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A REVIEW ON HEPATIC DISEASES AND DEVELOPMENT OF HERBAL DRUGS FOR THE TREATMENT OF LIVER COMPLICATIONS

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ABSTRACT

Herbal plants or ayurvedic medicines have been used traditionally by herbalist worldwide for the prevention and treatment of various hepatic diseases. The traditional plants play a major role in the life of human beings and animals. The liver plays a central role in transforming and clearing chemicals. Liver has one of the highest value of importance for the systemic detoxification and deposition of endogenous and exogenous substances. Liver diseases are considered to be a serious health disorders. Liver dysfunction that challenges not only health care professionals but also the pharmaceutical industry and drug regulatory agencies. Drug-induced liver injury (DILI) possesses a major clinical problem. DILI has become the leading cause of acute liver failure and transplantation in Western countries. Medicinal plants are significant source of Hepatoprotective drugs. The plants are one of the indispensable natural sources, widely used in the treatment of various diseases, including liver disorders, without adverse effect. Therefore the present review is aimed at compiling data based on various liver disorders such as Viral Hepatitis, Cirrhosis, Alcoholic liver disease, Fatty liver, Drug induced liver injury etc and pharmacologically active phytochemicals from medicinal plants that have been investigated in various hepatotoxicity animals models.

KEYWORDS: Herbal plants, hepatic disease, hepatotoxicity, hepatoprotective, Cirrhosis.

INTRODUCTION

The liver is the largest glandular present in vertebrates and some other animals. Liver has many functions than any other human organ. In humans entire blood supply passes through the liver several times a day; The Liver has a vital role in human metabolism. Liver produces and secretes bile, it also produces prothrombin and fibrinogen, both blood clotting factors, and heparin, a mucopolysaccharide sulfuric acid ester that helps to keep blood from clotting within the circulatory system. The liver has the major role for the conversion of sugar into glycogen.[1] Liver diseases have become one of the major causes of morbidity and mortality in man and animals all over world. Hepatotoxicity due to drugs appears to be the most common contributing factor.[2] Liver damage is a very common complication because liver has to detoxicate many toxic substances. Most of the hepatotoxic chemicals damage liver cells primarily by producing reactive species which form covalent bond with the lipids of the tissue. Due to excessive exposure to hazardous chemicals like carbon tetrachloride, Alcohol, Thioacetamide etc. sometimes the free radicals generated are so high that they overpower the natural defensive system causing to hepatic damage and lead jaundice, cirrhosis and fatty liver.[3,4] Medicinal plants play a key role in the human health care. About 80% of the world population beliefs on the use of traditional medicine which is predominantly based on plant materials.[5] The traditional medicine refers to a wide range of ancient natural health care practices including folk or tribal practices as well as Ayurveda, Siddha and Unani. It is estimated that about 7,500 plants are used therapeutically mostly in rural and tribal villages of India. Out of these, the real medicinal value of over 4,000 plants is either little known or hitherto unknown to the mainstream population. The classical systems of medicine such as Ayurveda, Siddha, Amchi, Unani and Tibetan use about 1,200 plants.[6] Scientific evaluation of plants has often shown that active principles in these are responsible for therapeutic success. A large number of medicinal plants have been tested and found to contain active principles with preventive properties against a variety of diseases.[7] Hepatoprotective plants possesses opulent chemical constituents like phenols, coumarins, lignans, essential oil, monoterpenes, carotinoids, glycosides, flavanoids, organic acids, lipids, alkaloids and xanthenes.[8] Recent experience has shown that plant drugs are relatively non-toxic, safe and even free from serious side effects.[9] There is also concern with respect to the numerous well-established interactions of herbs and drugs. In consultation with a physician, usage of herbal remedies should be clarified. Some herbal remedies have the potential to cause adverse drug interactions when used in combination with various prescriptions and over-the-counter pharmaceuticals[10] many consumers believe that herbal medicines are safe because

they are "natural", herbal medicines and synthetic drugs may interact, causing toxicity to the patient. This review article has been presented to enumerate some life threatening hepatic diseases and therapeutic potentials of indigenous plants that have hepatoprotective properties.

A portfolio of various Liver diseases

The liver supports almost every organ in the body and is vital for survival. Because of its strategic location and multidimensional functions, the liver is also prone to many diseases. The most common liver diseases are include Infections such as (1) hepatitis A, B, C, D, E, (2) cirrhosis, 3) Alcohol Damage,(4)Fatty liver (5) Liver cancer and (6) Drug induced Liver injury particularly by Non steroidal anti-inflammatory Drugs.

Viral Hepatitis

Viral hepatitis is the liver inflammation due to a viral infection. It may present in acute or chronic forms. The most common causes of viral hepatitis are the five unrelated hepatotropic viruses Hepatitis A, Hepatitis B, Hepatitis C, Hepatitis D, Hepatitis E, Hepatitis F and GB Virus C. In addition to the nominal hepatitis viruses, other viruses that can also cause liver inflammation include Herpes simplex, Cytomegalovirus, Epstein-Barr virus, or Yellow fever.[11-15]

Cirrhosis

Cirrhosis is a consequence of chronic liver disease characterized by replacement of liver tissue by fibrosis, scar tissue and regenerative nodules leading to loss of liver function. Cirrhosis is most commonly caused by alcoholism, hepatitis B and hepatitis C, and fatty liver disease, but has many other possible causes. Some cases are idiopathic. Ascites is the most common complication of cirrhosis, and is associated with a poor quality of life, increased risk of infection, and a poor long-term outcome. Other potentially life-threatening complications are hepatic encephalopathy such as confusion and coma as well as bleeding from esophageal varices. Cirrhosis is generally irreversible, and treatment usually focuses on preventing progression and complications. In advanced stages of cirrhosis the only option is the liver transplant.[16-18]

Alcoholic liver disease

Alcoholic liver disease is a term that encompasses the hepatic manifestations of alcohol over consumption. It is the major cause of liver disease in Western countries. Although steatosis mean fatty liver will develop in any individual who consumes a large quantity of alcoholic

beverages over a long period of time, this process is transient and reversible. Of all chronic heavy drinkers, only 15–20% develops hepatitis or cirrhosis, which can occur concomitantly or in succession. 80% of alcohol passes through the liver to be detoxified. Chronic consumption of alcohol results in the secretion of pro-inflammatory cytokines like as TNF-alpha, IL6 and IL8, oxidative stress, lipid peroxidation and acetaldehyde toxicity. These factors cause inflammation, apoptosis and eventually fibrosis of liver cells. Additionally, the liver has tremendous capacity to regenerate and even when 75% of hepatocytes are dead, it continues to function as normal.[19-20]

Fatty liver

Fatty liver, also known as fatty liver disease is a reversible condition where large vacuoles of triglyceride fat accumulate in liver cells via the process of steatosis i.e. abnormal retention of lipids within a cell. Despite having multiple causes, fatty liver can be considered a single disease that occurs worldwide in those with excessive alcohol intake and those who are obese. The condition is also associated with other diseases that influence fat metabolism.[21] Accumulation of fat may also be accompanied by a progressive inflammation of the liver is called steatohepatitis. By considering the contribution by alcohol, fatty liver may be termed alcoholic steatosis or nonalcoholic fatty liver disease (NAFLD), and the more severe forms as alcoholic steatohepatitis and Non-alcoholic steatohepatitis (NASH). Fatty liver is commonly associated with alcohol or metabolic syndrome i.e. diabetes, hypertension, obesity and dyslipidemia. But fatty liver can also be due to any one of many causes like as Metabolic, Nutritional, Drugs and toxins etc.[22, 23]

Liver cancer

Liver cancer also known as hepatic cancer is a cancer that originates in the liver. Liver cancers are malignant tumors that grow on the surface or inside the liver. Liver tumors are discovered on medical imaging equipment or present themselves symptomatically as an abdominal mass, abdominal pain, jaundice, nausea or liver dysfunction. Many things are known to increase the risk of cancer, including tobacco use, certain infections, radiation, lack of physical activity, obesity, and environmental pollutants.[24]

Drug induced liver injury

Analgesics rarely induce liver damage due to their widespread use; NSAIDs have emerged as a major group of drugs exhibiting hepatotoxicity. Both dose-dependent and idiosyncratic reactions have been documented. Aspirin and phenylbutazone are associated with intrinsic

hepatotoxicity; idiosyncratic reaction has been associated with ibuprofen, sulindac, phenylbutazone, piroxicam, diclofenac and indomethacin.[25] Acetaminophen is usually well tolerated in prescribed dose, but overdose is the most common cause of drug-induced liver disease and acute liver failure worldwide.[26] Damage to the liver is not due to the drug itself but to a toxic metabolite (N-acetyl-p-benzoquinone imine NAPQI, or NABQI) which is produced by cytochrome P-450 enzymes in the liver.[27] In normal circumstances, this metabolite is detoxified by conjugating with glutathione in phase 2 reaction. In an overdose, a large amount of NAPQI is generated which overwhelms the detoxification process and leads to liver cell damage.

Hepatotherapeutic herbal medicines

The use of herbal medicine can be first started back to 2100 BC in ancient China at the time of Xia dynasty, and in India during the Vedic period. The first written books are timed to 600 BC with Charaka samhita of India.[28] There are more than 300 preparations in the Indian tradional systems of medicine for the treatment of jaundice and chronic liver diseases. In India more than 87 medicinal plants are used in different combinations as herbal drugs for liver diseases.[29] The development of herbal products clearly isolate and elucidate the active constituents as well as determine the mechanism based pharmacological activities. This would lead to quicker development of herbal medicinal sector. A semi-synthetic analogue of such compounds also be useful in pharmaceutical sector. Drugs discovered from herbs will give good therapeutic medicines with fewer side effects and lower cost. Significant number of herbals shows promising activity for hepatotoxicity treatment like *Aegle marmelos* and *Eclipta alba*[30] in alcohol induced hepatitis, *Flacourtia indica*[31] to treat in ccl_4 induced hepatitis also a number of herbal combinations from China and Japan that deserve testing in appropriate studies. The present review is based on reported research works on hepatoprotective phytochemicals from various medicinal plants that have been assayed in various experimental hepatotoxicity models.

Andrographis paniculata

Hepatoprotective activity of herbal formulation containing different proportion of *Andrographis paniculata* was estimated by using hepatotoxicity model treatment with aqueous extract of *Andrographis Paniculata* (50mg/kg, 100mg/kg and 200mg/kg body weight) was found to protect the rat from hepatotoxic action of ethanol as evidenced by significant reduction in the elevated serum transaminase levels. Histopathological studies

show marked reduction in fatty degeneration and centrizonal necrosis in animals receiving different doses of *A. paniculata* along with ethanol as compared to the control group. These experimental reports revealed that the *Andrographis paniculata* is a vital ayurvedic plant which exerted hepatotherapeutic effect against ethanol -induced hepatotoxicity in rats.[32]

Azadirachta indica.

The present review was carried out to evaluate the hepatoprotective role of leaf extracts of *Azadirachta indica.* Hepatoprotective activities of ethanolic and aqueous extracts of Azadirachta indica were examined against carbon tetrachloride induced liver damage in mice using silymarin as control group. Various liver Enzyme activities of Serum Glutamate Oxaloacetate Transaminase (SGOT), Serum Glutamate Pyruvate Transaminase (SGPT) and Alkaline Phosphatase (ALP) were evaluated. Phytochemical leaf extracts of *Azadirachta indica* exhibited significant hepatoprotective activity. Ethanolic and aqueous leaf extracts of *Azadirachta indica* exhibited moderate activity over carbon tetrachloride treated animals. Results conclude the traditional ethnomedicinal use of *Azadirachta indica* as a potential source of hepatoprotective agent.[33]

Fumaria indica

Fumaria indica were studied for their hepatoprotective activity against various drugs like carbontetrachloride, paracetamol and rifampicin-induced heptatotoxicites in albino rats. The petroleum ether extract against carbonetrachloride, total aqueous extract against paracetamol and methanolic extract against rifampicin-induced hepatotoxicities showed similar decreasining phenomenon in the elevated levels of some of the serum biochemical parameters in a manner similar that of standard drug silymarin indicating its potential as a hepatoprotective agent. These experimental reports revealed that the *Fumaria indica* is a vital ayurvedic plant which exerted hepatoprotection effect against hepatotoxins induced hepatotoxicity in rats.[34]

Cichorium intybus

The present review describes hepatoprotective activities of *Cichorium intybus* against chlorpromazine induced liver damage. In these studies an alcoholic extract of the *Cichorium intybus* was found to be potential against chlorpromazine - induced liver damage in adult albino rats. Extracts of *Cichorium intybus* were screened for their activity to protect the Carbon Tetrachloride and paracetamol intoxicated liver in rats and were found to results

significant hepatotherapeutic properties. Study done by using ethanol extract of *Cichorium intybus* in dose of 300 mg/kg showed significant liver protective effects of the plant.[35-36]

Pisonia aculeate

The effect of methanolic extract of leaves of *Pisonia aculea* showed a significant hepatoprotective activity and antioxidant activity against Rifampicin and Isoniazid induced hepatotoxicity was investigated from the serum marker enzymes and antioxidant levels in liver tissues. Rifampicin and Isoniazid induced animals showed a mark rise in aspartate amino transferase (AST), alanine amino transferase (ALT), alkaline phosphatase (ALP), total bilirubin, gamma glutamate transpeptidase (GGTP), lipid peroxidase (LPO) with a reduction of total protein, superoxide dismutase (SOD), catalase, glutathione peroxidase (GPx), reduced glutathione (GSH), Glutathione reductase (GR), Vitamin C and E. Treatment of rats with different doses of methanolic extract of leaves of *Pisonia aculea* (250 and 500 mg/kg) significantly ($P<0.001$) reversed the levels of serum marker enzymes and antioxidant enzymes to near normal control rats when compared to Rifampicin and Isoniazid induced hepatotoxicity rats. This extract also altered the drug metabolizing enzymes such as NADPH Cytochrome C reductase, Cytochrome P450, and glutathione S transferase. In this stydy hepatoprotective potency of the extract at dose of 500 mg/kg was well comparable to the standard drug, silymarin (50 mg/kg, p.o.). Histopathological changes of liver sample were compared with respective control. Results indicate the hepatoprotective and antioxidant properties of *Pisonia aculeata* against rifampicin and isoniazid -induced hepatotoxicity in rats. This medicinal plant also effective against ccl_4 induced hepatotoxicity model.[28]The findings indicated that the methanolic extract of leaves of *Pisonia aculea* retain a chief source of active phytoconstituents that could offer protective effects against rifampicin and isoniazid induced hepatotoxicity.[37]

Abutilon indicum

In this Study hepatoprotective activity of the 70% Ethanolic extract of *Abutilon indicum* flowers was assessed using CCl_4 induced hepatotoxicity in albino rats. The degree of Hepatoprotection against liver toxicity was determined by measuring the biochemical markers such as SGPT, SGOT, ACP, ALP and Bilirubin. In addition morphological changes of liver like wet liver volume and wet liver weight were recorded. Further, histopathological examination of the liver was also studied. Marketed drug Silymarin at the dose of 25 mg/kg, p.o. was used as reference standard drug and it exhibited significant protection. In addition to

the screening of hepatoprotective activity, in vitro antioxidant activity was studied by superoxide anion scavenging activity and hydroxyl radical scavenging activity methods. Above review indicated that the herbal plant *Abutilon indicum* having potent hepatoprotective and antioxidant properties.[38]

Bombax ceiba L.

Bombax ceiba is a important medicinal plant of tropical and subtropical India. Its medicinal usage has been reported in the traditional systems of medicine such as Ayurveda, Siddha and Unani. Hepatoprotective activity of methanolic extract of flowers of *Bombax ceiba* L. was assayed against Isoniazid and Rifampicin produced hepatotoxicity in Wistar strain male albino rats. Liver damage in rats was produced by combination of two anti tubercular drugs Isoniazid and Rifampicin for 10 and 21 days through intraperitoneal route in rats. Three graded dose of *Bombax ceiba* L. (150, 300 and 450 mg/kg i.p.) were administered to study the hepatoprotective activity. It has been observed that there were a significant rise in AST, ALT, ALP, total bilirubin and significantly decreased in total protein level for Isoniazid and Rifampicin treated rats when compared to normal control rats. Different dosage administration of *Bombax ceiba* L. significantly altered the serum enzymes levels. This plant markedly lowered the level of TBARS and elevated the level of GSH at all doses as compared to normal control. Histopathology of the liver section of the animals treated with *Bombax ceiba* L. protected the liver damage caused by isoniazid and rifampicin. Except hepatotoxicity this plant also widely used in other diseases such as Inflammation, hypertension, antiangiogenic and antioxidant activities.[39-41]

Ziziphus mauritiana

The Liver protective effects of aqueous extract of *Ziziphus mauritiana* leaf on alcohol induced hepatotoxicity in rats were experimentally investigated. Thirty six male Wistar albino rats weighing between 100-120 g were equally distributed into six groups of six rats respectively and treated for six weeks. Hepatotoxicity can be achieved by Chronic administration of alcohol at (40% v/v, 1ml/100g), for 6 weeks showed a significant ($p<0.05$) rise in levels of alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALP), and total bilirubin (TB). There was also a significant ($p<0.05$) reduced levels of catalase, glutathione peroxidase, glutathione reductase and superoxide dismutase as compared to normal control rats. Whereas pretreatment of rats different doses 200, 400 mg/kg body weight of aqueous leaf extract of *Ziziphus mauritiana* or 100 mg/kg silymarin

significantly ($p<0.05$) restored the levels of ALT, AST, ALP, and TB near to normal value. As well as the administration of *Ziziphus mauritiana* significantly elevated those following antioxidant parameters like catalase, glutathione peroxidase, glutathione reductase and superoxide dismutase when compared to group treated with alcohol only. Histopathology of rat liver treated with alcohol only showed in cell necrosis, fatty degeneration, etc which indicated severe liver damaged. Treatment with the aqueous extract of *Ziziphus mauritiana* or silymarin prevented the morphological changes as well as cell necrosis that are associated with chronic alcohol consumption. The protective activity of the plant *Ziziphus mauritiana* may be due to the presence of antioxidant constituent i.e tannins, saponins and phenolic compounds etc.[42]

Cassia fistula

During this study an attempt was made to investigate the hepatoprotective effect of leaves and bark of Cassia fistula against carbon tetrachloride (CCl4) induced hepatotoxicity in rats. Sixty albino Wistar rats were divided into six equal groups of 10. Four groups received extracts leaves/bark of Cassia fistula and intraperitoneal (i.p.) CCl4 (0.2 ml/100 g) either before or after administration of extracts. Two groups were controls, one treated with CCl4 and one with normal saline. Liver damage was assessed by plasma concentration of bilirubin and enzyme activities of aspartate aminotransferase, alanine aminotransferase, and alkaline phosphatase. Treatment with aqueous extract of leaves and bark significantly reduced CCl4 -induced elevation in plasma enzyme and bilirubin concentration in rats. This study indicated that CCl4 -induced liver damage in rats can be prevented by treatment of extracts from leaves and bark.[43]

Embelia tsjeriam-cottam

The Liver protective role of both alcoholic and aquous fruit extracts of *Embelia tsjeriam-cottam* were examined in isoniazid induced liver damage in rats. The groups treated with isoniazid(50gm/kg, for 30days) showed significantly elevated level of ALT, AST, billirubin and significantly decreased total protein content as compared to normal control animals. The animals treated with aqueous, alcoholic extract showed significant reverse action in all the biochemical parameters. In vivo lipid peroxidation study reveals that rats of isoniazid treated group showed significant rise in malondialdehyde (MDA) when compared with rats of normal control group. The administration of alcoholic and aqueous extracts were significantly lowered the MDA level. There was a decrease in the level of GSH and the activities of SOD

and CAT in isoniazid treated group when compared with normal control group. The GSH level and activities of SOD and CAT were significantly increased in alcoholic and aqueous extract treated group. Histopathological examination of liver from control group showed normal hepatic cells and natural hepatic morphology. The liver of the rats damaged with isoniazid there was vacuolation, sinus congestion, mild inflammation and centrilobular degeneration of hepatic cells with centrilobular necrosis. Both alcoholic extract and aqueous extract of *Embelia tsjeriam-cottam* were minimised the isoniazid induced liver toxicity.[44]

Wedelia calendulacea L.

The hepatoprotective activity of ethanolic extract of Wedelia calendulacea L. (Family: Asteraceae) was studied against Carbon tetrachloride induced, acute hepatotoxicity in rats. Hepatoprotective activity of the ethanolic-leaf extract of W.calendulacea was studied by estimating serum enzyme activities of aspartate aminotransferase (AST), alanine aminotransferase (ALT), alkaline phosphatase (ALP), total protein and total bilirubin. The treatment with Wedelia calendulacea L. showed a dose-dependent reduction of Carbon tetrachloride induced elevated serum levels of enzyme activities with parallel increase in total protein and bilirubin, indicating the extract could preserve the normal functional status of the liver. The weight of the organs such as liver, heart, lung, spleen and kidney in Carbon tetrachloride induced experimental animals administered with Wedelia calendulacea L. showed an increase over Carbon tetrachloride control group. So this plant shows hepatoprotection against Carbon tetrachloride induced liver damage and it is proved to be a herbal remedies for liver ailment.[45]

Boerhavia diffusa

The roots of *Boerhavia diffusa*, commonly known as 'Punarnava', are used by a large number of tribes in India for the treatment of various hepatic disorders. The hepatoprotective activity of different parts of Boerhavia diffusa Linn. (Nyctaginaceae) such as root and aerial parts was evaluated against Ibuprofen induced hepatotoxicity in Wistar albino rats. The administration of ibuprofen (500mg/kg. b. wt.) produced significant changes in the normal hepatic cells, resulting in the formation of gastric lesions, centrilobular necrosis, vacuolization, and hepatomegaly. The effect of ibuprofen was reflected in the levels of serum biochemical parameters of liver marker enzymes such as ALT, AST, ALP, and bilirubin. The activities of hepatic oxidatative stress parameters like superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPx), and Glutathione-S-transferase (GST) were decreased

significantly. The methanol extract (85%) of the root and aerial part of Boerhavia diffusa L.(500 mg/kg. b. wt.) produced significant changes in injured hepatic cell architecture and restored nearly normal structure and functions of hepatic cells. Similarly the different parts of the Boerhavia diffusa L. (500 mg/kg. b. wt.) restored the altered biochemical parameters of liver marker enzymes that are similar to normal control levels. The observed results show the root of Boerhavia diffusa L. possesses more hepatoprotective efficacy than the aerial part of the same plant. The results suggest that the hydro alcoholic (15:85%) extract of Boerhavia diffusa L. possesses significant potential effect as a hepatoprotective agent. From the above review it can be regarded as the medicinal plant *Boerhavia diffusa*, proved to be a competent hepatoprotective herbal drug.[46]

Mikania scandens (L) willd.

Chronic alcohol administration is resulting the generation of reactive oxygen species, thereby leading to liver damage. There is a lack of reliable hepatoprotective drugs in modern medicine in the alcohol induced liver damage. Plant products play a vital role in the hepatoprotection by its antioxidants property. Natural products are the important source of remedies for the treatment of diseases including hepatic disorders. So the identification of a potential hepatotherapeutic agent for the protection of liver from various hepatotoxins will provide a useful way for the prevention of these liver related diseses. This study evaluates the hepatoprotective activity of Mikania scandens (L) willd. in rats. Administration of alcohol at 40%v/v ethanol (2ml/100g body wt. p.o), for 21 days showed a significant elevated levels of aspartateaminotransferase (AST), alkaline phosphatase (ALP), alanine aminotransferase (ALT), total bilirubin (TB), triglycerides, cholesterol and lipid peroxidation(LPO). There was also a significant decreased levels of catalase, glutathione reductase and superoxide dismutase when compared to normal control rats. Pretreatment of rats with 500 mg/kg body weight of extract and fractions of *Mikania scandens (L)* willd. or silymarin(100 mg/kg) was found to protect the rat from hepatotoxic action of ethanol as evidenced by significant reverse action when compared to group administered alcohol only. Histopathological studies show marked reduction in fatty degeneration and centrizonal necrosis in animals receiving *Mikania scandens (L)* willd. along with ethanol as compared to the control group. The findings indicated that the *Mikania scandens (L)* willd. provide a chief source of antioxidants that could offer potential protective effects against alcohol induced hepatotoxicity.[47]

CONCLUSION

The present review has presented comprehensive details of Hepatoprotective herbal plants. It shows that these plants highlighted above have distinctive hepatotherapeutic activity. Chronic hepatic disorders are regarded as burning health trouble in worldwide, associated with hepatitis, alcoholic liver diseases, fatty liver diseases, liver cancer etc. Use of modern synthetic medicines may cause diverse adverse drug reactions as well as those are high cost. Hence treating liver complications with plant based bioactive constituents are more popular with low cost. In this review article has reported many hepatoprotective medicinal plants from India and abroad. So this study will give the pharmacological support to use of folk medicine in the therapeutic management of various liver diseases.

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