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Exploring the Hepatoprotective Potential of Plants: A Comprehensive Review

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Abstract
The liver is an important organ that aids in the metabolism and elimination of xenobiotics from the body. Liver injury or malfunction is a serious public health issue that affects not only doctors and nurses, but also the pharmaceutical business and drug regulatory bodies. Excessive alcohol use, toxic chemicals (particular antibiotics, chemotherapeutic drugs, carbon tetrachloride (CCL_4), thioacetamide (TAA), and microorganisms all induce liver cell harm. In this scenario, the current synthetic medications to treat liver problems promote more liver damage. As a result, herbal drugs have grown in popularity and are widely used. For a long time, herbal remedies have been utilized to treat liver problems. There are a variety of herbal preparations on the market. The goal of this review is to compile information on promising phytochemicals from medicinal plants that have been investigated in hepatotoxicity models utilizing cutting-edge scientific methods.

Keywords: Carbon Tetrachloride (CCL_4), Hepatotoxicity, Herbal Drugs, Liver Injury, Serum Transaminases.

Introduction

The liver is one of the body's largest organs and the primary site for carbohydrate, protein, and fat metabolism and excretion. It's involved in nearly every metabolic route that leads to growth, disease resistance, nutrition delivery, energy provision, and reproduction[1]. However, it is constantly and varyingly exposed to environmental toxins, and also abused by unhealthy drug habits, alcohol, and prescribed and over-the-counter drugs, all of which can lead to numerous liver disorders such as hepatitis, cirrhosis, and alcoholic liver disease[2, 3]. Hydroxyl, superoxide, nitric oxide, nitrogen dioxide, peroxyl, lipid peroxyl and hydrogen peroxide are examples of free radicals that are produced by normal cellular metabolism[4-7]. Reactive oxygen species leakage from mitochondria causes oxidative damage to cell components such as proteins, lipids, and nucleic acids[8.] Increased oxidative stress has been hypothesized as a key cause of cancer, cardiovascular illness, diabetes mellitus, neurological diseases (Alzheimer's disease and Parkinson's disease), autoimmune disorders, rheumatoid arthritis, and ageing pathogenesis[7, 9, 10]. They play a significant part in the inflammation process after intoxication with carbon tetrachloride produced hepatotoxicity[11]. Damage to the structural integrity of liver is reflected by increase in the liver hepato-specific enzymes (ALP, ALT and AST) in the serum, because they are

cytoplasmic in location and are released into circulation after cellular damage[12, 13], therefore, it can be measured in serum[14].

Hepatoprotective Plant

Hepatoprotective herbs Herbal-based therapeutics for liver disorders has been in use in India for a long time and has been popularized world over by leading pharmaceuticals. Despite the significant popularity of several herbal medicines in general, and for liver diseases in particular, they are still unacceptable treatment modalities for liver diseases. The use of natural remedies for the treatment of liver diseases has a long history, starting with the Ayurvedic treatment, and extending to the Chinese, European and other systems of traditional medicines. A large number of plants and formulations have been claimed to have hepatoprotective activity. Nearly 160 phytoconstituents from 101 plants have been claimed to possess liver protecting activity. In India, more than 87 plants are used in 33 patented and proprietary multi-ingredient plant formulations. In spite of the tremendous advances made, no significant and safe hepatoprotective agents is available in modern therapeutics. Therefore, due importance has been given globally to develop plant-based hepatoprotective drugs effective against a variety of liver disorders. The present review is aimed at compiling data based on reported works on promising phytochemicals from medicinal plants that have been tested in hepatotoxicity models.

1) Magnolia Grandiflora

Magnolia grandiflora L., generally known as chapha, is a member of the *Magnoliaceae* family. Flavonoids[15], sesquiterpenes[16] and volatile oils[17-22] have been identified through phytochemical studies of the flower. The hepatoprotective activity of hydro-ethanolic extracts of the stamen, gynoecium, and petal (100 mg kg-1 body weight, each) was determined using Klassen and Plaa's method[23]. Adult male albino Sprague–Dawley rats (120–155g) were given an intraperitoneal injection of 25 percent CCl_4 in liquid paraffin (5 mL kg1) to induce liver damage. Alanine aminotransferase (ALT), aspartate aminotransferase (AST), and alkaline phosphatase (ALP) were all determined in the blood. The results obtained were compared to a silymarin standard (25 mg kg-1 body weight). The introduction of dosages of *magnolia grandiflora* hydroethanolic extract, causes considerable biochemical alterations intoxification and demonstrates their potential hepatoprotective effect in the generation of liver parenchyma cells. TLC was used to detect the flavonoids in the ethyl acetate fraction qualitatively, followed by HPLC-PDA. Because of its high flavonoid content, the stamen extract had a higher efficacy. These flavonoids have hydrogen-donating antioxidant activity and the potential to bind divalent metal cations, and this investigation found that the stamen extract had a protective role against oxidative liver damage[24].

Figure no 1. *Magnolia Grandiflora*

2) Annonamuricata

Annonamuricata is a member of the *Annonaceae* family and is locally known as hanuman phal. The alcoholic extract of *A.muricata* was tested for hepatoprotective effect against carbontetrachloride in albino rats. The activity of serum glutamic oxaloacetictransminase (SGOT, AST) and glutamic pyruvic transaminase (SGPT, ALT) was determined in biochemical tests using Reitman and Frankel's method (1957). The levels of serum alkaline phosphatase (SALP) were determined using the Bessey et al. technique (1946). The lipid peroxidation levels in the liver and brain were calculated using the Ohkawa et al. (1979) method, and the total protein content in the liver and brain was calculated using Lowry et (1951). The alcoholic extract of *A.muricata* showed a decrease in the levels of liver peroxidation (LPO) and serum alkaline phosphate (SALP), indicating that the extract had hepatoprotective activity[25].

Figure no 2. *Annonamuricata*

3) Jacaranda acutifolia

Jacaranda acutifolia is a part of the *Bignonicaceae* family and is popularly known as Neel mohor. Flavonoids, triterpenes, quinines, and acetosides[26] are the primary constituents, and the leaves contain verbascoside, jacaranone, phenyl acetic-glucoside, scutellarein-7-glucoronide and hydroquinone[27]. The antioxidant and hepatoprotective effects of leaves of methanol extract of *Jacaranda acutifolia* on taxoxifen (TAM) caused liver damage in female Sprague-Dawley rats were investigated (120-140g). When compared with control, serum ALT and AST levels in TAM-treated rats were 264.8% and 190% higher respectively. Treatment with a methanolic extract of *jacaranda acutifolia* leaves reduced the increase in ALT and AST by 33.6 and 36.8% respectively. Methanol preparations of JA leaves demonstrated strong hepatoprotective action, according to the findings[28].

Figure no 3. *Jacaranda acutifolia*

4) Ficus bengalesis

Ficus bengalesis Linn. is a part of the *Moraceae* family, it is termed in English as a banyan and in Marathi as vad. To the bowels, all portions of the plant are caustic, sweetish, and astringent. The bark of the plant is anti-diabetic and can be used to treat piles, gonorrhoea, syphilis, diarrhoea, and liver inflammation. Tannins, flavonoids, saponins, and sugar were found in a preliminary phytochemical analysis. The goal of the study was to see if a methanolic extract of ficus bengalensis bark might protect rat's livers from paracetamol and CCl_4-induced damage. The levels of serum glutamate pyruvate transminase SGPT, serum glutamate oxaloacetate transminase SGOT, alkaline phosphatise ALP, total and direct bilirubin all increased significantly when rats were given CCL_4 and paracetamol. The levels of these enzymes increased in rats pretreated with methanolic extract of *ficus bengalesis* barks at 100 and 250 mg/kg body weight p.o., although it was much less than in rats treated with paracetamol and CCL_4 separately. In the case of CCL_4 induced hepatotoxicity, the maximum hepatoprotective action was observed at 250mg/kg body weight, while in the case of paracetamol-induced hepatotoxicity, the maximum hepatoprotective effect was discovered at 500mg/kg body weight. As a result, the methanolic extract of *F.bengalesis* bark showed hepatoprotective effect against paracetamol and CCL_4-induced toxicity[29].

Figure no 4. *Ficus bengalesis*

5) Garcinica indica Linn

Garcinica indica often known as 'kokum' is a member of the *Clusiaceae* family. *Garcinica indica* fruit is used to treat many diseases, including skin rashes caused by allergies, sunstroke, dysentery, appetite, liver tonic and cardiotonic. The antioxidant activity of the fruits rind has been discovered[30-33]. Polyisoprenylated benzophenones, garcinol, xanthochymol, isomer isogarcinol, and isoxanthochymol are all found in the fruit peel[34]. Citric acid, malic acid, polyphenols, polysaccharides, anthocyanins, flavonoids, and ascorbic acid are some of the additional antioxidant chemicals found in *Garcinica indica*[35-38]. The antioxidant and hepatoprotective activity of *garcinica indica Linn* aqueous and ethanolic extracts on carbon tetrachloride (1.5ml/kg) caused liver damage in wistar albino rats was examined. Total bilirubin levels and the activity of the enzymes ALKP, ALT, and AST were evaluated using the jendrassil, bergmeyer, Reitman and berger method respectively. When compared to the drug silymarin, the aqueous and ethanolic extract at a dose level of 500mg/kg significantly reduced serum biomarkers

and restored near normal levels in CCL_4 induced hepatotoxic experimental rats and produced significant ($P<0.01$) antioxidant and hepatoprotective activity[14].

Figure no 5. ***Garcinica indica Linn***

6) Tectona grandis

The *Tectona grandis* belogs to *Lamiaceae* and commonly known as the sagvan tree, may be found all over India[39]. The level of hepatospecific enzymes which are cytoplasmic and released into circulation after cellular damage, increases when a liver cell is damaged. A significant increase in total bilirubin content as well as SGOT, SGOT, and ALP activity in the CCL_4 treated group could be used as an indication of liver injury in this study. In comparison to the CCL_4-treated group *Tectona grandis* bark ethenolic extract decreased CCL_4 induced elevations in total bilirubin and SGOT, SGOT, and ALP activity[40]. Because of the presence of quinones and tannin-like phytoconstituents in *Tectona grandis* bark ethenolic extract, it has hepatoprotective and antioxidant properties[41].

Figure no 6. ***Tectona grandis***

7) Ancardium Occidentale

Anacardium occidentale (cashew) is a flowering plant in the *Anacardiaceae* family. A. occidentale leaves extract contains phytoconstituents such as saponins, tannins, and flavonoids, which have been shown to have antioxidant properties. A substantial antioxidant capacity was also detected in wister mice

against hepatocarcinogenesis induced by aflatoxin B1. Analysis of blood biochemical parameters of serum liver enzymes (AST, ALT, and ALP) levels in the treatment groups. Elevation of AST level was observed in CCL_4 treated group, silymarin and CCL_4 treated group and extract (1000mg/kg MLAO) and CCL_4 treated group showed decrease enzyme (AST) level when compared to the control[42].

Figure no 7. ***Ancardium Occidentale***

8) Mimusops elengi

Mimusops elengi belongs to *Sapotaceae* family. The in-vivo hepatoprotective activity of a methanolic extract of *Mimusops elengi* bark was studied. At different doses carbon tetrachloride caused hepatotoxicity in wistar rats of either sex weighing 130 to 145 gm. Biochemically and histopathologically the hepatoprotective activity was evaluated. The effects of crude methanol extracts of *M.elengi* at doses of 100, 200, and 400 mg/kg on rats intoxicated with carbon tetrachloride showed dose-dependent effectiveness in recovering increased levels of biochemical markers. The treatment restored serum SGOT, SGOT and cholesterol levels, but the dose of 400 mg/kg resulted in the most complete restoration of increased enzymatic markers[43].

Figure no 8. ***Mimusops elengi***

9) Limonia elephantum

Limonia elephantum belongs to *Rutaceae* family and it has long been used in Indian folk medicine. The hepatoprotective activity of *L.elephantum* was tested in rats after they were given paracetamol to cause liver injury. For hepatoprotective effect, liver superoxide dismutase, lipid peroxidation, glutathione peroxidase, catalase level, and serum biochemical profile such as serum glutamate oxalate transaminase, alkaline phosphate, bilirubin, and total protein were examined. The results of the current studies strongly indicate that the higher dose (409mg/kg) if ethanolic extract of *Limonia elephantum* proved[44].

Figure no 9. ***Limonia elephantum***

10) Curcuma longa

Curcuma longa is a perennial herb that belongs to the *Zingiberaceae* (ginger) family and is often known as turmeric. It is widely grown in Asia and India. *Curcuma longa* rhizomes contain about 2% volatile oils, including alpha and beta turmerone, 5% curcuminoids, mostly curcumin demethoxycurcumin, bis-demethoxycurcumin, and dihydrocurcumin as well as minerals carotene and vitamin C.curcumin is the active ingredient of the yellow spice *curcuma longa*, which has been shown to have a wide range of medicinal properties. In hepatotoxicity produced by carbon tetrachloride, curcumin treatment has been shown to have hepatoprotective activity[45].

Figure no 10. ***Oroxylum Indicum***

11) Azadirachta indica

In India, neem (*azadirachta indica*) belongs to family *Meliaceae* and it is probably the most widely used traditional medicinal plant. Using silymarin as a control, the hepatoprotective effects of ethanolic and aqueous extracts of A.indica were investigated against carbon tetrachloride-induced liver injury in mice. Serum glutamate oxaloacetate transaminase (SGOT), serum glutamate pyruvate trasaminase (SGPT), and alkaline phosphate (ALP) enzyme activity were investigated. Hepatoprotective effect was found in a phytochemical leaf extract of *A.indiaca*. Over carbon tetrachloride-treated animals, ethanolic and aqueous leaf extracts of *A.indica* showed moderate effect. The results supported the traditional medicinal usage of *A.indica* as a hepatoprotective agent[46].

Figure no 11. *Oroxylum Indicum*

12) Oroxylum Indicum

Oroxulum Indicum popularly known as Indian caper or Tetu in Maharashtra is a member of the *Bignoniaceae* family. In the traditional ayurvedic medical system, it has been used as a 'Rasayana' drug. Dysentery, stomach disorders, diarrhoea and rheumatic swelling are also treated with the plants[47]. Snake bite is treated with root, bark, leaf, and stem in Hindu religion[48]. Flavonoids such as chrysin (5, 7-dihydroxyflavone), oroxulum A (5, 7-dihydroxy-6-methoxyflavone), baicalein (5, 6, 7-trihydroxyflavone) and baicalein glycoside, as well as benzoic acid and fatty acids, are found in the plant. The hepatoprotective effect of *Oroxulum indicum* leaves (300mg/kg) was investigated using hepatotoxicity induced by CCL_4 and various extracts (petroleum ether, ethanol, water, and chloroform extracts). The administration of several extracts causes' considerable changes in biochemical parameters to return to normal and *Oroxylum indicum* was discovered to have antioxidant and hepatoprotective properties. The presence of polar phenolic compounds flavonoids, tannins, and saponin was discovered to be responsible for this activity[49].

Figure no 12. *Oroxylum Indicum*

13) Areca catechu

Areca catechu is a member of the *Arecaceae* family and is locally known as supari. Polyphenolic chemicals found in the plant include procyanidin dimers, trimers, and tetramers[50]. Antifungal,

anthelmintic, antibacterial, antioxidant, anti-inflammatory, insecticide, and larvicidal properties of areca seeds[51]. Aqueous extracts of *Areca catechu* seeds in male wistar rats, the hepatoprotective effect against carbon tetrachloride-induced liver injury was evaluated. Using commercially condensed tannins from areca seeds procyanidin, liver parameters such as serum activities of alanine aminotransferase (ALT) and aspartate aminotransferase (AST) were evaluated, which could contribute to the prevention of hepatotoxicity. These results indicate that traditional medicines have a hepatoprotective effect[52].

Figure no 13. *Areca catechu*

14) Ocimum scantum

Ocimum sanctum is belonged to family *Lamiaceae* and commanly known as tulsi. It has a complex chemical makeup, comprising numerous nutrients and other biologically active substances. Eugenol (an essential oil) and ursolic acid are two of the most well-known active components that have been found and extracted[53]. The immunological system, reproductive system, central nervous system, cardiovascular system, stomach system, urinary system, and blood are all affected by the tulsi plant and its active component eugenol. In rats, *Ocimum sanctum* leaf extract was reported to be hepatoprotective against the hepatotoxic paracetamol by lowering serum enzymes such as aspartate aminotransferase (AST), alanine aminotransferase (ALT) and alkaline phosphatase (ALP). On histological inspection, there was also a significant reduction in fatty degeneration of the liver[54].

Figure no 14. *Ocimum scantum*

15) TabebuIa Argentea

Tabebuia Argentea sometimes known as the silver trumpet tree is a member of the *Bignoniaceae* family. Many chemical compounds particularly phenolic and polyphenolic molecules are rich in them. The goal of the study was to see if different *Tabebuia argentea* leaf extracts (petroleum ether, methanolic, and

aqueous extracts) might protect albino wistar rats from paracetamol-induced liver injury. Serum enzymes SGPT, SGOT, ALP, total bilirubin, and total protein were assessed as liver parameters. In comparison to the disease control group, administration of plant extracts resulted in significant reductions in SGPT, SGOT, SALP and TB as well as an increase in total protein. They also reduce the weight and volume of the liver. In the methanolic extract of *Tabebuia argentea*, phytochemical investigations shows the presence of carbohydrates, glycosides, saponins, alkaloids, phytosterols, proteins, phenolics, tannins, and flavonoids, whereas the aqueous extract of the plant revealed similar constituents except phytosterols. Fats and fixed oils were found in a petroleum ether extract. In comparison to petroleum ether (53.21 mg GAE/ g of extract) and aqueous extract (10.32 mg GAE/ g of extract), the methanolic extract had a higher Phenolic concentration (69.23 mg GAE/ g of extract). *T.argentea* displayed dose-dependent hepatoprotective effect in the PCM model, according to our findings[55].

Figure no 15. *TabebuIa Argentea*

16) Santalum album Linn.

Santalum album linn. is a member of the *Santalaceae* family and is locally known as chandan. Gastric irritation, jaundice, dysentery, tension, and confusions are treated with the root, wood, bark, and leaves of the plant. Previous studies have shown that the plant wood and root bark have abortifacient, hepatoprotective, urinary antiseptic, stomachic, antiviral, and antiherpetic properties[56]. The goal of this study was to see if a hydroalcoholic extract of *Santalum album* leaves could protect wistar albino rats from experimentally induced liver injury caused by carbon tetrachloride and paracetamol. The antioxidant state, as well as the levels of serum marker enzymes, biliruhin, and total protein, were determined. Oral pre-treatment with a hydroalcoholic extract of *S.album* leaves (200 and 400 mg/kg) showed significant hepatoprotective activity against CCI4 and paracetamol-induced hepatotoxicity by lowering serum marker enzymes, bilirubin and lipid peroxidation and increasing glutathione, superoxide dismutase, catalase and protein levels in a dose-dependent manner as evidenced by a decrease in the total weight of liver. The extract also had a lot of antioxidant activity, according to the data. The inclusion of flavonoids, saponins, and other polyphenolic chemicals, which are related to antioxidant activity, may explain the extract hepatoprotective effect in both experimental models[57].

Figure no 16. ***Santalum album Linn.***

17) Averrhoea carambola

Averrhoea carambola often known as karmal, is a member of the *Oxalidaceae* family. The fruit is a tonic, thermogenic, febrifuge, antipyretic, antiscorbutic, and antiscorbutic. It's used as a diaphoretic, diuretic, expectorant, antidiarrhoeal, antiemetic and in acute dyspepsia in traditional Ayurvedic medicine. Hemorrhoids, intermittent fever, liver dysfunctions, and other types of poisoning are all treated by it[58]. 5-hydroxy methyl furfural[59] some volatile principles[60] and polyphenolic antioxidants[61] are all found in plants. The goal of this investigation is to see if the purported hepatoprotective effect of the *A.carambola* fruit aqueous extract can protect albino rats from carbon tetrachloride-induced hepatic damage by administering CCL_4 intraperitoneally. A 0.9 g/kg body weight dosage of aqueous extract of the fruit of *A.carambola* was given. The fruit extract *A.carambola* considerably lowered blood levels of ALT, AST, and ALP enzymes, as well as significantly enhanced liver glutathione levels 24 hours after carbon tetrachloride administration. The inclusion of flavonoids, ascorbic acid, carotenoids, tannins, or lignans among the plant ingredients may account for the observed protective role of the plant extract against carbon tetrachloride. Flavonoids are antioxidants, free radical scavengers, and antilipoperoxidants, all of which help to protect the liver[62].

Figure no 17. ***Averrhoea carambola***

18) Ficus Carica

Ficus Carica is a member of the *Moraceae* family. It is known as fig in English (anjir). Proteolytic enzymes[63], amino acids, minerals, and sugars[64], triterpenes[65] and organic acid[66] have all been studied extensively in *F.carica*. The leaves are boiled and is used as a steam bath for uncomfortable or bloated

piles, as well as a decoction and stomachic[67]. It has mild laxative, demulcent, digestive, and pectoral properties[68]. The decoction of the leaves is used to treat diabetes and kidney and liver calcifications[69]. In male albino rats, ethanolic extract from *F.carica* leaves (obtained by maceration) was tested for hepatoprotective efficacy in CCL_4-induced toxicity. CCI_4-treated mice had considerably higher levels of marker enzymes such alanine aminotransferase (ALT) and aspartate aminotransferase (AST). The activity of these two enzymes were found to be lower in the group that had been pretreated with the plant extract. There are three distinct dosages of *F.carica* used in studies (200, 400, and 800 mg/kg), with the 200 mg/kg dose showing considerable hepatoprotective activity[70].

Figure no 18. *Ficus Carica*

19) Ceiba Pentandra

Ceiba pentandra (Bombacaceae) is also known as kapok and sweta salmali in Ayurveda. Hepatitis and vata and kapha vitiation are treated with the bark, which is acrid, bitter, thermogenic, diuretic, emetic, purgative, and tonic. The roots have diuretic, aphrodisiac, and antipyretic qualities. The decoction of the flowers is commonly used as a laxative, while the leaves are used as an emollient. The tree can generate a dark, almost opaque gum that is astringent, tonic, and laxative[71, 72]. The current study shows that the ethyl acetate portion of a methanol extract of *Ceiba pentandra* stem bark protects rats against paracetamol-induced liver injury. Isolated isoflavonoid, sesquiterpene, naphthoquinone, and water soluble acidic polysaccharides were obtained from *Ceiba pentandra*. The ethyl acetate portion of a methanol extract of *Ceiba pentandra* stem bark protects rats from paracetamol induced liver injury according to the study. Rats with hepatotoxicity due to paracetamol (3 gm/kg) toxicity were administered the ethyl acetate fraction (400 mg/kg) orally. The ethyl acetate fraction of the methanolic extract of *Ceiba pentandra* has hepatoprotective potential against paracetamol-induced hepatotoxicity, according to a significant ($P<0.05$) reduction in serum enzymes GOT (ALT), aspartate aminotransferase (AST), GPT alkaline phosphatase (ALP), total bilirubin content, and histopathological screening in the rats treated[73].

Figure no 19. ***Ceiba Pentandra***

20) Aegle marmelos

Aegle marmelos, sometimes known as Bael, is a spiny tree that belongs to the *Rutaceae* family. Leaves, roots, bark, seeds, and fruits are all edible and have medicinal properties. Bael has been shown to have a hepatoprotective effect in the treatment of alcohol-induced liver injury in albino rats using important biochemical parameters. The thiobarbituric acid assay is the most widely used method for determining the quantity of malondialdelyde which is an indicator of lipid peroxidation and free radical activity. The increase in malondialdelyde in ethanol-induced liver damage has been linked to an increase in lipid peroxidation, a degradative process of membraneous polyunsaturated fatty acids. When comparing the levels of TBARS in the liver tissues of ethanol-intoxicated rats to the levels of TBARS in control animals, the levels of TBARS in the liver tissues of ethanol-intoxicated rats were considerably higher. The use of the herbal medicine Aegle marmelos at therapeutic doses (1g/Kg b.wt) resulted in the greatest reduction in TBARS levels. Silymarin, a well-known hepatoprotective medication, kept the liver's lipid peroxidation levels below normal limits. The results indicate that the herbal drug *Aegle marmelos* has a strong hepatoprotective effect in the treatment of liver damage[74].

Figure no 20. ***Aegle marmelos***

Discussion & Conclusion

Chronic hepatic diseases stand as one of the foremost health troubles worldwide, with liver cirrhosis and drug induced liver injury accounting ninth leading cause of death in western and developing countries.

Therapies developed along the principles of western medicine are often limited in efficacy, carry the risk of adverse effects, and are often too costly, especially for the developing world. Therefore, treating liver diseases with plant-derived compounds which are accessible and do not require laborious pharmaceutical synthesis seems highly attractive. In this review article, an attempt has been made to compile the reported hepatoprotective plants useful to the pharmacologists, scientists, and scholars working in the field of pharmacology and therapeutics to produce evidence-based alternative medicine to treat various types of liver ailments in humans and animal.

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