

Journal of Drug Discovery and Therapeutics

Available Online at www.jddt.in

CODEN: - JDDTBP (Source: - American Chemical Society)

Volume 12, Issue 03; 2024, 18-39

Medicinal Plants with Hepatoprotective Activity: A Systematic Review

Krishna Anand¹ & Jitendra Malviya²

¹ Research scholar, Sunrise University, Alwar Rajasthan.

² Research supervisor, Sunrise University, Alwar Rajasthan.

Received: 22-03-2024 / Revised: 17-04-2024 / Accepted: 10-05-2024

Corresponding author: Krishna Anand

Conflict of interest: No conflict of interest.

Abstract:

Liver diseases such as hepatitis, fatty liver, cirrhosis, and liver cancer are significant global health concerns, resulting from viral infections and exposure to substances that are harmful to the liver. Natural products are crucial in the identification of several novel medications and active components. Medicinal herbs and herbal mixtures are used to treat a variety of liver problems. However, in extreme circumstances, the efficacy of a single medicinal plant is not very satisfying. These plants possess potent medicinal compounds such as alkaloids, glycosides, saponins, flavonoids, antioxidants, and terpenes that have hepatoprotective properties against harmful substances.

Silibum marianum, also known as milk thistle, contains Silymarin which has proven efficacy against specific liver diseases. *Glycyrrhiza glabra*, or Glycyrrhizin, *Picrorhiza kurroa* with picrosides I and II, *Phyllanthus maderaspatensis* with β -sitosterol, *Andrographis paniculata* with Andrographolide, *Trichopus zeylanicus*, *Eclipta alba*, and *Phyllanthus amarus* are also effective against certain liver diseases.

Keywords: Hepatoprotective, hepatitis, medicinal plants, phytochemicals

INTRODUCTION

The liver is a vital and sizable organ in the body that has significant functions in hormone synthesis, serum protein production, clotting factor formation, cholesterol synthesis, bile production, enzyme production, detoxification of harmful substances (such as certain drugs and alcohol), maintenance of homeostasis, and metabolism of carbohydrates, proteins, and lipids. Liver deterioration leads to significant health complications. The primary categories of liver illnesses include

hepatitis, fatty liver, cirrhosis, and liver cancer. Cirrhosis and liver cancer are the most significant global public health issues [1, 9].

Hepatitis is the inflammatory condition of hepatocytes, resulting from viral infections, exposure to chemicals or medications, and excessive alcohol use. The category of viruses includes hepatitis A, B, C, D, E, and G viruses. Hepatitis A, B, C, and D are prevalent viruses among this group. Typical

indications and symptoms of hepatitis include icterus (yellowing of the skin and eyes), nausea, vomiting, loss of appetite, weariness, stomach pain, soreness in the right hypochondriac region (RHR), fever, dark urine, myalgia, and arthralgia [1-3]. Out all these infections, the hepatitis B virus is the most perilous. Around the globe, an estimated 240 million individuals have been affected with chronic hepatitis B virus. Chronic hepatitis B may lead to the development of liver cirrhosis and liver cancer. Liver cancer arises from the genetic damage that occurs inside the cells of the liver [2, 3].

Throughout history, herbal and medicinal plants have been used to treat various ailments. Emperor Shen Nung, in 2500 BC, authored a Chinese book called "Pen T' Sao," which documents 365 medicinal plants and their corresponding remedies. Several therapeutic herbs mentioned in this book, like ephedra (containing Ephedrine, Pseudoephedrine, and Methyl ephedrine) and cinnamon bark (containing Cinnamaldehyde, Camphor, and Eugenol), are now used. Around 1550 BC, approximately authored the book "Ebers Papyrus," which documents 700 plant species used for medicinal reasons [4].

The researcher's study has verified that herbal medications are used to treat different liver conditions [5-7]. The pharmacological activities of *silybum marianum* include

antioxidant, anti-inflammatory, anti-lipid peroxidative, immunomodulating, antifibrotic, and liver regenerative actions. This substance is used to treat conditions such as toxic hepatitis, cirrhosis, fatty liver, viral hepatitis, radiation toxicity, and ischemia damage of the liver. *Picrorhiza kurroa* has beneficial benefits in the treatment of liver disorders [8]. Herbalists across the world use several medicinal herbs to prevent and cure liver disorders [10]. Several herbs possess hepatoprotective characteristics, and several plants are said to have liver healing capabilities based on diverse scientific studies [11, 12].

Hepatitis B and C are the most dangerous forms of hepatitis compared to other varieties. This is because the hepatitis B virus is highly linked to hepatocellular carcinoma, a type of liver cancer, while the hepatitis C virus is significantly related with liver cirrhosis, which is the scarring and fibrosis of the liver [13-20]. This systematic review specifically examines the ethanobotanical survey of medicinal plants that are used in the therapy of different liver ailments. The databases Google Scholar, PubMed, NCBI, ScienceDirect, Scopus, MIDLINE, Handawi, and Semantic Scholars were queried using the phrases "herbal medicine," "natural products," "medicinal plants," and "traditional medicines" in relation to hepatoprotective properties or hepatitis.

Table 1: The present research presents a thorough evaluation of medicinal plants with hepatoprotective properties in different solvents such as methanol, ethanol, and aqueous solutions. The results are shown below.

S. No	Name of Plant	Family Name	Part used	Hepatotoxicity inducing agents	Extraction	Measurement of Biochemical Markers and Histopathological Parameters
1	<i>Orthosiphon Stamineus</i> (21)	Lamiaceae	Leaves	Acetaminophen	Methanol	Aspartate transaminase, ALT and Alkaline phosphatase
2	<i>Phyllanthus niruri</i> (22)	Euphorbiaceae	Leaves and fruits	CCl4	Methanolic and aqueous	Toxic effects of ccl4 reduced by the extract <i>Phyllanthus niruri</i> Which exhibit the reduction of serum glutamate oxaloacetate transaminase, serum glutamate pyruvate transaminase, DPPH (2, 2-diphenylpicrylhydrazyl).
3	<i>Cassia fistula</i> (23)	Leguminosae	Leaf	Carbon Tetrachloride	Menthol	Liver profile(SGPT, SGOT, serum bilirubin and (ALP)
4	a. <i>Apium graveolens</i> b. <i>Hygrophila auriculata</i> (24)	a. Apiaceae b. Acanthaceae	Seeds	Thioacetamide and Acetaminophen	Menthol and petroleum ether	SGOT, SGPT, ALP, LDH, GLDH, S.bilirubin, histopathological studies.
5	<i>Sphaeralcea obtusicaulis</i> (25)	Cucurbitae	Fruits	Carbon tetrachloride (CCL4)	Methanolic extracts, Petroleum ether and acetone	Serum glutamate oxaloacetate aminotransferase, serum glutamate pyruvate aminotransferase, alkaline phosphatase and serum albumin
6	<i>Croton oblongifolius</i> And <i>Apiumgra_ eolens</i> Linn. (26)	Euphorbiaceae or euphorbias Apiaceae/ Umbelliferae	Aerial parts Seeds	Carbon tetrachloride	Acetone, methanol and Petroleum ether	Estimation of liver aminotransferases (GOT and GPT), alkaline phosphatase, total protein and Albumin
7	<i>Gentiana elliptica</i> (27)	Gentianaceae	All parts of the plant	Tetrachloromethane	Methyl alcohol	Significant decrease in alanine aminotransferase, aspartate aminotransferase, ALKP, serum bilirubin level, Histopathological evaluation
8	<i>Equisetum arvense</i> /horsetail (28)	Equisetaceae	Aerial parts	Carbon tet (CCl4)	Methanol extract	ALT, aspartate transaminase (AST), ALP, and Histopathology studies of liver tissues
9	<i>Cucumis cucumerina</i> (29)	Cucurbitaceae	Whole plant	CCL4	Methanolic	Serum ALT, AST, ALP, TB, TP and albumin (ALB), glutathione (GSH) and malondialdehyde (MDA) level were estimated. Evaluation of histopathological changes.
10	<i>Terminalia neelgherrense</i> (30)	Pittosporaceae	Bark	Paracetamole, 2-amino- 2-deoxy-D-galactose, Carbon tetrachloride (ccl4).	CH ₃ OH (Methanol)	Serum glutamic oxaloacetic transaminase, serum glutamic pyruvic transaminase.
11	<i>Asplenium adnigrum</i> mill (31)	Liliaceae	Dried aerial parts	Carbon tetrachloride (CCL4)	Trichloromethane, Petroleum ether and methanol	Serum transaminases (ALT and AST), ALKP, serum bilirubin, glucose-6- phosphatase, serum triglycerides or triacylglycerol level and glutathione level.

12	<i>Mum vitifolium</i> (32)	Rosperma- ceae	Bark	Carbon tetrachloride	Hexane (C ₆ H ₁₄), methylene chloride Methyl alcohol	Aspartate transaminase and ALP
13	<i>Lactuca indica</i> (33)	Asteraceae / Compositae	Aerial parts	Carbon tetrachloride	Methanolic	SGPT and alkaline phosphatase
14	<i>Orthosiphon stamineus</i> (34)	Labiatae / Lamiacea	Leaves	Paracetamol	Methanol	Lipid peroxides, ALP, SGPT and SGOT.
15	<i>Cassia fistula</i> (35)	Fabaceae OR Leguminosae	Seeds	Paracetamol	Methanolic	Serum bilirubin, ALP SGOT and SGPT
16	<i>Carpus marsupium</i> Roxb (36)	Papilionaceae	Bark(Stem)	Carbon tetrachloride (tetrachlorometh- ane)	Both Methanolic extract and aqueous extract used in the study	Total bilirubin, alkaline phosphatase, serum alanine and protein. Transaminases (ALT and AST) and Microscopic examination of liver tissue.
17	<i>Spondias pinnata</i> (37)	Anacardiaceae	Stem	Carbon tetrachloride	C ₄ H ₈ O ₂ and Methanolic	SGPT or ALT, SGOT or AST, ALKP, serum bilirubin level in the blood.
18	<i>Juncus subulatus</i> (38)	Juncaceae	Powdered tubers	Paracetamol(PCM) (C ₈ H ₉ NO ₂)	70% methanol	Liver enzymes e.g ALT, AST, ALP), total albumin and protein level. serum cholesterol, triglycerides, nitric oxide (NO), malondialdehyde (MDA).
19	<i>Phyllanthus polyphullus</i> (39)	Euphorbiaceae	Leaves	Acetaminophen (C ₈ H ₉ NO ₂)	Methanolic	Aspartate transaminase. (AST), alanine amino transferase (ALT), (ALP) alkaline phosphatase, total bilirubin, gamma glutamyl. transferase, lipid peroxidase. (LPO) with a reduction catalase and glutathione S-transferase (GST).
20	<i>Scoparia dulcis</i> (40)	Scrophulari-aceae	Whole plant	Carbon tetrachloride	i.Methanol ii.diethyl-ether	Pathological studies of liver tissue, serum AST, alanine amino transferase (ALT), alkaline phosphatase (ALP) and total bilirubin
21	<i>Hoslundia opposite</i> (41)	Lamiaceae	Stem	Paracetamol and carbon tetrachloride	Methanol and ethyl Acetate	Serum AST, SGPT and Bilirubin
22	<i>Tylophora indica</i> (42)	Asclepidaceae	Leaves	Carbon tetrachloride	Methanolic	Serum GPT, GOT, ALP and Bilirubin
23	a. <i>Cajanus cajan</i> , b. <i>Caesalpinia bonduc</i> , c. <i>Argemone Mexicana</i> , d. <i>Casuarina equisetifolia</i> , e. <i>Glycosmis pentaphylla</i> , f. <i>Bixa orellana</i> , g. <i>Physalis minima</i> , (43)	a. Fabaceae b. Fabaceae c. Papaveraceae d. Casuarinaceae e. Rutaceae f. Bixaceae g. Solanaceae	Plant materials	Carbon tetrachloride	Methanolic extract	Serum (cholesterol, GOT and GPT)
24	<i>Tridax procumbens</i> (44)	Compositae	Foliage	Carbon tetrachloride	Ethanolic extract	Catalase, Glutathione (N-(N-L-gamma-glutamyl-L-cysteinyl) glycine and superoxide dismutase.

25	<i>Saururus chinensis</i> (Lour.) Baill (45)	Saururaceae	Whole plant	Carbon tetra-chloride	Ethanol	Lishu wang <i>et al.</i> conducted a study in 2009. The study suggested that ethanolic extract of <i>Saururus chinensis</i> effectively decreased the elevated level of hepatic enzyme (HA, SOD, AST, ALT, MDA, TAG, LP and ALB). Histopathological observation also suggested that the plant has antifibrotic effects against CCL4 toxicity.
26	<i>Schisandrae chinensis</i> (SC) (46)	Magnoliaceae	Dried fructus	CCL4	Ethanol	Significant decrease of liver enzyme (ALT, AST, ALP) due to use of ethanolic extract of <i>Schisandrae chinensis</i>
27	<i>Cordia macleodii</i> (47)	Boraginaceae	Leaves	CTC	Ethanol	Liver enzymatic activity Total bilirubin and serum [GPT, GOT and Alk. Phosphatase (ALP)]
28	<i>Arachniodes exilis</i> (48)	Dryopteridaceae	Rhizomes	Perchloromethane	Ethanol	Evaluation of antioxidant effects of the extract (superoxide dismutase, DPPH, and H2O2). Ser.GPT, GOT and malondialdehyde
29	<i>Momordica dioica</i> . (49)	Cucurbitaceae.	Leaves.	Tetrachloromethane	Aqueous solvent and ethanolic extract	Liver sections histopathological examination showed normal architecture, (AST), (ALT), total bilirubin and serum alkaline phosphatase (SALKP)
30	<i>Gentiana olivieri</i> (50)	Gentianaceae	Aerial parts	Ccl4	Ethanol	Estimation of malondialdehyde in liver tissue, and glutathione level, along with of plasma transaminase enzyme levels (SGPT/ALT and SGOT/AST)
31	<i>Clerodendrum inerme</i> / <i>Clerodendrum inerme</i> (Linn.) Gaertn <i>Volkameria inermis</i> L. (51)	Verbenaceae	Leaves	Methane tetrachloride	C2H5OH	Ser. ALT, AST, alkaline phosphatase, triglyceride and total cholesterol level (TC)
32	<i>Zanthoxylum armatum</i> (52)	Rutaceae/ Rue family/ citrus family	Bark	Carbon tetrachloride	Extract of <i>Zanthoxylum armatum</i> in C2H5OH solvent	LFT along with antioxidant enzymes such as glutathione, superoxide dismutase, catalase
33	<i>Conium maculatum</i> Pers (53)	Crassulaceae/ stonecrop family or the orpine family	Leaves	tetrachloride or Ccl4	Ethanolic extract and fresh juices of the leaves	Serum AspAT (SGOT), serum glutamyl pyruvate transaminase (SGPT) alkaline phosphatase (ALKP), serum bilirubin (SBLN) and histological studies of liver.
34	<i>Nelumbo nucifera</i> Gaertn (54)	Nelumbonaceae	Leaves	Carbon tetrachloride	Ethanolic	AL.transaminase and ASAT
35	<i>Peucedanum kaoui</i> (55)	Apiaceae	Power of dried Roots	Carbon tetrachloride	Ethanolic	Microscopic examination of liver with Serum level of GOT, GPT, bilirubin (BLN) and alkaline phosphatase (ALKP)
36	<i>Euphorbia fusiformis</i> (56)	Euphorbiaceae	Ethanolic extract of Tubers	Rifampicin	Ethanol	250 mg/kg oral dose has significant effects to decrease SGOT,SGPT, gamma glutamyl transpeptidase (GGTP), total bilirubin, alkaline phosphatase (ALP), and total protein in albino rats

37	<i>Phyllanthus amarus</i> Schum. Et Thonn. (57)	Euphorbiaceae	All parts of the plant are used except the root	AFB-1	Ethanolic	Ethanolic extract enhance the reduced level of glutathione. The oxidant activity of glutathione peroxidase, catalase, GST and superoxide dismutase (SOD) are inhibited.
38	<i>Andrographis indica</i> (58)	Meliaceae.	Leaf	Paracetamol or Acetaminophen (C ₈ H ₉ NO ₂)	Ethanol extract(70%)	Significant lower the liver enzyme (Glutathione peroxidase (GPO), catalase (CAT), glutathione-S-transferase (GST),and superoxide dismutase (SOD)
39	<i>Phyllanthus Niruri</i> (59)	Euphorbiaceae.	Leaf of the plant	Paracetamol	Ethanol extract 50% and Petroleum ether	Serum SGOT, SGPT, SALP and γ - glutamyltransferase (GGT) level decreased after the use of <i>Phyllanthus Niruri</i> extract with the recovery histopathological effects of the liver due to paracetamol.
40	<i>Capparis spinosa</i> (60)	Capparidaceae/caper family	Root bark	Carbon tetrachloride	Ethanolic	Serum ALT and AST are reduced after use of ethanolic extract of <i>Capparis spinosa</i>
41	<i>Cleome viscosa</i> linn (61)	Capparidaceae	Leaf powder	Carbon tetrachloride	Ethanolic (C ₂ H ₆ O)	Important enzyme such as Aspartate amino transferase (AST), alanine amino transferase (ALT), alkaline phosphatase (ALP) and total bilirubin are decreased by the use of <i>Cleome viscosa</i> linn extract. Histopathological analyses of liver samples shows hepatoprotective activity from Ccl ₄ .
42	<i>Andrographis Kurrooa</i> 62)	Scrophulariaceae	Root and rhizomes	Alcohol-carbon tetrachloride	Ethanol	12 mg/kg/ p.o dose lower the elevated level of serum GOT, GPT, acid phosphatase, alk. phosphatase, LDH and bilirubin level in the rat.
43	<i>Ginkgo Biloba</i> (63)	Ginkgoaceae	Dried extract	(CTC)	Ethanol	S.bilirubin level (total, direct and indirect) SGPT, SGOT, Serum alkaline phosphatase, and histopathological analysis confirm hepatoprotective effects of the plant extract
44	<i>Averrhoa carambola</i> (64)	Oxalidaceae	Fruit	Diethylnitrosamine (DENA) and Carbon tetrachloride(ccl ₄)	90% ethyl alcohol was used for the extraction	Hepatotoxicity was induced by DENA and CCL ₄ which was recovered by the <i>Averrhoa carambola</i> fruit extract in the following manner. The investigation exhibits that fruit extract of <i>Averrhoa carambola</i> has prophylactic role against hepatocellular carcinoma (HCC).
45	<i>Samanea acerifolium</i> . (65)	Sterculiaceae...	Leaves...	Carbon tetrachloride.	Ethanol.	25mg/kg/day dose reduced serum aspartate amino transferase (AST),(ALT) and alkaline phosphatase (ALP) level in the rats.

46	<i>Vitex trifolia</i> (66)	Verbenaceae	Leaves	Carbon tetra-chloride	ethanol and water	Increased biomarker such as aspartate amino transferase (AST), alanine amino transferase (ALT), alkaline phosphatase (ALP) due to ccl4 toxicity are Significant reduced after treated with ethanolic and aqueous extract of <i>Vitex trifolia</i> . CCl4 induced hepatocellular injury is restored into normal architecture by using the extract of the plant
47	<i>Coccoloba Planchoni</i> (67)	Coclospermaceae	Rhizomes/ creeping rootstalks/ rootstalks	Carbon tetrachloride (CTC) or chloromethane (TCM)	Aqueous	Increased liver enzyme (SGTP,SGOT, AKP) and total bilirubin are reduced due to use of aq. extract of <i>Coccoloba Planchoni</i>
48	"Teng-Khia-U" (Taiwan traditional medicine) <i>E. mollis</i> H.B.K. and <i>b. Pseudo-elephantopus spicatus</i> (Juss. ex Aubl.) Rohr <i>Elephantopus scaber</i> L., (68)	Asteraceae	Whole plant	(D- galN) or (2-Amino-2-Deoxy-Galactopyranose) and acetaminophen (AAP)	Water Extract of the plants	Ser. glutamate-oxalate-transaminase and GPT level decreased after treatment and changes of the liver improved after treatment
49	<i>Boerhaavia racemosa</i> (69)	Liliaceae	Whole plant	radiation (range of 75–900 Gy)	Crude extract and a purified aqueous Fraction	Extract of the plant prevent liver damage from oxidative stress of lipid peroxidation
50	A traditional Chinese herbal drug "CGX" which name meaning liver cleaning from the toxic substances (70)	-----	-----	Carbon tetrachloride (CTC/ccl4)	Aqueous	CGX significantly decreased the catalase activity and glutathione content and it inhibit the TNF- α in liver tissue induced by ccl4
51	a. <i>Tephrosia purpurea</i> (L.) pers And b. <i>Tecomella undulate seem</i> (71)	a.Fabaceae b.Bignoniaceae	a.Aerial parts b.stem bark	Paracetamol (C ₈ H ₉ NO ₂)	a.Hydro-ethanolic b.Ethanolic extract	Extract of the plants decrease the serum aminotransaminase (GPT and GOP), GTT, ALP and total bilirubin along with improvement of glutathione level.
52	<i>Boerhaavia diffusa</i> (72)	Nyctaginaceae	Roots	Acetothioamide (CH ₃ CSNH ₂)	Aqueous	High level GOT, GPT and Bilirubin and ALP level are reduced after use of <i>Boerhaavia diffusa</i> aqueous extract
53	<i>Gundelia tourenfortii</i> (L.) (73)	Asteraceae	Dried powdered of foot stalks	Carbon tetrachloride	hydroalcoholic	The histopathological study of liver section support that hydroalcoholic extract of <i>Gundelia tourenfortii</i> (L.) have hepatoprotective effects. SGOT, SGPT, ALP, and serum bilirubin level have significantly reduced.
54	<i>Boerhaavia occidentalis</i> (74)	Caesalpiniaceae	Leaves	Paracetamol (C ₈ H ₉ NO ₂) and ethyl alcohol (C ₂ H ₅ OH)	Aqueous-ethanolic extract(50% v/v)	Histopathological alteration are restored with decrease level of Serum transaminases (asp. aminotransferase and alanine transaminase), alkaline phosphatase and serum cholesterol.

55	<i>us amarus(PA) (75)</i>	Euphorbiaceae	All parts of the plant except the underground parts	Ethanol	Aqueous	Increase level of serum transaminases level (AST and ALT), serum triacylglyceride (STAG), hepatic triglycerol is significantly decreased by use of (PA) extract. Histopathological studies confirm that extract of (PA) prevents liver injury.
56	<i>laurif-olia Linn. (76)</i>	Acanthaceae	Leaves	Ethanol	Aqueous extract	Pornpen pramyothin <i>et al.</i> conducted the relevant study which demonstrate that Serum glutamyl oxaloacetic acid transaminase (SGOT), SGPT, Alk.phos and serum billirun level are significantly reduced. The study revealed that ethanolic extract of <i>Thunbergia laurifolia Linn</i> has hepatoprotective activity.
57	<i>Nigella Sativa(Thymoquinone) (77)</i>	Ranunculaceae	Seeds	Tert-butyl hydroperoxide(TBHP)	Aqueous-ethanolic extract	Thymoquinone prevent the release of ALT and AST from the liver cells by healing of hepatocytes
58	<i>per chaba (78)</i>	Piperaceae	Fruit	i.D-galactosamine (2-Amino-2-Deoxy-D-Galactose) ii.lipopolysaccharides	Aqueous acetone	The study explored that <i>Piper chaba</i> extract normalized the deteriorate enzyme of the liver (SGPT, Alk. phos and GOT) caused by the toxic agents.
59	<i>ta chinensis (79)</i>	Convolvulaceae	Seeds	(AAP or C8H9NO2)	Ethanolic And Aqueous	Antioxidant effects of the certain enzyme such as catalase, superoxide dismutase (SOD) and malondialdehyde (MDA) to prevent liver damage.
60	<i>ila auriculata (80)</i>	Acanthaceae	Root	CTC	Aqueous extract	<i>Hygrophila auriculata</i> Aqueous extract reduce the following enzyme of the liver. a.Alanine transaminase, b.aspartate transaminase (AST) c.alkaline phosphatase (ALP) d.total bilirubin. e.Investigation reveals normal histology of liver.
61	<i>Byrsocarpus coccineus Schum. & thonn. (81)</i>	Connaraceae	Leaf	CCl4 (Carbon-tetrachloride)	Aqueous	Ccl4 causes hepatolysis and increases serum ALT, AST and total protein, which are reduced with the help of <i>Byrsocarpus coccineus Schum. & thonn</i> extract.
62	<i>um japonicum (82)</i>	Clusiaceae	Whole Plant	<i>Isothiocyanate</i> (α -naphthyl-Isothiocyanate)($C_{11}NH_7S$) (Anit) and Carbon tetrachloride	chloroform, aqueous, petroleum ether solvents are used for extracts	<i>Hypericum japonicum</i> manifest potential effects against hepatotoxicity along with reduction of several liver enzyme.
63	<i>ois hamiltonii (83)</i>	Asclepiad-aceae	Roots	Carbon tetrachloride	Aqueous extract	1. Significantly protective effects of liver toxicity with decrease liver marker enzyme (LDH, AST, ALT and AKLP). Inhibition of lipid peroxidation and protein carbonylation. Restoration antioxidant enzymes SOD, glutathione,GST, CAT, GPx.

64	Berginin is an important constituents of (<i>Mallotus japonica</i>) (84)	Euphorbiaceae	Cortex	Carbon tetrachloride	Water	Elevated serum enzyme (SGOT, SGPT, sorbitol dehydrogenase and GGT are restore towards normal values. Reduced activity of glutathione S-transferase and glutathione reductase was maintain by "Berginin".
65	<i>Arma lucidum</i> (85)	Polyporaceae	Winter mushroom	(2-Amino-2-Deoxy-D-Galacto-pyranoside) OR C ₆ H ₁₃ NO ₅	Aqueous juice	Serum (AST, ALT) and MDA, GSH and histological investigation reveals the hepatoprotective activity.
66	<i>Cardifolia</i> Linn (86)	Rubiaceae	Roots	ccl4	Aqueous ethanolic	After the use of aqueous ethanolic extract the serum glutamate oxaloacetate transaminase (SGOT), serum alkaline phosphatase (SALP), serum glutamate pyruvate transaminase (SGPT), and γ -Glutamyltransferase (G-glu-transpept) are reduced to normal level
67	<i>Picrorrhiza rhizome</i> (87)	Scrophulariaceae	Dried rhizome	Poloxamer 407 (px-407)	Water/Aqueous	AST,ALT, LDL,triglyceride(TG) and total cholesterol levels were observed to reduce after use of <i>Picrorrhiza rhizome</i>
68	<i>Absinthium linn</i> (88)	Asteraceae	Powder form of aerial parts	10 μ g carbon tetrachloride (CCl ₄) injected i.v to mice to produce toxic effects	Aqueous	Reduced the following in the serum. a. aspartate transaminase (AST), b. alanineaminotransferase (ALT) c. TNF- α (tumor necrosis factor) d. interleukin-1(IL-1) e. superoxide dismutase (SOD)
69	<i>Copticum L.</i> (89)	Apiaceae/ Umbelliferae	Seeds	Acetaminophen And ccl4 (Carbon tetrachloride)	Water	Aspartate transferases (AST and ALT), and alkaline phosphatase (ALP)
70	<i>Mamoridca subangulata</i> And <i>Naragamia alata</i> (90)	Cucurbitaceae OR Meliaceae	a. Leaf and b. All parts of the plant	Paracetamol	2% (w/v) gum acacia is used for preparation of 10% aqueous suspension	Aspartate transferases (GOT), and (SGPT)
71	<i>Chamomile recutita capitula</i> (91)	Asteraceae/ Compositae	Fresh natural mature Capitula	Paracetamol(Acetaminophen)(AAP)	Aqueous Ethanolic	Liver serum marker enzymes AST, ALT and bilirubin level are reversed to normal level by using chamomile extract and shows the antihepatotoxic effects.
72	<i>Aerva lanata</i> Linn (92)	Amaranth-aceae	Coarse powder plant material	Paracetamol (PCM) or Acetaminophen	Hydro-alcoholic	Serum ALT(IU), AST(IU), ALP and bilirubin level reduced by hydroalcoholic extract of <i>Aerva lanata</i> Linn.
73	Galic acid an active chemical constituents of (<i>Acacia confuse</i>) (93)	Leguminosae OR Fabaceae	Bark	Carbon tetrachloride	Hydro-alcoholic	Galic acid reduced the following substances. a. Malondialdehyde (MDA) b. Aspartate transaminase (AST) c. Alanine aminotransferase (ALT) d. CYP2E1

						SOD Glutathione peroxidase (GPX) vii. Catalase (CAT).
74	<i>Calotropis procera</i> , <i>Kigelia africana</i> , <i>Alchornea cordifolia</i> and <i>Hibiscus sabdariffa</i> (94)	Apocynaceae Bignoniaceae Euphorbiaceae Malvaceae	Leaves of a, b, c and Calyces(d)	Paracetamol (AAP)	Distilled water	Normalized the serum GPT and GOT level along with the reduction of lipid peroxidation product activities (catalase (cat), superoxide dismutase, glutathione peroxidase (GTPO))
75	<i>A. indica</i> Linn (95)	Araceae	Leaves	Acetaminophen (PCM)	Hydro-alcoholic	Extract of <i>Alocasia indica</i> Linn decrease serum transaminases enzyme along with AL Pase and total bilirubin
76	<i>Embelia ribes</i> (96)	Myrsinaceae	Fruits	Paracetamol	Water	Elevated enzymes such as SGPT, SGOT, ALP, Total bilirubin (TB) caused by paracetamol toxicity are turn back to normal level. The relevant study exhibit hepatoprotective activity.
77	<i>Tylophora indica</i> (97)	Asclepiadaceae	powder of the leaves	Ethanol	Aqueous	<i>Tylophora indica</i> extract indicates the antihepatic activity with significantly turn down serum liver transaminases enzyme asp.TA, AlnTA, alkaline phosphatase (ALKP) and total bilirubin.
78	<i>Communis</i> . L (98)	Euphorbiaceae	Leaves or Foliage	Carbon tetrachloride	Cold aqueous extract	The relevant study was conducted by M.V Natu <i>et al.</i> on the leaves of <i>Ricinus communis.linn</i> . The conclusion of the study described that the plant exhibited to recover the damage tissue of the liver and decreased the elevated level of liver biomarker such as asp.amino transferase, ALT, alk. phosphatase and total bilirubin.
79	<i>Ocimum sanctum</i> (99)	Labiatae	Leaf	Acetaminophen (PCM)	Hydro-alcoholic	Hydroalcoholic extract of <i>Ocimum sanctum</i> normalized the necrotic lesion of the liver caused by PCM toxicity, with remarkable decrease of (AST), SGPT or alanine amino (ALT), total bilirubin, alkaline phosphatase (ALP).
80	<i>Trianthema decandra</i> L. (100)	Aizoaceae martynov	Leaves	Carbon tetrachloride	Aqueous	<i>Trianthema decandra</i> L. extract reduce liver toxicity triggered by CCl4 and fall serum AST, ALT and Bilirubin upto regular level.
81	<i>esculentus</i> Linn (101)	Malvaceae	Roots	1,1,1,1-tetrachloro methane (CTC)	Water	Hepatic enzyme SGPT (7-56 IU), SGOT (5- 40 IU), ALP (20-140 IU) and total bilirubin (TB) (0.1-1.2 mg/dl) are reduced to normal level with <i>Hibiscus esculentus</i> Linn therapy.

82	<i>Aegle marmelos(L.) correa Ex Roxb (102)</i>	Rutaceae	Pulp/seeds	(1,1,1,1-tetrachloro methane) or Carbon tetrachloride (CTC) or tetrachloro-methane	Water	Elevated level of AST, ALT and bilirubin are abated via aqueous extract of <i>Aegle marmelos correa ex Roxb</i> and the study reveals hepatoprotective effects
83	<i>Bauhinia purpurea (103)</i>	Fabaceae	Leaves	Paracetamol	Methanolic (CH ₃ OH)	Investigation reveals that ethanolic extract of <i>B.purpurea</i> remarkably reduced the AST and ALT level along with reduction of necrotic lesion/area of the liver caused by PCM.
84	<i>Elephantopus scaber (104)</i>	Asteraceae	Leaves of the plant in the month of October	Alcohol	Ethanol	The plant possess to reduce the serum biochemical profile of liver (AST, ALT, ALP, triglyceride, total bilirubin). The study also demonstrate antihepatic activity treated with ethanol extract.
85	Traditional Chinese formula(Zhi-Zi-Da-Huang 26)with 8:1:3:4 ratio of, Semen Sojae Preparatum Rheum officinale Baill Gardenia jasminoides Ellis. Citrus aurantium L. (105)	-----	-----	Alcohol	Diethyl ether and water	The formula shows a significant reduction of transaminases and antioxidant substances such as glutathione, malondialdehyde (MDA) and superoxide dismutase (SOD).
86	Fermented Soybean (Nutrient Enriched Soybean Tempeh) 106	-----	-----	Alcohol	Cooled water extract	1000mg/kg weight material has lower the liver biomarker and also antioxidant properties.
87	<i>Parpterodonta (107)</i>	Asteraceae	All parts are used	Ccl ₄ (CTC), 2-Amino-2-Deoxy-D-Galactopyranose, (DPPH)	i. Ethyl alcohol aqueous	Extract of the plant material decrease the level of transaminase beside with alkaline phosphatase (ALP) and total protein and bilirubin.
88	<i>Cassia tora (108)</i>	Caesalpiniaceae	Leaves	Carbon tetrachloride	Ethyl-acetate or ethyl-ethanoate (C ₄ H ₈ O ₂)	Exhibit antioxidant activity of glutathione to prevent liver cells from hepatolysis due to which the liver biomarker are reduced to normal.
89	<i>Sarcostemma brevistigma (109)</i>	Asclepiadaceae	Stem	Carbon tetrachloride	Acetic acid ethyl ester (C ₄ H ₈ O ₂)	Important enzyme of the liver such as Serum glutamic oxaloacetic transaminase (SGOT), serum GPT, alkaline phosphatase(ALPase or Alk Phos), gamma glutamate trans-peptidase (GGTP) and total bilirubin are decreased via <i>Sarcostemma brevistigma</i> extract.
90	<i>Carissa opaca(110)</i>	Apocynaceae	Leaves	Carbon tetrachloride	Methanolic	The study indicated that the leaves extract has protective properties against ccl ₄ toxicity and significantly decrease the ALKP ant bilirubin level along with serum amino-transferases (GPT, GOT).

91	<i>Amaranthus spinosus</i> (111)	Amaranth-aceae	Whole plant	Carbon tetrachloride	Petroleum ether	<p><i>Amaranthus spinosus</i> extract indicates to normalize the damage tissue of liver caused by CCL4.</p> <p>It also decrease aminotransferases, serum alkaline phosphatase (SALP) and total deteriorate by carbon tet- chloride</p>
92	<i>Combretula retzius</i> (112)	Combretaceae	Whole plant	<i>tert</i> -butylhydroperoxide-(<i>t</i> -BHP-)	Water	The study showed that extract of the plant remarkably reduced the changes(increase of liver enzyme) with prevention of liver injury via oxidative stress.
93	<i>Saponarin is an active constituent of Gypsophila trichotoma</i> Wend. (113)	Caryophyllaceae	Overground parts of plant material	CM(paracetamol or acetaminophen)	methanol	In this study, saponarin has the ability to normalize the damage tissues of the liver to normal cellular architecture. It also exhibited the Antioxidant properties to reduce SOD, CAT, GST, GSH-Px.
94	<i>Propolis (a sticky hive substance collected by honeybees from several flower sources</i> (114)	-----	-----	D-galactosamine (2-Amino-2-Deoxy-Galactopyranoside) (ADGP) and alpha-tumor necrosis factor (tnf-a)	Wood alcohol (CH3OH) and water extracts	Conclusion of the study are, i. Free radical scavenging activity ii. Successfully restore SGPT, SGOT and Alk. Phosphatase iii. Successfully alleviated hepatic injury stimulated by D-galactoseamine.
95	<i>Amalkadi Ghrita 24 (AG), is composed of cow's ghee and the following herbs. a. Glycyrrhiza glabra (10g) and b. Emblica officinalis (10g)</i> (115)	-----	-----	Ccl4	Crude drug	<i>Amalkadi Ghrita 24</i> mitigated the biochemical markers upto normal level. The study also demonstrated that AG restored the normal function and architecture of the liver
96	<i>Caesalpinia crista</i> Linn (synonyms of <i>C. bonducella</i> [L.] Roxb.) (116)	Fabaceae	Leaves	Liver Toxicity is induced by iron-Overload	100 g of powder was mixed in methanol : water (7 : 3)	The study concluded that <i>C. bonducella</i> [L.] Roxb extract has antioxidant activity. The ability of the plant material is to prevent the liver damage from iron overload by chelating mechanism.
97	<i>Bridelia ferruginea</i> Benth <i>Vernonia amygdalina</i> <i>Tridax procumbens</i> , <i>Ocimum gratissimum</i> . L and <i>Lawsonia inermis</i> (117)	Euphorbiaceae Asteraceae/ Compositae/ sunflower family Compositae Lamiaceae Lythraceae	Leaves	2-Acetylaminoflourene(2-AAF)	100 g of leaves are soaked in 500ml of water	The leaves extract showed hepatoprotective effects against histopathological changes induced by 2-AAF.
98	<i>Cichorium intybus</i> <i>Silybum marianum</i> (118)	Asteraceae	Leaves	Thioacetamide(TAA)	Chloroform (CHCl ₃) OR Trichloromethane	The study explained that the leaves of <i>Cichorium intybus</i> and <i>Silybum marianum</i> (silymarin) decreased essential liver enzymes i.e SGOT, GPT, alkaline phosphate(ALK.phos) and bilirubin. It has protective effects of liver tissues against TAA.

99	<i>Cuscuta australis (119)</i>	Convolvulaceae	Seed & stem of the plant	Acetaminophen(AAP)	Ethanollic extract	<p style="text-align: right;">Histopathology</p> <p>The relevant study demonstrated that <i>Cuscuta australis</i> possess the ability to maintain the normal cytoarchitecture of the liver in the presence of paracetamol overdose.</p> <p>2. Biomarkers A significant reduction of the liver injury marker (SGOT, SGPT, ALP and Billirubin, SOD and catalase) observed in this study.</p>
100	<i>Boesenbergia rotunda (120)</i>	Zingiberaceae	Rhizome	Thioacetamide (CH ₃ CSNH ₂)(TAA)	Ethanollic extract	<p>i. Microscopic examination was performed and observed the normal structure of the liver cells after the treatment of plant extract.</p> <p>ii. Extract of the <i>Boesenbergia rotunda</i> inhibit the release of the Reactive oxygen species to protect the liver injury and decrease the elevated biological markers.</p>

Conclusion

Synthetic allopathic drugs may lead to significant adverse effects and are often expensive. Therefore, liver issues are treated using medicinal plants that contain bioactive elements, which have little side effects and are cost-effective. This review paper provides a comprehensive analysis of medicinal plants with hepatoprotective properties. Medicinal plants are rich in alkaloids, glycosides, terpenes, flavonoids, and saponins, which have therapeutic properties for treating liver disorders. Medicinal plant extracts facilitate the exploration of novel molecules (drugs). Medicinal plants, whether taken alone or in combination, have significant effectiveness in treating liver illnesses caused by viruses and harmful substances.

Abbreviation

SGPT (Serum glutamate pyruvate transaminase), SGOT (Serum glutamate oxaloacetate transaminase), ALT (Alanine transaminase), AST (Aspartate transaminase), AspAT (Aspartate transaminase), AlnTA (Alanine

transaminase), CCL₄ or CTC (Carbon tetrachloride), AAP (Acetaminophen), PCM (Paracetamol), DPPH (diphenylpicrylhydrazyl), LFT (Liver function test), ALP or ALKP or (Alkaline phosphatase), LDH (Lactate dehydrogenase), GLDH (Glutamate dehydrogenase), GOT (Glutamic Oxaloacetic transaminase), GPT (Glutamic pyruvic transaminase), GPO or GSH-Px (Glutathione peroxidase), GSH (Glutathione), MDA (Malondialdehyde), LPO (Lipid peroxidase), SOD (Superoxide dismutase), TAA (Thioacetamide), TCM (Tetrachloromethane), LP (Lipoprotein), AFB-1 (aflatoxin B1), CYP2E1 (cytochrome P4502E1), TAG (Triacylglycerol), 2-AAF (2-Acetylaminoflourene), HA (Hyaluronic acid), CAT (Catalase), DENA (Diethylnitrosamine), GPx (Glutathione peroxidase), TG (Triglyceride), γGT (Gamma- glutamyltransferase), TB (Total bilirubin), TP (total protein), ALB (Albumin), IU (International unit), AFB-1 (Aflatoxin B1), CTC (Carbon tetrachloride), C₂H₅OH (Ethanol), C₆H₁₃NO₅ (D-galactosamine), TBARS (Thiobarbituric acid reactive substances).

References

1. Sun B, Karin M. NF- κ B signaling, liver disease and hepatoprotective agents. *Oncogene* 2008;27(48):6228- 6244.
2. Naveed S, Was HK, Talib SA, Anum H, Wasi HK, Azam M. Awareness of Hepatitis B in Phar.
3. Basra G, Basra S, Parupudi S. Symptoms and signs of acute alcoholic hepatitis. *World journal of hepatology* 2011;3(5):118.
4. Sarin SK, Kumar M, Lau GK, Abbas Z, Chan HLY, Chen CJ et al. Asian-Pacific clinical practice guidelines on the management of hepatitis B: a 2015 update. *Hepatology international* 2016;10(1):1-98.
5. Stickel F, Schuppan D. Herbal medicine in the treatment of liver diseases. *Digestive and liver disease* 2007;39(4):293-304.
6. Sakinah SS, Handayani ST, Hawariah LA. Zerumbone induced apoptosis in liver cancer cells via modulation of Bax/Bcl-2 ratio. *Cancer cell international* 2007;7(1):4.
7. Zhang A, Sun H, Wang X. Recent advances in natural products from plants for treatment of liver diseases. *European journal of medicinal chemistry*, 2013;63:570-577.
8. Petrovska BB. Historical review of medicinal plants' usage. *Pharmacognosy reviews* 2012;6(11):1.
9. Ozougwu JC. Physiology of the liver. *International Journal of Research in Pharmacy and Biosciences* 2017;4(8):13-24.
10. Bhawna S, Kumar SU. Hepatoprotective activity of some indigenous plants. *Int J Pharm Tech Res* 2009;4:1330- 1334.
11. Scott Luper ND. A review of plants used in the treatment of liver disease: part 1. *Alternative medicine review* 1998;3(6)410-421.
12. Shaik AA, Elumalai AA, Eswaraiah MC, Swathi S. An updated review on hepatoprotective medicinal plants. *Journal of Drug Delivery and Therapeutics* 2012, 2(2).
13. Maity T, Maity S, Pahari N, Kar DR, Ganguli S. A review on hepatic diseases and development of herbal drugs for the treatment of liver complications. *World Journal of Pharmaceutical Research* 2015;4:677-691.
14. Zhang JY, Dai M, Wang X, Lu WQ, Li DS, Zhang M. A case-control study of hepatitis B and C virus infection as risk factors for hepatocellular carcinoma in Henan, China. *International journal of epidemiology* 1998;27(4):574-578.
15. Queiroz DMM, Rocha AMC, Rocha GA, Cinque SMS, Oliveira AG, Godoy A. Association between *Helicobacter pylori* infection and cirrhosis in patients with chronic hepatitis C virus. *Digestive Diseases and Sciences* 2006;51(2):370-373.
16. Sierra CM, Arizcorreta A, Dí; az F, Roldá R, Martí; n- Herrera L, Pérez-Guzmán E, JoséA GG. Progression of chronic hepatitis C to liver fibrosis and cirrhosis in patients coinfectd with hepatitis C virus and human immunodeficiency virus. *Clinical infectious diseases* 2003;36(4):491-498.
17. Benhamou Y, Di Martino V, Bochet M, Colombet G, Thibault V, Liou A. Factors affecting liver fibrosis in human immunodeficiency virus–and hepatitis C virus– coinfectd patients: impact of protease inhibitor therapy. *Hepatology* 2001;34(2):283-287.
18. Benhamou Y, Bochet M, Di Martino V, Charlotte F, Azria F, Coutellier A. Liver fibrosis progression in human immunodeficiency virus and hepatitis C virus coinfectd patients. *Hepatology* 1999;30(4):1054-1058.
19. Di Martino V, Rufat P, Boyer N, Renard P, Matheron S, Le Moing V et al. The

- influence of human immunodeficiency virus coinfection on chronic hepatitis C in injection drug users: a long-term retrospective cohort study. *Hepatology* 2001;34(6):1193-1199.
21. Sanchez-Quijano A, Andreu J, Gavilan F, Luque F, Abad MA, Soto B. Influence of human immunodeficiency virus type 1 infection on the natural course of chronic parenterally acquired hepatitis C. *European Journal of Clinical Microbiology and Infectious Diseases* 1995;14(11):949-953.
 22. WHO. regional office for the western pacific research guideline for evaluating the safety and efficacy of herbal medicine, manila, WHO 1993.
 23. R. Harish, T shivanandappa, antioxidant activity and hepatoprotective potential of pallyanthus niruri, food chemistry 2006;95:180-185.
 24. T bhakta A, Pulok K, Mukherjee B, Kakali Mukherjee AS, Banerjee A, Subhash C et al., Evaluation of Hepatoprotective activity of cassia fistula leaf extract, journal of ethnopharmacology 1999;66:277-282.
 25. Anubha Singh SS, Handa. Hepatoprotective Activity of Apium Graveolens And Hygrophila Auriculata against Paracetamol And Thioacetamide Intoxication In Rats, Journal of Ethnopharmacology 1995;49:119-126.
 26. Bahar Ahmed, Tanveer Alam, Shah A. Khan, Hepatoprotective Activity Of Luffa Echinata Fruits, Journal of Ethnopharmacology 2001;76:187-189.
 27. Bahar Ahmed, Tanveer Alam, Manoj Varshney, Shah Alam Khan. Hepatoprotective activity of two plants belonging to the apiaceae and the euphorbiaceae family, journal of ethnopharmacology 2002;79:313-316.
 28. Bouang, Xiaoquanban, Jingshenghe, Hongzeng, Pengzhang, Youweiwang, Hepatoprotective and antioxidant effects of the methanolic Extract from Halenia Elliptica, Journal Ofethnopharmacology Xxx (2010) Xxx–Xxx.
 29. Hyuncheol Oh, Do-Hoon Kim, Jung-Hee Cho, Youn-Chul Kimc, Hepatoprotective and Free Radical Scavenging Activities Of Phenolic Petrosins and Flavonoids isolated from Equisetum Arvense, Journal Of Ethnopharmacology 2004;95:421-424.
 30. Sathesh Kumar S, Ravi Kumar B, Krishna Mohan G. Hepatoprotective Effect Of Trichosanthes Cucumerina Var Cucumerina L. on Induced Liver Damage in Rats, Journal Of Ethnopharmacology 2009;123:347-350.
 31. Shyamal S, Latha PG, Shine VJ, Suja SR, S Rajasekharan T, Ganga Devi. Hepatoprotective Effects Of Pittosporum Neelgherrense Wight & Arn., A Pop ular Indian Ethnomedicine, Journal of Ethnopharmacology 2006;107:151-155.
 32. Chandan BK, Saxena AK, Sangeeta Shukla, Neelam Sharma, D.K. Gupta, K.A. Suri, Jyotsna Suri, M. Bhadauria, B. Singh, Hepatoprotective Potential of Aloe Barbadensis Mill. Against Carbon Tetrachloride Induced Hepatotoxicity, Journal of Ethnopharmacology 2007;111:560-566.
 33. S´Anchez-Salgado JC, Ortiz-Andrade RR, Aguirre- Crespo F, Vergara-Galicia J, Le´On-Rivera I. Vasorelaxant and Hepatoprotective Effects of Cochlospermum Vitifolium (Willd.) Sprengel: A Potential Agent for the treatment of metabolic syndrome, Journal of ethnopharmacology
 34. Ki Hyun Kim, Young Ho Kimb A, Kang Ro Leea. Isolation of Quinic Acid Derivatives and Flavonoids from the Aerial Parts of Lactuca indica L. And Their Hepatoprotective Activity In vitro, Bioorganic & Medicinal Chemistry Letters 2007;17:6739-6743.
 35. Maheswari C, Maryammal R,

- Venkatanarayanan R. Hepatoprotective Activity of "Orthosiphon Stamineus" on Liver Damage Caused By Paracetamol In Rats, *Jordan Journal Of Biological Sciences* 2008;1:105-108.
36. Chaudhari NB, Chittam KP, Patil VR, Hepatoprotective Activity Of Cassia Fistula Seeds against paracetamol-induced hepatic injury in rats, *Arch Pharm Sci & Res Vol* 2009;1(2):218-221.
37. Mankani KL, Krishna V, Manjunatha BK, Vidya SM, Jagadeesh Singh SD. Avinash, Evaluation of hepatoprotective activity of stem bark of *Pterocarpus marsupium* Roxb., *Indian J Pharmacol*, 2005;37:165-168.
38. Ganga Rao B, Jaya Raju N. Investigation Of hepatoprotective activity of *Spondias pinnata*, *International Journal of Pharma Sciences and Research* 2010;1(3):193-198.
39. Ayman F, Abdel-Razika, Abdel-Samid Elshamya I, Mahmoud Nassara I, Salah El-Kousy M, Hanaa Hamdyc. Chemical Constituents and Hepatoprotective Activity of *Juncus Subulatus*, 2009, 70-84.
40. Raj Kapoor B, Venugopal Y, Anbu J, Hari Krishnan N, Gobinath M, Ravichandran V. Protective Effect of *Phyllanthus Polyphyllus* On Acetaminophen Induced Hepatotoxicity In Rats, *Pakistan Journal of Pharmaceutical Sciences* 2008;21:57-62.
41. Praveen TK, Harmaraj SD, Jitendra Bajaj SP, Dhanabai S, Manimaran MJ, Nanjan, et al. Hepatoprotective activity of petroleum ether, diethyl ether and methanol extract of *Scoparia Dulcis* L. Against CCL4-Induced Acute Liver Injury In Mice, *Indian Journal Of Pharmacology* 2009;41:110-114.
42. Pete Akah A, Gasmir Odo L. Hepatoprotective Effect Of The Solvent Fractions Of The Stem Of *Hoslundia* Opposite Vahl (Lamiaceae) Against Carbontetrachloride And Paracetamol Induced Liver Damage In Rats, *International Journal Of Green Pharmacy*, 2010, 54-58.
43. Mujeeb M, Aeri V, Bagri P, Khan SA. Hepatoprotective Activity Of Methanolic Extract Of *Tylophora Indica* (Burm.F.) Merrill. Leaves, *International Journal Of Green Pharmacy* 2010, 125-127.
44. Md. Rajib Ahsan, Km Monirul Islam, Israt Jahan Bulbul, Md. Ashik Musaddik, Ekramul Haque. Hepatoprotective Activity Of Methanol Extract Of Some Medicinal Plants Against Carbon Tetrachloride-Induced Hepatotoxicity In Rats, *European Journal of Scientific Research* 2009;37(2):302-310.
45. Reddipalli Hemalatha, Anti-Hepatotoxic and Anti- Oxidant Defense Potential of *Tridax Procumbens*, *International Journal of Green Pharmacy* 2010, 164-169.
46. Lishu Wanga B, Dongyan Chenga, Haisheng Wanga, Lin Dia, Xuefeng Zhou, Tunhai Xuc. The Hepatoprotective And Antifibrotic Effects Of *Saururus Chinensis* Against Carbontetrachloride Induced Hepatic Fibrosis In Rats, *Journal Of Ethnopharmacology* 2009;126:487-491.
47. Fei Yana,1, Qiao-Yanzhanga,1, Leijiaoa, Tinghana, Hongzhanga, Lu-Pingqina, Rahman Khalid, Synergistic Hepatoprotective effect of *Schisandrae* Lignans With *Astragalus* Polysaccharides On Chronic Liver Injury In Rats, *Phytomedicine* 2009;16:805-813.
48. Naseem N, Qureshi A, Bhanudansh S, Kuchekar B, Nadeem Logade A, Majid A. Antioxidant And Hepatoprotective Activity of *Cordia Macleodii* Leaves, *Saudi Pharmaceutical Journal*, 2009;17:299-302.

49. Daonian Zhoua B, Jinlan Ruana, Yaling Caia, Zhaemou Xionga, Weifua, Anhua Weia. anti- antioxidant And Hepatoprotective Activity of Ethanol Extract of *Arachniodes exilis* (Hance) Ching, *Journal of Ethnopharmacology* 2010;129:232-237.
50. Avijeet Jain, Manish Soni, Lokesh Deb, Anurekha Jain, Roul AP, Gupta VB, Krishna KL. Antioxidant and Hepatoprotective Activity of Ethanolic and Aqueous Extracts of *Momordica Dioica* Roxb. Leaves, *Journal of Ethnopharmacology* 2008;115:61-66.
51. Didem Deliorman Orhana, Mustafa Aslana, Go`Knur Aktayb, Ender Ergunc, Erdem Yesiladaa, Fatma Erguna. Evaluation Of Hepatoprotective Effect Of *Gentiana Olivieri* Herbs on subacute Administration And Isolation Of Active Principle, *Life Sciences* 2003;72:2273-2283.
52. Gopal A, S Sengottuvelu B. Hepatoprotective Activity of *Clerodendrum Inerme* against CCL4 Induced Hepatic Injury In Rats, *Fitoterapia* 2008;79:24-26.
53. Lalit singh, Ranawat, Jigar Bhatt, Jagruti Paetl. Hepatoprotective activity of Ethanolic Extracts of Bark of *Zanthoxylum armatum* DC In Ccl4 Induced Hepatic Damage In Rats, *Journal of Ethnopharmacology* 2010;127:777-780.
54. Yadav NP, Dixit VK. Hepatoprotective Activity of Leaves of *Kalanchoe pinnata* Pers, *Journal of reEthnopharmacology* 2003;86:197-202.
55. Be-Jen Wang, Chu-Ting Liu, Chin-Yin Tseng, Chien- Ping Wu, Zer-Ran Yu. Hepatoprotective And Antioxidant Effects Of *Bupleurum kaioi* Liu (Chao Et Chuang) Extract And Its Fractions Fractionated Using Supercritical CO₂ On Ccl₄-
56. Be_Jen Yang Chu, Ting Leu, Chin, Yin Tseng, Chein- Ping Wu, Zer-Ran Yu. Hepatoprotective And Antioxidant Effects Of *Bupleurum kaioi* Liu Extract And its Fractions fractionated using supercritical Co₂ on Ccl₄ induced liver damage food and chemical Toxicology 2004;42:609-617.
57. Anusuya N, Raju K, Manian S. Hepatoprotective and Toxicological Assessment of an Ethnomedicinal Plant *Euphorbia fusiformis* Buch.-Ham.Ex D.Don, *Journal Of Ethnopharmacology* 2010;127:463-467.
58. Farah Naaz, Saleem Javed MZ. Abdin, Hepatoprotective Effect of Ethanolic Extract of *Phyllanthus amarus* Schum. Et Thonn. on Aflatoxin B₁-Induced Liver Damage in Mice, *Journal of Ethnopharmacology* 2007;113:503-509.
59. Chattopadhyay RR, Bandyopadhyay M. Possible Mechanism Of Hepatoprotective Activity Of *Azadirachta Indica* Leaf Extract Against Paracetamol-Induced Hepatic Damage In Rats: Part III, *Indian J Pharmacol* 2005;37:184-185.
60. Nahid Tabassum, Sushma Chattervedi S, S Aggrawal, Nissar Ahmed, Hepatoprotective Studies On *Phyllanthus Niruri* On Paracetamol Induced Liver Cell Damage In Albino Mice, *Experimental Medicine* 2005;12:211-212.
61. Nasrin Aghela, Iran Rashidib, Amir Mombeinia. Hepatoprotective activity of *Capparis Spinosa* Root Bark against CCl₄ induced hepatic damage in mice, *Iranian Journal Of Pharmaceutical Research* 2007;6(4):285-29.
62. Nishant Kumar Gupta, Vinod Kumar Dixit. Evaluation Of Hepatoprotective Activity Of *C; Eome Viscose* Linn. Extract. *Indian Journal Of Pharmacology* 2009;41:36-40.
63. Tripathi SC, Patnaik GK, Dhawan BN. Hepatoprotective Activity Of *Picroliu*

- Against Alcohol-Carbon Tetrachloride Induced Damage In Rat, Indian Journal Of Pharmacology 1991;23:143-148.
64. Ashok Shenoy, Somayaji SN, Bairy KL. Hepatoprotective Effects Of Ginko Biloba Against Carbon tetrachloride, Induced Hepatic Injury In Rats, Indian Journal Of Pharmacology 2001;33:260-266.
65. Singh R, Sharma J, Goyal PK. Prophylactic role of Averrhoa carambola (star fruit) extract against chemically induced hepatocellular carcinoma in Swiss albino mice. Advances in pharmacological sciences, 2014.
66. Kharpate S, Vadnerkar G, Deepthi Jain, Jain S. Evaluation of Hepatoprotective activity of ethanol extract of *Pterospermum acerifloium* Ster leaves, Indian Journal Of Pharmaceutical Sciences 2007;69:850-852.
67. Manjunatha BK, Vidya SM. Hepatoprotective activity of *Vitex Trifolia* against CCl₄ induced hepatic damage, Indian Journal Of Pharmaceutical Sciences 2008;70(2):241-245.
68. Roseline Aliyu A'b, Okoye A ZSC, Thomas Shier WB. The Hepatoprotective Cytochrome P-450 Enzyme Inhibitor Isolated From The Nigerian Medicinal Plant *Cochlospermum planchonii* Is A Zinc Salt, Journal Of Ethnopharmacology 1995;48:89-97.
69. Chun-Ching Lln, Chin-Chuan Tsal, Ming-Hong Yen B, The Evaluation Of Hepatoprotective Effects of Taiwan Folk Medicine 'Teng-Khia-U', Journal Of Ethnopharmacology 1995;45:113-123.
70. Jayashree P. Kamat A, Krutin K. Bolor A, Thomas P.A. Devasagayam A, S.R. Venkatachalam Bantioxidant Properties of *Asparagus Racemosus* against Damage Induced By G-Radiation in Rat Liver Mitochondria, Journal of Ethnopharmacology 2000;71:425-435.
71. Xiao-Ping Hu, Jang-Woo Shin, Jing-Huawang, Jung-Hyo Cho, Jin-Young Son, Chong-Kwan Cho, Chang-Gue Son, Antioxidative And Hepatoprotective Effect of Cgx, An Herbal Medicine, Against Toxic Acute Injury In Mice Journal Of Ethnopharmacology 2008;120:51-55.
72. Amit Khatria, Arun Gargb, Shyam S Agrawal C, Evaluation of Hepatoprotective Activity Of Aerial Parts of *Tephrosia purpurea* L. And Stem Bark of *Tecomella Undulate*, Journal Of Ethnopharmacology 2009;122:1-5.
73. Rawat KS, Mehrotra AS, Tripathi ASC, Shome BU. Hepatoprotective Activity Of *Boerhaavia diffusa* L. Roots - A Popular Indian Ethnomedicine, Journal Of Ethnopharmacology 1997;56:61-66.
74. Akram Jamshidzadeh, Fatema Fereidooni, Zohreh Salehi, Hossein Niknahad, Hepatoprotective activity of *Gundelia tourenfortii*, Journal of Ethnopharmacology 2005;101:233-237.
75. Jafri MA, Jalis Subhani AM. Kalim A, Javed A, Surender Singh B. Hepatoprotective Activity Of Leaves Of *Cassia Occidentalis* Against Paracetamol And Ethyl Alcohol Intoxication In Rats, Journal Of Ethnopharmacology 1999;66:355-361.
76. Pornpen pramyothin, Chanon ngamtin, Somlak Pongshompoo, Chaiyo Chaichantipyuth, Hepatoprotective Activity of *Phyllanthus amarus* Schum. Et. Thonn. Extract In Ethanol Treated Rats: In Vitro And In Vivo Studies, Journal Of Ethnopharmacology 2007;114:169-173.
77. Pornpen Pramyothin, Hemvala Chirdchupunsare, Anudep Rungsipipat, Chaiyo Chaichantipyuth C, Hepatoprotective Activity Of *Thunbergia laurifolia* Linn Extract In Rats Treated With Ethanol: In Vitro And

- In Vivo Studies, *Journal of Ethnopharmacology* 2005;102:408-411.
78. Mohamed Hesham Daba, Mohamed S. Abdel-Rahman, Hepatoprotective Activity of Thymoquinone in Isolated Rat Hepatocytes, *Toxicology Letters* 1998;95:23-29.
79. Hisashi Matsuda A, Kiyofumi Ninomiya AB, Toshio Morikawa AB, Daisuke Yasuda A, Itadaki Yamaguchi A, Masayuki Yoshikawa A. Hepatoprotective Amide Constituents From The Fruit Of Piper Chaba: Structural Requirements, Mode Of Action, And New Amides, *Bioorganic & Medicinal Chemistry* 2009;17:7313-7323.
80. Induced Liver Damage, *Food And Chemical Toxicology* 2004;42:609-617.
81. Feng-Lin Yen, Tzu-Hui Wu, Liang-Tzung Lin, Chun-Ching Lin. Hepatoprotective And Antioxidant Effects Of *Cuscuta Chinensis* Against Acetaminophen-Induced Hepatotoxicity In Rats, *Journal Of Ethnopharmacology* 2007;111:123-128.
82. Abidemi Akindele J, Kenneth Ezenwanebe O, Chidozie Anunobi C, Olufunmilayo Adeyemi O. Hepatoprotective And In Vivo Antioxidant Effects of *Byrsocarpus coccineus* Schum. and Thonn. (Connaraceae), *Journal of Ethnopharmacology* 2010;129:46-52.
83. Ning Wang, Peibo Li, Yonggang Wang, Wei Peng, Zhong Wu, Suiyi Tan. Shaoling Liang, Xiao Shen, Weiwei Su, Hepatoprotective Effect of *Hypericum Japonicum* Extract And Its Fractions, *Journal Of Ethnopharmacology* 2008;116:1-6.
84. Anup Srivastava, T. Shivanandappa, Hepatoprotective Effect Of The Root Extract Of *Decalepis Hamiltonii* Against Carbon Tetrachloride-Induced Oxidative Stress In Rats, *Food Chemistry* 2010;118:411-417.
85. Hwa-Kyung Lim, Hack-Seang Kim, Hong-Serck Choi, Seikwan Oh, Jongwon Choi. Hepatoprotective Effects of Berberin, A Major Constituent of *Mallotus japonicus*, on Carbon Tetrachloride-Intoxicated Rats, *Journal of Ethnopharmacology* 2000;72:469-474.
86. Yanling Shi, Jie Sun, Hui He, Hui Guo, Sheng Zhang. Hepatoprotective Effects Of *Ganoderma lucidum* Peptides Against D-Galactosamine-Induced Liver Injury in Mice, *Journal of Ethnopharmacology* 2008;117:415–419.
87. Guntupalli M, Mohana Rao, Chandana V, Rao, Palpu Pushpangadan, Annie Shirwaikar, Hepatoprotective Effects Of Rubiadin, A Major Constituent Of *Rubia cordifolia* Linn., *Journal Of Ethnopharmacology* 2006;103:484-490.
88. Hyeung Sik Lee, Hyo Chan Ahn, Sae Kwang Ku, Hypolipidemic Effect Of Water Extracts Of *Picrorrhiza Rhizoma* In PX-407 Induced Hyperlipemic ICR Mouse Model With Hepatoprotective Effects: A Prevention Study, *Journal Of Ethnopharmacology* 2006;105:380-386.
89. Nurmhammat Amata, Halmuratupura, Biljanabla Zekovi' Cb. In Vivo Hepatoprotective Activity Of The Aqueous Extract Of *Artemisia Absinthium* L. Against Chemically An Immunologically Induced Liver Injuries In Mice, *Journal OF Ethnopharmacology* Xxx (2010) Xxx–Xxx.
90. A.H. Gilani A,, Q. Jabeen A, M.N. Ghayur A, K.H. Janbaz B, M.S. Akhtar C, Studies On The Antihypertensive, Antispasmodic, Bronchodilator And Hepatoprotective Activities Of The *Carum Copticum* Seed Extract, *Journal Of Ethnopharmacology* 2005;98:127-135.
91. ASHA VV. Preliminary Studies On The Hepatoprotective Activity Of *Mamordica*

- subangulata And Naragamia alata, Indian Journal Of Pharmacology 2001;33:276-279.
92. Ajay Kumar Gupta and Neelam Misra, hepatoprotective activity of aqueous ethanolic extract of Chamomile capitula in paracetamol intoxicated albino rats, American Journal of Pharmacology and Toxicology 2006;1(1):17- 20.
93. Manokaran S, Jaswanth A, Sengottuvelu S, Nandhakumar J, Duraisamy R, Karthikeyan R. hepatoprotective activity of *Aerva lanata* Linn. against paracetamol induced hepatotoxicity in rats, Research J Pharm. And Tech 2008, 1(4).
94. Yu-Tang Tung, Jyh-Horng Wu, Chi-Chang Huang, Hsiang-Chi Peng, Ya-Ling Chen, Suh-Ching Yang. protective effect of *Acacia confusa* Bark extract and its active compound gallic acid against carbon tetrachloride- induced chronic liver injury in rats, Food and Chemical Toxicology, 2009, 03-21.
95. Tolulope Olaleye M, BT B, Joa Rocha O. Acetaminophen-induced liver damage in mice: Effects of some medicinal plants on the oxidative defence system, Experimental and Toxicologic Pathology 2008;59:319- 327.
96. Wahid A Mulla, Vijay R Salunkhe & Satish B Bhise, Hepatoprotective activity of hydroalcoholic extract of leaves of *Alocasia indica* (Linn.), Indian Journal Of Experimental Biology, October 2009;47:816-821.
97. Nahid Tabassum, Shyam S. Agrawal, hepatoprotective activity of *Emebelia ribes* against paracetamol induced acute hepatocellular damage in mice, Experimental Medicine 2003;10:43-44.
98. Vipul Gujrati, Nilesh Patel, Venkat N, Rao K.Nandakumar TS. Gouda, Md.Shalam, S.M.Shanta Kumar, Hepatoprotective Activity Vof Alcoholic and Aqueous Extracts of Leaves of *Tylophora Indica* (Linn.) In Rats, Indian Journal Of Pharmacology 2007;39:43-47.
99. Natu MV, Suraj Agarwal SL, Agarwal, Agarwal S. Protective Effect Of *Ricinus Communis* Leaves In Experimental Liver Injufry. Indian Journal Of Pharmacology 1977;9(4):265-268.
100. Chattopadhyay RR, Sarkar SK, Ganguly S, Medda C, Basu TK. Hepatoprotective Activity Of *Oclmum sanctum* Leaf Extract Against Paracetamol Induced Hepatic Damage In Rats, Indian Journal Of Pharmacology 1992;24:163-165.
101. Singaravel Sengottuvelu, Duraisamy Srinivasan, Rasilingam Duraisami, Jothivel Nandhakumar, Mani Vasudevan. Thangavel Sivakumar, hepatoprotective activity of *Trianthema Decandra* on CCl₄ induced hepatotoxocity on rats, International Journal of Green Pharmacy 2010, 122-125.
102. Anbu Jeba Sunilson J, Jayaraj P, Syam Mohan M, A Anitha Gnana Kumara, R. Varatharajan, Antioxidant And Hepatoprotective Effect Of The Roots Of *Hibiscus Esculentus* Linn, International Journal Of Green Pharmacy, 2010, 200-203.
103. Ramnik Singh, Harwinder Singh Rao, Hepatoprotective Effect Of The Pulp/Seed Of *Aegle Marmelos Correa* Ex Roxb Against Carbontetrachloride Induced Liver Damage In Rats, International Journal Of Green Pharmacy, 2010, 232-234.
104. Yahya F, Mamat SS, Kamarolzaman MFF, Seyedan AA, Jakius KF, Mahmood ND. Hepatoprotective activity of methanolic extract of *Bauhinia purpurea* leaves against paracetamol-induced hepatic damage in rats. Evidence- Based Complementary and Alternative Medicine, 2013.

105. Ho WY, Yeap SK, Ho CL, Abdul Rahim R, Alitheen NB. Hepatoprotective activity of *Elephantopus scaber* on alcohol-induced liver damage in mice. *Evidence-Based Complementary and Alternative Medicine*, 2012.
106. Hang Wanga, Fang Fenga. B, Boyang Zhuanga, Ya sunc, Evaluation of Hepatoprotective Effect of Zhi-Zi- Da-Huang Decoction And Its Two Fractions Against Acute Alcohol- Induced Liver Injury In Rats, *Journal of Ethnopharmacology* 2009;126:273–279.
107. Amani S, Awaad ADJ, Maitlandb, Solimanc GA. Hepatoprotective Activity Of *Schouwia thebica* Webb, *Bioorganic & Medicinal Chemistry Letters* 2006;16:4624-4628.
108. Yihang Wu A, Leixiang B, Yang B, Fang Wang C, Xiumei Wu D, Changxin Zhou B. Hepatoprotective And Antioxidative Effects Of Total Phenolics From *Laggera pterodonta* on chemical-induced injury in primary cultured neonatal rat hepatocytes, *Food and Chemical Toxicology* 2007;45:1349-1355.
109. Muniyappan Dhanasekarana, Savarimuthu Ignacimuthua, Paulagastianb, Potential Hepatoprotective Activity Of Ononitol Monohydrate Isolated From *Cassia Tora* L. On Carbontetrachloride Induced Hepatotoxicity In Wistar Rats, *Phytomedicine* 2009;16:891-895.
110. Nirmal Neoliya K, Yogendra Shukla N, Mamta Mishra. Hepatoprotective Activity of *Sarcostemma brevistigma* Against Carbontetrachloride-Induced Hepatic Damage In Rats *current Science* 2003;84:9.
111. Jayasekhar P, Mohanan PV, Rathinam K. Hepatoprotective Activity Of Ethyl Acetate Extract Of *Acacia Catechu*, *Indian Journal Of Pharmacology* 1997;29:426-428.
112. Hussain Zeashan A, Amresh G, Satyawan A, Singh B, Chandana Venkateswara Rao A. Hepatoprotective Activity Of *Amaranthus spinosus* In Experimental Animals, *Food And Chemical Toxicology* 2008;46:3417–3421.
113. Choi MK, Kim HG, Han JM, Lee JS, Lee JS, Chung SH. Hepatoprotective effect of *Terminalia chebula* against t-BHP-induced acute liver injury in C57/BL6 mice. *Evidence-Based Complementary and Alternative Medicine*, 2015.
114. Simeonova R, Vitcheva V, Kondeva-Burdina M, Krasteva I, Manov V, Itcheva M. Hepatoprotective and antioxidant effects of saponarin, isolated from *Gypsophila trichotoma* Wend. on paracetamol-induced liver damage in rats. *BioMed research international*, 2013.
115. Arjun H, Banskota A, Yasuhiro Tezuka A, I Ketut Adnyana A, Kiyoshi Midorikawa A, Katsumichi Matsushige A et al., Cytotoxic, Hepatoprotective And Free Radical Scavenging Effects of Propolis From Brazil, Peru, The Netherlands And China, *Journal Of Ethnopharmacology* 2000;72:239-246.
116. Girish S, Achliya Sudhir G, Wadodkar, Avinash K. Dorle, Evaluation of Hepatoprotective Effect of *Amalkadi ghrita* Against Carbon Tetrachloride-Induced Hepatic Damage In Rats, *Journal Of Ethnopharmacology* 2004;90:229-232.
117. Sarkar R, Hazra B, Mandal N. Hepatoprotective potential of *Caesalpinia crista* against iron-overload-induced liver toxicity in mice. *Evidence-Based Complementary and Alternative Medicine*, 2012.
118. Adetutu A, Olorunnisola OS. Hepatoprotective potential of some local

- Medicinal Plants against 2-Acetylaminoflourene-induced damage in rat. *Journal of toxicology*, 2013.
119. Madani H, Talebolhosseini M, Asgary S, Naderi GH. Hepatoprotective activity of *Silybum marianum* And *Clchorium intybus* against Thioacetamide In Rats, *Pakistan Journal of Nutrition* 2008;7(1):172-176.
120. Folarin RO, Omirinde JO, Bejide R, Isola TO, Usende LI, Basiru A. Comparative hepatoprotective activity of ethanolic extracts of *Cuscuta australis* against acetaminophen intoxication in wistar rats. *International scholarly research notices*, 2014.
121. Salama SM, Abdulla MA, AlRashdi AS, Hadi AHA. Mechanism of hepatoprotective effect of *Boesenbergia rotunda* in thioacetamide-induced liver damage in rats. *Evidence-Based Complementary and Alternative Medicine*, 2013.