

Review Article

Hepatoprotectives: Role of Various Herbs as Hepatoprotectives: A Review

*¹Buchake V V, ²Talele G S, ¹Talele S G, ¹Jadhav S S, ³Bachhav R S, ¹Chaudhari G N.

¹Sandip Institute of Pharmaceutical Sciences, Mahiravani, Nashik.

²Nasik Gramin Shikshan Prasarak Mandal's College of Pharmacy, Anjaneri, Nasik - 422213

³RGS College of Pharmacy, Anjaneri, Nashik - 422112

ABSTRACT

As liver plays an important role in the metabolism of carbohydrates, fats, proteins and many others, subsequently it becomes key organ for human being and animals.

Management of liver and liver diseases is challenge to the current modern medicines. In the present review article various herbs and there relative utility in management of liver diseases is discussed. These are the Herbal or Ayurvedic drugs which are not only best known for the hepatoprotective activity in convalescence but also can be used in a proper combination formulation in prophylaxis too. Such drugs are not known with considerable toxicity so no any adverse events are reported.

Key words: Hepatoprotectives, Herbs, Liver.

INTRODUCTION

The liver is the heaviest gland of body, weighing about 1.4 kg in an average adult. The basic functional unit of the liver is the liver lobule, which is a cylindrical structure several millimeters in length and 0.8 to 2 millimeter in diameter. Liver plays an important role in metabolism of carbohydrates, fats, proteins, drugs and many others. So, liver becomes the key organ for human beings and animals. Management of liver diseases are till today a challenge to the current medicines.¹Today human beings are exposed to various toxic chemicals; number of allopathic drugs administered for treating these ailments are reported to adversely affect the liver function. Up till now no specific treatment is available in the drug induced liver damage, where in only option left is to switch over to alternate therapy.

In the present paper a stress is given to discuss new herbal medicines and collection of data, which will be useful in the treatment of liver diseases.

Acatopanax senticosus: (Araliaceae): *Acatopanax senticosus* extend some antioxidant effects on carbontetrachloride or acetaminophen intoxicated model. The levels of aspartate, amino transferase, and alanine were increased by carbontetrachloride or acetaminophen administration and reduced by treatment with the plant extracts in small doses. Treatment in larger doses would possibly induce some cell toxicity.²

Ambrosia maritima: (Compositae): The hepatoprotective activity of aqueous and methanolic extract of *Ambrosia maritima* was investigated against acetaminophen induced hepatic damage. Acetaminophen at a dose of 640mg/kg produced liver damage in rats as manifested by significant rise in serum levels of glutamate, oxaloacetate transaminase, glutamate pyruvate transaminase and alkaline phosphatase. These biochemical alteration

resulting from acetaminophen administration were inhibited by pretreatment with *A. maritima* extract.³

Andrographis paniculata herb: (Acanthaceae): Andrographolide, a active constituent isolated from the plant of *A. paniculata* has been found to be useful in protecting liver from various chemical damage. Oral administration of andrographolide compound shows extensive first pass metabolism. To avoid this effect the rectal suppositories (50mg/suppository) were prepared with different preparation of P.E.G bases and evaluated. It was found that it is showing improved bioavailability.⁴

Apocynum venetum leaves: A water extract of the leaves of *Apocynum venetum* showed protective effect against liver injury in mice. Tumor necrosis factor alpha (TNF-alpha) secreted from LPS-stimulated macrophage is most crucial mediator in the D-gal N/LPS- induce liver injury model. The extract has no significant inhibition on the increase of serum TNF-alpha.⁵

Artichoke leaves (Cynara scolymus): (Asteraceae): *Artichoke* leaves at concentration between 0.08 to 0.5mg/ml were able to prevent the formation of bizarre canicular manner when added simultaneously with the bile acid. Tauroolithocholate induced cholestatic bile canicular membrane distortion were studied by electron microscopy.⁶

Asparagus racemosus: (Asparagaceae, Liliaceae): Ethanolic extract of *asparagus racemosus* has been proved to shows hepatoprotective in rats. carbon tetrachloride induced hepatic damage models in rats was used for assessment of antihepatotoxic activity. Serum enzymes were measured to assess hepatic damage *Asparagus* root extract reduced the levels of increased enzymes in carbon tetrachloride treated rats to optimum.⁷

Azadirachta Indica leaves: (Meliaceae): The effect of aqueous leaf extract of *Azadirachta indica* was evaluated

in paracetamol-induced hepatotoxicity in rats. Liver necrosis was produced by administering single dose of paracetamol and the liver damage was evidenced by elevated level of serum aspartate aminotransferase (AST), Alanine aminotransferase (ALT), gamma glutamyl transferase peptidase and by histopathological observation of liver section. Aqueous leaf extract of *A.indica* significantly reduce the elevated levels of AST, ALT and gamma GT. Paracetamol induce liver necrosis was also found to be reduced as observed macroscopically and histologically.⁸

Capparis moonii fruits: (Capparidaceae): *C.moonii* commonly known as 'Rudanti'. It has been known for its antitubercular activity. The ethanolic fruit extract of *C. moonii* was screened for hepatoprotective activity in wistar albino rats with carbontetrachloride induce hepatotoxicity.⁹

Cichonium intybus : (Asteraceae): *C.Intybus* is a popular Ayurvedic remedy for the treatment of liver diseases. In mice liver protection was observed at various dose after carbontetrachloride intoxication.^{10,11}

Citharexylum quadrangulare: (Verbenaceae): Bioactive constituents iridoids glycoside, phlomiol, 5-deoxy pulchelloside lamide durantoside and lamidoside is isolated from the *C. quadrangulare*. Biological screening of 70% aqueous ethanolic extract of *C. quadrangulare* revealed a significant antiulcer, antihypertensive and hepatoprotective effects.¹²

Cnidium monnieri herb(Apiaceae): Ethanolic extract of *C.monnieri* contains two hepatoprotective sesquiterpenes torlin and torilolone, together with a new derivatives, hydroxy torium. Both these compounds showed hepatoprotective effect on tacrine-induced cytotoxicity in human liver derived Hep.G2 cells.¹³

Coffia-arabica seeds (Syn: Green and roasted coffee): The properties of green and roasted coffee are valuated by determining the reducing substance (RS) of coffee and its antioxidant activity in vitro and ex vivo as protective activity against rat, their cells microsome lipid peroxidation measured as TBA-reacting substances. Protective activity was significantly lower in green coffee compared to that of all roasted sample. Most protective compounds are extracted from acidified dark roasted coffee solution with ethyl acetate. Low molecular mass fraction showed protective activity. The small amount of these acidic, low molecular fraction isolated indicate that they contains very strong protective agents.¹⁴

Coccinia Indica leaves: (Cucurbitaceae): Ethanolic extract (50%) has shown significant hepatoprotective activity by lowering the serum enzyme like SGPT, SGOT, and ALP in wistar rats intoxicated with Carbon tetrachloride.¹⁵

Aqueous light petroleum, chloroform, alcohol, benzene and acetone extracts of the leaves of *Coccinia indica* were screened for hepatoprotective activity. Alcohol and light petroleum ether extract were found to have good activity against carbon tetrachloride induced hepatic damage.¹⁶

Combretum quadrangulare seeds: (Combretaceae): Water-Fraction of methanol extract of *Combretum*

quadrangulare seeds contains new gallic acid derivative, 1-o-galloyl-6-o-(4-hydroxy-3, 5-dimethoxy) benzoyl-beta-D-glucose which exhibit potent hepatoprotective activity against D-Gal N/TNF-alpha induced cell death in primary cultured mouse hepatocytes.¹⁷

Curcuma longa rhizomes: (Zinziberaceae): Assay guided fraction of EtOAc soluble fraction furnished three free radicals diaarylheptanoids, curcumin (1) dimethyl curcumin (2) and bisdemethoxycurcumin (3) compounds. These three compounds shows significant hepatoprotective effect on tacrine -induced cytotoxicity in human liver derived HepG2 cells.¹⁸

Turmeric has been found to protect animal liver from a variety of hepatotoxic substances, inducing carbontetrachloride, galactosamine, pentobarbital, 1-Chloro-2, 4-dinitrobenzene, 7, 4-hydroxy-nonenal and paracetamol.^{19,20}

Curculigo orchoides: (Hypoxidaceae) liver retains to near normalcy in animal co-administered with methanolic extract of *C.Orchoides*. It was observed that other biochemical parameters in serum were decrease the level of AST, ALT and GGT.²¹

Diospyros montana: (Ebenaceae): Total aqueous extract and successive petroleum extract, ethanolic and aqueous extract were screened for activity. A significant decrease in the malondialdehyde level, in fatty degeneration, reduced necrosis as well as triglyceride accumulation in hepatocytes was observed in case of total aqueous extract and petroleum extract.²²

Ecallium elaterium fruits: (Cucurbitaceae): Dried juice of fruit of *Ecballium elaterium* and *cucubitaicin* was studied for hepatoprotective activity. The experiment was carried out on the rats and the liver damage is carried out by carbontetrachloride. Administration of dried juice shows decrease in the SGPT level.²³

Eclipta alba herb: (Compositae): An annual and prostate herb found to be used through out India is a traditional medicine for liver disorder. Experiment conducted on albino rats confirmed hepatoprotective activity of ethanolic extracts of its leaves.²⁴

Elephantopus scaber Linn: (Compositae): The efficiency of the elephantopus scaber to prevent carbon tetrachloride induced chronic liver dysfunction in the rats was examined. The biochemical changes induced by the carbon tetrachloride in the liver tissue improved following treatment with *E.scaber*.²⁵

Embllica officinalis fruits: (Euphorbiaceae): *Embllica officinalis* extracts were found to inhibit the hepatotoxicity produced by acute & chronic carbon tetrachloride administration in rats as seen from the decreased levels of serum and liver lipids peroxides glutamate pyruvate transaminase and alkaline phosphatase.²⁶

Eucalyptus tereticornis leaves: (Myrtaceae): Ursolic acid isolated from the leave of *Eucalyptus ursolic* acid showed significant preventive effect in vitro against ethanol induced toxicity in isolated rat hepatocytes compared with the incubation of isolated hepatocytes with ethanol only.²⁷

Ficus hispida leaves: (Urteicaceae): The methanol extract of the leaves of *Ficus hispida* at an oral dose of 400 mg /kg exhibited a significant protective effect by lowering the serum levels of transaminase bilirubin and alkaline phosphatase. The activity of extract was also comparable to that of Liv-52 a known hepatoprotective formulation.²⁸

Ficus racemosa bark: (Moraceae): The stem bark of *Ficus racemosa* Linn is known as 'gular umbar' is found throughout India. It is very useful in treating several liver disorders. carbon tetrachloride induced hepatotoxicity was carried out in liquid paraffin. The result established pharmacological evidence as hepatoprotective agent and thereby it substantiated the folklore claim.²⁹

Foeniculum vulgare mill oil: (Umbelliferae): Fennel oil shows considerable hepatoprotective activity against carbontetrachloride induced hepatotoxicity. Fennel oil when administered in hepatic damage, it was found that there is considerably decreased level of serum aspartate aminotrasferase (AST), alanine aminotransferase (ALT), alanine phosphatase (ALP) and bilirubin.³⁰

Garcinia indica fruits : (Guttiferae): The fruits of *Garcinia indica* is known as refreshing drink in Goa. It improves appetite and alleys & thirst and used as anthelmintic, cardiotoxic, tumors pains and heart diseases. It is used in liver disorders. In current studies an effect has been made to establish hepatoprotective activity of ethanolic & aqueous extracts of fruits rind of *Garcinia indica*. Both the ethanolic and aqueous extract showed significant hepatoprotective activity.³¹

Gloriosa superba-tubers: (Liliaceae): In the systematic studied experiment, it was found that hydroalcoholic extract of *Gloriosa superba-tubers* was found to lower down the serum level of enzyme and this effect is quite greater as compared to petroleum extract and alcoholic extract.³²

Glycyrrhiza glabra rhizomes: (Papilionaceae): *Glycyrrhiza glabra* contain triterpene saponin known as glycyrrhizin which has potential hepatoprotective activity.⁴³ Glycyrrhizin can alleviate histological disorder due to inflammation and restore the liver structure and function from the damage due to carbontetrachloride lowering the SGPT level, reducing the degeneration and necrosis and also recovering the glycogen and RNA of liver cells.³³

Glycyrrhiza uralensis rhizomes: (Leguminoseae): Water-soluble extract of glycyrrhiza uralensis, glycyrrhizin was isolated as potent inhibitor of beta-glucuronidase. However glycyrrhizin was orally administered and it showed a hepatoprotective activity. However when glycyrrhizin was intraperitoneally administered, it didn't have hepatoprotective activity.

18-beta -glycyrrhizin which is major metabolite of glycyrrhizin by human intestinal bacteria was also a potent inhibitor of beta glucuronidase. When 18-beta-glycyrrhethinic acid was intraperitoneally administered, it also had some hepatoprotective activity. These results suggest that glycyrrhizin may be natural prodrug for the observed hepatoprotective effect.³⁴

Grewia asiatica bark : (Liliaceae): It is a traditional medicinal and as remedy for liver cirrhosis. Crude methanolic extract of bark *Grewia asiatica* was used to test hepatoprotective activity using carbon tetrachloride induced hepatotoxic method in rats. Crude methanolic extract of bark were administered orally along with acacia mucilage to albino rats 1hr prior to induction of hepatotoxicity. Blood samples were collected from marginal vein before and after treatment and were analyzed to determine SGOT, SGPT and serum bilirubin levels.³⁵

Hemidesmus indicus roots: (Asclepiadaceae): The study was undertaken to investigate the relationship between liver protective effect and antioxidant activity of the dried root of *H.indicus* in carbon tetrachloride induced hepatic damage in rats .It was proved that 50% ethanolic extract of *H.indicus* roots exhibited the formation of oxygen dried free radical production. The oral administration of extract significantly reduced carbontetrachloride induced hepatotoxicity in rats as judged from serum marker enzyme. These results were comparable with those obtained with quercetin. Based on these findings, it may suggest that liver protective antioxidant effects of *H.indicus* possibly involve each related to free radicals scavenger effect.³⁶

Hedychium spicatum rhizomes: (Scitaminaceae): Different extracts of *Hedychium spicatum* shows the presence of steroid glycoside and carbohydrates. It is reported by H.Hukkeri et al that the ethyl acetate and alcohol extract of dried rhizomes showed significant hepatoprotective activity. These extracts lowered enzymes like serum glutamate, oxaloacetate, transaminase and serum glutamate pyruvate transaminase in albino rats intoxicated with carbon tetrachloride.³⁷

Ilex Paraguariensis leaves: (Aguifoliaceae): It is commonly known as 'mate' or 'yerba' mate is used for the preparation of most popular tea like beverage of south America. Cholestatic, hypocholestatic, antioxidant and bitter taste properties are attributed to the phenolic constituents of the leaves.³⁸

Indigofera tinctoria herb (Papilionaceae): *I. Tinctoria* pretreated male albino rats showed considerable protection against acute hepatitis induced by D-galactosamine (D-gal N) endoxine. D-Galactosamine/endotoxin--induced oxidative stress as evidenced by a significant increase in the activities of all the antioxidant enzyme and significant decrease in level of lipid peroxidase.³⁹

A bioactive fraction, indictone (FA), obtained by fraction of petroleum ether extract of the aerial parts of *Indigofera tinctoria* showed significant hepatoprotective activity against carbon tetrachloride induced liver injury in rats and mice. And, in hexobarbitone and zoxalamine induces liver damage pre and post treatment with the fraction of FA significantly decreases the effect of these drugs.⁴⁰

The *in vitro* study carried out by Sreepriya S et al on rat bile flow showed that the release of LDH and level of urea is altered by *I. Tinctoria*.⁴¹

Ixeris laevigata var. *oldhami*: (Asteraceae): The hepatoprotective effect of *Ixeris laevigata* var. *oldhami*

(IL) were studied on cholestatic hepatitis induced by alpha-naphthylisothiocyanate and acute hepatitis induced by carbon tetrachloride in rats and it shows significant hepatoprotective effect.⁴²

Lanata camara roots: (Verbenaceae): Two novel triterpenoids has isolated from the root of *Lanata camara*, 3-beta, 19-alpha dihydroxy ursan 28-oic acid and 21, 22 beta-epoxy-3 beta-hydroxy olean-12-en-28 oic acid in its methyl ester form. Its leaves has yielded an essential oil which was rich in sesquiterpene oleanolic acid which showed hepatoprotective activity.⁴³

Lawsonia alba bark: (Lythraceae): The aqueous suspension of extract of *Lawsonia alba* bark extract shows good hepatoprotective activity against carbon tetrachloride induced liver damage.⁴⁴ The experiment was performed on rats and aqueous extract was administered orally to rats for period of ten days which shows best hepatoprotective activity. The ethanolic extract also shows good hepatoprotective activity.⁴⁵

Legumes: Phaseolus aureus (Mung bean) *Paseolus angularis* (Adzuli bean), *Castanospermum australe* (Black bean), *Rheum officinale* (Rice bran) are food, folk and traditional medicine of Taiwan. Water extract concentration in range of 100,500mg/kg by wt. and Silymarin is used as hepatoprotective against acetaminophen induced liver injury.⁴⁶

Ligustrum robustum: (Oleaceae): Glycoside rich fraction B2 shows marked hepatoprotective activity in rat liver damaged by acetic acid.⁴⁷

Lycium chinense fruits: (Solanaceae): New cerebroside LCC isolated from the fruits of *Lycium chinense* and it was used to assess the hepatoprotective activity. Primary culture of rat hepatocytes exposed to galactosamin were used for screening system.⁴⁸

Mallotus japonicus: (Ephorbiaceae): Bergenin a major constituent of *Mallotus japonicus* administered orally once daily for successive seven days and then the mixture of 0.5 ml/ kg of carbontetrachloride in olive oil was injected two times each at 12&36 hours after final administration of bergenin, the substantially elevated serum enzymatic activities of alanine / aspartate aminotransferase, sorbitol dehydrogenase & gamma-glutamyl transferase due to carbontetrachloride treatment were close dependently restored towards normalization.⁴⁹

Mikania cordata roots: (Compositae): Methanolic fraction of *mikania cordata* root extract (50,100, or 150mg/kg) was administered once daily for 15 consecutive days, liver tissue was excised to assay for lipid peroxidation (LPO), glutathione-s-transferase (GST), glutathione content, glutathione peroxidase activity following standard procedure. The increased LPO (2fold) and decrease GSH level due to carbon tetrachloride treatment were significantly reversed towards normalization is an inverse dose responsive manner by treatment with extract.

These result indicate a possible hepatoprotective role of methanolic extract of

M. cordata root against carbon tetrachloride induced oxidative damage.⁵⁰

Morus alba herb: (Maraceae): Ethanolic extract of *morus alba* as guided by free radical scavenging activity furnished (1) 5,7-dihydroxycoumarin 7-Methyl ether (2) 2-phenyl flavones, (3) cudraflavone B (4) oxyresveratrol. Compound one and four showed superoxide scavenging effect and compounds 2 and 4 shows hepatoprotective effect on tacrine induced cytotoxicity in human liver derived hepatic G2cells.⁵¹

Momordica charantia fruits: (Cucurbitaceae): *M.charantia* selected for evaluation of hepatoprotective activity against carbon tetrachloride induced liver toxicity. The successive extracts of petroleum, pet. ether, benzene, chloroform, ethanol were prepared and screen for hepatoprotective activity in male waster rats.

Between different extracts, chloroform and ethanolic extract exhibited significant hepatoprotective activity at 200mg/kg body wt., which was comparable to activity exhibited by reference standard, Silymarin in carbontetrachloride induced hepatotoxicity model.⁵²

Nardostchys Jatamansi rhizomes: (Valerianaceae): In an experiment, ethanolic extract of *Nardostchys Jatamansi* rhizomes for three consecutive ameliorated the liver damage in rats exposed hepatotoxic compound thioacetamide alone. Elevated level of serum transaminase and alkaline phosphatase observed in thioacetamide alone treated group of animals were significantly lowered in *Nardostchys* pretreated rats.⁵³

Nigella sativa fruit: (Umbelliferae): An aqueous extract of *Nigella sativa* fruits exhibited hepatoprotective activity against paracetamol-induced heaptotoxicities in rats.⁵⁴

Ocimum sanctum herb: (Labiatae): Effect of *Ocimum sanctum* leaf was studied on paracetamol induced hepatic damage in rats. *O. sanctum* was found to protect the rats from hepatotoxic action of paracetamol as evidenced by significant reduction in the elevated serum enzyme levels. Histopathological studies should marked reduction in fatty generation in animals receiving *O. sanctum* along with paracetamol as compared to the control group. It is stipulated that the extract treated group was partially protected from hepatic cell damage caused by paracetamol.⁵⁵

Pergularia daemia leaves: *P.daemia* use as a folk remedy for jaundice in Orissa. Leaf of *P.daemia* with yog hurt was administered as in graded doses to rats before and after carbon tetrachloride. The changes in liver weight and liver volume and biochemical parameters were studied. Histopathological examination of liver showed that in rats receiving higher doses, liver damage was comparatively less.⁵⁶

Pistacacia lentiscus: (Anescardiaceae): The hepatoprotective effect of boiled and non boiled aqueous extract of *Pistacacia lentiscus*, *phillyrea latifolia*, *nicotiana glauca* that are alleged to be effectiveness in the treatment of jaundice in Jordanian folk medicines was evaluated in vivo by using carbon tetrachloride, intoxicated rats was experimental models. The bilirubin level and the activity of alkaline phosphatase (ALP) were both reduced upon treatment with boiled aqueous extract of *P.latifolia* without reducing the activity of alkaline. Aqueous extract of *P.lentiscus* (both boiled and non

boiled) showed marked hepatoprotective against carbon tetrachloride by reducing the activity of three enzymes and level of bilirubin.⁵⁷

Platycodon grandiflorum roots: (Campanulaceae): *Platycodon grandiflorum* used as traditional medicine. Extracts from the roots have wide ranging health benefits. In Korea, the roots is used as food and employed as a folk remedy for adult disease.

Lee and others from South Korea student studied the aq.extract from the roots on acetaminophen induce hepatotoxicity and the mechanism underlying these protective effects in mice.⁵⁸

Pomegranate peel fruits: (*Punica granatum*-Lythraceae): The acetone and methanolic extract of dried peel powder of *Punica granatum* was subjected to a study to ascertain the hepatoprotective activity in rats intoxicated with carbon tetrachloride . The hepatoprotective activity of the acetone and methanol extract is detected by the decreased level of SGPT (Serum glutamate pyruvic transaminase) enzyme activity which has been shown to reduce microsomal enzyme and thereby accelerating the excretion of carbon tetrachloride . The aqueous and powder extract did not show any activity. Further study to identify the active principles is required on such a potential hepatoprotective material.⁵⁹

Psoralea corylifolia seeds: (Leguminosae, Papilionaceae): Bioassay guided fraction of the water extract of seeds of *P.corylifolia* furnished two compound bakuchicin and psoralen which protect the liver against tacrine induced cytotoxicity.⁶⁰

Sarcotema acidium stem(Asclepiadaceae): *Sarcotema acidium* voigt. (syn *S brevistigma* Wight and Arn)(Hindi-Somlata). It is reported to possess antirheumatic , antiallergic, antiemetic and bronchodialatory activities. The oral administration in varying doses of ethyl acetate extract of its sarcostemma (stem) acidium to albino rats for seven days shows best hepatoprotective activity against carbontetrachloride induced hepatic damage.⁶¹

Sarurus chinensis: (*Sauraceae*): Two new diastereomeric sauchinone - A and epi-sauchinone along with the known a phenylpropanoid (Sarisan)and two known lignans (galbacin and saucernetin)were isolated from n-hexane incubation of cultured rat hepatocytes initially injured with carbon tetrachloride .With each of the compounds significantly reduced the levels of glutamic pyruvic transaminase released by the damage hepatocytes.⁶²

Scutellaria baicalensis roots: (Labiateae): *S.baicalensis* root extract exhibited the best hepatoprotective effect in induced carbon tetrachloride liver lesion where hepatotoxicity improved in baicalensis treated rats, compared with sylimarol.⁶³

Scoparia duicis(Scrophulariaceae): A study was conducted in albino rats to evaluate the hepatoprotective activity in aqueous and alcoholic extracts of *S.duicis* in carbontetrachloride induce cirrhosis.

Simultaneous treatment with aqueous extract and alcoholic extract was significantly protected the carbon tetrachloride induced hepatotoxicity. The result obtained from a base study indicated that aqueous extract showed

most significant activity, alcoholic extract also exhibited potent activity but less than aqueous extract.⁶⁴

Scrophularia buergeriana: (Scrophulariaceae): Phenyl propanoid (4-o-E-p-Methoxycinnamoyl alpha L-rhamnopropanoside ester, p-methoxycinnamic acid and isoferulic acid) from *scrophularia buergeriana* shows hepatoprotective activity induced by carbon tetrachloride .The activities of enzyme involve in the glutathione (GSH) redox system were measured and assayed the level in primary cultures of rat hepatocytes were significantly preserved by the treatment with these three phenylpropanoids. The activities of glutathione disulfide reductase and glutathione –s-transferase which normally decrease in Carbontetrachloride injured rat hepatocytes were significantly preserved by the treatment with these three phenyl propanoid .⁶⁵

Silybum marianum herb (Compositae): Infusion of *Silybum marianum* on some enzymes relevant to liver function was investigated in mice. The content of glutathion cytochrome P 450 and transamine in animal tissue suggest the hepatoprotective activity.⁶⁶

Silymarin is a mixture of flavanoid lignans isolated from *Silybum marianum* at dose administered at dose 0,10,50, & 250 mg/kg, daily for five days to mouse and effect of cyanokinase in mouse was studied. It was observed alteration of transforming growth factor betal and c-mye expression in liver may involve in the hepatoprotective effect.⁶⁷

Sida cordifolia roots: (Malvaceae): Antihepatotoxic activities of various extract of the roots of *Sida cordifolia* against carbontetrachloride intoxicated rats has been studied. Pet. ether and chloroform extract did not shows any protection and methanolic extract exhibited marked protection as evidenced by serum biochemical parameters and histological examination .⁶⁸

Taraxacum officinalis roots: (Compositae): Traditionally *Taracum officinale* has been used as remedy for jaundice and other disorder of liver and gallbladder. Oral administration of extracts from these roots of *taracum officinale* has been shown to act as cholagogue, increasing the flow of bile.⁶⁹

Terminalia catappa leaves: (Combretaceae): Punicalagin and punicalin were isolated from the leaves of *Terminalia catppa*. The antihepatotoxic activity of punicalagin and punicalin on acetaminophen –induced toxicity in rat liver was studied. After evaluating the changes of several biochemical functions in serum the levels of aspartate aminotransferase and alanine aminotransferase were increased by acetaminophen administration and reduce by punicalagin and punicalin. Histological changes induced by acetaminophen were also recovered by both compound. Punicalagin and punicalin shows antihepatotoxic activity, but treatment with larger doses with punicalagin enhanced liver damage.⁷⁰

Terminalia myrocarpa leaves:(Combretaceae): 4,5,6,4'5',6'hexahydroxybiphenyl-2-2'-diyldicarbonyl– (alpha/beta)-D-glucopyranose(1), Flavogallic acid(2), ethyl gallate, 2,3-di-o-(5), 4,5,6,4'5', 6'hexahydroxybiphenyl-2-2'-diyl dicarbonyl (alpha/beta)- punicalagin bioactive constituents isolated

from the leaves of *T. Myrocarpa*. It is reported that these constituents shows significant hepatoprotective activity. Comparison was made between (1) and (2). It was found that 1 shows significant activity than 2 against carbon tetrachloride induce hepatotoxicity.⁷¹

Thespesia populnea: (Malvaceae): The methanolic and aqueous extracts were compared for hepatoprotective activity against carbontetrachloride induced liver damage. It was observed that methanolic extracts exhibited higher hepatoprotection than aqueous extract.⁷²

Trianthema portulacastrum fruits: (Ficoidaceae): The administration of ethanolic extract of *T. Portulacastrum* to mice elicited a marked protection against carbontetrachloride induced hepatotoxicity as indicated by several hematological parameters.⁷³

Tridax procumbens (Compositae): The ethanolic extract of the leaves of *Tridax procumbens* (Maxican Daisy) is reported to posses antihepatotoxic activity. The hepatotoxicity induced by high doses of paracetamol in Wister rats and shade dried powdered leaves were given to rats with a paracetamol suspension. Marked protection as evidence by serum biochemical parameters and histological examination.⁷⁴

Vitex negundo roots: (Verbenaceae): Ethanolic extract of the roots of *Vitex negundo* exhibited hepatoprotective activity against carbon tetrachloride intoxication in rats. Further fractionation of ethanolic extract showed that the acetone insoluble fraction of the extract is responsible for the significant hepatoprotective action. The activity was evaluated with biochemical parameters.⁷⁵

Wedelia calendulacea leaves: (Compositae): Coumestans isolated from the leaves of *W. calendulacea* was evaluated in the paracetamol induced liver damage. The increase serum enzyme levels (Lactate dehydrogenase, alanine and aspartate transaminase and alanine phosphatase) by paracetamol induction were significantly lowered due to coumestans treatment Results show that coumestan shows protective action against hepatocellular injury.⁷⁶

DISCUSSION

Number of such plant drugs are included in several Ayurvedic formulations which are proven as a hepatoprotective therapy since many years in popular brands like Liv-52 and Livomyn. This implies that many of the other plant drugs are yet to be investigated for its safe use in human beings. Such a sumptuous plant drugs treasure from ayurveda and herbalism must be well established and protected too. Some examples of plants which are included in the branded formulations are *Andrographis paniculata*, *Boerhavia diffusa*, *Azadirachta indica*, *Phyllanthus niruri*, *Emblica officinalis* and several others.

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