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Review Article

Therapeutic Evaluation of Syrup Nexoliv™ for Liver Health Support

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Abstract

Background: Liver disorders, ranging from hepatitis to cirrhosis, are prevalent globally due to infections, toxins, and metabolic imbalances. Traditional medicine offers numerous herbal formulations known for their hepatoprotective properties. Syrup Nexoliv™ is a polyherbal formulation composed of 23 medicinal plants traditionally recognized for liver protection, detoxification, and overall hepatobiliary support. This study evaluates the hepatoprotective potential of Syrup Nexoliv (SN) based on its rich phytoconstituents.

Objective: To assess the hepatoprotective effect of Syrup Nexoliv through its pharmacologically active ingredients, focusing on their synergistic roles in liver health.

Methods: Syrup Nexoliv contains key hepatoprotective herbs such as Kalmegh (*Andrographis paniculata*), Kutki (*Picrorhiza kurroa*), Punarnava (*Boerhavia diffusa*), and Bhui Amla (*Phyllanthus niruri*), known for their anti-inflammatory, antioxidant, and detoxifying properties. The formulation was evaluated through literature-based evidence highlighting individual and combined therapeutic effects of its components on hepatic cells, liver enzymes, and oxidative stress parameters.

Results: Phytochemical analysis of the ingredients revealed the presence of bioactive compounds such as andrographolides, picrosides, berberine, and glycyrrhizin, which exhibit hepatoprotective, anti-inflammatory, and antioxidant actions. These compounds help in stabilizing hepatic cell membranes, reducing elevated liver enzymes, enhancing bile secretion, and protecting against hepatotoxins. Herbal ingredients like Gilo (*Tinospora cordifolia*) and Mulethi (*Glycyrrhiza glabra*) further contribute to immune modulation and liver tissue regeneration. Collectively, these herbs demonstrate a synergistic effect in managing liver dysfunction and supporting hepatic detoxification processes.

Conclusion: Syrup Nexoliv, with its comprehensive blend of hepatoprotective herbs, presents a promising natural therapeutic option for preventing and managing liver disorders. Further clinical studies are warranted to validate its efficacy and safety in liver disease patients, along with its potential role as an adjunct to conventional hepatoprotective therapies.

Keywords: Liver disorders, herbal formulations, Syrup Nexoliv

1. Introduction

The liver is a vital organ that plays a central role in maintaining the body's overall health and metabolic balance¹. Often referred to as the body's "chemical factory," the liver performs a wide range of essential functions, including detoxification, protein synthesis, bile production, and the regulation of blood glucose levels². It is responsible for metabolizing nutrients from food, breaking down harmful substances, and supporting the immune system³. Given its crucial functions, the liver is constantly exposed to various internal and external

stressors such as toxins, pathogens, drugs, alcohol, and unhealthy diets, which can lead to liver damage and a variety of hepatic disorders⁴. Common liver diseases include hepatitis, cirrhosis, fatty liver disease, hepatocellular carcinoma, and liver fibrosis, all of which can significantly impact quality of life and, if untreated, may become life-threatening⁵.

In recent years, there has been a growing interest in natural remedies and medicinal plants for the prevention and treatment of liver diseases⁶. Unlike synthetic drugs that may come with side effects, medicinal plants offer a

holistic and safer approach to supporting liver health. Various herbs traditionally used in systems of medicine such as Ayurveda, Unani, and Traditional Chinese Medicine have been recognized for their hepatoprotective effects—the ability to prevent damage to the liver and promote its healing⁷. These plants possess bioactive compounds such as flavonoids, alkaloids, glycosides, and polyphenols that exhibit antioxidant, anti-inflammatory, antiviral, and immune-modulating properties, which are highly beneficial in protecting the liver from oxidative stress and cellular injury⁸. Among these medicinal plants, Kalmegh (*Andrographis paniculata*) stands out as a potent liver tonic⁹. Rich in andrographolide, Kalmegh is known for its strong anti-inflammatory and antioxidant effects, which help protect liver tissues from toxins and support detoxification processes¹⁰. Similarly, Kutki (*Picrorhiza kurroa*) has been extensively used for its ability to reduce liver inflammation and promote bile flow, making it effective in managing conditions like jaundice and fatty liver disease¹¹. Bhumi Amla (*Phyllanthus niruri*), commonly called “stonebreaker,” has gained attention for its antiviral properties, particularly in the treatment of hepatitis B infections, while also helping to regulate liver enzymes and reduce fibrosis¹².

In addition, Mako (*Solanum nigrum*) is traditionally used to treat liver enlargement and inflammation due to its soothing and hepatoprotective actions¹³. It is rich in natural steroids and alkaloids that help in cellular repair and regeneration of damaged liver tissues¹⁴. Kasni (*Cichorium intybus*), commonly known as chicory, is another well-regarded herb for liver health. It works by stimulating bile production, aiding digestion, and acting as a mild laxative, which supports the liver’s detoxifying abilities¹⁵.

These medicinal plants offer a promising and complementary approach in the management of hepatic disorders⁸. They not only aid in preventing liver damage but also contribute to the regeneration of hepatocytes (liver cells), regulation of liver enzymes, and improvement in overall liver function¹⁶. Furthermore, their natural antioxidant properties combat oxidative stress, which is a major factor in chronic liver diseases¹⁷. By integrating these herbs into therapeutic strategies, either as supplements or in combination with conventional treatments, patients with liver disorders may experience improved outcomes and reduced disease progression¹⁸.

The liver's health is fundamental to the body’s well-being, and safeguarding it from damage is of utmost importance. Medicinal plants like *Kalmegh*, *Kutki*, *Bhumi Amla*, *Mako*, and *Kasni* offer natural, effective, and time-tested solutions for supporting liver function and managing various hepatic disorders⁹⁻¹⁵. Ongoing research continues to validate their traditional uses and explore their potential in modern hepatoprotective therapies, reinforcing the importance of herbal medicine in liver care.

2. Causes of liver diseases:

Liver disease can develop due to a wide range of factors that damage the liver cells and impair its essential functions [19]. These causes may be environmental, lifestyle-related, infectious, or genetic, and often involve long-term exposure to harmful substances that overwhelm the liver's ability to repair itself [20]. One of the leading causes of liver disease is viral infections, particularly Hepatitis B, Hepatitis C, and Hepatitis A²¹. These viruses attack liver cells, leading to inflammation (hepatitis), fibrosis, cirrhosis, and in severe cases, liver cancer [20]. Chronic viral hepatitis remains a major global health concern due to its progressive nature and high risk of complications²². Alcohol consumption is another significant cause of liver damage. Excessive and long-term alcohol intake can result in alcoholic fatty liver disease, alcoholic hepatitis, and eventually cirrhosis, where normal liver tissue is replaced by scar tissue, leading to liver failure²³.

In addition, non-alcoholic fatty liver disease (NAFLD) has become increasingly common, especially among individuals with obesity, diabetes, and high cholesterol. NAFLD occurs when excess fat accumulates in the liver unrelated to alcohol use, and it can progress to non-alcoholic steatohepatitis (NASH), fibrosis, and cirrhosis²⁴.

Drug-induced liver injury from medications such as acetaminophen (paracetamol), antibiotics, and certain herbal supplements can also cause acute or chronic liver damage if taken in high doses or over long periods²⁵.

Other causes include autoimmune liver diseases, where the immune system mistakenly attacks liver cells, genetic disorders like hemochromatosis and Wilson’s disease, and prolonged exposure to environmental toxins and chemicals²⁶.

Altogether, these factors contribute to liver disease by causing inflammation, oxidative stress, and cellular damage, which disrupt the liver’s ability to function and regenerate, ultimately leading to serious health complications if left untreated²⁷.

3. Predisposing Factors of Hepatic Disorders

The liver is constantly exposed to numerous internal and external factors that may compromise its function and structure, leading to various hepatic disorders²⁸. Understanding the predisposing factors is crucial for the prevention and early management of liver diseases [29]. These factors can be broadly categorized into lifestyle habits, infections, metabolic conditions, environmental exposures, and genetic influences³⁰.

One of the most common predisposing factors is excessive alcohol consumption²³. Chronic alcohol intake leads to alcoholic liver disease (ALD), which progresses from fatty liver to hepatitis, fibrosis, and eventually cirrhosis. Similarly, unhealthy diets high in saturated fats, sugars, and processed foods contribute to non-alcoholic fatty liver disease (NAFLD), a condition increasingly prevalent due to rising obesity rates worldwide³¹.

Viral infections such as Hepatitis B, C, and E are major global contributors to liver damage²¹. These viruses cause chronic inflammation, which can progress to cirrhosis and hepatocellular carcinoma if not properly managed²². Additionally, exposure to environmental toxins, including industrial chemicals, pesticides, and aflatoxins from contaminated food, can directly harm liver cells and disrupt normal liver function³².

The use of certain medications such as non-steroidal anti-inflammatory drugs (NSAIDs), antibiotics, and chemotherapeutic agents can induce drug-induced liver injury (DILI), particularly when taken in high doses or over long periods³³. Autoimmune conditions, where the immune system mistakenly attacks liver tissue, also contribute to chronic liver diseases³⁴.

Furthermore, genetic factors may predispose individuals to metabolic liver disorders like Wilson's disease or hemochromatosis, while stressful lifestyles and emotional disturbances may exacerbate liver imbalances, particularly in traditional systems of medicine that link mental states with organ health³⁵. In combination, these factors can significantly increase the risk of developing hepatic disorders, highlighting the need for a balanced lifestyle, early detection, and protective measures such as the use of hepatoprotective medicinal plants³⁶.

4. Clinical Features of Liver Disease

Liver diseases present with a wide range of clinical features, which may vary depending on the underlying cause, severity, and stage of the condition³⁷. In the early stages, liver diseases are often silent, showing minimal or no symptoms. However, as the disease progresses, several characteristic signs and symptoms begin to appear due to impaired liver function and structural damage³⁸. One of the most common clinical features is jaundice, characterized by yellowing of the skin and eyes. This occurs due to the accumulation of bilirubin, a yellow pigment that the liver normally processes and eliminates³⁹. Fatigue and weakness are also frequent complaints, as the liver's reduced ability to metabolize nutrients and detoxify the blood affects overall energy levels⁴⁰. Patients may experience abdominal pain or discomfort, particularly in the right upper quadrant where the liver is located³⁰. This can be due to liver inflammation, swelling, or congestion³⁷. Loss of appetite, nausea, and vomiting are also common, leading to unintended weight loss in chronic cases⁴¹. In advanced liver diseases such as cirrhosis, other significant signs may develop, including ascites (accumulation of fluid in the abdomen), peripheral edema (swelling of the legs and ankles), and easy bruising or bleeding due to decreased production of clotting factors by the liver⁴². Itching (pruritus), caused by bile salt accumulation in the skin, may also occur^{28,30}. Neurological symptoms like confusion, memory problems, and drowsiness are signs of hepatic encephalopathy, which results from the liver's inability to clear toxins from the blood⁴³. Additionally, spider angiomas (small, spider-like blood vessels on the skin), palmar erythema (redness of the palms), and hormonal imbalances, such as gynecomastia (enlarged breast tissue in men), may appear in chronic liver disease.

Recognizing these clinical features is essential for the early diagnosis and management of liver disorders to prevent serious complications⁴⁴.

5. Preventive Measures of Hepatic Disorders

The liver is a crucial organ responsible for detoxification, metabolism, and the storage of essential nutrients^{30,45}. However, it is highly susceptible to damage from various factors such as infections, toxins, poor diet, alcohol consumption, and sedentary lifestyle habits^{30,46}. Hepatic disorders like hepatitis, fatty liver disease, cirrhosis, and liver cancer can develop over time due to continuous liver strain⁴⁷. Fortunately, many liver diseases are preventable through proper lifestyle modifications, healthy dietary habits, and supportive natural remedies⁴⁸. Understanding and adopting preventive measures is vital to maintain optimal liver health and avoid long-term complications⁴⁹.

5.1. Healthy Diet and Nutrition

A balanced diet plays a fundamental role in preventing liver disorders⁵⁰. High consumption of processed foods, saturated fats, and refined sugars increases the risk of non-alcoholic fatty liver disease (NAFLD) and other hepatic issues⁵¹. Instead, a liver-friendly diet should focus on fresh fruits, vegetables, whole grains, lean proteins, and healthy fats such as those found in nuts, seeds, and fish. Fiber-rich foods support digestion and ease the liver's workload⁵². Hydration is equally important, as water aids in flushing out toxins from the body⁵³.

5.2. Limiting Alcohol and Toxin Exposure

Excessive alcohol consumption is one of the leading causes of liver damage and diseases like alcoholic hepatitis and cirrhosis⁵⁴. To protect the liver, it is recommended to either avoid alcohol or consume it in moderation. Additionally, limiting exposure to environmental toxins, such as industrial chemicals, pesticides, and harmful medications, can prevent liver overload. Always use protective measures when handling chemicals and only take medicines as prescribed by a healthcare provider⁵⁵.

5.3. Maintaining a Healthy Weight

Obesity and being overweight are major risk factors for fatty liver disease⁵⁶. Regular physical activity helps maintain a healthy weight and promotes good liver function by improving metabolism and reducing fat accumulation in the liver⁵⁷. At least 30 minutes of moderate exercise, such as walking, cycling, or swimming, most days of the week is recommended for overall liver health⁵⁸.

5.4. Vaccination and Safe Practices

Preventing viral hepatitis (especially hepatitis A and B) is critical in reducing the risk of severe liver diseases⁵⁹. Vaccinations against these viruses are widely available and highly effective. Practicing safe hygiene, consuming clean food and water, and avoiding the sharing of needles or personal hygiene items can also minimize the risk of hepatitis transmission⁶⁰.

5.5. Use of Hepatoprotective Medicinal Plants

Traditional medicinal plants such as *Kalmegh*, *Kutki*, *Bhumi Amla*, *Mako*, and *Kasni* have been used for centuries to support liver health [9-15]. These herbs have hepatoprotective, antioxidant, and anti-inflammatory properties that can help prevent liver damage from toxins and infections^{8,10,11}. Regular use of these plants, under the guidance of healthcare professionals, can aid in detoxification, protect liver cells, and enhance the liver's regenerative capacity^{8,9}.

5.6. Regular Health Check-Ups

Routine medical check-ups, including liver function tests, are essential to detect early signs of liver stress or damage⁶¹. Early diagnosis of hepatic disorders allows timely intervention and prevents the progression of disease⁶². The prevention of hepatic disorders relies on adopting a healthy lifestyle, minimizing liver stressors, and incorporating natural liver-supportive remedies³⁰. By taking proactive steps, individuals can protect this vital organ and ensure long-term health and wellness⁶³.

6. Diagnosis of Hepatic Disorders

The accurate diagnosis of hepatic (liver) disorders is essential for effective treatment and prevention of disease progression⁶⁴. Since liver diseases often present with non-specific symptoms such as fatigue, loss of appetite, nausea, abdominal discomfort, or jaundice, proper diagnostic evaluation helps identify the underlying cause and extent of liver damage⁶⁵. The diagnostic process for hepatic disorders typically begins with a thorough clinical history and physical examination³⁰. This includes assessing risk factors such as alcohol consumption, medication use, and exposure to hepatitis viruses, family history of liver diseases, and other metabolic conditions⁶⁶. Physical signs like jaundice

(yellowing of the skin and eyes), abdominal swelling, and tenderness in the upper right quadrant of the abdomen may raise suspicion of liver dysfunction⁶⁷.

Laboratory investigations play a vital role in confirming liver disease³⁰. Liver function tests (LFTs) are the primary blood tests used to evaluate the health of the liver⁶⁸. These include measurements of liver enzymes such as alanine aminotransferase (ALT) and aspartate aminotransferase (AST), which increase when liver cells are damaged. Other important markers include bilirubin levels, alkaline phosphatase (ALP), albumin, and prothrombin time, which collectively help assess liver performance and detect abnormalities⁶⁹.

To further support diagnosis, imaging techniques such as abdominal ultrasound, computed tomography (CT), and magnetic resonance imaging (MRI) are used to visualize the liver's structure, identify fatty infiltration, tumors, fibrosis, or blockages in bile ducts⁷⁰. In some cases, a liver biopsy may be required to obtain a small tissue sample for microscopic examination. This is often done when precise staging of liver fibrosis or cirrhosis is needed⁷¹. Early and accurate diagnosis of hepatic disorders is crucial to prevent complications and guide appropriate treatment strategies, including the use of hepatoprotective therapies like medicinal plants and conventional medical interventions⁷².

7. Mechanism of action of Syrup Nexoliv Ingredients

Syrup Nexoliv is a polyherbal formulation composed of various medicinal plants, each contributing specific therapeutic actions, particularly hepatoprotective, antioxidant, anti-inflammatory, and digestive benefits. Below is a detailed description of the mechanisms of action of its ingredients:

| Ingredient | Botanical Name | Part Used | Mechanism of Action |
|------------|--------------------------------|-------------|---|
| Kalmegh | <i>Andrographis paniculata</i> | Aerial Part | Rich in andrographolide, it provides strong antioxidant, anti-inflammatory, and liver enzyme-regulating effects, protecting hepatocytes from toxins and oxidative stress. ⁷³ |
| Bhringraj | <i>Eclipta alba</i> | Whole Plant | Exhibits hepatoprotective activity by enhancing liver regeneration and reducing lipid peroxidation. ⁷⁴ |
| Kutki | <i>Picrorhiza kurroa</i> | Root | Acts as a cholagogue and anti-inflammatory agent, promoting bile secretion and detoxification. ⁷⁵ |
| Punarnava | <i>Boerhavia diffusa</i> | Root | Offers diuretic and anti-fibrotic effects, reducing liver swelling and supporting fluid balance. ⁷⁶ |
| Bhui Amla | <i>Phyllanthus niruri</i> | Whole Plant | Provides antiviral properties (notably against Hepatitis B), reducing liver inflammation and fibrosis. ⁷⁷ |
| Daruhaldi | <i>Berberis aristata</i> | Stem | Contains berberine, which exhibits antimicrobial, anti-inflammatory, and cholagogue effects. ⁷⁸ |
| Mako | <i>Solanum nigrum</i> | Fruit | Soothes liver inflammation and aids in protecting hepatocytes through its antioxidant properties. ⁷⁹ |

| | | | |
|--------------|-----------------------------|-------------|---|
| Kasni | <i>Cichorium intybus</i> | Leaf, Seed | Acts as a mild laxative, bile stimulant, and hepatoprotective, supporting detoxification. ⁸⁰ |
| Saunf | <i>Foeniculum vulgare</i> | Fruit | Aids digestion, reduces bloating, and has carminative and mild antioxidant actions. ⁸¹ |
| Brinjasif | <i>Achillea millefolium</i> | Whole Plant | Offers anti-inflammatory and spasmolytic effects, supporting gastrointestinal comfort. ⁸² |
| Chitrakmol | <i>Plumbago zeylanica</i> | Root | Acts as a digestive stimulant and improves liver metabolism by enhancing digestive fire (Agni). ⁸³ |
| Ghafis | <i>Gentiana olivieri</i> | Flower | Stimulates appetite, supports bile flow, and exhibits liver tonic properties. ⁸⁴ |
| Revand Chini | <i>Rheum emodi</i> | Root | Provides laxative effects and supports mild detoxification through gentle bowel regulation. ⁸⁵ |
| Mulethi | <i>Glycyrrhiza glabra</i> | Root, Stem | Known for anti-inflammatory, hepatoprotective, and immune-modulating properties. ⁸⁶ |
| Jhao | <i>Tamarix gallica</i> | Leaf | Acts as a mild diuretic and supports liver health through detoxification. ⁸⁷ |
| Sadkofi | <i>Cyperus rotundus</i> | Rhizome | Provides anti-inflammatory and digestive support. ⁸⁸ |
| Afsanteen | <i>Artemisia absinthium</i> | Leaf | Acts as a bitter tonic, enhancing digestion and liver metabolism. ⁸⁹ |
| Turbud | <i>Operculina turpethum</i> | Root | Functions as a purgative, helping clear toxins from the gastrointestinal tract and liver. ⁹⁰ |
| Baobarnag | <i>Embelia ribes</i> | Fruit | Offers anthelmintic and detoxifying actions, protecting against parasitic and toxic burdens. ⁹¹ |
| Gilo | <i>Tinospora cordifolia</i> | Stem | Renowned for immune modulation, anti-inflammatory, and hepatoprotective actions. ⁹² |
| Sonth | <i>Zingiber officinale</i> | Rhizome | Improves digestion and reduces inflammation, supporting liver detox pathways. ⁹³ |
| Pipli | <i>Piper longum</i> | Fruit | Enhances bioavailability of other herbs, stimulates digestion, and protects liver cells. ⁹⁴ |
| Rohitaka | <i>Tecomella undulata</i> | Stem Bark | Provides hepatoprotective, anti-inflammatory, and antioxidant effects, beneficial in liver disorders. ⁹⁵ |

Summary of Actions

The combined action of these ingredients provides comprehensive support in liver disorders through:

- **Hepatoprotection** – guarding liver cells against toxins, inflammation, and oxidative stress.
- **Detoxification** – enhancing bile flow, digestion, and clearance of waste.
- **Anti-inflammatory effects** – reducing hepatic inflammation.
- **Antiviral and immune modulation** – particularly relevant in viral hepatitis.
- **Digestive support** – improving appetite, reducing bloating, and aiding metabolic function
- This synergistic formulation ensures multi-targeted therapy, supporting both acute and chronic liver conditions, and enhancing overall gastrointestinal health ^{96,97}.

Conclusion

Liver disorders, such as hepatitis, cirrhosis, and fatty liver disease, are increasing worldwide due to factors like infections, environmental toxins, poor lifestyle habits, and metabolic imbalances. In this context, traditional medicine offers valuable solutions through the use of herbal formulations with proven hepatoprotective effects. Syrup Nexoliv™ is a polyherbal formulation containing 23 medicinal plants, each known for their roles in liver protection, detoxification, and overall hepatobiliary health. Key ingredients like Kalmegh (*Andrographis paniculata*), Kutki (*Picrorhiza kurroa*), Punarnava (*Boerhavia diffusa*), and Bhui Amla (*Phyllanthus niruri*) are rich in bioactive compounds such as andrographolides, picrosides, berberine, and glycyrrhizin, which provide anti-inflammatory, antioxidant, and immune-modulating effects crucial for liver health. These ingredients work synergistically to stabilize liver cell membranes, reduce elevated liver enzymes, enhance bile flow, and protect against liver-

damaging agents. Additionally, herbs like Gilo (*Tinospora cordifolia*) and Mulethi (*Glycyrrhiza glabra*) support immune regulation and liver tissue repair, further strengthening the formulation's therapeutic potential.

Overall, Syrup Nexoliv offers a natural, plant-based approach to preventing and managing liver disorders. However, further clinical research is needed to establish its long-term efficacy and safety, as well as its potential use alongside conventional liver treatments.

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References

- Sina I. Al qanoon fit tib. (Urdu Translation by Ghulam Hussain Kantoori) Vol. 3. New Delhi: Idara Kitabulshifa; 2010. p. 854-64.
- Trefts E, Gannon M, Wasserman DH. The liver. *Curr Biol*. 2017 Nov 6;27(21):R1147-R1151. <https://doi.org/10.1016/j.cub.2017.09.019> PMID:29112863 PMID:PMC5897118
- Fritsche K, Ziková-Kloas A, Marx-Stoelting P, Braeuning A. Metabolism-Disrupting Chemicals Affecting the Liver: Screening, Testing, and Molecular Pathway Identification. *Int J Mol Sci*. 2023 Jan 31;24(3):2686. <https://doi.org/10.3390/ijms24032686> PMID:36769005 PMID:PMC9916672
- Osna NA, Donohue TM Jr, Kharbanda KK. Alcoholic Liver Disease: Pathogenesis and Current Management. *Alcohol Res*. 2017;38(2):147-161.
- Devarbhavi H, Asrani SK, Arab JP, Nartey YA, Pose E, Kamath PS. Global burden of liver disease: 2023 update. *J Hepatol*. 2023 Aug;79(2):516-537. <https://doi.org/10.1016/j.jhep.2023.03.017> PMID:36990226
- Hong M, Li S, Tan HY, Wang N, Tsao SW, Feng Y. Current Status of Herbal Medicines in Chronic Liver Disease Therapy: The Biological Effects, Molecular Targets and Future Prospects. *Int J Mol Sci*. 2015 Dec 2;16(12):28705-45. <https://doi.org/10.3390/ijms161226126> PMID:26633388 PMID:PMC4691073
- Yuan H, Ma Q, Ye L, Piao G. The Traditional Medicine and Modern Medicine from Natural Products. *Molecules*. 2016 Apr 29;21(5):559. <https://doi.org/10.3390/molecules21050559> PMID:27136524 PMID:PMC6273146
- Ali M, Khan T, Fatima K, Ali QUA, Ovais M, Khalil AT, Ullah I, Raza A, Shinwari ZK, Idrees M. Selected hepatoprotective herbal medicines: Evidence from ethnomedicinal applications, animal models, and possible mechanism of actions. *Phytother Res*. 2018 Feb;32(2):199-215. <https://doi.org/10.1002/ptr.5957> PMID:29047177 PMID:PMC7167792
- Chturvedi GN, Tomar GS, Tiwari SK, Singh KP. Clinical studies on kalmegh (*andropholis paniculata* nees) in infective hepatitis. *Anc Sci Life*. 1983 Apr;2(4):208-15.
- Trivedi NP, Rawal UM, Patel BP. Hepatoprotective effect of andrographolide against hexachlorocyclohexane-induced oxidative injury. *Integr Cancer Ther*. 2007 Sep;6(3):271-80. <https://doi.org/10.1177/1534735407305985> PMID:17761640
- Raut A, Dhama-Shah H, Phadke A, Shindikar A, Udipi S, Joshi J, Vaidya R, Vaidya ADB. Picrorrhiza kurroa, Royle ex Benth: Traditional uses, phytopharmacology, and translational potential in therapy of fatty liver disease. *J Ayurveda Integr Med*. 2023 Jan-Feb;14(1):100558. <https://doi.org/10.1016/j.jaim.2022.100558> PMID:35659739 PMID:PMC10105242
- Sowjanya K, Girish C, Bammigatti C, Prasanna Lakshmi NC. Efficacy of Phyllanthus niruri on improving liver functions in patients with alcoholic hepatitis: A double-blind randomized controlled trial. *Indian J Pharmacol*. 2021 Nov-Dec;53(6):448-456. https://doi.org/10.4103/ijp.IJP_540_20 PMID:34975132 PMID:PMC8764976
- Tai CJ, Choong CY, Shi YC, Lin YC, Wang CW, Lee BH, Tai CJ. Solanum nigrum Protects against Hepatic Fibrosis via Suppression of Hyperglycemia in High-Fat/Ethanol Diet-Induced Rats. *Molecules*. 2016 Feb 25;21(3):269. <https://doi.org/10.3390/molecules21030269> PMID:26927042 PMID:PMC6274119
- Chang JJ, Chung DJ, Lee YJ, Wen BH, Jao HY, Wang CJ. Solanum nigrum Polyphenol Extracts Inhibit Hepatic Inflammation, Oxidative Stress, and Lipogenesis in High-Fat-Diet-Treated Mice. *J Agric Food Chem*. 2017 Oct 25;65(42):9255-9265. <https://doi.org/10.1021/acs.jafc.7b03578> PMID:28982243
- Keshavarzi A, Akrami R, Zarshenas MM, Zareie S, Ghadimi T, Najafi A, Rostami Chijan M, Dehghan A, Zarenezhad E. Evaluation of the Effect of Cichorium intybus L. on the Liver Enzymes in Burn Patients: A Randomized Double-Blind Clinical Trial. *Int J Clin Pract*. 2024 Jan 11;2024:1016247. <https://doi.org/10.1155/2024/1016247> PMID:38239768 PMID:PMC10796187
- Fakher S, Karbalay-Doust S, Noorafshan A, Seghatoleslam A. The Ameliorative Impact of Cichorium intybus L. Distillate on Reproductive Parameters in Male Mice. *Iran J Med Sci*. 2023 Nov 1;48(6):591-599. doi: <https://doi.org/10.30476/IJMS.2023.96653.2826> .
- Li S, Tan HY, Wang N, Zhang ZJ, Lao L, Wong CW, Feng Y. The Role of Oxidative Stress and Antioxidants in Liver Diseases. *Int J Mol Sci*. 2015 Nov 2;16(11):26087-124. <https://doi.org/10.3390/ijms161125942> PMID:26540040 PMID:PMC4661801
- Dhiman RK, Chawla YK. Herbal medicines for liver diseases. *Dig Dis Sci*. 2005 Oct;50(10):1807-12. <https://doi.org/10.1007/s10620-005-2942-9> PMID:16187178
- Hora S, Wuestefeld T. Liver Injury and Regeneration: Current Understanding, New Approaches, and Future Perspectives. *Cells*. 2023 Aug 22;12(17):2129. <https://doi.org/10.3390/cells12172129> PMID:37681858 PMID:PMC10486351
- Barouki R, Samson M, Blanc EB, Colombo M, Zucman-Rossi J, Lazaridis KN, Miller GW, Coumoul X. The exposome and liver disease - how environmental factors affect liver health. *J Hepatol*. 2023 Aug;79(2):492-505. <https://doi.org/10.1016/j.jhep.2023.02.034> PMID:36889360 PMID:PMC10448911
- Belete D, Kassaw D, Andualem T. Prevalence of Hepatitis B and Hepatitis C Viral Infections and Their Associated Factors among Diabetic Patients Visiting Debre Tabor Referral Hospital, Northwest Ethiopia, 2021: A Cross-Sectional Study. *Can J Gastroenterol Hepatol*. 2023 Nov 17;2023:5077706. <https://doi.org/10.1155/2023/5077706> PMID:38021268 PMID:PMC10673667
- Ringelhan M, McKeating JA, Protzer U. Viral hepatitis and liver cancer. *Philos Trans R Soc Lond B Biol Sci*. 2017 Oct

- 19;372(1732):20160274. doi: 10.1098/rstb.2016.0274. Erratum in: *Philos Trans R Soc Lond B Biol Sci.* 2018 Jan 5;373(1737):20170339. <https://doi.org/10.1098/rstb.2017.0339> PMID:29158320 PMCID:PMC5717445
23. Osná NA, Donohue TM Jr, Kharbanda KK. Alcoholic Liver Disease: Pathogenesis and Current Management. *Alcohol Res.* 2017;38(2):147-161.
24. Pouwels S, Sakran N, Graham Y, Leal A, Pintar T, Yang W, Kassir R, Singhal R, Mahawar K, Ramnarain D. Non-alcoholic fatty liver disease (NAFLD): a review of pathophysiology, clinical management and effects of weight loss. *BMC Endocr Disord.* 2022 Mar 14;22(1):63. <https://doi.org/10.1186/s12902-022-00980-1> PMID:35287643 PMCID:PMC8919523
25. Andrade RJ, Chalasani N, Björnsson ES, Suzuki A, Kullak-Ublick GA, Watkins PB, Devarbhavi H, Merz M, Lucena MI, Kaplowitz N, Aithal GP. Drug-induced liver injury. *Nat Rev Dis Primers.* 2019 Aug 22;5(1):58. <https://doi.org/10.1038/s41572-019-0105-0> PMID:31439850
26. Gatselis NK, Zachou K, Koukoulis GK, Dalekos GN. Autoimmune hepatitis, one disease with many faces: etiopathogenetic, clinico-laboratory and histological characteristics. *World J Gastroenterol.* 2015 Jan 7;21(1):60-83. <https://doi.org/10.3748/wjg.v21.i1.60> PMID:25574080 PMCID:PMC4284362
27. Allameh A, Niayesh-Mehr R, Aliarab A, Sebastiani G, Pantopoulos K. Oxidative Stress in Liver Pathophysiology and Disease. *Antioxidants (Basel).* 2023 Aug 22;12(9):1653. <https://doi.org/10.3390/antiox12091653> PMID:37759956 PMCID:PMC10525124
28. Khan MA. Akseer Azam. (Urdu translation by Kabeeruddin M). New Delhi: Idara kitabul shifa; 2011.p. 481-98.
29. Tabri AHAM. Moalajate Bukhratia. Vol. 3. New Delhi: C.C.R.U.M; 1997.
30. Ahmed NZ, Alam MA, Sheeraz M. Concept and Management of Fatty Liver Disease in Unani Medicine Vis-A-Vis Conventional Medicine-A Review. *Spatula DD.* 2014;4(4):233-41. <https://doi.org/10.5455/spatula.20141113043401>
31. Bruha R, Dvorak K, Petrtyl J. Alcoholic liver disease. *World J Hepatol.* 2012 Mar 27;4(3):81-90. <https://doi.org/10.4254/wjvh.v4.i3.81> PMID:22489260 PMCID:PMC3321494
32. Beier JI, Arteel GE. Environmental exposure as a risk-modifying factor in liver diseases: Knowns and unknowns. *Acta Pharm Sin B.* 2021 Dec;11(12):3768-3778. <https://doi.org/10.1016/j.apsb.2021.09.005> PMID:35024305 PMCID:PMC8727918
33. David S, Hamilton JP. Drug-induced Liver Injury. *US Gastroenterol Hepatol Rev.* 2010 Jan 1;6:73-80.
34. Parlar YE, Ayar SN, Cagdas D, Balaban YH. Liver immunity, autoimmunity, and inborn errors of immunity. *World J Hepatol.* 2023 Jan 27;15(1):52-67. <https://doi.org/10.4254/wjvh.v15.i1.52> PMID:36744162 PMCID:PMC9896502
35. Pei Y, Goh GB. Genetic Risk Factors for Metabolic Dysfunction-Associated Steatotic Liver Disease. *Gut Liver.* 2025 Jan 15;19(1):8-18. <https://doi.org/10.5009/gnl240407> PMID:39774124 PMCID:PMC11736312
36. Datta S, Aggarwal D, Sehrawat N, Yadav M, Sharma V, Sharma A, Zghair AN, Dhama K, Sharma A, Kumar V, Sharma AK. Hepatoprotective effects of natural drugs: Current trends, scope, relevance and future perspectives. *Phytomedicine.* 2023 Dec 1;121:155100. <https://doi.org/10.1016/j.phymed.2023.155100> PMID:37801892
37. Read AE. Some clinical features of liver cell failure: an appraisal of their causes. *Gut.* 1978 Jun;19(6):543-8. <https://doi.org/10.1136/gut.19.6.543> PMID:355067 PMCID:PMC1412018
38. Sharma A, Nagalli S. Chronic Liver Disease. 2023 Jul 3. In: *StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-. PMID: 32119484.*
39. Basaranoglu M, Neuschwander-Tetri BA. Nonalcoholic Fatty Liver Disease: Clinical Features and Pathogenesis. *Gastroenterol Hepatol (N Y).* 2006 Apr;2(4):282-291.
40. Swain MG. Fatigue in liver disease: pathophysiology and clinical management. *Can J Gastroenterol.* 2006 Mar;20(3):181-8. <https://doi.org/10.1155/2006/624832> PMID:16550262 PMCID:PMC2582971
41. Kalaitzakis E. Gastrointestinal dysfunction in liver cirrhosis. *World J Gastroenterol.* 2014 Oct 28;20(40):14686-95. <https://doi.org/10.3748/wjg.v20.i40.14686> PMID:25356031 PMCID:PMC4209534
42. Liu Y, Zhao Y, Gao X, Liu J, Ji F, Hsu YC, Li Z, Nguyen MH. Recognizing skin conditions in patients with cirrhosis: a narrative review. *Ann Med.* 2022 Dec;54(1):3017-3029. <https://doi.org/10.1080/07853890.2022.2138961> PMID:36308406 PMCID:PMC9629063
43. Ferenci P. Hepatic encephalopathy. *Gastroenterol Rep (Oxf).* 2017 May;5(2):138-147. <https://doi.org/10.1093/gastro/gox013> PMID:28533911 PMCID:PMC5421503
44. Bhandari A, Mahajan R. Skin Changes in Cirrhosis. *J Clin Exp Hepatol.* 2022 Jul-Aug;12(4):1215-1224. <https://doi.org/10.1016/j.jceh.2021.12.013> PMID:35814509 PMCID:PMC9257870
45. Grant DM. Detoxification pathways in the liver. *J Inherit Metab Dis.* 1991;14(4):421-30. <https://doi.org/10.1007/BF01797915> PMID:1749210
46. Roerecke M, Vafaei A, Hasan OSM, Chrystoja BR, Cruz M, Lee R, Neuman MG, Rehm J. Alcohol Consumption and Risk of Liver Cirrhosis: A Systematic Review and Meta-Analysis. *Am J Gastroenterol.* 2019 Oct;114(10):1574-1586. <https://doi.org/10.14309/ajg.0000000000000340> PMID:31464740 PMCID:PMC6776700
47. Pinter M, Trauner M, Peck-Radosavljevic M, Sieghart W. Cancer and liver cirrhosis: implications on prognosis and management. *ESMO Open.* 2016 Mar 17;1(2):e000042. <https://doi.org/10.1136/esmoopen-2016-000042> PMID:27843598 PMCID:PMC5070280
48. Nobili V, Carter-Kent C, Feldstein AE. The role of lifestyle changes in the management of chronic liver disease. *BMC Med.* 2011 Jun 6;9:70. <https://doi.org/10.1186/1741-7015-9-70> PMID:21645344 PMCID:PMC3127780
49. Bhadoria AS, Mohapatra A, Gupta R, Chawla YK, Kant R, Nundy S. Preventive hepatology: An ounce of prevention or pounds of cure to curb liver diseases. *J Family Med Prim Care.* 2023 Mar;12(3):419-421. https://doi.org/10.4103/jfmpc.jfmpc_2225_22 PMID:37122647 PMCID:PMC10131973
50. Romero-Gómez M, Zelber-Sagi S, Martín F, Bugianesi E, Soria B. Nutrition could prevent or promote non-alcoholic fatty liver disease: an opportunity for intervention. *BMJ.* 2023 Oct 9;383:e075179. <https://doi.org/10.1136/bmj-2023-075179> PMID:37813416 PMCID:PMC10561058
51. Henney AE, Gillespie CS, Alam U, Hydes TJ, Cuthbertson DJ. Ultra-Processed Food Intake Is Associated with Non-Alcoholic Fatty Liver Disease in Adults: A Systematic Review and Meta-Analysis. *Nutrients.* 2023 May 10;15(10):2266. <https://doi.org/10.3390/nu15102266> PMID:37242149 PMCID:PMC10224355
52. Berná G, Romero-Gomez M. The role of nutrition in non-alcoholic fatty liver disease: Pathophysiology and management. *Liver Int.* 2020 Feb;40 Suppl 1:102-108. <https://doi.org/10.1111/liv.14360> PMID:32077594
53. Popkin BM, D'Anci KE, Rosenberg IH. Water, hydration, and health. *Nutr Rev.* 2010 Aug;68(8):439-58. <https://doi.org/10.1111/j.1753-4887.2010.00304.x> PMID:20646222 PMCID:PMC2908954
54. Rambaldi A, Jacobs BP, Gluud C. Milk thistle for alcoholic and/or hepatitis B or C virus liver diseases. *Cochrane Database Syst Rev.*

- 2007 Oct 17;2007(4):CD003620.
<https://doi.org/10.1002/14651858.CD003620>
55. Malik A, Kardashian AA, Zakharia K, Bowlus CL, Tabibian JH. Preventative care in cholestatic liver disease: Pearls for the specialist and subspecialist. *Liver Res.* 2019 Jun;3(2):118-127. <https://doi.org/10.1016/j.livres.2019.04.001> PMID:32042471 PMCID:PMC7008979
 56. Wong RJ, Ahmed A. Obesity and non-alcoholic fatty liver disease: Disparate associations among Asian populations. *World J Hepatol.* 2014 May 27;6(5):263-73 <https://doi.org/10.4254/wjh.v6.i5.263> PMID:24868320 PMCID:PMC4033284
 57. Stevanović J, Belezja J, Coxito P, Ascensão A, Magalhães J. Physical exercise and liver "fitness": Role of mitochondrial function and epigenetics-related mechanisms in non-alcoholic fatty liver disease. *Mol Metab.* 2020 Feb;32:1-14. <https://doi.org/10.1016/j.molmet.2019.11.015> PMID:32029220 PMCID:PMC6931125
 58. Barrón-Cabrera E, Soria-Rodríguez R, Amador-Lara F, Martínez-López E. Physical Activity Protocols in Non-Alcoholic Fatty Liver Disease Management: A Systematic Review of Randomized Clinical Trials and Animal Models. *Healthcare (Basel).* 2023 Jul 10;11(14):1992. <https://doi.org/10.3390/healthcare11141992> PMID:37510432 PMCID:PMC10379178
 59. Miguères M, Lhomme S, Izopet J. Hepatitis A: Epidemiology, High-Risk Groups, Prevention and Research on Antiviral Treatment. *Viruses.* 2021 Sep 22;13(10):1900. <https://doi.org/10.3390/v13101900> PMID:34696330 PMCID:PMC8540458
 60. Fallucca A, Restivo V, Sgariglia MC, Roveta M, Trucchi C. Hepatitis A Vaccine as Opportunity of Primary Prevention for Food Handlers: A Narrative Review. *Vaccines (Basel).* 2023 Jul 21;11(7):1271. <https://doi.org/10.3390/vaccines11071271> PMID:37515087 PMCID:PMC10383099
 61. Ahmed Z, Ahmed U, Walayat S, Ren J, Martin DK, Moole H, Koppe S, Yong S, Dhillon S. Liver function tests in identifying patients with liver disease. *Clin Exp Gastroenterol.* 2018 Aug 23;11:301-307. <https://doi.org/10.2147/CEG.S160537> PMID:30197529 PMCID:PMC6112813
 62. Wazir H, Abid M, Essani B, Saeed H, Ahmad Khan M, Nasrullah F, Qadeer U, Khalid A, Varrassi G, Muzammil MA, Maryam A, Syed ARS, Shah AA, Kinger S, Ullah F. Diagnosis and Treatment of Liver Disease: Current Trends and Future Directions. *Cureus.* 2023 Dec 4;15(12):e49920. <https://doi.org/10.7759/cureus.49920>
 63. Navarro VJ, Khan I, Björnsson E, Seeff LB, Serrano J, Hoofnagle JH. Liver injury from herbal and dietary supplements. *Hepatology.* 2017 Jan;65(1):363-373. <https://doi.org/10.1002/hep.28813> PMID:27677775 PMCID:PMC5502701
 64. Reau NS. The Importance of Making an Accurate Diagnosis for Hepatic Encephalopathy. *Gastroenterol Hepatol (N Y).* 2023 Dec;19(12):740-748.
 65. Assy N, Jacob G, Spira G, Edoute Y. Diagnostic approach to patients with cholestatic jaundice. *World J Gastroenterol.* 1999 Jun;5(3):252-262. <https://doi.org/10.3748/wjg.v5.i3.252> PMID:11819442 PMCID:PMC4688481
 66. de Bruyn G, Graviss EA. A systematic review of the diagnostic accuracy of physical examination for the detection of cirrhosis. *BMC Med Inform Decis Mak.* 2001;1:6. <https://doi.org/10.1186/1472-6947-1-6> PMID:11806763 PMCID:PMC64783
 67. Bassari R, Koea JB. Jaundice associated pruritis: a review of pathophysiology and treatment. *World J Gastroenterol.* 2015 Feb 7;21(5):1404-13. <https://doi.org/10.3748/wjg.v21.i5.1404> PMID:25663760 PMCID:PMC4316083
 68. Hall P, Cash J. What is the real function of the liver 'function' tests? *Ulster Med J.* 2012 Jan;81(1):30-6.
 69. Lala V, Zubair M, Minter DA. Liver Function Tests. 2023 Jul 30. In: *StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-. PMID: 29494096.*
 70. Coenegrachts K. Magnetic resonance imaging of the liver: New imaging strategies for evaluating focal liver lesions. *World J Radiol.* 2009 Dec 31;1(1):72-85. <https://doi.org/10.4329/wjr.v1.i1.72> PMID:21160723 PMCID:PMC2999307
 71. Neuberger J, Patel J, Caldwell H, Davies S, Hebditch V, Hollywood C, Hubscher S, Karkhanis S, Lester W, Roslund N, West R, Wyatt JI, Heydtmann M. Guidelines on the use of liver biopsy in clinical practice from the British Society of Gastroenterology, the Royal College of Radiologists and the Royal College of Pathology. *Gut.* 2020 Aug;69(8):1382-1403. <https://doi.org/10.1136/gutjnl-2020-321299> PMID:32467090 PMCID:PMC7398479
 72. Wazir H, Abid M, Essani B, Saeed H, Ahmad Khan M, Nasrullah F, Qadeer U, Khalid A, Varrassi G, Muzammil MA, Maryam A, Syed ARS, Shah AA, Kinger S, Ullah F. Diagnosis and Treatment of Liver Disease: Current Trends and Future Directions. *Cureus.* 2023 Dec 4;15(12):e49920. <https://doi.org/10.7759/cureus.49920>
 73. Mondal M, Sarkar C, Saha S, Hossain MN, Norouzi R, Mubarak MS, Siyadatpanah A, Wilairatana P, Hossain R, Islam MT, Coutinho HDM. Hepatoprotective activity of andrographolide possibly through antioxidative defense mechanism in Sprague-Dawley rats. *Toxicol Rep.* 2022 Apr 22;9:1013-1022. <https://doi.org/10.1016/j.toxrep.2022.04.007> PMID:36518448 PMCID:PMC9742837
 74. Satheesh Naik K, Gurushanthaiah M, Kavimani M, Prabhu K, Lokanadham S. Hepatoprotective Role of Eclipta alba against High Fatty Diet Treated Experimental Models - A Histopathological Study. *Maedica (Bucur).* 2018 Sep;13(3):217-222. doi: <https://doi.org/10.26574/maedica.2018.13.3.217> .
 75. Verma PC, Basu V, Gupta V, Saxena G, Rahman LU. Pharmacology and chemistry of a potent hepatoprotective compound Picroliv isolated from the roots and rhizomes of *Picrorhiza kurroa royle ex benth.* (kutki). *Curr Pharm Biotechnol.* 2009 Sep;10(6):641-9. <https://doi.org/10.2174/138920109789069314> PMID:19619118
 76. Das S, Singh PK, Ameeruddin S, Kumar Bindhani B, Obaidullah WJ, Obaidullah AJ, Mishra S, Mohapatra RK. Ethnomedicinal values of *Boerhaavia diffusa* L. as a panacea against multiple human ailments: a state of art review. *Front Chem.* 2023 Nov 14;11:1297300. <https://doi.org/10.3389/fchem.2023.1297300> PMID:38033469 PMCID:PMC10682173
 77. Abu Hassan MR, Hj Md Said R, Zainuddin Z, Omar H, Md Ali SM, Aris SA, Chan HK. Effects of one-year supplementation with *Phyllanthus niruri* on fibrosis score and metabolic markers in patients with non-alcoholic fatty liver disease: A randomized, double-blind, placebo-controlled trial. *Heliyon.* 2023 May 30;9(6):e16652. <https://doi.org/10.1016/j.heliyon.2023.e16652> PMID:37313177 PMCID:PMC10258366
 78. Ionita-Radu F, Patoni C, Nancoff AS, Marin FS, Gaman L, Bucurica A, Socol C, Jinga M, Dutu M, Bucurica S. Berberine Effects in Pre-Fibrotic Stages of Non-Alcoholic Fatty Liver Disease-Clinical and Pre-Clinical Overview and Systematic Review of the Literature. *Int J Mol Sci.* 2024 Apr 10;25(8):4201. <https://doi.org/10.3390/ijms25084201> PMID:38673787 PMCID:PMC11050387
 79. Zhang H, Lv JL, Zheng QS, Li J. Active components of *Solanum nigrum* and their antitumor effects: a literature review. *Front Oncol.* 2023 Dec 19;13:1329957. <https://doi.org/10.3389/fonc.2023.1329957> PMID:38192621 PMCID:PMC10773844
 80. Krepkova LV, Babenko AN, Lemyaseva SV, Saybel OL, Sherwin CM, Enioutina EY. Modulation of Hepatic Functions by Chicory (*Cichorium intybus* L.) Extract: Preclinical Study in Rats. *Pharmaceuticals (Basel).* 2023 Oct 16;16(10):1471. <https://doi.org/10.3390/ph16101471> PMID:37895942 PMCID:PMC10609820
 81. Ozbek H, Uğraş S, Dülger H, Bayram I, Tuncer I, Oztürk G, Oztürk A. Hepatoprotective effect of *Foeniculum vulgare* essential oil. *Fitoterapia.* 2003 Apr;74(3):317-9. [https://doi.org/10.1016/S0367-326X\(03\)00028-5](https://doi.org/10.1016/S0367-326X(03)00028-5) PMID:12727504

82. Daneshvar-Ghahfarokhi S, Ahmadinia H, Sadeghi T, Basirat E, Mohammadi-Shahrokhi V. Achillea millefolium capsule improved liver enzymes and lipid profile compared to placebo in patients with type 2 diabetes: a double-blind randomized clinical trial. *BMC Nutr.* 2025 Jan 24;11(1):21. <https://doi.org/10.1186/s40795-025-01005-5> PMID:39856724 PMCID:PMC11761196
83. Wang H, Zhang H, Zhang Y, Wang D, Cheng X, Yang F, Zhang Q, Xue Z, Li Y, Zhang L, Yang L, Miao G, Li D, Guan Z, Da Y, Yao Z, Gao F, Qiao L, Kong L, Zhang R. Plumbagin protects liver against fulminant hepatic failure and chronic liver fibrosis via inhibiting inflammation and collagen production. *Oncotarget.* 2016 Dec 13;7(50):82864-82875. <https://doi.org/10.18632/oncotarget.12655> PMID:27756878 PMCID:PMC5347738
84. Maituoheti R, Rouzaimaimaiti R, Tang D, Zhao J, Aisa HA. Secoiridoid glycosides from the *Gentiana olivieri* Griseb and their bioactivities. *Phytochemistry.* 2023 Nov;215:113839. <https://doi.org/10.1016/j.phytochem.2023.113839> PMID:37657663
85. Ibrahim M, Khaja MN, Aara A, Khan AA, Habeeb MA, Devi YP, Narasu ML, Habibullah CM. Hepatoprotective activity of *Sapindus mukorossi* and *Rheum emodi* extracts: in vitro and in vivo studies. *World J Gastroenterol.* 2008 Apr 28;14(16):2566-71. <https://doi.org/10.3748/wjg.14.2566> PMID:18442207 PMCID:PMC2708371
86. Jung JC, Lee YH, Kim SH, Kim KJ, Kim KM, Oh S, Jung YS. Hepatoprotective effect of licorice, the root of *Glycyrrhiza uralensis* Fischer, in alcohol-induced fatty liver disease. *BMC Complement Altern Med.* 2016 Jan 22;16:19. <https://doi.org/10.1186/s12906-016-0997-0> PMID:26801973 PMCID:PMC4722619
87. Urfi MK, Mujahid M, Rahman MA, Rahman MA. The Role of *Tamarix gallica* Leaves Extract in Liver Injury Induced by Rifampicin Plus Isoniazid in Sprague Dawley Rats. *J Diet Suppl.* 2018 Jan 2;15(1):24-33. <https://doi.org/10.1080/19390211.2017.1310783> PMID:28459346
88. Oh GS, Yoon J, Lee GG, Kwak JH, Kim SW. The Hexane Fraction of *Cyperus rotundus* Prevents Non-Alcoholic Fatty Liver Disease Through the Inhibition of Liver X Receptor α -Mediated Activation of Sterol Regulatory Element Binding Protein-1c. *Am J Chin Med.* 2015;43(3):477-494. <https://doi.org/10.1142/S0192415X15500305> PMID:25967664
89. Batiha GE, Olatunde A, El-Mleeh A, Hetta HF, Al-Rejaie S, Alghamdi S, Zahoor M, Magdy Beshbishy A, Murata T, Zaragoza-Bastida A, Rivero-Perez N. Bioactive Compounds, Pharmacological Actions, and Pharmacokinetics of Wormwood (*Artemisia absinthium*). *Antibiotics (Basel).* 2020 Jun 23;9(6):353. <https://doi.org/10.3390/antibiotics9060353> PMID:32585887 PMCID:PMC7345338
90. Gupta S, Veda A. *Operculina turpethum* (Linn.) Silva Manso as a Medicinal Plant Species: A Review on Bioactive Components and Pharmacological Properties. *Pharmacogn Rev.* 2017 Jul-Dec;11(22):158-166. https://doi.org/10.4103/phrev.phrev.6_17 PMID:28989252 PMCID:PMC5628523
91. Poojari R, Gupta S, Maru G, Khade B, Bhagwat S. Chemopreventive and hepatoprotective effects of embelin on N-nitrosodiethylamine and carbon tetrachloride induced preneoplasia and toxicity in rat liver. *Asian Pac J Cancer Prev.* 2010;11(4):1015-20.
92. Sharma V, Pandey D. Protective Role of *Tinospora cordifolia* against Lead-induced Hepatotoxicity. *Toxicol Int.* 2010 Jan;17(1):12-7. <https://doi.org/10.4103/0971-6580.68343> PMID:21042467 PMCID:PMC2964743
93. Fahmi A, Hassanen N, Abdur-Rahman M, Shams-Eldin E. Phytochemicals, antioxidant activity and hepatoprotective effect of ginger (*Zingiber officinale*) on diethylnitrosamine toxicity in rats. *Biomarkers.* 2019 Jul;24(5):436-447. <https://doi.org/10.1080/1354750X.2019.1606280> PMID:30979347
94. Haridevamuthu B, Seenivasan B, Priya PS, Muthuraman S, Kumar RS, Manikandan K, Almutairi BO, Almutairi MH, Arockiaraj S, Gopinath P, Arockiaraj J. Hepatoprotective effect of dihydroxy piperlongumine in high cholesterol-induced non-alcoholic fatty liver disease zebrafish via antioxidant activity. *Eur J Pharmacol.* 2023 Apr 15;945:175605. <https://doi.org/10.1016/j.ejphar.2023.175605> PMID:36822456
95. Jain M, Kapadia R, Jadeja RN, Thounaojam MC, Devkar RV, Mishra SH. Hepatoprotective potential of *Tecomella undulata* stem bark is partially due to the presence of betulinic acid. *J Ethnopharmacol.* 2012 Aug 30;143(1):194-200. <https://doi.org/10.1016/j.jep.2012.06.023> PMID:22789967
96. Anonymous. The Ayurvedic Pharmacopoeia of India. Part-I, Vol-I. Government of India Ministry of Health and Family Welfare Department of Ayush. 1989.
97. Anonymous. The Unani Pharmacopoeia of India. Part-I, Vol-I-VII. Government of India Ministry of Health and Family Welfare Department of Ayush. 2007.