

<https://doi.org/10.48047/AFJBS.6.14.2024.6313-6318>



African Journal of Biological Sciences

Journal homepage: <http://www.afjbs.com>



Research Paper

Open Access

SYNERGISTIC EFFECT OF AZADIRACHTA INDICA LEAF EXTRACT FOR HEPATOPROTECTIVE ACTIVITY: A COMPREHENSIVE STUDY

Anupama Maurya¹, Abhay Gupta²

¹Research Scholar, Faculty of Pharmacy, Lords University Chikani, Alwar, Rajasthan, India

²Faculty of Pharmacy, Lords University, Chikani, Alwar, Rajasthan, India

***Corresponding Author:** Anupama Maurya*, Research Scholar, Faculty of Pharmacy, Lords University Chikani, Alwar, Rajasthan, India

Volume 6, Issue 14, Aug 2024

Received: 15 June 2024

Accepted: 25 July 2024

Published: 15 Aug 2024

doi: [10.48047/AFJBS.6.14.2024.6313-6318](https://doi.org/10.48047/AFJBS.6.14.2024.6313-6318)

Abstract:

Liver diseases pose significant health challenges globally, necessitating the exploration of effective natural hepatoprotective agents. This study investigates the hepatoprotective effects of *Azadirachta indica* (neem) leaf extract and evaluates its potential synergistic benefits when combined with other herbal extracts. Using a murine model of chemically induced hepatotoxicity, we assessed the effects of *Azadirachta indica* leaf extract through biochemical assays, oxidative stress measurements, and histopathological evaluations. The results demonstrate significant hepatoprotective effects, suggesting that *Azadirachta indica* could be a valuable natural therapeutic agent for liver protection.

Keywords: *Azadirachta indica*, hepatoprotective, liver health, oxidative stress, natural medicine

1. Introduction

Liver diseases such as hepatitis, cirrhosis, and fatty liver disease are major global health issues that significantly affect the quality of life and increase healthcare costs. Traditional medicine has long utilized various herbal remedies for liver health, with *Azadirachta indica* (neem) being one of the most prominent. Known for its wide range of medicinal properties, neem is traditionally used for its antibacterial, antifungal, and anti-inflammatory effects [1].

Azadirachta indica contains numerous bioactive compounds, including flavonoids, terpenoids, and alkaloids, which are believed to contribute to its hepatoprotective properties [2]. Despite these traditional uses, there is limited comprehensive research on the effectiveness of neem leaf extract in liver protection and its potential synergistic effects when combined with other herbal extracts.

This study aims to fill this gap by investigating the hepatoprotective effects of neem leaf extract and exploring the potential enhancement of these effects through synergistic combinations.

2. Literature Review

Liver diseases represent a significant global health challenge due to their impact on metabolic functions and overall well-being. Traditional medicine has increasingly turned to natural remedies for managing liver health, with *Azadirachta indica* (neem) leaf extract emerging as a prominent candidate. This review consolidates recent research on the hepatoprotective and synergistic effects of *Azadirachta indica* leaf extract, exploring its mechanisms of action and potential benefits in combination therapies.

2. *Azadirachta indica* and Liver Health

Azadirachta indica, commonly known as neem, has been recognized for its diverse medicinal properties, particularly in the context of liver health. Ganguly and Pal (2020) provide a comprehensive overview of neem's role in liver health, highlighting its traditional use and the scientific evidence supporting its hepatoprotective effects. They emphasize that neem leaves contain various bioactive compounds, such as flavonoids, terpenoids, and alkaloids, which contribute to its therapeutic properties [1].

According to Rao and Kumar (2019), neem leaf extract exhibits substantial hepatoprotective and antioxidant effects. Their review details how neem's active compounds, including azadirachtin, nimbin, and nimbolide, have been shown to counteract liver damage induced by various toxins. They also discuss the mechanisms through which neem extract mitigates oxidative stress and inflammation, essential factors in liver damage [2].

3. Extraction Methods and Antioxidant Activity

The efficacy of neem leaf extract is closely tied to the method of extraction used. Sharma and Gupta (2021) explore different extraction methods and their impact on antioxidant activity. They found that both aqueous and ethanolic extracts of neem leaves exhibit significant antioxidant activity, with ethanolic extracts generally providing higher yields of active compounds. This study underscores the importance of extraction methods in maximizing the hepatoprotective potential of neem leaf extract [3].

4. Experimental Evidence of Hepatoprotective Effects

Singh and Kaur (2018) provide experimental evidence on the protective effects of neem leaf extract against liver toxicity induced by carbon tetrachloride (CCl_4) in rats. Their study demonstrates that neem extract significantly reduces liver enzyme levels, indicating decreased liver damage. Histopathological analyses revealed reduced necrosis and inflammation in liver tissues of treated animals, confirming neem's protective role against hepatotoxicity [4].

5. Synergistic Effects of Neem Leaf Extract

The concept of combining neem leaf extract with other herbal extracts to enhance liver protection is explored by Srinivasan and Ramachandran (2020). Their research shows that neem leaf extract, when combined with other herbal remedies, provides a synergistic effect, improving overall liver health beyond what is achievable with single extracts alone. This synergistic interaction is believed to arise from the complementary mechanisms of action among the different herbal components [5].

6. Biochemical Assays and Oxidative Stress Assessment

Kumar and Verma (2022) review various biochemical assays used to assess liver function, including the measurement of liver enzymes such as AST, ALT, and ALP. These assays are critical for evaluating the hepatoprotective effects of treatments. Yadav and Gupta (2019) discuss the role of oxidative stress in liver disease and the importance of antioxidant defense mechanisms. They highlight how oxidative stress contributes to liver damage and how neem leaf extract's antioxidant properties can help mitigate this damage [6][7].

3. Materials and Methods

3.1. Plant Material and Extract Preparation

Fresh *Azadirachta indica* leaves were collected. After thorough washing and drying, the leaves were powdered and subjected to extraction using aqueous and ethanolic solvents. Aqueous extraction involved boiling the powdered leaves in distilled water, while ethanolic extraction involved soaking the powder in ethanol for 48 hours. Both extracts were then concentrated using a rotary evaporator and stored for further use.

3.2. Experimental Design

3.2.1. Animal Model

Male sprague-dawley rats (200-250 grams) were acclimatized for one week before being divided into the following groups: control, hepatotoxicity-induced (model), and treatment groups (receiving varying doses of *Azadirachta indica* leaf extract and combinations with other herbal extracts). Hepatotoxicity was induced using carbon tetrachloride (CCl_4) administered intraperitoneally.

3.2.2. Treatment Administration

The treatment groups received *Azadirachta indica* leaf extract at doses of 100, 200, and 400 mg/kg body weight, respectively. A combination group was also treated with *Azadirachta indica* extract and other herbal extracts in the same dosages. Treatments were administered orally for four weeks.

3.3. Biochemical Assays

3.3.1. Liver Function Tests

Blood samples were collected at the end of the study period to measure serum levels of liver enzymes: aspartate aminotransferase (AST), alanine aminotransferase (ALT), and alkaline phosphatase (ALP). These assays were performed using standard commercial kits.

3.3.2. Oxidative Stress Assessment

Oxidative stress was assessed by measuring malondialdehyde (MDA) levels, a marker of lipid peroxidation, and glutathione (GSH) levels, an indicator of antioxidant defense. Liver tissues were homogenized, and MDA and GSH levels were determined using spectrophotometric methods.

3.4. Histopathological Analysis

Liver tissues were fixed in formalin, embedded in paraffin, and sectioned. The sections were stained with hematoxylin and eosin (H&E) and examined under a light microscope to evaluate liver damage, necrosis, and inflammation.

4. Results

4.1. Biochemical Findings

4.1.1. Liver Enzyme Levels

The hepatotoxicity-induced group exhibited significantly elevated serum levels of AST, ALT, and ALP compared to the control group. Treatment with *Azadirachta indica* leaf extract resulted in a dose-dependent reduction in these enzyme levels. The high-dose group showed reductions approaching normal levels, while the combination treatment group demonstrated an even greater decrease in enzyme levels.

4.1.2. Oxidative Stress Markers

MDA levels were significantly higher in the hepatotoxicity-induced group, and GSH levels were significantly lower. Treatment with *Azadirachta indica* leaf extract led to a significant decrease in MDA levels and an increase in GSH levels. The combination treatment further improved these parameters, indicating enhanced antioxidant protection.

4.2. Histopathological Observations

Histopathological examination revealed severe liver necrosis and inflammation in the hepatotoxicity-induced group. Treatment with *Azadirachta indica* leaf extract improved liver histology, with reduced necrosis and inflammation. The combination treatment group showed the most pronounced restoration of liver tissue structure, highlighting the synergistic effect.

5. Discussion

The hepatoprotective effects of *Azadirachta indica* leaf extract were evident from the significant improvements observed in liver function tests, oxidative stress markers, and histopathological evaluations. The extract demonstrated dose-dependent hepatoprotective effects, with the highest dose showing the most substantial benefits. The combination treatment also revealed enhanced efficacy, suggesting a synergistic interaction between *Azadirachta indica* extract and other herbal extracts.

5.1. Mechanisms of Action

The hepatoprotective effects of *Azadirachta indica* leaf extract are likely due to its rich content of bioactive compounds with antioxidant and anti-inflammatory properties. Flavonoids and terpenoids in neem have been shown to scavenge free radicals and reduce oxidative stress, which is a key contributor to liver damage. Additionally, neem's anti-inflammatory properties help mitigate liver inflammation and promote tissue repair.

5.2. Clinical Implications

The findings of this study support the potential use of *Azadirachta indica* leaf extract as a natural hepatoprotective agent. Its ability to reduce liver enzyme levels, improve oxidative stress parameters, and restore liver tissue structure highlights its therapeutic potential. Further clinical trials are needed to confirm these effects in humans and to explore the optimal formulation and dosage.

Conclusion

This research underscores the significant hepatoprotective effects of *Azadirachta indica* leaf extract and its potential for synergistic enhancement when combined with other herbal extracts. The improvements in liver function, oxidative stress parameters, and histological findings suggest that *Azadirachta indica* could be a valuable addition to natural therapies for liver health. Further research and clinical validation are essential to fully understand its therapeutic potential and practical applications.

6. References

1. Ganguly, D., & Pal, S. (2020). *Azadirachta indica* (Neem) in liver health: A comprehensive review. *Journal of Traditional and Complementary Medicine*, 10(3), 334-345.
2. Pramod K, Deval RG, Lakshmayya, Ramachandra SS. Antioxidant and hepatoprotective activity of tubers of *Momordica tuberosa* Cogn. Against CCl₄ induced liver injury in rats. *Indian J Exp Biol* 2008;46(7):510-3.
3. Rao, M.V., & Kumar, K.S. (2019). Hepatoprotective and antioxidant effects of neem (*Azadirachta indica*) leaf extract: A review. *Journal of Medicinal Plants Research*, 13(8), 162-171.
4. Sharma, A., & Gupta, S. (2021). Extraction methods and antioxidant activity of *Azadirachta indica* leaf extracts. *Phytotherapy Research*, 35(4), 1080-1092.
5. Singh, R., & Kaur, S. (2018). Protective effect of neem (*Azadirachta indica*) against liver toxicity induced by carbon tetrachloride in rats. *Biochemical Pharmacology*, 156, 212-224.
6. Srinivasan, K., & Ramachandran, C. (2020). Synergistic effects of neem leaf extract and other herbal extracts on liver health. *Journal of Herbal Medicine*, 20, 100-110.
7. Kumar, V., & Verma, S.K. (2022). Biochemical assays for liver function tests: An overview. *Clinical Biochemistry*, 89, 15-24.

8. Yadav, R., & Gupta, N. (2019). Assessment of oxidative stress and antioxidant defense in liver disease. *Free Radical Biology and Medicine*, 139, 66-75.
[Link](<https://doi.org/10.1016/j.freeradbiomed.2019>)