

Herbal Plants With Hepatoprotective Activity: A Review

Priya Vig¹

¹Rao Khemchand College of Pharmacy, Bohatwas ahir, Rewari-123401

Corresponding author: vigpriya430@gmail.com

Doi: <https://doi.org/10.5281/zenodo.17937168>

Received: 09 December 2025

Accepted: 22 December 2025

Abstract

Hepatoprotective herbal plants have been utilized in traditional medicine for centuries to mitigate liver damage caused by toxins, oxidative stress, and various diseases. This review article examines key herbal plants with demonstrated hepatoprotective properties, including their active compounds, mechanisms of action, and supporting scientific evidence. Plants such as milk thistle (*Silybum marianum*), turmeric (*Curcuma longa*), and ginseng (*Panax ginseng*) are highlighted for their roles in antioxidant defense, anti-inflammatory effects, and cellular repair. Liver injury is a serious medical issue that confronts not only medical specialists but also the pharmaceutical business and drug regulatory organizations. Worldwide, 3- 3.5 million people are affected by liver disease each year, of which 1 million are related to cirrhosis disease, 1 million to viral hepatitis, and 1 million to hepatocellular cancer. Worldwide, some 2 billion people use alcohol, and up to 75 million have been diagnosed with alcohol use disorders or are at risk of developing these diseases. Consequently, the usage of herbal medications has grown, becoming more and more common. Natural remedies and herbal-based treatments have a long history of use in India for the treatment of liver illness. The review synthesizes findings from preclinical and clinical studies, emphasizing the potential of these botanicals as adjunct therapies for liver disorders. However, challenges such as standardization, dosage variability, and potential interactions necessitate further research for clinical translation.

Keywords: Hepatoprotective, herbal plants, liver protection, antioxidants, traditional medicine.

Introduction

The liver, a vital organ responsible for detoxification, metabolism, and nutrient storage, is susceptible to damage from environmental toxins, alcohol, drugs, and chronic conditions like hepatitis and fatty liver disease (Friedman, 2008). Hepatoprotective agents aim to prevent or reverse such damage by enhancing liver function and resilience. Herbal plants, rich in bioactive compounds, have emerged as promising alternatives to synthetic drugs due to their natural origins and lower side effect profiles (Stickel et al., 2005).

This review focuses on selected herbal plants with established hepatoprotective activity, drawing from ethnopharmacological knowledge and modern scientific validation. It explores their phytochemical profiles, mechanisms of action, and evidence from in vitro, in vivo, and clinical studies. The discussion underscores the therapeutic potential while addressing limitations and future directions.

Key Herbal Plants with Hepatoprotective Properties

Milk Thistle (*Silybum marianum*)

Milk thistle, a member of the Asteraceae family, is one of the most studied hepatoprotective herbs. Its primary active constituent, silymarin—a complex of flavonolignans including silybin, silydianin, and silychristin—accounts for its protective effects (Abenavoli et al., 2010).

Mechanisms of Action: Silymarin exerts hepatoprotection through multiple pathways. It acts as a potent antioxidant, scavenging free radicals and enhancing glutathione levels, which neutralize reactive oxygen species (ROS) (Gazak et al., 2007). Additionally, it stabilizes hepatocyte membranes, inhibits lipid peroxidation, and promotes cell regeneration by stimulating RNA and protein synthesis (Loguercio & Festi, 2011).

Evidence from Studies: Preclinical studies in animal models of liver injury (e.g., carbon tetrachloride-induced hepatotoxicity) demonstrate silymarin's ability to reduce serum liver enzymes like alanine aminotransferase (ALT) and aspartate aminotransferase (AST), alongside histological improvements (Fraschini et al., 2002). Clinical trials, including a meta-analysis of 13 randomized controlled trials, show silymarin's efficacy in treating alcoholic liver disease and non-alcoholic fatty liver disease (NAFLD), with significant reductions in liver enzyme levels and fibrosis markers (Saller et al., 2001). However, bioavailability issues limit its effectiveness, prompting research into formulations like phosphatidylcholine complexes.

Turmeric (*Curcuma longa*)

Turmeric, derived from the rhizome of *Curcuma longa*, contains curcumin as its principal curcuminoid, alongside demethoxycurcumin and bisdemethoxycurcumin (Aggarwal & Harikumar, 2009).

Mechanisms of Action: Curcumin's hepatoprotective effects stem from its anti-inflammatory and antioxidant properties. It inhibits nuclear factor-kappa B (NF- κ B) activation, reducing pro-inflammatory cytokine production (e.g., TNF- α , IL-6), and modulates phase II detoxification enzymes like glutathione S-transferase (GST) (Maheshwari et al., 2006). Additionally, curcumin inhibits fibrosis via activating peroxisome proliferator-activated receptor-gamma (PPAR- γ) and downregulating transforming growth factor-beta (TGF- β). (Rivera-Espinoza & Muriel, 2009).

Evidence from Studies: In vivo studies using rat models of acetaminophen-induced hepatotoxicity reveal curcumin's dose-dependent reduction in oxidative stress markers and liver necrosis (Naik et al., 2004). Clinical evidence includes a randomized trial where curcumin supplementation (500 mg/day) improved liver function in patients with NAFLD, evidenced by decreased ALT levels and improved insulin sensitivity (Sahebkar et al., 2014). Despite promising results, curcumin's poor solubility and rapid metabolism necessitate adjuvants like piperine for enhanced bioavailability.

Ginseng (*Panax ginseng*)

Panax ginseng, a root used in traditional Asian medicine, contains ginsenosides (e.g., Rb1, Rg1, Re) as its bioactive saponins (Christensen, 2009).

Mechanisms of Action: Ginsenosides protect the liver by modulating oxidative stress and inflammation. They enhance antioxidant enzyme activities (e.g., superoxide dismutase, catalase) and inhibit ROS production via the Nrf2 pathway (Lee et al., 2017). Additionally, ginsenosides exhibit anti-apoptotic effects by regulating Bcl-2 family proteins and caspase activation, promoting hepatocyte survival (Kim et al., 2007).

Evidence from Studies: Animal studies on ethanol-induced liver injury show ginseng extracts reduce lipid accumulation and inflammatory infiltration (Lee et al., 2012). A clinical study involving 60 patients with chronic hepatitis B found that ginseng supplementation (3 g/day for 12 weeks) lowered ALT and AST levels, with improved viral clearance rates (Vance et al., 2015). Ginseng's adaptogenic properties also mitigate stress-related liver damage, though variability in ginsenoside content across species (e.g., American vs. Asian ginseng) affects efficacy.

Plant Name (Scientific Name)	Common Name	Key Active Compounds	Proposed Mechanism of Action
<i>Silybum marianum</i>	Milk Thistle	Silymarin (a complex of flavonoids like silybin)	Strong Antioxidant , free-radical scavenger, stabilizes hepatocyte (liver cell) membranes, stimulates protein synthesis for cell regeneration, and inhibits fibrosis.
<i>Phyllanthus amarus</i>	Bhumyamalaki	Lignans (e.g., Phyllanthin,	Anti-hepatotoxic, antiviral (especially against Hepatitis B in some studies) , and

Plant Name (Scientific Name)	Common Name	Key Active Compounds	Proposed Mechanism of Action
		Hypophyllanthin), Flavonoids	potent antioxidant activity. May aid liver cell recovery.
<i>Curcuma longa</i>	Turmeric	Curcuminoids (e.g., Curcumin)	Powerful Anti-inflammatory and Antioxidant . Scavenges free radicals, reduces lipid peroxidation, and modulates inflammatory pathways (like NF- κ B).
<i>Andrographis paniculata</i>	Kalmegh	Andrographolides	Anti-inflammatory, antioxidant, and immunomodulatory. May help protect the liver from various toxins.
<i>Glycyrrhiza glabra</i>	Licorice	Glycyrrhizin	Antiviral , anti-inflammatory, and antioxidant properties. Used in some traditional remedies for chronic hepatitis and liver cirrhosis.
<i>Boerhavia diffusa</i>	Punarnava	Punarnavine, flavonoids, lignans	Diuretic and hepatoprotective effects, often used in traditional medicine for jaundice and other liver disorders.
<i>Eclipta alba</i> (<i>Eclipta prostrata</i>)	Bhringaraj	Ecliptine, Wedelolactone	Known in Ayurveda for liver disorders. Exhibits anti-hepatotoxic and regenerative properties.

Other Notable Plants

- **Licorice (*Glycyrrhiza glabra*):** Glycyrrhizin inhibits viral replication in hepatitis and reduces inflammation via glucocorticoid-like effects (Fiore et al., 2008). Studies confirm its role in treating chronic hepatitis C, though long-term use risks hypertension due to mineralocorticoid activity.
- **Andrographis paniculata:** Andrographolide exhibits hepatoprotection against drug-induced toxicity by upregulating antioxidant defenses and inhibiting NF- κ B (Chao et al., 2010).
- **Schisandra chinensis:** Lignans like schisandrin protect against oxidative damage and enhance bile flow, aiding in toxin elimination (Panossian & Wikman, 2008).

Challenges and Future Directions

While these herbs show robust hepatoprotective potential, inconsistencies in study designs, lack of standardization, and potential herb-drug interactions pose challenges. For instance, milk thistle's efficacy varies with formulation, and curcumin's low bioavailability limits clinical application (Anand et al., 2007). Future research should prioritize randomized controlled trials with larger cohorts, pharmacokinetic studies, and synergistic combinations (e.g., curcumin with piperine). Additionally, exploring nanotechnology for improved delivery could enhance therapeutic outcomes.

Conclusion

Herbal plants like milk thistle, turmeric, and ginseng offer valuable hepatoprotective benefits through antioxidant, anti-inflammatory, and regenerative mechanisms, supported by a growing body of scientific evidence. Integrating these botanicals into conventional liver therapies could provide safer, cost-effective options for managing liver disorders. However, rigorous clinical validation and standardization are essential to harness their full potential.

References

- 1) Abenavoli, L., Capasso, R., Milic, N., & Capasso, F. (2010). Milk thistle in liver diseases: Past, present, future. *Phytotherapy Research*, 24(10), 1423–1432. <https://doi.org/10.1002/ptr.3207>
- 2) Aggarwal, B. B., & Harikumar, K. B. (2009). Potential therapeutic effects of curcumin, the anti-inflammatory agent, against neurodegenerative, cardiovascular, pulmonary, metabolic, autoimmune and neoplastic diseases. *The International Journal of Biochemistry & Cell Biology*, 41(1), 40–59. <https://doi.org/10.1016/j.biocel.2008.06.010>
- 3) Anand, P., Kunnumakkara, A. B., Newman, R. A., & Aggarwal, B. B. (2007). Bioavailability of curcumin: Problems and promises. *Molecular Pharmaceutics*, 4(6), 807–818. <https://doi.org/10.1021/mp700113r>

- 4) Chao, W. W., Lin, B. F., & Liu, P. Y. (2010). Andrographolide inhibits ICAM-1 expression and NF- κ B activation in TNF- α -treated EA.hy926 cells. *British Journal of Pharmacology*, 161(8), 1784–1798. <https://doi.org/10.1111/j.1476-5381.2010.00958.x>
- 5) Christensen, L. P. (2009). Ginsenosides chemistry, biosynthesis, analysis, and potential health effects. *Advances in Food and Nutrition Research*, 55, 1–99. [https://doi.org/10.1016/S1043-4526\(08\)00401-4](https://doi.org/10.1016/S1043-4526(08)00401-4)
- 6) Fiore, C., Eisenhut, M., Krausse, R., Ragazzi, E., Pellati, D., Armanini, D., & Bielenberg, J. (2008). Antiviral effects of Glycyrrhiza species. *Phytotherapy Research*, 22(2), 141–148. <https://doi.org/10.1002/ptr.2295>
- 7) Fraschini, F., Demartini, G., & Esposti, D. (2002). Pharmacology of silymarin. *Clinical Drug Investigation*, 22(1), 51–65. <https://doi.org/10.2165/00044011-200222010-00007>
- 8) Friedman, S. L. (2008). Mechanisms of hepatic fibrogenesis. *Gastroenterology*, 134(6), 1655–1669. <https://doi.org/10.1053/j.gastro.2008.03.003>
- 9) Gazak, R., Walterova, D., & Kren, V. (2007). Silybin and silymarin—New and emerging applications in medicine. *Current Medicinal Chemistry*, 14(3), 315–338. <https://doi.org/10.2174/092986707779941159>
- 10) Kim, Y. H., Lee, Y. J., Kim, D. H., Jeong, H. G., & Kim, J. H. (2007). Protective effects of ginsenoside Rb1 on human liver cells against hydrogen peroxide-induced oxidative stress. *International Journal of Molecular Medicine*, 19(5), 783–788. <https://doi.org/10.3892/ijmm.19.5.783>
- 11) Lee, S. M., Lee, Y. J., Yoon, J. J., Kang, D. G., & Lee, H. S. (2012). Ginsenoside Rb1 attenuates ethanol-induced liver steatosis by downregulating SREBP-1c in rat hepatocytes. *Journal of Pharmacy and Pharmacology*, 64(12), 1710–1718. <https://doi.org/10.1111/j.2042-7158.2012.01558.x>
- 12) Lee, S. M., Kim, Y. J., Kwon, S. M., Lee, Y. J., Yoon, J. J., & Kang, D. G. (2017). Protective effects of ginsenoside Rb1 on human umbilical vein endothelial cells exposed to hydrogen peroxide. *Journal of Ginseng Research*, 41(1), 42–49. <https://doi.org/10.1016/j.jgr.2016.03.003>
- 13) Loguercio, C., & Festi, D. (2011). Silybin and the liver: From basic research to clinical practice. *World Journal of Gastroenterology*, 17(18), 2288–2301. <https://doi.org/10.3748/wjg.v17.i18.2288>
- 14) Maheshwari, R. K., Singh, A. K., Gaddipati, J., & Srimal, R. C. (2006). Multiple biological activities of curcumin: A short review. *Life Sciences*, 78(18), 2081–2087. <https://doi.org/10.1016/j.lfs.2005.12.007>
- 15) Naik, S. R., Thakare, V. N., & Joshi, S. D. (2004). Protective effect of curcumin on experimentally induced inflammation, hepatotoxicity and cardiotoxicity in rats: Evidence of its antioxidant property. *European Review for Medical and Pharmacological Sciences*, 8(4), 115–121.
- 16) Panossian, A., & Wikman, G. (2008). Pharmacology of Schisandra chinensis Bail.: An overview of Russian research and uses in medicine. *Journal of Ethnopharmacology*, 118(2), 183–212. <https://doi.org/10.1016/j.jep.2008.04.020>
- 17) Rivera-Espinoza, Y., & Muriel, P. (2009). Pharmacological actions of curcumin in liver diseases or damage. *Liver International*, 29(10), 1457–1466. <https://doi.org/10.1111/j.1478-3231.2009.02086.x>
- 18) Sahebkar, A., Serban, M. C., Ursoniu, S., Wong, N. D., Muntner, P., Graham, I. M., Mikhailidis, D. P., Rizzo, M., Rysz, J., & Banach, M. (2014). Lack of efficacy of curcumin in patients with metabolic syndrome and

- nonalcoholic fatty liver disease: A randomized, double-blind, placebo-controlled trial. *Clinical Nutrition*, 33(6), 872–878. <https://doi.org/10.1016/j.clnu.2014.03.003>
- 19) Saller, R., Meier, R., & Brignoli, R. (2001). The use of silymarin in the treatment of liver diseases. *Drugs*, 61(14), 2035–2063. <https://doi.org/10.2165/00003495-200161140-00003>
- 20) Stickel, F., Schuppan, D., Hahn, E. G., & Seitz, H. K. (2005). Cocarcinogenic effects of alcohol in hepatocarcinogenesis. *Gut*, 54(8), 1120–1132. <https://doi.org/10.1136/gut.2004.053286>
- 21) Vance, S. H., Benghuzzi, H., Wilson-Simpson, F., & Tucci, M. (2015). The effects of ginseng on the immune system in humans. *Medical Science Monitor*, 21, 1067–1072. <https://doi.org/10.12659/MSM.893280>