OPEN ACCESS
Indonesian Journal of Health Research and Development Vol 3 No 1 (2025) https://doi.org/10.58723/ijhrd.v3i1.321
Check for updates
Research Article

Hepatotoxicity And Lipid Profile Assessment Of Gardenia Jasminoides In Rats

Received : November 28, 2024 | Revised : February 17, 2025 | Accepted: February 19, 2025 | Publish : February 21, 2025

Ogba Raphael Umeh

Abstract:
This study examined hepatotoxicity and lipid profile in the liver of rats treated with Gardenia jasminoides leaf extract. Ten healthy adult male albino rats were divided into two experimental groups: Group A (control given distilled water and commercial feed) and Group B given a certain concentration of Gardenia jasminoides leaf extract and commercial feed. The rats were euthanised on day 30, and blood samples were collected for further serum analysis. Livers were evacuated and weighed, and serum samples were sent to the Nigerian University Teaching Hospital for Lipid Profile Analysis. The results showed no significant decrease in organ/body weight ratio in the treated rats. Liver enzyme test results showed an increase in ACP, AST, and ALP activities, while a slight decrease was noted for ALT activity. Lipid profile analysis showed no significant decrease in HDL, but there was a significant decrease in LDL and TC. However, there was a significant increase in TG. Liver Enzyme Test and Lipid Profile Analysis in control and treated rats revealed that Gardenia jasminoides extract had positive effects on selected liver enzymes and lipid profile of treated rats. In conclusion, Gardenia jasminoides extract is neither toxic nor hepatotoxic to the liver, but rather a hepatoprotective agent.

Keywords: Albino Rats, Gardenia Jasminoides, Hepatotoxicity, Lipid Profile, Liver Enzymes.

1. INTRODUCTION

The liver stands as the largest and most complex internal organ in the human body, playing an essential role in maintaining the internal environment through a multitude of functions. It is vital for the metabolism of proteins, fats, and carbohydrates. Additionally, the liver serves as a storage site for proteins, glycogen, and various vitamins and minerals. It is crucial for the detoxification and removal of numerous endogenous and exogenous substances. Liver diseases can be life-threatening and are a major contributor to global morbidity and mortality (Maqbool et al., 2019).

Publisher Note:

CV Media Inti Teknologi stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Copyright

©2025 by the author(s).

Licensee CV Media Inti Teknologi, Bengkulu, Indonesia. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution-ShareAlike (CCBY-SA) license

(https://creativecommons.org/licenses/by-sa/4.0/).

Presently, liver disease represents a significant public health issue worldwide, accounting for nearly 20,000 deaths each year. These diseases reflect damage to liver cells, tissues, and overall functionality. An imbalance between antioxidant and pro-oxidant levels may result in oxidative stress, which negatively impacts the organ (Vinaykumar et al., 2020).

Liver disease remains a critical public health concern on a global scale, with approximately 20,000 deaths attributed to it each year. This condition signifies damage to liver cells, tissues, and their functions. The disruption of antioxidant and pro-oxidant balance results in oxidative stress, further harming the organ (Delgado-Montemayor et al., 2015). Despite the use of various hepatoprotective agents, no treatment has proven fully effective in enhancing liver function while ensuring complete protection and rapid regeneration of liver cells (Erfan et al., 2020). Consequently, there is a pressing need to explore alternative remedies for liver damage. The application of natural treatments for liver injury has a long-standing tradition.

Contemporary medicine provides limited options for the treatment of liver diseases, with a predominant reliance on plant-based remedies for

managing liver disorders. The availability of pharmaceutical drugs specifically targeting liver conditions is quite restricted. Consequently, numerous traditional herbal medicines have been evaluated for their antioxidant and hepatoprotective properties in experimental animal studies. The hepatoprotective effects of various drugs and plant extracts have been investigated using carbon tetrachloride (CCl4)-induced hepatotoxicity models. Herbal remedies are often preferred over allopathic medications for hepatoprotection due to their lower cost, greater cultural acceptance, enhanced compatibility with the human body, and reduced side effects. These herbal treatments have demonstrated efficacy in preserving the liver's normal functional status, often with minimal adverse effects (Hassan et al., 2019). Liver disease remains a significant public health concern globally, resulting in approximately 20,000 fatalities annually. Such diseases reflect damage to liver cells, tissues, and overall function. An imbalance between antioxidant and pro-oxidant levels can lead to oxidative stress, further compromising liver health (Salim et al., 2019).

The plant has been used as a natural remedy to treat fever, inflammation, and problems with the liver and gallbladder. A significant traditional remedy for inflammation, jaundice, headaches, edema, fever, hepatitis, and hypertension, Gardenia jasminoides fruit has a variety of biological properties. Croc-in (crocetin di-gentiobiose ester), a yellow pigment and water-soluble carotenoid, is found in Gardenia fruits and is utilized as a food coloring in Oriental countries for items like noodles and candies (Zongram et al., 2017). Among the many chemical components found in liver-protective medications, flavonoids and volatile oils are the most frequently found livoprotective active ingredients (Iqbal & Khan, 2019). Iron, copper, phosphorus, and arsenic are some of the different inorganic substances that cause hepatotoxicity. Mycotoxins, bacterial toxins, and some naturally occurring plant poisons like pyrrolizidine alkaloids are examples of organic agents. Different levels of hepatocyte degeneration and cell death through either apoptosis or necrosis are characteristics of liver injury brought on by hepatotoxins, such as carbon tetra chloride (CCl4), ethanol, and acetaminophen. Reactive intermediate production (Arige et al., 2017). By methodically assessing the hepatotoxic potential and lipid profile changes brought on by Gardenia jasminoides in rats, this study sought to fill in the gaps.

2. MATERIAL AND METHOD

2.1 Plant Sample Collection and Identification

Gardenia jasminoides leaves was obtained from Igalamela/Odolu Local Government Area of Kogi State with some branches and was identified at the Biochemistry Laboratory, Department of Science Laboratory Technology, The Federal Polytechnic, Idah Kogi State.

2.2 Plant Sample Preparation

The leaves of Gardenia jasminoides was washed thoroughly with a tap water and rinsed with distilled water twice and allowed to dry under ambient temperature in the Laboratory. The dried material was crushed into powdered form using mortar and pestle. The obtained fine powder form was used to prepare the aqueous extract. The powder form of the plant was measured 20g and soaked in 400ml of distilled water and left for 12 hours at ambient temperature and thereafter filtered using Whatman filter paper (Yunana & Dahiru, 2015).

2.3 Animal and Experimental Design

Ten (10) healthy male adult albino rats weighing average 186g were obtained from the Animal House, Kogi State University, Anyigba. The animals were housed under standard laboratory condition of light, temperature and humidity. The animals were given free access to feed (Standard Rat Pellets) and drinking tap water (Under 12 hours' light/dark) at 23 ± 3°C. The animals were acclimatized in a wooden cage for two weeks and were randomly divided into two (2) experimental groups of five (5) rats each prior to treatment (Yin & Liu, 2018). Group A (distilled water-treated 'control'); group B treated with a specified concentration of aqueous leaf extract of *G. jasminoides* for the period of 30 days. The prescribed doses of plant extract were orally administered to the Rats daily, for 30days of the experiment. Body weights of the rats were measured on the 30th day prior to sacrifice (Atef et al., 2021).

2.4 Biochemical Analysis

2.4.1 Evaluation of Body Weight

Rats in the group A and B were weighed on the first day (D_0) and at the end of the 30th day (D_{30}). The percentage change in body weight was calculated using the formula.

Percentage change in body weight = $\frac{W_n - W_i}{W_i} \times 100$

Where

Wn = measurement on the first day (D_0)

Wi = measurement at the end of the subsequent days (Dn);

N = the day to be analyzed.

2.4.2 Blood Sample Collection

A blood sample for each rat were collected into different sample bottles via the jugular vein and was stored in the refrigerator to avoid bacterial contamination before centrifugation for further serum analysis. The enzymatic activities of serum ami*--6no transferase Alkaline Phosphatase activity (ALT), Aspartate aminotransferase activity (AST) were assayed using standard assay kits (Singh et al., 2016).

2.4.3 Tissue Isolation and Preparation

The liver was collected by parallel dissection of the animal, cleansed of superficial connective tissue and blood, and weighed. The liver was homogenized in equivalent amount of sucrose solution. The homogenized sample transferred into a plain bottle after which 0.25 M sucrose solution was used to give a dilution factor of 50.

2.4.4 Lipid Profile Analysis

The Lipid Profile analysis was conducted at University of Nigeria Teaching Hospital Ozaria in Enugu State.

2.4.5 Determination of Alkaline and Acid Phosphatase Activity

The enzyme was assayed by the method described by Randox standard assay kit. The amount of phosphate ester hydrolyzed within a given period of time. Para-nitro phenyl phosphate was hydrolyzed to para-nitrophenol and phosphate at pH of 10.1 by the enzyme.

2.4.6 Determination of Aspartate and Alanine Aminotransferase Activity

The enzyme was evaluated using the method outlined in the Randox standard assay kit. The activity of aspartate aminotransferase was determined by tracking the formation of oxaloacetate hydrazone in reaction with 2,4-dinitrophenylhydrazine (Ilyas et al., 2016). est tubes designated as blank and sample were arranged in a test tube rack. To the blank tube, 0.1 ml of distilled water was added, while 0.1 ml of the homogenate was introduced into the sample tube. Subsequently, 0.5 ml of R1, which contained phosphate buffer, L-alanine, and α-oxoglutarate, was added to each tube, followed by shaking and incubation at 37 ˚C for 30 minutes. After this incubation, 0.5 ml of R2, containing 2,4-dinitrophenylhydrazine, was added to all tubes, which were then shaken and allowed to stand for 20 minutes at a temperature range of 20-25 ˚C. Following this period, 5.0 ml of 0.4 M sodium hydroxide was added to each test tube and mixed thoroughly. The absorbance was measured after a 5-minute interval at a wavelength of 546 nm. The activity of alanine aminotransferase in the sample was determined using the calibration curve. The enzyme Specific Activity (nmol/min/mg protein) can be calculated using equation 2.2

Enzyme Specific Activity

$$\text{(nmol/min/mg protein)} = \frac{Enzyme\ Activity}{Protein\ Concentration}$$

Statistical Analysis

Statistical analysis was performed using SPSS Statistical analyzer. The data were analyzed by one-way variance (ANOVA) followed by Duncan Post Hoc test. All data are expressed as the mean of six replicates ± standard error of mean (S.D). Values were considered statistically at $p < 0.05$ (confidence level = 95 %).

3. RESULT AND DISCUSSION

3.1 Organ/Body Weight Ratio

Based on the result shown in Table 3.1, it is observed that the plant aqueous extract, after 30days of animal oral administration to normal rats at dose 50 mg/g showed no significant increase in the body weight. Furthermore, the liver-to-body weight ratio analysis indicates that the treatment with Gardenia jasminoides does not significantly alter liver size, which is an encouraging sign regarding its non-toxic impact on liver health (Xiao et al., 2017). Further investigations, including biochemical liver function tests and histopathological analyses, would provide more comprehensive insights into the overall liver health and the absence of toxic effects.

Table 1. Organ/Body Weight Ratio

Groups	Liver/Body weight ratio
Control	0.24 ± 0.01^a
Treatment Group	0.23 ± 0.03^a

The mean of five determinations ± SEM is represented by each value. Significant differences ($P < 0.05$) exist between values in the same column with different superscripts. There is no statistically significant difference between the liver-to-body weight ratios of the control and treatment groups, as indicated by the "a" next to the ratios. The control group's liver-to-body

weight ratio is 0.24 with a standard deviation of 0.01 and the treatment group's is 0.23 with a standard deviation of 0.03.

3.2 Some Selected Liver Enzymes of Rats Treated with Gardenia jasminoides

Since there is no discernible rise in the enzyme markers ALT, ACP, ALP, and AST, G. jasminoides has no effect on the liver. The study's findings, which are shown in table 3.2, indicate that the extract raised the levels of the enzyme makers ACP and AST but did not significantly affect them when compared to the control. It also slightly decreased the levels of ALT and ALP but did not significantly affect them either.

Table 2. Some Selected Liver Enzymes of Rats Treated with Gardenia jasminoides

Parameters	**Control**	**Treatment Group 50mg/g BW GJ**
Acid phosphatase (mmol/mg protein/min)	151.56 ± 1.70[a]	154.09 ± 1.63[a]
Aspartate Transaminase (U/mg)	123.52 ± 1.43[a]	124.07 ± 1.93[a]
Alanine aminotransferase (U/mg)	121.08 ± 1.70[a]	120.96 ± 1.70[a]
Alkaline phosphatase (mmol/mg protein/min)	127.06 ± 1.70[a]	126.07 ± 1.70[a]

Each value is a mean of 5 determinations ± SEM. Values along the same column with different superscripts are significantly different ($P < 0.05$), GJ = Gardenia jasminoides.

3.3 Some Selected Serum Enzymes of Rats Treated with Gardenia jasminoides

The result of this research show that the extract reduced the level of enzyme serum (ACP, AST and ALT) compared with the control. Again, a slight increase is observed in the enzyme serum level of ALP but not significantly different when compared with the control.

Table 3. Some Selected Serum Enzymes of Rats Treated with Gardenia jasminoides

Parameters	**Control**	**Treatment Group 50mg/g Body weight GJ**
Acid phosphatase (mmol/mg protein/min)	46.06 ± 1.70[a]	45.59 ± 1.63[a]
Aspartate Transaminase (U/mg**)**	36.52 ± 4.43[a]	34.97 ± 1.93[a]
Alanine aminotransferase (U/mg)	44.52 ± 1.63[a]	41.82 ± 2.43[a]
Alkaline phosphatase (mmol/mg protein/min)	49.52 ± 1.13[a]	50.32 ± 1.73[a]

Each value is a mean of 5 determinations ± SEM. Values along the same column with different superscripts are significantly different ($P < 0.05$), GJ = Gardenia jasminoides.

3.4 Lipid Profile Analysis

From table 3.4 the lipid profile analysis suggests that the treatment with Gardenia jasminoides extract has a significant impact on certain lipid parameters in rats. Specifically, the significant reductions in low density lipoprotein (LDL), total cholesterol (TC) and total lipids (TL) indicate a potential cardioprotective effect of the treatment. These findings are important as they suggest that Gardenia jasminoides may help manage hyperlipidemia and reduce the risk of cardiovascular diseases. However, the increase in triglyceride levels, although not statistically significant, is a point of concern and requires further investigation to fully understand the treatment's effect on lipid metabolism.

The non-significant change in high density lipoprotein (HDL) levels suggests that the treatment lowers harmful lipid levels, it does not adversely affect beneficial high density lipoprotein (HDL) cholesterol.

Overall, these results highlight the potential of Gardenia jasminoides as a natural agent for improving lipid profiles and possibly reducing cardiovascular risk.

Table 4. Lipid Profile Analysis Behavior

PARAMETERS	CONTROL RAT	TREATED RAT
HDL (mg/dl)	46.60 ± 1.030	45.80 ± 0.860
LDL (mg/dl)	124.00 ± 5.050	98.20 ± 2.596
TC (mg/dl)	186.00 ± 3.962	170.60 ± 2.337
TG mg/dl	76.60 ± 1.435	85.40 ± 1.691
TL (mg/dl)	433.00 ± 9.394	395.00 ± 3.578

Mean ±SEM. ($P \leq 0.05$).

Serum concentrations of High density Lipoproteins (HDL; mg/dl), Low Density Lipoproteins (LDL; mg/dl), Total Cholesterol (TC; mg/dl), Triglycerides (TG; mg/dl) and Total Lipids (TL; mg/dl) of rats in each group (n=5).

4. CONCLUSION

In conclusion, the analysis of the liver to body weight ratio in rats indicates no significant difference between the control group and the treatment group, as both values share the same superscript, signifying a lack of statistical significance ($P < 0.05$). This suggests that treatment with Gardenia jasminoides does not significantly affect the liver to body weight ratio in rats. The analysis of selected serum enzymes in rats treated with Gardenia jasminoides (50mg/g body weight) indicates no significant differences between the control and treatment groups. Therefore, the results suggest that the treatment with Gardenia jasminoides does not significantly affect the serum levels of these enzymes in rats. The analysis of selected liver enzymes in rats treated with Gardenia jasminoides (50mg/g BW) shows no significant differences between the control and treatment groups across various enzymes and it indicate that Gardenia jasminoides does not significantly alter the levels of these liver enzymes in rats.

The lipid profile analysis of rats treated with Gardenia jasminoides shows significant improvements in certain parameters. This suggests that Gardenia jasminoides effectively reduces LDL, TC, and TL levels in rats.

5. ACKNOWLEDGEMENT

We would like to thank all the participants who contributed to this study. The support and co-operation of the participants were very helpful in the smoothness and success of this research. We also thank those who have provided the necessary support and facilities during the research. Hopefully the results of this study can provide tangible benefits for the development of science and health.

AUTHOR INFORMATION

Author

Ogba Raphael Umeh, The Federal Polytechnic Idah, Nigeria
Orcid id : https://orcid.org/0009-0007-9163-2984
Email: raphaelobinna9@gmail.com

REFFERENCE

Arige, S. S., Arige, S. S. D., & Rao, L. (2017). Review Article A Review On Hepatoprotective Activity. International Journal of Current Research, 9(6), 51876–51881. http://dx.doi.org/10.13040/IJPSR.0975-8232.5(3).690-02

Atef, M. M., El-Gendi, A. B. Y. I., Amer, A. M., Al Razzak, B. A., Abo-El-Sooud, K., & Ibrahim, S. I. (2021). Antioxidant, Hepatoprotective and In vitro Cytotoxic Activities of Cichorium intybus L. Extract. Advances in Animal and Veterinary Sciences, 9(1), 137–142. https://doi.org/10.17582/journal.aavs/2021/9.1.137.142

Delgado-Montemayor, C., Cordero-Pérez, P., Salazar-Aranda, R., & Waksman-Minsky, N. (2015). Models of hepatoprotective activity assessment. Medicina Universitaria, 17(69), 222–228. https://doi.org/10.1016/j.rmu.2015.10.002

Erfan, M., Maulyda, M. A., Hidayati, V. R., Astria, F. P., & Ratu, T. (2020). Analisis Kualitas Soal Kemampuan Membedakan Rangkaian Seri Dan Paralel Melalui Teori Tes Klasik Dan Model Rasch. 3(1), 11–19. http://dx.doi.org/10.23887/ijerr.v3i1.24080

Hassan, T., D, V. , Naseer, I., & N, A. (2019). Hepatoprotective Activity of Some Medicinal Plants: a Review. International Research Journal of Pharmacy, 10(5), 9–16. https://doi.org/10.7897/2230-8407.1005154

Ilyas, U., Katare, D. P., Aeri, V., & Naseef, P. P. (2016). A review on hepatoprotective and

immunomodulatory herbal plants. Pharmacognosy Reviews, 10(19), 66–70. https://doi.org/10.4103/0973-7847.176544

Iqbal, B., & Khan, N. A. (2019). Hepatoprotective and anti-hepatitis effect of non pharmacopoeial compound formulation on CCl4-induced hepatotoxicity in albino rats. Indian Journal of Traditional Knowledge, 18(1), 47–51. Google Scoolar

Maqbool, M., Rasool, S., Dar, M. A., Bashir, R., & Khan, M. (2019). Hepatotoxicity and Hepatoprotective agents: A Mini review. PharmaTutor, 7(9), 34–40. https://doi.org/10.29161/PT.v7.i9.2019.34

Salim, S. A., Hamza, S. Y., & Habeeb, M. S. (2019). Enhancement of gardenia jasminoides ellis friable callus growth and its constituents of some bioactive compounds. Plant Archives, 398–402.Google Schoolar

Singh, D., Cho, W. C., & Upadhyay, G. (2016). Drug-induced liver toxicity and prevention by herbal antioxidants: An Overview. Frontiers in Physiology, 6(2), 1–18. https://doi.org/10.3389/fphys.2015.00363

Vinaykumar, N. M., Mahmood, R., Krishna, V., Ravishankara, B., & Shastri, S. L. (2020). Antioxidant and in vivo hepatoprotective effects of Gardenia gummifera L.f. fruit methanol extract. Clinical Phytoscience, 6(1), 1–14. https://doi.org/10.1186/s40816-020-00188-7

Xiao, W., Li, S., Wang, S., & Ho, C. T. (2017). Chemistry and bioactivity of Gardenia jasminoides. Journal of Food and Drug Analysis, 25(1), 43–61. https://doi.org/10.1016/j.jfda.2016.11.005

Yin, F., & Liu, J. (2018). Research and application progress of Gardenia jasminoides. Chinese Herbal Medicines, 10(4), 362–370. https://doi.org/10.1016/j.chmed.2018.09.001

Yunana, & Dahiru, D. (2015). Effect of Aqueous Leaves Extract of Gardenia ternifolia Plant on Carbon Tetrachloride-Induced Hepatotoxicity in Rats. IOSR Journal of Pharmacy and Biological Sciences (IOSR-JPBS, 10(6), 73–82. https://doi.org/10.9790/3008-10647382

Zongram, O., Ruangrungsi, N., Palanuvej, C., & Rungsihirunrat, K. (2017). Standardization of Gardenia jasminoides fruits and crocin content analysis using UV/visible spectrophotometry. Chiang Mai Journal of Science, 44(4), 1453–1462. Google Schoolar