hypercholesterolemia which coexist quite often in diabetics (Farnier 2002) especially with the ethanolic extract.

Elevated blood triglyceride and cholesterol are some of the diabetic indicators and significant decreases of these parameters obtained in this study (Tables 4.3) were indicative of the potentials of extracts of *C. citratus* to reduce plasma levels of these indicators to asymptomatic limit. These reductions of both cholesterol and triglyceride concentrations in the ethanolic extracts treated normal rats could be beneficial in preventing diabetic complications and improving lipid metabolism in diabetics (Cho et al 2002). Hypercholesterolemia plays an important role in the initiation and progression of atherosclerosis and is known to have a positive correlation with cardiovascular disease, largely depending on the oxidation of LDL, the main cholesterol carrier in plasma (Hsu 2003). Flavonoid and saponin contents of extracts of *T. scleroxylon* may have also contributed to the reduction in the blood levels of triglyceride and cholesterol in experimental rats as has been widely reported by Prohp & Onoagbe (2012).

Increase in LDL (bad cholesterol) or lethally dangerous lipoprotein carry a lot of health risks as its accumulation could occlude major arteries causing myocardial infarction, atherosclerosis, heart attack, stroke and even high blood pressure. Thus, both extracts significantly reduced LDL.

Avci et al (2006) reported an increase in HDL in male Swiss albino mice by aqueous and ethanol extracts of *Agrostemmagithago*, *Potentilla reptans*, *Thymbra spicata*, *Urtica dioica* and *Viscum album*. HDL carries cholesterol and cholesterol esters from the peripheral tissues and cells to the liver, where cholesterol is metabolised into bile acids. This pathway plays a very important role in reducing cholesterol levels in the blood and peripheral tissues and in inhibiting atherosclerotic plaque formation in the aorta (Karmarker 2008, Kim et al 2008). The increased levels of HDL (good cholesterol) concentrations obtained in this study were indicative of potentials of extracts to protect against heart diseases.

## CONCLUSION

In conclusion, *Cymbopogon citratus* are recommended cardiac glycoside and the cardiac glycosides serves as defence mechanisms against cardiovascular disease and digestive problems. Thus, *Cymbopogon citratus* (Lemon grass) whole plant materials are recommended to be taken because it has many beneficial effects in human health.

## REFERENCES

1. Balbaa SI & Johnson CH (1955) The microscopic structure of lemongrass leaves. J Am Pharm Assoc Am Pharm Assoc (Baltim), 44(2): 89-98.
2. Banthorpe DV, Duprey RJ, Hassan M, Janes JF, & Modawi BM (1976) Chemistry of the Sudanese flora. I. Essential oils of some *Cymbopogon species*. Planta Med. 29(1): 10-25.
3. Ebomoyi O (2008) Traditional Medicine in Mental health care. The Journal of American Science, 4(4): 21-25.
4. Nelson DL & Cox MM (2000) "Lehninger, Principles of Biochemistry" 3rd Ed. Worth Publishing: New York. pp 234-235.
5. Lampe MA, Burlingame AL, Whitney J, Williams ML, Brown BE, Roitman E, & Elias M (1983) "Human stratum corneum lipids: characterization and regional variations". J. Lipid Res. 24: 120–130.
6. Olson RE (1998) "Discovery of the lipoproteins, their role in fat transport and their significance as risk factors". J. Nutr. 128(2 Suppl): 439S–443S.
7. Lecerf JM & de Lorgeril M (2011) "Dietary cholesterol: from physiology to cardiovascular risk". Br J Nutr, 106(1): 6–14.
8. Emeka EJI & Funmilayo DO (2011) Hypoglycemic effects, biochemical and histological changes of *Spondias mombin linn* and *Perinari ployandra benth* seeds ethanolic extracts in alloxan induced rats. Journal of pharm. Toxicol. 6(2): 1001-102.
9. Momo CEN, Oben JE, Tazoo D & Dongo E (2006) Antidiabetic and hypolipemic effects of *laportea ovalifolia* (urticaceae) in alloxan induced diabetic rats. Afr. J. Trad. CAM: 3: 36-43.
10. Farnier M (2002) Ezetimibe in hypercholesterolaemia. Int J Clin Pract, 56: 611-614.
11. Hsu HHT (2003) In vitro effect of cholesterol on calcifying activity of vesicles isolated from rabbit aortas. Biochimica et Biophysica Acta (BBA) - Molec. Basis Dis. 1638: 235-240.

12. Avci G, Kupeli E, Eryavuz A, Yesilada E & Kucukkurt I (2006) Antihypercholesterolemic and antioxidant activity assessment of some plants used as remedy in Turkish folk medicine. *J. Ethno-Pharmacol.*, 107: 418-423.
13. Karmarker B (2008) Polaxamers and their applications in Pharmacy student articles, <http://www.pharmainfo.net/>.
14. Kim H, Jeong D, Jung H, Yokozawa T & Choi J (2008) Hypolipidemic effects of *Sophora flavescens* and its constituents in Poloxamer-407 induced hyperlipidemic and cholesterol-fed rats. *Biol. Pharm. Bull.* 31(1): 73–78.
15. Prohp TP & Onoagbe IO (2012) Plasma Lipid Profile in Non-Diabetic Rats Treated with Extracts of *Triplochiton Scleroxylon* K. Schum. *J Phys Pharm Adv*, 2012; 2(12): 389-399.
16. Cho SY, Park JY, Park EM, Choi MS, Lee MY, Jeon SM, Jang MK, Kim MJ and Park YB (2002) Alternation of hepatic antioxidant enzyme activities and lipid profile in streptozotocin-induced diabetic rats by supplementation of dandelion water extract. *Clin. Chim. Acta*, 317: 109–117.
17. Javitt NB (1994) "Bile acid synthesis from cholesterol: regulatory and auxiliary pathways". *FASEB J.* 8(15): 1308–11.
18. Hanukoglu I and Jefcoate CR (1980) "Pregnenolone separation from cholesterol using Sephadex LH-20 mini-columns". *Journal of Chromatography A*, 190(1): 256–262.
19. Wolkoff AW & Cohen DE (2003) "Bile acid regulation of hepatic physiology: I. Hepatocyte transport of bile acids". *Am. J. Physiol. Gastrointest. Liver Physiol.* 284(2): G175–9.
20. Pande MB, Talpada PM, Patel ZN, Purohit LP & Shukla PC (1980) Note on processed babul feeding to mature kankrej bullocks. *Indian J. Animal Sci.*, 52: 798-9.
21. Ravi K, Rajasekaran S & Subramanian S (2005) Antihyperlipidemic effect of *Eugenia jambolana* seed kernel on streptozotocin-induced diabetes in rats. *Food Chem. Toxicol.* 43: 1433-1439.
22. Kim JS, Jung BJ, Choi CW & Kim SC (2006) Hyperglycemic and antihyperlipidemic effect of four Korean Medicinal plants in alloxen induced diabetic rats. *Am J Biochem Biotechnol.* 2: 154-60.
23. Trinder P (1969) Determination of glucose in blood using glucose oxidase with an alternative oxygen acceptor. *Ann. Clin. Biochem.* 6: 24-27.
24. Gbile (1986) *Ethnobotany, Taxonomy and Conservation of Medicinal Plants*. Ibadan University press, Ibadan, 126–130.

25. Sidhu D and Naugler C (2012) "Fasting Time and Lipid Levels in a Community-Based Population". *Archives of Internal Medicine*, 172(22): 1–4.
26. Onoagbe IO & Esekheigbe A (1999) Studies on the anti-diabetic properties of *Uvaria Chamae* in streptozotocin-induced diabetic rabbits. *Biokemistri*. 9: 79-84.
27. Sutcliffe P, Connock M, Gurung T, Freeman K, Johnson S, Ngianga-Bakwin K, Grove A, Gurung B, Morrow S, Stranges S & Clarke A (2013) "Aspirin in primary prevention of cardiovascular disease and cancer: a systematic review of the balance of evidence from reviews of randomized trials.". *PLOS ONE*, 8(12): e81970.
28. Sutcliffe P, Connock M, Gurung T, Freeman K, Johnson S, Kandala NB, Grove A, Gurung B, Morro S and Clarke A (2013) "Aspirin for prophylactic use in the primary prevention of cardiovascular disease and cancer: a systematic review and overview of reviews.". *Health technology assessment (Winchester, England)*, 17(43): 1–253.