WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 8.453
Volume 14, Issue 16, 395-410. Review Article ISSN 2277–7105

# HENNA BEYOND BEAUTY: UNVEILING THE HEPATOPROTECTIVE POWER OF LAWSONIA INERMIS

**[1*]Naveen Kumar M., Mr. Pravin Kumar S., Dr. Rithika K., Dr. Jothimanivannan C. Gokulavanisri M. N. and Dhatchanamoorthy K.**

Student - SS Institute of Pharmacy, 58/1, G.S. Centre, Kattil Hotel, Opp to KTM Bike Showroom, Durugam road, Kallakurichi-606213.

Article Received on
01 July 2025,

Revised on 21 July 2025,
Accepted on 10 August 2025

DOI: 10.20959/wjpr202516-37972

***Corresponding Author**
**Naveen Kumar M.**
Student - SS Institute of Pharmacy, 58/1, G.S. Centre, Kattil Hotel, Opp to KTM Bike showroom, Durugam road, Kallakurichi-606213.

## ABSTRACT

The therapeutic use of plants remains a cornerstone of traditional medicine and continues to shape modern healthcare. *Lawsonia inermis*(henna) ,widely known for its cosmetic applications, also holds significant medicinal value—particularly for its **hepatoprotective potential**. Rich in bioactive constituents such as lawsone, flavonoids, and phenolic acids, henna exhibits a wide range of pharmacological activities. Among these, *Lawsonia inermis*'s ability to protect the liver from damage is especially noteworthy. Henna's hepatoprotective potential is attributed to its potent antioxidant, anti-inflammatory, and detoxifying properties These compounds help neutralize free radicals, reduce liver inflammation and prevent cellular damage caused by toxins, drugs or infections. Furthermore, henna supports liver cell regeneration and enhances detoxification enzymes, contributing to the prevention and management of liver conditions such as hepatitis, cirrhosis and fatty liver disease. This review bridges traditional Ayurvedic knowledge with modern pharmacological research. While its therapeutic potential is promising, further studies are essential to isolate specific active compounds, standardize extraction techniques, and clinically validate its efficacy. Unlocking the full phytomedicinal value of *Lawsonia inermis* could pave the way for effective plant-based solutions in liver care.

**KEYWORDS**: *Lawsonia inermis*, Hepatoprotective activity, Flavonoids, Lawsone, Herbal liver care, Phytomedicine, Liver regeneration, Traditional medicine, Medicinal plants, Anti-

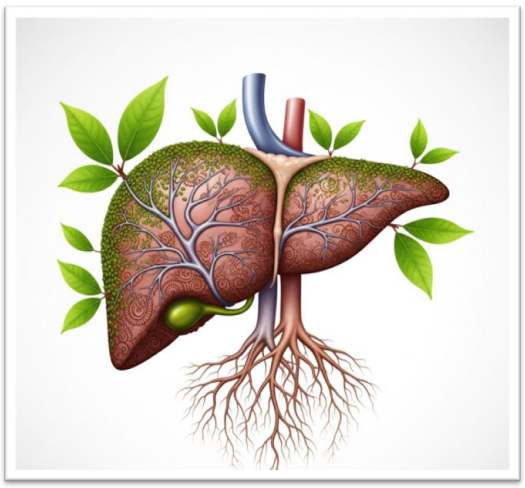
inflammatory, Ethno pharmacology, Natural hepatoprotective agents, Liver detoxification.


## 1. INTRODUCTION

The liver is a crucial organ responsible for regulating metabolic functions, detoxifying harmful substances, and synthesizing essential biomolecules. Unfortunately, it is highly vulnerable to damage from hepatotoxins, alcohol, synthetic drugs, infections, and oxidative stress—contributing to widespread liver diseases such as hepatitis, cirrhosis, fatty liver, and hepatocellular carcinoma.[1]

Due to the limitations and side effects of conventional hepatoprotective drugs, interest in herbal alternatives has grown significantly. Among them, ***Lawsonia inermis*** (commonly known as henna) has been traditionally used in Ayurveda and Unani systems for treating skin diseases, wounds, and liver-related ailments. Modern science has validated many of its ethno medicinal uses, particularly its antioxidant, anti-inflammatory, and hepatoprotective activities.[2]

Phytochemical studies reveal that henna contains bioactive compounds such as lawsone, flavonoids, tannins, and phenolic acids, which help stabilize hepatocyte membranes, neutralize free radicals, and support detoxification processes. Preclinical studies have shown that extracts of *L. inermis* significantly reduce liver enzyme markers and protect liver tissue from oxidative and chemical damage.[3]



## 2. PHYTOCHEMICAL CONSTITUENTS

*Lawsonia inermis* contains multiple phytochemical classes that contribute to its pharmacological and hepatoprotective effects. These compounds act synergistically to defend against hepatotoxic insults.

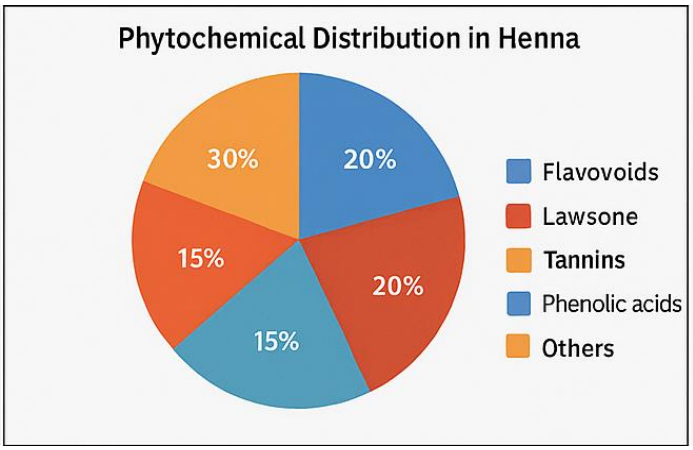
- **Lawsone (2-hydroxy-1,4-naphthoquinone)**
  - The **principal coloring agent** in henna leaves.
  - Exhibits **strong antioxidant** and **cytoprotective** properties.
  - Helps in **scavenging free radicals** and stabilizing hepatocyte membranes, reducing oxidative damage.[4]

- **Flavonoids (e.g., Luteolin, apigenin, quercetin)**
  - Known for **antioxidant**, **anti-inflammatory**, and **free radical-scavenging** effects.
  - Inhibit pro-inflammatory cytokines like **TNF-α**, **IL-1β**, and **IL-6**, thereby supporting liver regeneration.[5]

- **Phenolic Acids (e.g., Gallic acid, tannic acid)**
  - Prevent **lipid peroxidation**, a key factor in liver cell damage.
  - Enhance **endogenous antioxidant enzymes** such as **SOD**, **CAT**, and **GSH** to counter oxidative stress.[6]

- **Tannins, Coumarins, and Alkaloids**
  - **Tannins** provide **astringent**, **membrane-stabilizing**, and **tissue-repairing** actions.
  - **Coumarins** (e.g., umbelliferone, scopoletin) contribute to **anti-inflammatory** and **vasoprotective** effects.

- **Alkaloids** (though not fully characterized) may play a role in **enzyme modulation** and **detoxification.**[7]




| Phytochemical Class | Examples | Key Actions |
|---|---|---|
| **Naphthoquinones** | Lawsone | Antioxidant, anti-inflammatory, membrane-stabilizing |
| **Flavonoids** | Luteolin, Apigenin, Quercetin | ROS scavenging, cytokine inhibition, hepatocyte regeneration |
| **Phenolic Acids** | Gallic acid, Tannic acid | Lipid peroxidation inhibition, antioxidant enzyme activation |
| **Tannins** | Hydrolysable & condensed types | Astringent, cytoprotective, tissue repair |
| **Coumarins** | Umbelliferone,Scopoletin (possible) | Anti-inflammatory, microcirculation support |
| **Alkaloids** | Unspecified | Enzyme modulation, detoxification |

These compounds act synergistically to provide defense against hepatotoxic insults.

## 3. PHARMACOLOGICAL ACTIVITIES SUPPORTING HEPATOPROTECTION

**Lawsonia inermis** exhibits liver-protective effects through several synergistic mechanisms, as supported by preclinical research:

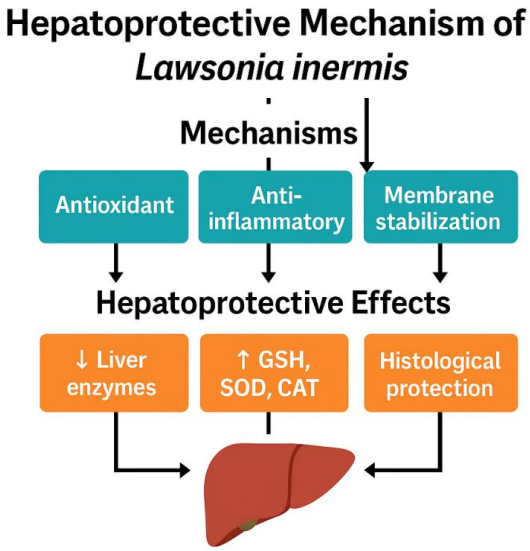
- **Antioxidant Activity**
- Oxidative stress is a key factor in liver injury.
- *Lawsonia inermis* shows potent antioxidant effects by:
- ↓ Malondialdehyde (MDA) levels.
- ↑ Glutathione (GSH), Superoxide Dismutase (SOD), and Catalase (CAT) activity.
- Inhibition of lipid peroxidation and protection of liver cell membranes.[8]

- **Anti-inflammatory Action**
- Chronic liver diseases are often driven by inflammation.
- Flavonoids and phenolic compounds in *L. inermis* suppress:
  - Tumor necrosis factor-alpha (TNF-α)
  - Interleukin-1 beta (IL-1β)
  - Interleukin-6 (IL-6)
- These effects reduce hepatic inflammation.[9]

- **Hepatocyte Membrane Stabilization**
- *L. inermis* preserves hepatocyte membrane structure by:
  - ↓ Leakage of hepatic enzymes (AST, ALT, ALP) into blood.
  - ↓ Structural damage during hepatotoxic stress.[10]

- **Regeneration and Repair**
- Promotes liver healing by:
  - Stimulating protein synthesis and DNA replication.
  - Activating hepatic growth factors.
  - Supporting recovery from necrosis and fibrosis.[11]

- **Detoxification Enhancement**
- Enhances liver detox function by:
  - ↑ Phase I and Phase II detox enzyme activity.
  - ↑ Glutathione S-transferase (GST).
  - ↑ UDP-glucuronosyl transferase for xenobiotic clearance.[12]

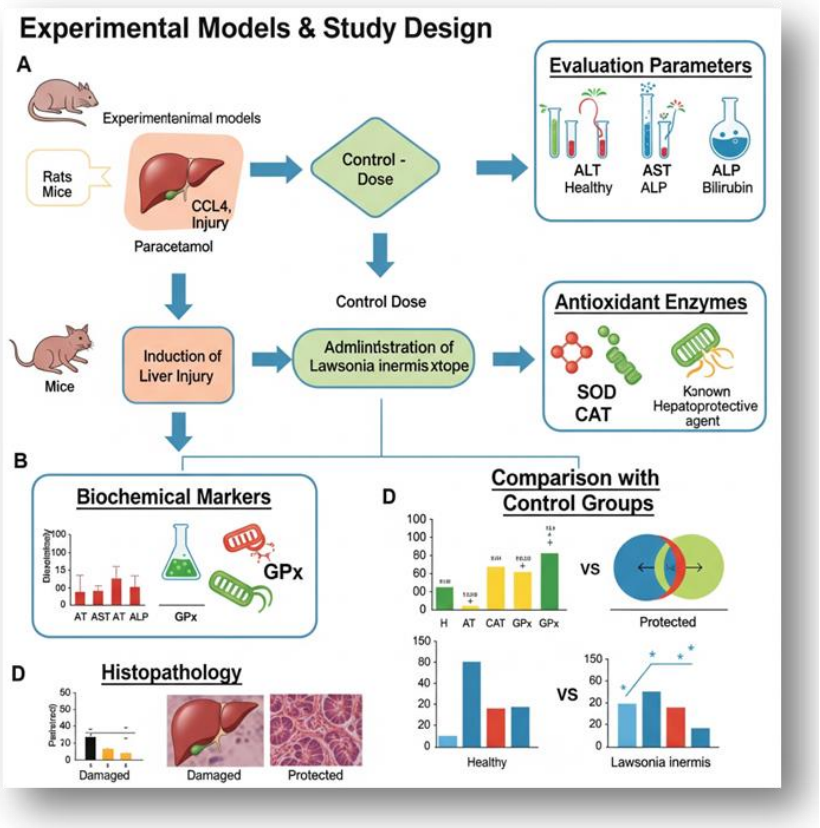


## 4. EXPERIMENTAL MODELS AND STUDY DESIGN OVERVIEW

Several preclinical studies have investigated the hepatoprotective effects of *Lawsonia inermis* using **Wistar or Swiss albino rats** as experimental models. In most studies, liver injury was induced using **paracetamol (acetaminophen)** or **carbon tetrachloride ($CCl_4$)** to mimic hepatotoxicity in vivo.[13] The **aqueous or ethanolic extracts** of *L. inermis* leaves were administered orally, typically at doses ranging from **100 to 500 mg/kg body weight** over periods of 7–21 days. These extracts were evaluated for their ability to restore liver function and prevent histological damage caused by hepatotoxins.[14] Key parameters assessed include

- **Biochemical markers**
  - ❖ ALT, AST, ALP, total bilirubin, and total protein
- **Antioxidant enzymes**
  - ❖ Superoxide dismutase (SOD), catalase, glutathione (GSH)
- **Histopathology**
  - ❖ Liver architecture, necrosis, cellular regeneration
- **Control comparisons**
  - ❖ Reference groups treated with silymarin or vehicle-only controls

| Research Gap | Proposed Solution | Expected Outcome |
|---|---|---|
| Lack of human clinical trials | Conduct randomized, controlled clinical studies with standardized extracts | Validation of safety, dosage, and efficacy in human liver disorders |
| Variability in extraction and phytochemical content | Develop standardized protocols for solvent use, dose, and compound profiling | Reproducible and reliable results across studies |
| Limited pharmacokinetic (PK) and toxicological data | Undertake detailed ADME (Absorption, Distribution, Metabolism, Excretion) studies | Better understanding of bioavailability and safety profile |
| Unexplored molecular mechanisms | Investigate specific pathways (e.g., Nrf2, NF-κB, MAPK) through in vitro/in vivo assays | Identification of targeted hepatoprotective mechanisms |




## 5. PRECLINICAL EVIDENCE ON THE HEPATOPROTECTIVE ACTIVITY OF *LAWSONIA INERMIS*

### $CCl_4$-Induced Liver Damage

- *L. inermis* extracts significantly:
  - ↓ Serum liver enzymes: AST, ALT, ALP, and bilirubin.
  - ↓ Lipid peroxidation (MDA).
  - ↑ Antioxidant enzymes: GSH, SOD, and CAT.
  - Improved liver histology with reduced necrosis and fatty change.
- Effects were **dose-dependent** and comparable to the standard hepatoprotective agent **silymarin.**[15]

### Paracetamol-Induced Hepatic Injury

- Administration of *L. inermis* extract:
  - Normalized serum levels of AST, ALT, and LDH.
  - ↑ Glutathione (GSH) levels and preserved hepatocyte structure.
  - Histology showed less inflammation and sinusoidal congestion.[16]

**Hepatotoxicity induced by Ethanol and Drug**

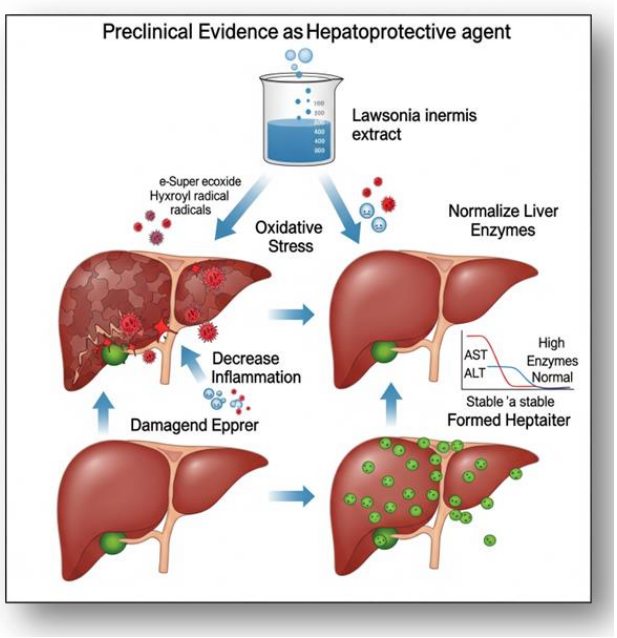
- ***L. inermis* showed protective effects by:**
- ↓ Hepatic lipid accumulation and inflammatory infiltration.
- ↓ Serum triglycerides and liver cholesterol.
- ↓ TNF-α and IL-6 levels (pro-inflammatory markers).
- Restored antioxidant enzyme levels and hepatic architecture.[17]

**General Observations**

- *L. inermis* consistently exhibited:
- Antioxidant, anti-inflammatory, hepatoprotective, and regenerative effects.
- The extract has shown effectiveness in both preventive and curative models of liver injury.
- No observable toxicity at therapeutic doses in animal models.[18]

**Limitations and Research Gaps**

- Inconsistencies across:
- Extraction methods (aqueous, methanolic, etc.).
- Dosing and duration of animal studies.
- Currently, no human clinical trials have been conducted
- Long-term safety and clinical efficacy remain **unverified**.



## 6. TRADITIONAL USE AND ETHNOMEDICINAL RELEVANCE

- *Lawsonia inermis* (henna) has been used for centuries in **Ayurveda, Siddha, and Unani** systems of medicine, not only as a dye but also for its **therapeutic benefits**.[19]
- Henna Leaf Decoctions (Boiled Extracts)
- Traditionally consumed for:
- **Liver enlargement**, **jaundice**, and **digestive complaints**.
- Believed to promote **bile regulation** and support liver detoxification.[20]

- **Paste Applications & Oral Herbal Formulations**
- It is used as a **blood purifier** and is thought to cleanse the liver and improve internal health.
- Combined with other herbs like **Andrographis**, **Neem**, or **Black pepper** in polyherbal liver remedies.
- Part of **compound formulations** for hepatobiliary disorders.[21]

- **Topical Use for Skin Ailments**
- Applied on:
- **Wounds, boils, rashes, and skin infections**.
- Anti-inflammatory and antimicrobial actions contribute to skin and internal health.
- Traditional belief: **Skin clarity = healthy liver**, reinforcing henna's role in **internal cleansing**.[22]

- **Forms of Administration**
- Used in multiple traditional preparations:
- **Leaf juice**, **infusions**, **dry leaf powder**, **decoctions**, and **pastes**.
- Often blended with **turmeric**, **neem**, or **pepper** to enhance detox and liver support.[23]

- **Cultural and Functional Relevance**
- Referred to as a "**cooling herb**" in ethno medicine:
- Used to reduce **body heat**, **inflammation**, and **bile excess**.
- These align with concepts of **liver heat** or **pitta imbalance** in traditional systems.[24]


## 7. TOXICITY AND SAFETY CONCERNS

➢ **Topical Safety**

- Henna has been **used topically for centuries** on skin, hair, and nails and is generally **recognized as safe**.
- Allergic reactions are **rare**, but possible, especially when adulterated.

❖ May cause **mild skin irritation** or **contact dermatitis**.

❖ Reactions are often linked to **"black henna"** containing **para-phenylenediamine (PPD).**[25]

➢ **Oral Use Requires Caution**

- Traditional systems use **small oral doses**, but there's **no modern dosage standardization**.
- **Lawsone**, the major naphthoquinone in henna:

❖ Has potential **hemolytic activity**, especially in: People with **G6PD deficiency**.

❖ **Children and neonates**, where it may lead to **acute hemolytic anemia**.[26]

➢ **Lack of Comprehensive Toxicity Data**

- Limited evidence on:

❖ **Acute**, **sub-chronic**, or **chronic** toxicity profiles.

❖ **$LD_{50}$ values**, therapeutic safety margins, or long-term usage effects.

- **Isolated phytochemicals** such as **flavonoids** or **lawsone** still lack detailed toxicological assessment.[27]

➢ **Need for Pharmacokinetic & Pharmacodynamic Studies**

- Very little is known about:

❖ **Absorption**, **distribution**, **metabolism**, and **elimination (ADME)** of henna constituents.

❖ Potential **interactions with liver enzymes** like **cytochrome P450**, affecting drug metabolism.

- Essential to evaluate:

❖ **Bioavailability** of active compounds.

❖ **Drug-herb interactions** and **toxicity accumulation** from chronic use.[28]

➢ **Use in Special Populations**

- Insufficient data for:

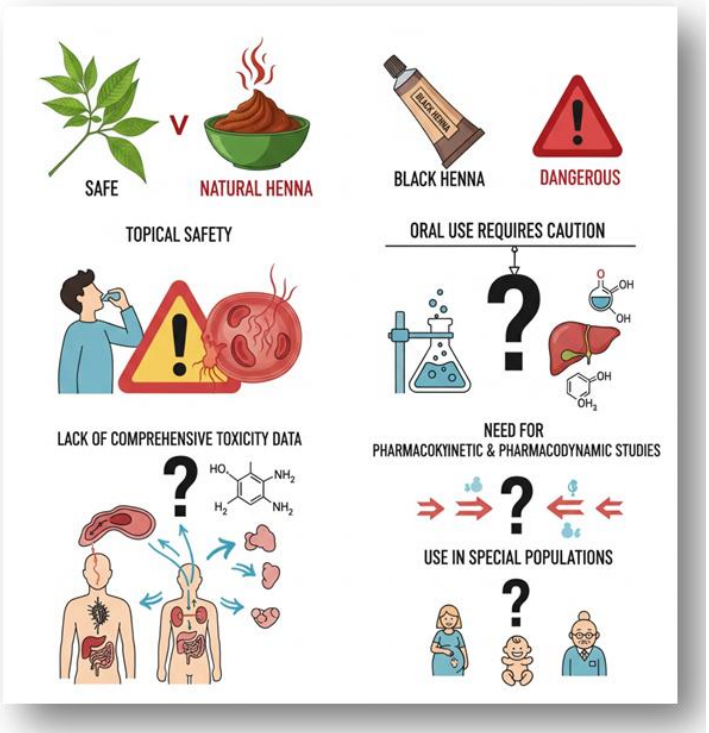
❖ **Pregnant or lactating women**.

❖ **Children** and **elderly patients**.

- Concerns include:

❖ Potential for **fetal toxicity** (though not confirmed).

❖ **Hemolytic** risk in neonates, especially with **undiagnosed G6PD deficiency**.[29]



## 8. FUTURE PERSPECTIVES AND RESEARCH GAPS

- **Lack of Human Clinical Studies**

No well-controlled clinical trials exist to evaluate the safety, dosage, or therapeutic potential of *Lawsonia inermis* in human liver disorders. [30]

- **Variability in Extraction and Standardization**

Differences in extraction methods (methanol, aqueous, butanol), phytochemical content, and dosing hinder reproducibility between studies. [31]

- **Limited Pharmacokinetic and Toxicology Data**

Information on absorption, metabolism, and potential drug–herb interactions are scarce.[32]

- **Unexplored Molecular Mechanisms**

The exact pathways (e.g., Nrf2, NF-κB modulation, growth factor signaling) of hepatoprotection remain unclear.[33]

- **Need for Standardized Formulations**

Further research is needed to develop safe, effective delivery forms like capsules, decoctions, or nano-formulations.[34]


## 9. CONCLUSION

*Lawsonia inermis*, commonly known as henna, holds substantial promise as a **natural hepatoprotective agent**. Traditionally used in **Ayurvedic, Unani, and Siddha** systems for managing liver and skin ailments, recent pharmacological research has begun to validate its

medicinal claims. The hepatoprotective effects of this plant are largely attributed to its **rich phytochemical profile**, including lawsone, flavonoids, phenolic acids, and tannins. These compounds possess **antioxidant**, **anti-inflammatory**, and **membrane-stabilizing** properties that help protect hepatocytes from toxin-induced damage, support cellular regeneration, and enhance detoxification pathways.[35]

Preclinical studies in animal models of hepatic injury—induced by agents such as **carbon tetrachloride ($CCl_4$)**, **paracetamol**, and **ethanol**—have consistently shown the ability of *L. inermis* extracts to

- Normalize liver enzymes and Reduce oxidative stress, and restore liver histoarchitecture.[37] However, despite this encouraging evidence, **clinical validation remains a significant gap**.
- There is an urgent need for standardized extracts, comprehensive toxicity profiling, and well-designed human trials to assess long-term safety, optimal dosing, and clinical efficacy."
- Long-term safety
- Optimal dosing and clinical efficacy[38]

**Lawsonia inermis emerges not just as a traditional remedy but as a scientifically promising ally in the battle against liver disorders."**

## CONFLICT OF INTEREST

The authors declare no conflicts of interest.

## ACKNOWLEDGEMENT

We thank our guide for his valuable guidance and support. We also acknowledge our **co-authors** for their contributions and thank our **friends, family**, and **God Almighty** for their constant encouragement throughout this work.

## REFERENCES

1. Oh JH, Jun DW. The latest global burden of liver cancer: a past and present threat. *Clin Mol Hepatol*.
2. Kumar S, Sood H, Chauhan S, Sharma A, Thakur R. Pharmacological and therapeutic potential of *Lawsonia inermis* Linn.
3. Rajopadhye A, Upadhye A, Rajopadhye S. Evaluation of hepatoprotective activity of

*Lawsonia inermis* leaf extract in albino rats.

4. Kumar S, Sood H, Chauhan S, Sharma A, Thakur R. Pharmacological and therapeutic potential of *Lawsonia inermis* Linn.
5. Ali BH, Al Wabel N, Blunden G. Phytochemical, pharmacological and toxicological aspects of *Lawsonia inermis* L. a review.
6. Adhami HR, Farsam H, Krenn L. Screening of medicinal plants from Iranian traditional medicine for acetyl cholinesterase inhibition. *Phytother Res*.
7. Singh V, Gupta A, Bansal P, Jaiswal N, Sharma S. Phytochemical evaluation and hepatoprotective activity of *Lawsonia inermis* leaves extract. *Pharmacogn J*.
8. Kumar S, Sood H, Chauhan S, Sharma A, Thakur R. Pharmacological and therapeutic potential of *Lawsonia inermis* Linn. – A review. *Pharmacogn Rev*.
9. Rajopadhye A, Upadhye A, Rajopadhye S. Evaluation of hepatoprotective activity of *Lawsonia inermis* leaf extract in albino rats. *Indian J Exp Biol*
10. Kumar S, Sood H, Chauhan S, Sharma A, Thakur R. Pharmacological and therapeutic potential of *Lawsonia inermis* Linn. – A review. *Pharmacogn Rev*.
11. Sanni FS, Oladimeji I, Mohammed G. Hepatoprotective activity of *Lawsonia inermis* leaf extract against paracetamol-induced hepatotoxicity in rats. *Niger J Physiol Sci*.
12. Rajopadhye A, Upadhye A, Rajopadhye S. Evaluation of hepatoprotective activity of *Lawsonia inermis* leaf extract in albino rats. *Indian J Exp Biol*
13. Selvanayaki R, Ananthi T. *Hepatoprotective activity of aqueous extract of Lawsonia inermis against paracetamol-induced hepatotoxicity in rats.* Asian J Pharm
14. Abdel-Moneim A et al. *Protective role of Lawsonia inermis against paracetamol-induced hepatotoxicity in mice.* Front Pharmacol. 2019;10:1473
15. Kumar S, Sood H, Chauhan S, Sharma A, Thakur R. Pharmacological and therapeutic potential of *Lawsonia inermis* Linn. – A review. *Pharmacogn Rev*.
16. Sanni FS, Oladimeji I, Mohammed G. Hepatoprotective activity of *Lawsonia inermis* leaf extract against paracetamol-induced hepatotoxicity in rats. *Niger J Physiol Sci*.
17. Rajopadhye A, Upadhye A, Rajopadhye S. Evaluation of hepatoprotective activity of *Lawsonia inermis* leaf extract in albino rats. *Indian J Exp Biol*.
18. Kumar S, Sood H, Chauhan S, Sharma A, Thakur R. Pharmacological and therapeutic potential of *Lawsonia inermis* Linn. – A review.
19. Kumar S, Sood H, Chauhan S, Sharma A, Thakur R. Pharmacological and therapeutic potential of *Lawsonia inermis* Linn

20. Uddin G, Rauf A, Siddiqui BS, Khan H. Phytochemical screening of *Pistacia integerrima* and *Lawsonia inermis*. *Middle East J Sci Res.*
21. Rajopadhye A, Upadhye A, Rajopadhye S. *Evaluation of hepatoprotective activity of Lawsonia inermis leaf extract in albino rats.*
22. Singh V, Gupta A, Bansal P, Jaiswal N, Sharma S. Phytochemical evaluation and hepatoprotective activity of *Lawsonia inermis* leaves extract.
23. Bairagi GB, Dhumal VR, More HN. Traditional uses, phytochemistry and pharmacological properties of *Lawsonia inermis*
24. Kumar S, Sood H, Chauhan S, Sharma A, Thakur R. Pharmacological and therapeutic potential of *Lawsonia inermis* Linn.
25. Nohynek GJ, Antignac E, Re T, Toutain H. Safety assessment of personal care products/cosmetics and their ingredients. *Toxicol Appl Pharmacol.*
26. Beutler E. G6PD deficiency. *Blood.*
27. Ali BH, Al Wabel N, Blunden G. Phytochemical, pharmacological and toxicological aspects of *Lawsonia inermis* L
28. Harizal SN, Mansor SM, Hasnan J, Tharakan JK, Abdullah J. Acute toxicity study of the standardized methanol extract of *Mitragyna speciosa* Korth in rodents. *J Ethnopharmacol*.
29. Malik A, Kalla NR, Singh S, Yadav RK, Yadav JP. Hepatoprotective potential of herbal extract against paracetamol-induced liver damage in rats. *Indian J Clin Biochem.*
30. Kumar S, Sood H, Chauhan S, Sharma A, Thakur R. Pharmacological and therapeutic potential of *Lawsonia inermis* Linn.
31. Sanni FS, Oladimeji I, Mohammed G. Hepatoprotective activity of *Lawsonia inermis* leaf extract against paracetamol-induced hepatotoxicity in rats
32. Darvin R, S.R. A, R.R. A, R.M. D, K.K. P. Hepatoprotective effect of lawsone on rifampicin-isoniazid induced hepatotoxicity in in vitro and in vivo models. Environ Toxicol Pharmacol.
33. Widyawati T, Syarifah S, Anggraini DR. Effect of *Lawsonia inermis* Linnaeus Leaf Ethyl Acetate Extract on Liver in Normal Rat. In: *International Conference of Science, Technology, Engineering, Environmental and Ramification Researches (ICOSTEERR 2018)*
34. Kumar S, Sood H, Chauhan S, Sharma A, Thakur R. Pharmacological and therapeutic potential of *Lawsonia inermis* Linn.

35. Ali BH, Al Wabel N, Blunden G. Phytochemical, pharmacological and toxicological aspects of *Lawsonia inermis* L.: a review
36. Rajopadhye A, Upadhye A, Rajopadhye S. Evaluation of hepatoprotective activity of *Lawsonia inermis* leaf extract in albino rats. *Indian J Exp Biol.*
37. Harizal SN, Mansor SM, Hasnan J, Tharakan JK, Abdullah J. Acute toxicity study of the standardized methanol extract of *Mitragyna speciosa* Korth in rodents.