European Journal of Medicinal Plants

Volume 35, Issue 6, Page 132-138, 2024; Article no.EJMP.123055
ISSN: 2231-0894, NLM ID: 101583475

Effect of Aqueous Extract of *Citrullus lanatus* (Watermelon) Seed on Lipid Profile and Electrolyte Function in Alcohol-induced Toxicity in Male Rats

Izunwanne, DI [a*]

[a] *Department of Physiology, Imo State University, Owerri, Nigeria.*

Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

Article Information

DOI: https://doi.org/10.9734/ejmp/2024/v35i61213

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/123055

Original Research Article

Received: 17/07/2024
Accepted: 19/09/2024
Published: 24/09/2024

ABSTRACT

Alcohol misuse and alcoholism pose significant health and socioeconomic challenges worldwide. Chronic consumption of alcohol can lead to the production of various reactive oxygen species (ROS), such as superoxide anion radicals, hydroxyl radicals, and hydrogen peroxide. This study aims to evaluate the effects of an aqueous extract of Citrullus lanatus seeds on lipid profiles and electrolyte levels after alcohol-induced toxicity in male Wistar rats. The rats were separated into five groups, each containing six individuals: Group A, which served as a positive control, was given only food and water; Group B, as a negative control, received only alcohol; Group C was administered 500 mg/kg of aqueous Citrullus lanatus seed extract (ASCL) for six weeks; Group D received a 35% alcohol solution for three weeks followed by 500 mg/kg of ASCL for an additional six weeks; and Group E received the same alcohol solution for three weeks and then underwent treatment with 1000 mg/kg of ASCL for six weeks. The duration of the experiment was nine weeks, with the

**Corresponding author: E-mail: desmondizunwanne@gmail.com;*

Cite as: *DI, Izunwanne,. 2024. "Effect of Aqueous Extract of Citrullus Lanatus (Watermelon) Seed on Lipid Profile and Electrolyte Function in Alcohol-Induced Toxicity in Male Rats". European Journal of Medicinal Plants 35 (6):132-38. https://doi.org/10.9734/ejmp/2024/v35i61213.*

treatment delivered via oral gavage. Comparisons showed that the group treated only with alcohol exhibited significant differences (P≤0.05) relative to the control group, and the alcohol-only group also showed significant differences (P≤0.05) when compared to the ASCL-treated groups concerning lipid profiles and electrolyte levels. The findings indicated that alcohol consumption resulted in hyperlipidemia, characterized by elevated levels of total cholesterol (TC), triglycerides (TG), low-density lipoprotein (LDL), and very low-density lipoprotein (VLDL), alongside reduced levels of high-density lipoprotein (HDL). Conversely, treatment with ASCL demonstrated hypolipidemic effects. Alcohol intake was associated with hyponatremia and hypokalemia, conditions that were mitigated by ASCL treatment.

Keywords: Citrullus lanatus; alcohol-induced toxicity; lipid profile; electrolyte function; hematological parameters.

1. INTRODUCTION

"Alcohol misuse and alcoholism are significant global health and socioeconomic challenges, recognized as one of the leading causes of preventable deaths, trailing only behind cigarette smoking. Chronic alcohol consumption can generate a high level of reactive oxygen species (ROS), including superoxide anion radicals, hydroxyl radicals, and hydrogen peroxide" [1].

On the other hand, electrolytes are vital for regulating body fluids and are involved in various biological processes [2]. "The key electrolytes of concern include sodium, potassium, and chloride, along with magnesium, calcium, phosphate, and bicarbonate. An imbalance in these electrolytes, whether it be an excess or deficiency, can disrupt normal physiological functions, leading to serious health complications" [3]. Disturbances in electrolyte levels are associated with numerous medical conditions, acting as underlying factors, or resulting from pathophysiological changes due to illnesses or injuries [2].

Lipids are fundamental components of life and essential for the functioning of mammalian cells [4]. Cholesterol plays a crucial role in the development of cardiovascular diseases, which are often associated with elevated serum lipid levels, including cholesterol and triglycerides, a condition referred to as hyperlipidemia. This increases the risk of atherosclerotic cardiovascular disease (CVD) [3]. "The lipid profile primarily includes total cholesterol, triglycerides, low-density lipoprotein (LDL-C), and high-density lipoprotein (HDL-C), which serve as important diagnostic indicators for cardiovascular risk factors" [4].

While moderate alcohol consumption may boost HDL cholesterol levels and reduce LDL cholesterol, potentially lowering the risk of cardiovascular diseases, excessive intake can disrupt lipid metabolism, lead to hypertriglyceridemia, and negatively affect liver function, contributing to fatty liver disease [5]. Chronic alcohol abuse can also impede the breakdown of triglycerides, further compromising cardiovascular health. Research by Li et al. [5] indicates that alcohol consumption can lower HDL levels while raising LDL levels, total cholesterol, and triglycerides.

Medicinal plants are significant in natural remedies, health, diet, and folk healing. They are used as spices and in herbal medicine for various ailments [6]. Plants are important in drug discovery due to their bioactive molecules [7]. Citrullus lanatus, a member of the Cucurbitaceae family, has been traditionally used for treating various illnesses globally [8]. Its various parts have pharmacological actions, including hepatoprotective, anti-ulcergenic, anti-diabetic, laxative, antisecretory, anti-prostatic hyperplasia, antioxidant, analgesic, antifungal, and anti-inflammatory properties. Consumption of *Citrullus lanatus* has been linked with changes in the levels of lipids as well as some electrolytes levels [9].

2. MATERIALS AND METHODS

2.1 Location of the Study

This research was carried out in the Animal House of the Department of Human Physiology, within the Faculty of Basic Medical Sciences at Nnamdi Azikiwe University, located in Awka, College of Medicine and Health Sciences.

2.2 Extract Collection

The seeds of Watermelon (*C. lanatus*) were collected from the Nkwo market Nnewi, Nnewi

North Local Government Area, Anambra State and processed to prepare a Citrullus lanatus Seed Extract. The seeds were washed, air-dried, milled into coarse powder, macerated in Luke-warm water, filtered, concentrated, and dried in a laboratory oven. The extract was stored in a refrigerator for later use. The extraction process was carried out with modifications based on the method outlined by Quek [10].

2.3 Experimental Wistar Rat and Design

Thirty (30) male Wistar rats were used in the experimental study. The rats were divided into five groups of six rats per group as follows;

Group A as a positive control and received feed and water only,
Group B as a negative control and received Alcohol only,
Group C received 500mg/kg of ASCL for 6-weeks,
Group D received 35% conc. of Alcohol for three-weeks and treated with 500mg/kg of ASCL for 6-week,
Group E received 35% conc. of Alcohol for three-weeks and treated with 1000mg/kg of ASCL for 6-weeks.

The experiment lasted for 9 weeks and involved oral gavage.

2.4 Acute Toxicity of Aqueous Seed Extract of *Citrullus lanatus* and Alcohol

The median lethal dose (LD_{50}) of the Alcohol and aqueous seed extract of *C. lanatus* (ASCL) was determined using the Lorkes method [11] and divided into two phases. The study aimed to determine the acute toxicity of the extract and alcohol in a study conducted at Nnamdi Azikiwe University.

2.5 Sample Collection and Termination of the Experiment

At the conclusion of the experiment, Wistar rats from the various groups were anesthetized with chloroform in a sealed container, 24 hours after the final dose of alcohol and the aqueous seed extract of *C. lanatus* (ASCL). Blood samples were collected by performing an ocular puncture using a heparinized capillary tube. The collected blood was placed in both a plain bottle and an EDTA-containing bottle to allow for clotting, and then it was centrifuged for 10 minutes at 3000 rpm. The resulting serum was carefully extracted using a micropipette from the plain bottle and utilized for analysis of serum electrolytes (sodium and potassium) as well as the lipid profile (total cholesterol, low-density lipoprotein, high-density lipoprotein, triglycerides, and very low-density lipoprotein). The heart was obtained via an intra-abdominal incision, weighed, and rinsed with normal saline. It was then fixed in 10% formo-saline as a primary fixative for subsequent histopathological examination.

2.6 Statistical Analysis

The values were expressed as mean ± SEM. Hypothesis testing method included one way analysis of variance (ANOVA) followed by post hoc performed with Least Significant Difference (LSD) dunnett. P value of less than 0.05 was considered to indicate statistical significance and 0.001 as highly significant respectively.

3. RESULTS

Table 1 result showed a significant increase in the total cholesterol levels in group B compared to A (*p=0.01*), while groups C, D and E (*p=0.02, p=0.03, p=0.00*) had a significant decrease compared to group B. The triglyceride result revealed a significant increase in group B compared to A (*p=0.00*), while groups C, D and E (*p=0.01, p=0.00, p=0.00*) had a significant decrease compared to group B.

Table 2 result revealed a significant decline in the levels of HDL in group B compared to A (*p=0.02*), groups C, D, and E (*p=0.01, p=0.04, p=0.03*) revealed a significant raised levels compared to B. The LDL result showed a significant increased level in group B compared to group A (*p=0.01*), while groups C, D, and E (*p=0.00, p=0.02, p=0.03*) revealed a significant decline compared to B.

Table 3 result showed a significant decrease in the sodium ion level in group B compared to A (*p=0.01*), while groups C, D, and E (*p=0.00, p=0.02, p=0.01*) had a significant increase compared to group B. The potassium result revealed a significant decrease in group B compared to group A (*p=0.02*), groups C, D, and E (*p=0.01, p=0.01, p=0.01*) had a significant increase compared to group B.

Table 1. Effect of aqueous seed extract of *Citrullus lanatus* on total cholesterol and triglyceride level following alcohol toxicity

	Total cholesterol (mmol/L)	Triglyceride (mmol/L)
	MEAN±SEM	**MEAN±SEM**
Group A (Positive control)	72.34±5.10*****	67.95±8.26*****
Group B (Alcohol only)	154.06±11.64	112.00±7.27
Group C (500 mg/kg of ASCL)	75.78±8.41*****	77.87±7.78*****
Group D (35% Alcohol + 500 mg/kg of ASCL)	135.98±9.01*****	69.66±9.22*****
Group E (35% Alcohol + 1000 mg/kg of ASCL)	115.67±10.13*****	59.90±7.75*****
F-ratio	**7.70**	**5.05**

*Data was analysed using ANOVA followed by post Hoc LSD multiple comparison and values were considered significant at p<0.05. ASCL: aqueous seed extract of Citrullus lanatus, * (significant), a (not-significant)*

Table 2. Effect of aqueous seed extract of *Citrullus lanatus* on HDL, LDL following alcohol toxicity

	High-Density-Lipoprotein (mmol/L)	Low-Density-Lipoprotein (mmol/L)
	MEAN±SEM	**MEAN±SEM**
Group A (Positive control)	52.62±4.20 *	77.67±10.26 *
Group B (Alcohol only)	42.52±6.38	117.27±7.76
Group C (500 mg/kg of ASCL)	69.16±7.93 *	87.47±9.49 *
Group D (3ml of Alcohol + 500 mg/kg of ASCL)	79.06±9.61 *	78.93±10.32 *
Group E (3ml of Alcohol + 1000 mg/kg of ASCL)	75.76±8.25 *	67.13±8.68 *
F-ratio	**8.81**	**7.98**

*Data was analysed using ANOVA followed by post Hoc LSD multiple comparison and values were considered significant at p<0.05. ASCL: aqueous seed extract of Citrullus lanatus, * (significant), a (not-significant)*

Table 3. Effect of aqueous seed extract of *Citrullus lanatus* on sodium and potassium ion level following alcohol toxicity

	Sodium ion (mmol/L)	Potassium ion(mmol/L)
	MEAN±SEM	**MEAN±SEM**
Group A (Positive control)	139.50±2.59*	6.60±0.30*
Group B (Alcohol only)	112.25±7.94	4.30±0.26
Group C (500 mg/kg of ASCL)	131.75±1.31 *	5.60±0.52 *
Group D (3ml of Alcohol + 500 mg/kg of ASCL)	144.25±2.46 *	6.57±0.39 *
Group E (3ml of Alcohol + 1000 mg/kg of ASCL)	134.25±2.46 *	7.87±0.39 *
F-ratio	**6.60**	**9.27**

*Data were analyzed using ANOVA followed by post Hoc LSD multiple comparison and values were considered significant at p<0.05. ASCL: aqueous seed extract of Citrullus lanatus, * (significant), a (not-significant)*

4. DISCUSSION

The measured concentrations of total cholesterol, triglycerides, low-density lipoprotein (LDL) cholesterol, and high-density lipoprotein (HDL) cholesterol in the positive control, negative control, and various treatment groups are summarized in Tables 1 and 2 of the results section. There was a significant decrease ($P < 0.05$) in total cholesterol, triglycerides, and LDL cholesterol among the groups treated with C. lanatus extract. This finding is based on comparative analyses between the positive control, negative control, and the final concentrations of the evaluated indices after six weeks of extract administration in the treated groups. Conversely, HDL levels increased as the dosage of the extract rose ($P < 0.05$). Given that

the extract led to a rise in HDL levels along with reductions in triglycerides, LDL, and total cholesterol, it suggests that the extract may be beneficial in treating cardiovascular diseases. Elevated cholesterol levels can contribute to plaque formation in arterial walls, which is a significant risk factor for cardiovascular issues.

Dennis et al. [12] Reported that; "HDL carries cholesterol from the arteries to the liver for excretion and this serves to protect the body's cardiovascular well-being. LDL oxidation leads to fat accumulation in the arteries, which cause atherosclerosis and other cardio vascular diseases". These findings have also been found to be consistent with the recent work of Akintunde et al. [13]. The increase in HDL suggests that the crude extract can be used to treat heart failure due to coronary arteries, which is a leading cause of death in industrialized societies. There is a negative correlation between the HDL and LDL. Atherosclerosis is due to high level of cholesterol and LDL in the blood. The plant extract has the ability to lower the cholesterol and the LDL levels and increase in the HDL level. The HDL is responsible for the clearance of cholesterol from the blood.

"Lipids are generally characterized by insolubility in aqueous or polar solvents but highly soluble in nonpolar or organic solvents. Biochemical reactions and transportations of molecules generally occur in aqueous medium. Hence, lipids are normally combined with specific proteins to form structures called lipoproteins which possess substantial degree of hydrophilicity. Low density lipoproteins, high-density lipoproteins, and chylomicrons which are basically composed of triglycerides are integral parts of the serum lipoproteins" [14]. "Except for the HDL cholesterol, high level of all lipids in the blood is arguably a high-risk factor in the onset of cardiovascular disorders. High serum concentrations of triglycerides and LDLs have been reported to cause atherosclerosis and coronary heart diseases" [15]. "Cholesterol is the primary sterol found in animal tissues and is predominantly located in cell membranes due to its amphipathic characteristics" [16]. "It is also present in organs such as the adrenal gland, liver, brain, and nervous system" [17]. Cholesterol is primarily synthesized from acetyl CoA in the liver, from where it is transported via the bloodstream to extrahepatic tissues to be used in the production of bile acids and steroid hormones, as well as for the regulation of membrane fluidity. However, elevated cholesterol levels in the blood can have detrimental effects on human health. Liu and Sempos [18] noted that "high cholesterol is a significant contributor to various cardiovascular issues, including atherosclerosis, myocardial infarction, and coronary heart disease".

"In this study, the administration of C. lanatus extract at doses of 500 and 1000 mg/kg resulted in a significant decrease in serum levels of total cholesterol, triglycerides, and LDL cholesterol in the rats. Additionally, the extract led to a concurrent increase in HDL cholesterol levels. This again is consistent with the work of McBride", [19], Akintunde et al. [13]. There is a possibility that the extract possesses the ability to facilitate the transport of cholesterol and triglycerides from the blood into tissues. This may have probably occurred through the induction or suppression of certain enzymes critical to the metabolism of these lipids. This finding is consistent with the report of Adebayo et al., [20] in which *Commiphora africanana* extract showed anti lipidaemic and anti cholesterolaemic activities in rats and also, the work of Ighodaro et al. [21] is also consistent with the above point.

"For sodium, there was an observed decrease as a result of alcohol-induced toxicity. However, following the administration of extract, there was a significant amelioration of the derangement in sodium ion. On the other hand, potassium ion showed a significant level of increase following the administration of the extract. The result showed a promising effect ameliorating electrolytes derangement following induction of toxicity and this has been found to be consistent with the finding" of Onwuka et al. [22].

5. CONCLUSION

The study found that alcohol ingestion report revealed hyperlipidemia, which resulted in increased levels of TC, TG and LDL and decreased levels of HDL, and treatment with ASCL indicated hypolipidemia. It was indicated that alcohol intake resulted in hyponatremia and hypokalemia which were attenuated by ASCL.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declares that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

CONSENT

It is not applicable.

ETHICAL APPROVAL

Ethical approval was obtained from the Animal ethics committee, Faculty of Basic Medical Sciences, College of Medicine and Health Sciences, Nnamdi Azikiwe University, Awka.

COMPETING INTERESTS

Author has declared that no competing interests exist.

REFERENCES

1. Capurso NA, Petrakis I. Dyslipidemia associated with heavy alcohol use. The American Journal on Addictions. 2016; 25(3):188–190.
2. Maeda H, Michiue T, Ishikawa T. Postmortem changes: Postmortem electrolyte disturbances. Encyclopedia of Forensic and Legal Medicine: Second Edition. 2016;32–42.
3. Fawwad A, Sabir R, Riaz M, Moin H. Measured versus calculated LDL-cholesterol in subjects with type 2 diabetes. Pakistan Journal of Medical Sciences. 2016;32(4):955–960.
4. Dasgupta A, Wahed A. Lipid metabolism and disorders. Clinical Chemistry, Immunology and Laboratory Quality Control. 2021;105–126.
5. Li LH, Dutkiewicz EP, Huang YC, Zhou HB, Hsu CC. Analytical methods for cholesterol quantification. Journal of Food and Drug Analysis. 2019;27(2):375–386.
6. Izunwanne DI, Egwurugwu JN, Emegano CL. Effect of tiger nut meal on some sex hormones and sperm cells in androgen-induced benign prostate hyperplasia in male wistar rats. Journal of Advances in Medicine and Medical Research. 2020;32(14):74-82.
7. Neglo D, Tettey CO, Essuman EK, Kortei NK, Boakye AA, Hunkpe G, Amarh F, Kwashie P, Devi WS. Comparative antioxidant and antimicrobial activities of the peels, rind, pulp and seeds of watermelon (*Citrullus lanatus*) fruit. Scientific African. 2021;11(3):78-91.
8. Odo RI, Uchendu CN, Okeke SE. Protective effects of Citrullus lanatus seed ethanol extract on aluminum chloride-induced testosterone, testicular and hematological changes in an experimental male rat model. Veterinary Research Forum. 2021;12(1):7–13.
9. Nwoye LO. Protective and therapeutic effects of Chamomilla Recutita extract on subacute ethanol intoxication in white albino rats. African Journal of Biotechnology. 2013;12(18):2378–2385. Available:https://doi.org/10.5897/AJB12.2729
10. Quek AM. Immunotherapy could benefit treatment-resistant Epilepsy. Nature Review Neurology. 2012;8:242-246.
11. Lorke D. A new approach to practical acute toxicity testing. Archives of Toxicology. 1983;54(4):275–287
12. Dennis AH, Cheema SK. Canadian Journal Physiology and Pharmacology. 2001;89: 1004.
13. Akintunde OG, Ajibola ES, Abakpa SA, Oluwo BH, Olukunle JO. Cardioprotective effect of *C. lonatus* rinds in male wistar rats. Nigerian Journal of Animal Production. 2017;44(1):106-113.
14. Rang HP, Dale MM, Ritter JM, Gardner P. Pharmacology, Churchill-Livinstone, NewYork, NY, USA; 1995.
15. Eisenhaver LA, Nicholes LW, Spencer RT, Bergan FW. Clinical pharmacology and nursing management, Lippincott, Philadelphia, Pa, USA; 1998.
16. Lehninger AL, Nelson DL, Cox MM. Lehninger principles of biochemistry, Worth Publishers, New York, NY, USA, 3rd edition; 2000.
17. Osmund CE. Basic Biochemistry of Food Nutrients, Immaculate Publication, Enugu, Nigeria, 1st edition; 2001.
18. Liu J, Sempos C, Donahue R, Dorn J, Trevisan M, Grundy SM. Joint distribution of non-HDL and LDL cholesterol and coronary heart disease risk prediction among individuals with and without diabetes. Diabetes Care. 2005;28(8):1916-1921.
19. McBride, PE. Triglycerides and risk for coronary heart disease. Journal of American Medical Association. 2007;298: 336-338
20. Adebayo H, Aliyu R, Gatsing D, Garba IH. The effects of ethanolic leaf extract of Commiphora Africana (Buseraceae) on lipid profile in rats. International Journal of Pharmacology. 2006;2(6):618–622.
21. Ighodaro MO, Omole JO. Effects of Nigerian *Piliostigma thonningii* species leaf

extract on lipid profile in wistar rats. International Scholarly Research Network; 2012.
22. Onwuka FC, Erhabor O, Eteng MU, Umoh IB. Ameliorative effect of cabbage extract on cadmium-induced changes on hematology and biochemical parameters of albino rats. Journal of Toxicology and Environmental Health Sciences. 2010; 2(2):11-16.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/123055