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A Review on Heparoprotective Medicinal Plants and Their Bioactive Compounds

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Abstract:

liver is a vital organ responsible for metabolism, detoxification, and maintaining physiological balance, yet it is highly vulnerable to damage from alcohol, drugs, toxins, and infections. Conventional treatments for liver disorders often have limited efficacy and may cause additional hepatic stress, highlighting the need for safer alternatives. Medicinal plants have emerged as promising hepatoprotective agents due to their antioxidant, anti-inflammatory, antifibrotic, and antiviral properties. Herbs such as Silybum marianum, Phyllanthus niruri, Picrorhiza kurroa, Curcuma longa Tinospora cordifolia, Glycyrrhiza glabra, Boerhaavia diffusa, and Ginkgo biloba have shown significant protective effects in experimental models.2 Popular herbal formulations like silymarin and Liv-52 are widely used for liver disorders and demonstrate beneficial outcomes in preclinical studies. In India, particularly in Chhattisgarh, these plants form an integral part of traditional medicine and exhibit promising local effectiveness. However, despite strong experimental evidence, clinical validation remains limited. To achieve global acceptance, further research focusing on standardized extracts, well-designed clinical trials, and modern dosage formulations is essential to confirm the therapeutic potential of these hepatoprotective medicinal plant

Keywords: Hepatoprotective agents, Herbal medicines, Polyherbal formulations, Liver disorders

Introduction

The liver is a vital organ responsible for diverse metabolic, detoxifying, and synthetic functions essential for maintaining physiological balance.[1] It plays a central role in carbohydrate, lipid, and protein metabolism and in detoxifying exogenous substances such as drugs and environmental toxins. However, due to its involvement in these biochemical pathways and the abundance of metabolic enzymes, the liver is highly susceptible to injury from various toxicants, chemicals, and pharmaceutical agents.[2] Among hepatotoxic substances, paracetamol (acetaminophen) is one of the most commonly used experimental models for inducing liver damage, as its overdose leads to oxidative stress, depletion of glutathione, and hepatocellular necrosis.[3]

Paracetamol-induced hepatotoxicity in experimental animals, particularly rats, has been extensively employed to evaluate the hepatoprotective potential of medicinal compounds.[4] In recent years, there has been increasing scientific interest in identifying plant-derived hepatoprotective agents that can restore liver function by counteracting oxidative stress, inflammation, and fibrosis.[5] Traditional

medicinal systems, such as Ayurveda, have long utilized herbs like Curcuma longa, Phyllanthus niruri, and Tinospora cordifolia for treating liver ailments.[6] Scientific validation of these plants has confirmed their antioxidant, anti-inflammatory, and enzyme-stabilizing properties, supporting their therapeutic potential in mitigating liver injury and promoting hepatic regeneration[7]

Table 1: Hepatoprotective Potential of some medicinal plants in Chhattisgarh:

Name of the plant	Source or Family	Plant parts used	Hepatotoxicity inducing agents/ Cell line	Extracts Studies	Biochemical and Histopathological Parameters studied
Alhagi camelorum. 8	Fabaceae	Leaves	Valproic acid	Hydroalcoholic-extract	AST and ALT, HPLC, DPPH, SOD, NO, Histopathological examination etc.
Punica granatum lin.9	Lythraceae Subfamily Punicodeae	Leaf or Peel	CCl4and D-D-GalN	Polyphenol-extract	ALT, ALP, AST etc.
Ganoderma lucidum.10	Ganodermataceae	Fruiting bodies	H2O2-induced liver injury	Water-extraction	GLPB2, GLPC2, 1H and 13C NMR, ALT and AST levels.
Sabia parviflora Wall. 11	Sabiaceae	Stems	cell lines (HepG2 and LO2)	Ethanol-extracts	Cell Viability Assay
Pseudobulbs of Pleione bulbocodioides.12	Orchidaceae	Dry pseudobulb s	N-acetyl-p-aminophenol, H2O2	Ethanol-extracts	In-vitro assays, Antioxidants activity.
Erythrina senegalensis .13	Fabaceae,	Stem and root bark	PCM-induced	Aqueous-extract	ALT, AST and ALP
Alangium salviifolium.14	Cornaceae	Bark	CCl4	Methanol-extract	AST, ALT, and ALP, OD, CAT.
Elytraria acaulis .15	Acanthaceae	root	PCM-induced	Maceration-extract	AST, SGOT, ALT SGPT, ALP and TB.

Capparis sinaica veil .16	Capparaceae	Aerial part	CCl4-induced	Methanolic-extract	HDL, ALB, GSH, CAT, SOD, GR, TL, TG, TC, LDL, G, TBil, alanine and AST and ALAT and ASAT, ALP and MDA, histopathological Studies.
Cassia occidentalis.17	Caesalpiniaceae	Leaves	PCM and ethyl alcohol-induced	Aqueous-ethanolic extract	AST and ALT, ALP, cholesterol, serum total lipids and Histopathological change.
Moringa Oleifera.18	Moringaceae	Leaf	Bisphenol A-Induced	Ethanolic-extracts	TC, TG, ALT and AST, ALP, albumin and TP, ELISA, GSH and SOD, Liver Tissue Homogenate and Sera, histological studies.
Hymenodictyon excelsum Wall .19	Rubiaceae	Bark	PCM-Induced	Methanol-extract	SGOT, SGPT, ALP, TBil, TP and histopathological examination.
Vitex negundo Linn .20	Lamiaceae	Leaf	PCM-induced	Ethanol extract	ALT, AST, ALP, histopathological analysis.
Amaranthus spinosus.21	Amaranthaceae	Leaf	CCL4-injected	Methanol-extract	SOD, CAT and MDA, ALT, AST and ALP.
Zanthoxylum armatum.22	Rutaceae	Bark	CCL4-induced	Ethanolic-extract	ALT and TB and SOD, CAT and GSH.
Boerhavia diffusa.23	Nyctaginaceae	Root	HepG2 cell induced	Methanol--extract	Boeravinone B and caffeic acid

Agathis robusta.24	Araucariaceae	Aerial parts	CCl4-induced	Methanolic Extracts	ALT, AST, MTT Assay.
Roselle and beetroots.25	Chenopodiaceae	Beet roots	CCl4 and E. coli-induced	Methanolic -extracts	GSH, SOD, MDA, c CAT, DPPH, FRAP, CAT and histopathology evaluated.
Parkia Biglobosa Husk.26	Fabaceae	Bean	CCl4-induced	Methanol-extract	AST, ALT, TBil, DB, ALP, TB and histological studies.
Green tea.27	Theaceae	Dried leaves	Thioacetamide (TAA)-produced	Methanol-extract	ALP, ALT, AST and B, SOD, CAT and MD, histological studies.
Hoslundia opposite.28	Lamiaceae	leaves	PCM-induced	Ethanol-extract	UA, Cholesterol, Urea, Creatinine, B, TB, TA.
Cordia Africana.29	Boraginaceae	Stem Bark	Acetaminophen (APAP)-induced	Methanol Extract	ALT, AST, ALP, GGT, and the level of TB TC, TGs, HDL, and LDL.
Anogeissus acuminate.30	Combretaceae	Leaf	Alcohol and Ethanol-induced	Ethanol-Extract	AST, ALT, ALP, GGT, and TB, histological studies.
Achillea millefolium.31	Asteraceae	Leaf	CCl4-induced	Macerated by hydroalcoholic solvent	GPT, GOT and ALP.
Sarang Banua (Clerodenrum fragrans Vent Willd).32	Verbenaceae.	leaves	Alloxan-induced	Ethanol and ethyl acetate-extract	SGOT, SGPT, and serum glucose.
Eucalyptus camaldulensis.33	Myrtaceae	Leaves	CCl4-induced	Hydro-distillation	TG, CT, HDL, and LDL ALT and AST.

Withania somnifera **Rubia cordifolia.34**	Solanaceae or nightshade Rubiaceae	Leaves Roots	CCl4-induced	Water extract	TB, ALP, histological studies.
Boerhavia diffusa L.35	Nyctaginaceae	Roots	TAA-induced	Aqueous-extract	GOT, ACP, GPT, and ALP, but not GLDH and bilirubin.
Ziziphus oenophilia.36	Rhamnaceae	Roots	I+R	Ethanolic-extract	SGPT, SGOT, SALP, BL, SOD, CAT, GPx and HST.
Seabuckthorn (Hippophae rhomboids).37	Elaeagnaceae	leaf	lead acetate-intoxicated	Drinking-water	AST, ALT, ACP, and ALP.
Blumea lacera (B. lacera) .38	Asteraceae	leaf	CCl4-induced	Ethanol-extract	AST, ALT, and ALP, CCl4, GAA, TBA, DMSO, NED, O-(H2O2), and DTNB.
Persicaria maculosa (linn.) **Tannic acid (TA).39**	Polygonaceae Actinidiaceae	Root parts Standard sources	CCl4-induced	Aqueous-extracts	ALT, AST, ALP and BIL, Histopathological analysis.
Tamarix articulate.40	Tamaricaceae	leaves	CCl4-induced	Methanolic-extract	AST, ALT, ALP, Bil, histological studies.
Morinda citrifolia L.41	Rubiaceae	fruit	APAP-induced,	Ethanolic-extract	SGPT, Histopathological studies.
Beta vulgaris.42	Amaranth (Amaranthaceae)	Roots	Acetaminophen-induced.	Ethanolic-Extract	AST, ALT, ALP, GSH, MDA.
Brassica nigra.43	Brassicaceae	Seeds	PHZ-Induced	Aqueous-extract	ALP, AST, ALTand TP, histological studies.

Alstonia congensis.44	Apocynaceae	Bark	CCl4-induced	Methanolic-extract	ALP, ALT, AST, B, LPO, TB, ALB, GSH and SOD, CAT and GPx, histopathological analysis.
Galium aparine L.45	Rubiaceae	Flower	APAP-induced	MEOH-extracts	AST, ALT, and BIL.
Polygonum persicaria.46	Polygonaceae	Roots	CCl4-induced	Aqueous-extract	Histological Studies.
Mangifera indica.47	Anacardiaceae	leaf	PCM-induced	Aqueous-extract	ALT, AST and ALP.
Garlic (Allium sativum).48	Alliaceae	Whole Parts	Nickel-induced	Ethanolic-Extract	ALT, AST, LDH, GPT, GOT, ALP, MDA., TB, GSH, CAT, GSH-Px, SOD etc.
Alchornea cordifilia.49	Euphorbiaceae.	leaves	CCl4-induced	Aqueous-extract	ALP, ALTand AST.
Annona muricata.50	Annonaceae	Fresh leaves	TAA-induced	Ethanolic-Extract	SOD, CAT, MDA, B, TB, ALB, ALP, ALT, and AST.
Citrus sinensis.51	Rutaceae	fruits	CCl4-Induced	Ethyl acetate-extract	AST and ALT, Histopathological Examination.
Chenopodium album.52	Amaranthaceae	Aerial parts	CCl4-Induced	Methanolic-extract	ALT, AST, ALP and histological studies.
Moringa oleifera.53	Moringaceae	leaves	PHZ -induced	Aqueous extract-	ALP, AST, ALT and TB.
Ginger (Zingiber officinale Roscoe)	Zingiberaceae	Rhizomes	CCl4-Induced	Juice-extract	ALP, G-GT, ALAT, ASAT, D-Bil, T-Bil, Histopathological Study.
Lemon (Citrus limon L.).54	Rutaceae	fruits			

Jasminum grandiflorum L. alleviates.55	Oleaceae	Dried flower	CCl4-Induced	Ethanol-extract	AST andALT, Histopathological study.
Wild Strawberry Fragaria vesca L.56	Rosaceae	Fresh fruits	PCM-Induced	Ethanol-extract	AST.
Decryodes edulis (African Black Pear).57	Amaranthaceae	Leaf	APAP-induced	Aqueous-extract	ALT, AST and ALP.
Solanum lycopersicum (Tomato).58	Solanaceae	Fresh ripe tomato fruits	INH+RIF-induced	Distilled-water	AST, ALT, ALP and bilirubin.
Parkinsonia aculeate.59	Fabaceae	Seed	CCl4-Induced	Methanol-extract	SOD, CAT, MDA.
Caralluma europaea (AECe).60	Apocynaceae	Stem	CCl4-Induced	Aqueous-extract	AST,ALT, ALP, TB, DB, MDA, TP, TG, TC, VLDL-c,
					LDL-c, HDL-c, urea, Cr, and uric acid.
Nelumbo nucifera Gaertn.61	Nelumbonaceae	Seedpod	APAP-induced	Macerated with hot distilled water	HepG2 cells.
Cordia lutea Lam.62	Boraginaceae	Flowers	PCM-induced	Maceration-extract	ALT, AST, ALP DB, TB, A, G and TP, Histopathological changes.
Annona cherimola Mill.63	Annonaceae	Leaves	PCM-induced	Ethanol-extract	AST, ALT and ALP, Histopathological changes.
Morus alba (linn).64	Moraceae	Leaves	PCM-induced	Alcohol (90%) and aqueous extract	SGOT and SGPT12. ALP13. and B, Preliminary

					phytochemical studies, Histopathological Study.
Garuga pinnata.65	Burseraceae	Leaves	CCl4-Induced	Ethanol-extract	SGOT, SGPT), ALP, ACP, GSH, SOD, CAT, LPO, and TP.
Hymenodictyon excelsum Wall.66	Rubiaceae	Bark	PCM-induced	Methanol-extract	SGOT, SGPT, ALP, serum TP and B, LPO, MDA, GSH, SOD, CAT, SEM, Histopathological observation.
Flacourtia jangomas (Lour.). 67	Salicaceae	Leaves and fruit	PCM-induced	Methanol-extract	AST, ALT, and LDH, MDA.
Gentiana olivieri.68	Gentianaceae	Aerial parts	CCL4-induced	Ethanol-extract	MDA, and liver tissue glutathione level,
Cayratia pedata var. Glabra.69	Vitaceae	Aerial plant	PCM-induced	Ethanol-extract	SGOT, SGPT, ALP, and TB, SOD, CAT, GPx and GST, Acute Toxicity Studies,Histopathologic al Studies.
Cnidoscolus Phyllacanthus .70	Euphorbiaceae	Leaves	D-galactosamine induced	Alcoholic-extraction	ALT, SGPT, AST, SGOTand ALP, Histological studies.
Sonneratia apetala.71	Lythraceae	Fruits	APAP-induced	Distilled water for 3 h before filtration.	ALT,AST, GSH, GSH-Px, SOD and MDA, histological

					studied.
Tamarindus indicus lin.72	Fabaceae	Fruit	I+R	Aqueous-extract	SGOT, SGPT, ALP, TP, GSH, LPO, SOD, CAT, Liver HST.
Lasimorpha senegalensis.73	Araceae	Leaf	PCM-induced	Methanol-extract	ALT, AST, ALP), TB, DB, histopathological studies.
Litsea martabanica.74	Lauraceae	Leaf	CPF-Induced	Decoction extracted with 95% ethanol.	MCV, MCH, MCHC, and PLT, BUN and Cr, TP, ALB, TB, DB, AST, ALT, and ALP, Histological Examination.
Cassia fistula.75	Leguminosae	Leaf	CCL4-induced	Methanol-extract	SGOT and SGPT, bilirubin and ALP.
Sweet basil (Ocimum basilicum L.).76	Lamiaceae	Specimens of basil	Acetaminophen-induced	Water-extraction	ASTand ALT, Histological analysis.
Schouwia thebica.77	Aceraceae	Aerial parts	CCl4-induced	Diethyl ether, chloroform, ethyl acetate, and n-butanol	ALT, AST, and GGT, and Glucose, Triglycerides, and Cholesterol.
Tephrosia villosa.78	Legumes	Whole plant	CCl4 and PCM-induced	Ethanolic-extract	SGOT, SGPT, ALP, and DB, histopathological exam.
Chenopodium botrys L.79	Chenopodiaceae	Aerial parts	Lead-induced	Methanolic and Aqueous-extract	LPO, ALPase, ACPase and SDH.

Ougeinia dalbergioides. 80	Papilionoideae	Barks	CCl4 and PCM-induced	Ethanolic and aqueous-extract	ALP, SGPT, SGOT, TB and DB.
Salvinia auriculata Aubl.81	Salviniaceae	Plant powder	MTX-Induced	Methanol-extract	ALT, AST, and LDH, Immunohistochemical Studies, Histopathological Studies,
Momordica dioica roxb.82	Cucurbitaceae	Leaves	CCL4-induced	Ethanolic and aqueous	AST, ALT, SALP and TB, Histopathological examination.
Ensete ventricosum (Welw.)83	Musaceae	Leaf	I and RIF - Induced	Macerated by using 80% methanol	ALT, ALP, and AST, histopathological studies.
Ocimum sanctum L.84	Lamiaceae	Basil Leaf	PCM-induced	Extracted by percolation with ethyl acetate	SGOT and SGP.
Triphala.85	Euphorbiaceae	Triphala	CCl4-induced	Water-extract	ALT, AST, MDA, TNF-α, and IL-6, Histopathological analysis.
Crassocephalum vitellinum.86	Asteraceae	Leaf	RIF-induced	Ethanolic-extract	ALT, ALP, AST, histomorphology study.
Euphorbia nivulia Buch.87	Euphorbiaceae	Aerial parts	CCl4-induced	Hydro alcoholic -extract	AST, ALT and ALP.
Tagetes lucida.88	Asteraceae	Root	CCl4-induced	Ethanolic-extract	TP, A, TB, and AST and ALT, and ALP.
Blumera lacera.89	Asteraceae	Leaves	RIF-Induced	Ethanolic-extract	SGOT, SGPT, ALP, TB,DB, histopathological studies.

Suaeda vermiculata.90	Amaranthaceae	Whole herbs	PCM-induced	Either aq. Ethanol-extract	AST, ALT, SOD, CAT, GR, LP, NO.
Ocimum basilicum.91	Lamiaceae	Whole plant	APAP -induced	Chloroform, diethyl ether, ethyl acetate, and methanol-extract.	ALP, TB, TP, albumin, AST, ALT, creatinine, and BUN.
Malus hupehensis tea.92	Rosaceae	Leaves	I- and RIF-induced	Ethanol-extract	LT, AST, TBIL, MDA, GSH-ST, SOD, GSH,
					DIL,Histological studies.
Nigellia sativa.93	Ranunculaceae	Seeds (oil)	I+RIF+P	Suitable solvent	ALP, ALT, AST, TP and BL and HST.
Ophiocordyceps Sinensis.94	Ophiocordycipitacea e	Mycelia	CCl4-Induced	Aqueous and methanol-extracts	ROS, ALT and AST, histopathological examination.
Ruta Graveolens and Angelica Sinensis.95	Rutaceae Umbellifers	Whole Plants	CCl4-Induced	Methanolic-extracts	DPPHIn-VitroHepatoprotective Activity.
Ephedra Alata.96	Ephedraceae	Whole Raw Material	Intoxication with Deltamethrin Pesticide	Macerated-extract	ALT, ALP, Bil and Urea, GSH, GST, and MDA.
Bryophyllum pinnatum.97	Crassulaceae	Leaves	Alcohol-induced	Boiled-extract	ALT, AST, ALP, AST, ALP,
Ficus benghalensis. 98	Moraceae	Aerial roots	I+ RIF	Methanolic-extract	ALP, ALT, AST, TP and BL, TBARS and GSH
Averrhoa bilimbi .99	Oxalidaceae	Leaves	Alcohol-induced	Ethanolic-extract	Biochemical parameters,
					histopathological examination.

Acalypha communis Mull.100	Euphorbiaceae	Leaves	Intoxication of TAA and RIF-induced	Aqueous-extract	Preliminary Phytochemical Screening, SGOT, SGPT, ALP, TB, T P, histopathological studies.
Cordia macleodii.101	Boraginaceae	leaves	CCl4-induced	Ethanolic extract	GPT, GOT, ALP and total bilirubin.
Thymoquinone.102	Ranunculaceae	Seeds	Tert-butyl hydroperoxide	Aqueous ethanolic-extract	ALT and AST.
Acalypha indica.103	Euphorbiaceae	Leaf	CCl4-induced	Methanolic Extracts	ALT, AST, ALP, ACP and LDH, LPO.
Plectranthus	Lamiaceae or mint	Leaf	DMBA-induced	Ethanolic-	ALT, AST, ALP, and B,
amboinicus.104				extract	TP, A and GLB,
					Histopathological
					observation.
Equisetum Arvense.105	Equisetaceae	Aerial parts	CCl4-induced	Methanolic -extract	AST, ALP, and Histopathological studies
Halenia Elliptica.106	Gentianaceae	Whole plant	CCl4-induced	Methanolic -extract	ALT, AST, ALP, and TBIL, Histopathological studies
Cuscuta Chinensis.107	Convolvulaceae	Seeds	APAP-induced	Aqueous and ethanolic	SOD, catalase CAT, and GPx, and MDA.
Cochlospermum Planchoni.108	Coclospermaceae	Rhizomes	CCL4-induced	Aqueous-extract	TB, ALP, ALT.
Tylophora indica.109	Asclepiadaceae	Leaves	CCL4-induced	Methanolic -extract	SGPT, SGOT, ALP and B.
Rhubarb Roots.110	Polygonaceae	Whole rhubarb	CCl4 Induced	Suitable-solvent	AST, ALT, ALP, TP, Alb, TBL,

					DBL. And
		roots			IDBL, MDA and activity of CAT, SOD, GSH and GPx Histopathological Examination.
Andrographis paniculata.111	Acanthaceae	Leaf	Methotrexate-Induced	Aqueous-extract	GCMS study, SOD, CAT, GSH, GPx.
Rosa rugosa.112	Rosaceae	Flower bud	Ameliorates Acetaminophen-Induced	Ethanol-extract	ERS, ERS Ameliorates APAP-Provoked Apoptosis and Ferroptosis in AML-12 Hepatocytes, Inhibition of Sirt1 Eliminates ERS-Mediated LKB1/AMPK/Nrf2 Axis, ALT, AST, LDH, TNF-α, IL-1β, IL-6, PGE2, NO, T-AOC, SOD, GSH, GPX-P, CAT.
Garlic Extract (Allium sativum).113	Allium sativum	Shade-dried bulbs	PCM-induced	Ethanol-extract	ALP, ALT, AST, Histopathological analyses, RBCs, Platelet, Hemoglo, Hema. DPPH free radical.
Artemisia Vulgaris L.114	Asteraceae	Aerial parts	Cisplatin-induce	Suitable-solvent	Phytochemical screening, ALT, AST, ALP and TSB.
Euphorbia fusiformis.115	Euphorbiaceae	Tubers	RIF-induced	Ethanol-extract	SGOT, SGPT, GGTP, ALP, total B and TP.
Mulaka (Raphanus	Rutaceae	Kanda (rhizom	PCM-induced	Suitable-solvent	SGPT, SGOT, ALP, TP,

Sativus Linn.).116		e)			ALB, TB, Chol, Urea, Cr, Triglyceride, Histo-pathological examination.
Dactylorhiza hatagirea.117	Orchidaceae	Root	PCM-induced	Hydroalcoholic-extract	AST, ALT, ALP and B, Physicochemical evaluation.
Jojoba (Simmondsia chinensis).118	Buxaceae.	Seed cake	PCM-induced	Aqueous-extracts	AST, ALT, GGT, ALP, and LDH, Histopathological study.
Scoparia dulcis L.119	Scrophulariaceae	Whole plant	CCL4-induced	Methanol, diethyl ether and petroleum ether-extract	AST, ALT, ALP, TB and Histopathological studies
Trichosanthes Cucumerina.120	Cucurbitaceae	Whole plant	CCL4-induced	Methanolic-extract	ALT, AST, ALP, TB, TP and ALB, GSH and MDA Histopathologic changes.
Tridex procumbensl..121	Asteraceae	Leaves	Polluted water-induced	Methanolic-extract	AST, ALT, ALP, TP, B, Body weight before & after treatment.
Naringi crenulate (roxb.).122	Rutaceae	Leaf and bark	CCl4 Induced	Ethanol-extracts	SGOT, SGPT, ALP, TP, ALB, globulin, total, conjugated and unconjugated bilirubin's., SOD, CAT, GPx and GRD and TBARS.
Euphorbia pilulifera.123	Euphorbiaceae	Leaf	CCl4-induced	Methanolic-extract	DPPH, MTT.

Mimusops elengi.124	Sapotaceae	Root	Anti-TB-induced	Hydro alcohol solvent	SGOT. SGPT, ALP, Histopathological study.
Woodfordia fruticosa Kurz.125	Lythraceae	Flowers	CCl4-Induced	PE, chloroform, ethyl alcohol and	Serum ALZT, B and triglycerides.
Punica granatum L var nana.126	Lythraceae	Leaves	CCl4-Induced	Methanolic-extract	AST, ALT, ALP, Alb, TC, TG, LDL, HDL, MDA, Histopathological study.
Citrullus Lanatus.127	Cucurbitaceae	Rind	Ethanol-induced	Aqueous-extract	ALT, AST, ALP, SOD and CAT, MDA and histopathological examinations
Steroidal Saponins.128	Agavaceae	Selected part	CCl4-Induced	Pure steroidal saponins-extracted	ALT, AST, ALP, TP, ALB, GLs and urea, SOD, catalase, GSH-Px, and GSH-Rd. Lipid MDA.
Eugenia uniflora l.129	Myrtaceae	Leaves	Gentamycin-induced	Aqueous-extract	AST, ALT, and ALP, Histological Studies.
Syzygium cumini.130	Myrtaceae	Seed	ROS-induced and ALX-induced diabetic rats	Ethanolic-extract	SOD, CAT, GSH, LPO, ST or SGOT, ALT, ALP, Histopathological Examination.
Capparis spinosa.131	Capparaceae	Root bark	CCL4-induced	Ethanolic extract	ALT and AST.
Allium roseum132	Liliaceae	Leaves	Cd-Induced	Many Suitable Solvent	FTIR-ATR, and NMR MDA, SOD, CAT.
Walnut oil and Caralluma	Juglandaceae and	Different parts	PCM-induced	Ethanol and water-	TC, TG, ALT, and HDL,

tuberculate.133	Apocynaceae			extract	Hematological parameters, Histopathology of the mice liver samples.
Cayratia trifolia (L.).134	Vitaceae	Leaves	NB-induced	Polar-extracts	ALP,AST,ALT, TB, DB Histopathological studies.
Adenanthera pavonine.135	Fabaceae	Leaves	Isoniazid+ Rifampicin	Methanolic-extract	SGOT, SGPT, ALP, LDH, Alb, TP, TB, CAT, SOD, MDA, GLT and HST
Cucurbita maxima.136	Cucurbitaceae (cucumber	Seed	PCM-induced and high fat diet-induced	Alcoholic-extract	SGPT, SGOT, ALP, TB, TB, TB, HDL, Triglycerides, VLDL, LDL, Histopathological studies.
Caesalpinia sappan l.137	Leguminosae	Herb	Alloxan Induced	Ethanolic-extract	AST and ALP, MDA.
Albizia Odoratissima. 138	Fabaceae	Bark	Ethanol-Induced	Methanolic-extract	SGPT and SGOT, ALP, TB, urea, and creatinine, Histopathological examinations.
Cochlospermum tinctorium, Terminalia macroptera,	Buxaceae Combretaceae Apocynaceae	Roots Leaves Aerial parts	CCL4-induced	Aqueous and hydroethanolic extracts	DPPH radical scavenging, LAD and LHM, Other biochemical parameters, histopathological
Leptadenia hastata and Commiphora Africana.139	Burseraceae	Roots			structure of the liver.
Aegle marmelos correa ex	Rutaceae	Pulp/seeds	CCL4-induced	Water-extract	AST, ALT and Bilirubin. Histopathologica

Roxb.140					l studies
Pterocarpus marsupium Roxb.141	Papilionaceous	Stem bark	CCL4-induced	Aqueous and Methanol	TB, ALT, AST, and Histopathological studies of the liver
Olea europaea L.142	Oleaceae	Seeds	Methotrexate-induced	Three solvents (Chloroform, methanol, and 50% aqueous ethanol)	GPT, GOT, and ALP, DPPH assay, Histopathology studies.
Marine Macroalgae.143	red (Rhodophyta), green (Chlorophyta) and brown (Phaephyta)	Seaweeds	CCl4-induced	Water extracts	ALAT & ASAT, ALP, LDH, total bilirubin, and direct bilirubin, Histopathology studies.
Curcuma longa (Zingiberaceae)144	Zingiberaceae	Fresh rhizomes	Alcohol-Induced	Aqueous-Extract	Phytochemical Screening, ALAT, GPT, histopathological.
Bauhinia acuminata (linn).145	Caesalpiniaceae	Leaves	CCl4 induced	Ethanolic and aqueous-extracts	SGOT, SGPT and ALP, Histopathological examination.
Osmium sanctum.146	Lamiaceae	leaf	PCM-induced	Suitable solvent-extract	AST, ALT, and the histology of the liver.
Curcuma xanthorrhiza 147	Zingiberaceae	Rhizome	CCl4-induced	Ethanolic-Extract	ALT, AST, ALP, Triglyceride, and TP levels, Histopathological examination.
Turmeric.148	Zingiberaceae	Rhizome	CCl4-induced	Ethanolic-Extract	TP, ALB, TB, ALT, AST, ALP, Catalase CAT, SOD, GSST, MDA,

					Histopathological analysis.
Mussaenda erythrophylla Lam.149	Rubiaceae	Stem	CCl4-induced	Ethyl acetate and methanol-extracts	SGOT, SGPT, ALP, TB, histopathological examinations.
Carissa edulis (vahl)150	Apocynaceae	Leaf	CCl4-induced	Ethanolic-extract	ALP, ALT, AST, TP, BIL, Albumin, HDL, CHL, TRIG, Histopathological examination.
Abroma augusta.151	Sterculiaceae, or Malvaceae	Leaves	Non-alcoholic fatty liver disease	Ethanolic-extract	ALT, AST, TG, TC, LDL, HDL, FFA and MDA, histopathological examinations.
Bombax costatum.152	Bombacaceae	Stem bark	CCl4-induced	Methanol-extract	MDA, CAT and GSH, histopathological examinations.
Catharanthus roseus.153	Apocynaceae	Leaf	Spartame-induced	Ethanol-Extract	T-Test, Histology.
Gooseberry And black mulberry.154	Moraceae	Suitable part	CCl4-induced	Aqueous and ethanolic-extracts	MDA,NO, Histopathological examination.
Andrographis paniculata.155	Acanthaceae	Roots, leaves, and aerial part	CCl4-induced	Ethanolic extract	ALP, ALT, and AST.
Cichorium intybus L.156	Asteraceae	Root	CCl4-induced	Suitable solvent -extract	Histopathological properties.
Osbeckia octandra.157	Melastomataceae	Leaf	TAA-Induced	Methanol extract And hexane-extract	ALT, AST, ALP, histopathological study.
Pandanus odoratissimus.158	Pandanaceae	Seed	PCM-induced	Methanol-extract	SGOT, SGPT, ALP, and GGT,

					Histopathology.
Tecomella undulata.159	Bignoniaceae	Bark	PCM and CCL4 Induced	Ethanolic and ethyl acetate-extract	AST, ALT, ALP GSH and MDA.
Pometia pinnata.160	Sapindaceae	Suitable part	CDDP-induced	Ethanol-extract	AST, ALT, LDH, and total protein,
Canthium dicoccum.161	Rubiaceae	leaves	PCM-induced	Methanolic -extract	AST, ALT, ALP, and bilirubin levels, SOD, CAT, and MDA levels,
Parkia Biglobosa.162	Fabaceae	leaves	APAP-Induced	Methanol-extract	ALT, AST and ALP Histopathological Study.
Ficus Carica.163	Moraceae	Fruits	CCl4-induced	Maceration: Methanol-extract	ALT, AST, ALP and Bil, Histopathology.
Acacia confuses164	Leguminosae	Bark	CCL4-induced	Hydroalcoholic-extract	AST, ALT and MDA, and CYP2E1, SOD, GPX and CAT.
Lallemantia Royleana.165	Lamiaceae	Seeds	Drug-Induced Liver Injury	Alcohol-extract	Histopathological examination.
Cicer arietinum.166	Fabaceae	Seeds	CCl4-Induced	Ethanolic-extract	HDL, A, GSH, CAT, SOD, GR, TL, TG, TC, LDL, G, TBil, MDA, Histopathological studies.
Honey.167	Apideae	Honey	CCl4-induced	Natural honey	ALT and AST, Histopathological study.
Ganoderma applanatum.168	Ganodermataceae	Crude	CCl4-induced-Induced	Suitable solvent-extract	ALT, AST, TNF-α, and IL-6, histopathological study.

Vitex trifolia.169	Verbenaceae	Leaves	CCl4-induced	Ethanol and water-extract	TP, Histopathological studies, AST, ALT, ALP,
Gongronema latifolium.170	Apocynaceae	Leaves	Alloxan-Induced	Aqueous-Extract	AST, ALT, GGT, ALP, TP, and ALB,PCV, Hb, RBC, MCHC, MCV, MCH, and WBC Haematology Analyzer–MC-2800.
Typha elephantina.171	Typhaceae	Leaves	Paracetamol intoxicated	Aqueous-extract	WBC, PLT count, lymphocytes, AST level, ALT and ALP GSH, TBRAS, Histopathological analysis.
Argan oil (Argania spinosa L).172	Sapotaceae	Both Roasted oils and unroasted	CCl4-induced	Roasting process	ALT, AST, TB and DB, triglycerides, LDL, plasmatic creatinine, urea, uric acid, and
		Argan oil			MDA
Pithecellobium Dulce.173	Legumes	Leaves	PCM-induced	Ethanolic-extract	Triglycerides, SGOT, SGPT, ALP, Bilirubin, Histopathological study.
Pterocarpus santalinoides DC.174	Legume	Fresh leaves	CCl4	Methanol-extract	Yield of PSCME and PSSE upon Extraction, Phytochemical Analyses, QCA ALT and AST.
Sterculia diversifolia.175	Malvaceae	Stem bark and leaves	Suitable inducing agent	Hydro-methanolic solvent (90%)	AST, ALP, ALT, and bilirubin, Histopathologica

					l liver.
Cichorium Intybus and Cynara Scolymus.176	Asteraceae	root and leave	PCM-induced Induced	Ethanolic-extracts	SGOT, GGT and CPK.
Vitis vinifera L.177	Vitaceae	Fruit	CCL4-induced	Distill water and with 70 % ethanol	AST and ALT, SALP, ALB and B, urea and creatinine, LDH, cholesterol and triglyceride, lipid peroxidation, reduced glutathione.
Pongamia Pinnata.178	Fabaceae	Leaves	Isoniazid & Rifampin-Induced	Ethanolic-extract	AST, ALT, and ALP.
Crocus sativus.179	Iridaceae	Petalsand both saffron petals and stamens	tert-Butyl Hydroperoxide-Induced	Suitable solvent -extract	SOD, CAT, GSH.
Pittosporum neelgherrense.180	Pittosporaceae	Stem bark	CCL4, d-galactosamine and APAP-induced	Methanolic -extract	SGOT, SGPT.
Centaurea Tougourensis Boiss. & Reut.181	Asteraceae	Aerial parts	Croton oil-induced streptozotocin-induced diabetes	Maceration After liquid-liquid extraction	ALAT, ASAT, HDL-C, LDL-C, Hepatoprotective activity.
Homalium zeylanicum.182	Salicaceae	Bark and leaf	CCL4-induced	PE and hydro alcohol (70%) by hot maceration	DPPH, SOD, NO, OH, SGOT, SGPT, ALP, TP and TB, TBARS assay kit, liver sections.
Cochlosperm um vitifolium.183	Cochlo-Spermaceae	Bark	CCL4-induced	Hexane, dichloromethan e, methanol	GPT and ALP

Stingless Bee.184	Apidae	Honey makes in live colony	Drug-induced liver injury	Gathering honey from beehives	SGPT, SGOT, BT, ALP, SOD,GSH, GR and CAT.
Calotropis procera, Kigelia Africana, Alchornea cordifolia and Hibiscus sabdariffa.185	Apocynaceae Bignoniaceae Euphorbiaceae Malvaceae	Leaves Leaves Leaves Calyces	PCM-induced	Distilled-water	TBARS, SOD, CAT, GPX, and d-amino levulinate dehydratase (d-ala-d) activities.
Desmodium repandum.186	Fabaceae	Leaves	PCM-Induced	Maceration: Ethanol-extract	Phytochemical screening, Hepatoprotective Activity.
Adhatodavasica.187	Acanthaceae	leaf	D-galactosamine-induced	Aqueous-extract	SGOT, SGPT, TBARS.
Justicia spicigera.188	Acanthaceae	Leaves	STZ-induced	Maceration with ethanol	DPPH, Blood Glucose and Body Weight Determination, LDL, VLDL, triglycerides, total lipids, and atherogenic index and TP, TB, DB, IDB, ALP, gamma glutamyl transferase, AAT, and ALT, Mitochondrial Isolation, SOD, CAT.
	Rubiaceae	Roots	CCL4-induced	Aqueous-extract	SGOT, SGPT, SALP and γ glumyltranferase
Chamomile capitula.190	Asteraceae	Fresh natural mature capitula	PCM-Induced	Aqueous-Ethanolic	Liver glutathione, Na+ K+- ATPase activity, B, glycogen and

					thiobarbituric acid.
Vernonia amygdalina.191	Daisy	Leaf	CCl4-Induced	Suitable-solvent	LDH, MDA, TAC, SOD, CAT, Glucose, TP, ALB, Total cholesterol, Triglyceride, LDL, HDL, AST, ALP, ALT, GGT.
Resveratrol and avocado oil.192	Resveratrol is a chemical which polyphenols called viniferins. Lauraceae	Oil Oil	PCM-induced	Suitable solvent-extract	TAS, TOS, histopathological examination.
Luffa echinata.193	Cucurbitaceae	Fruits	CCL4-induced	PE, acetone and methanolic-extracts	SGOT, SGPT, ALKP, TP and TA.
Phyllanthus niruri.194	Euphorbiaceae	Leaves and fruits	CCL4-induced	Methanolic and aqueous-extract	GOT, GPT, DPPH radical scavenging.
Schisandrae chinensis with Astragalus polysaccharides.195	Magnoliaceae	Dried fructus	CCL4-induced	Ethanol-extraxt	ALT, AST, ALP, MDA, GSH, CAT, SOD.
Swertiamarin isolated from Enicostemma Axillare.196	Gentianaceae	Whole plant	D-galactosamine	Ethyl acetate-extract	ASAT, ALAT, ALP, Triglycerides, Total cholesterol, TB, TP, Creatinine, ALB.
CGX- a modified traditional Chinese herbal drug.197	Liliaceae	Whole plant	CCL4-induced	Aqueous-extract	ALT, AST, LDH, MDA.

Tephrosia purpurea L. and Tecomella undulate.198	Fabaceae Bignoniaceae	Aerial parts and Stem Bark	TAA-induced	Aqueous ethanolic-extract	AST, gamma glutamyl, ALT, GSH, TB, ALP.
Aloe barbadensis Mill.199	Liliaceae	Dried aerial parts	CCL4-induced	PE, chloroform and methanol-extract	ALP, B, peroxidation, GSH, G6Pase and amidopyrine N-
					demethylase.
Hygrophila Auriculata and Apium graveolens.200	Acanthaceae Apiaceae	Seeds	PCM and TAA-induced	PE and methanol-extract	SGOT and SGPT, SDH, GLDH, ALP and B, Histopathological.
Clerodendrum inerme.201	Verbenaceae	Leaves	CCL4-induced	Ethanol-extract	ALT, AST, ALP, TGL, TC.
Gundelia tourenfortii.202	Asteraceae	Fresh edible stalk	CCL4-induced	Aqueous & ethanolic extract	ALT, AST, ALP, B and Histopathological studies.
Kalanchoe pinnata Pers.203	Crassulaceae	Leaves	CCL4-induced	Ethanolic-extract	SGOT, SGPT, ALKP, SBLN and Histopathological studies.
Phyllanthus amarus Schum. et. Thonn.204	Euphorbiaceae	Aerial part	Ethanol-induced	Aqueous-extract	AST, STG, ALT, STG, HTG, Histopathological examination.
Thunbergia laurifolia Linn.205	Acanthaceae	Leaves	Ethanol-induced	Aqueous-extract	SGOT, SGPT, ALKP, SBLN and Histopathological studies.
Piper chaba.206	Piperaceae	Fruit	D-gala, lipopolysaccharides	Aqueous-acetone extract	SGOT, SGPT, ALKP, TP, TA.

Hygrophila auriculata.207	Acanthaceae	Root	CCL4-induced	Aqueous-extract	AST, ALP, TP, TB, and
Laggera pterodonta.208	Asteraceae	Whole herb	CCL4, d-galn, d-galactosamine.	Ethyl alcohol and aqueous-extract	AST, ALP, TP, and TB.
Byrsocarpus coccineus Schum.209	Connaraceae	Leaf	CCL4-induced	Aqueous extract	ALP, AST and TP.
Decalepis hamiltonii.210	Asclepiadaceae	Roots	CCL4-induced	Aqueous extract	SOD, CAT, GPx, GR, and GST and GSH, Histopathological observations.

Discussion:

As a key organ in metabolism, the liver has a variety of enzymes that help with many biochemical processes but also make it susceptible to harm from different substances, medications, and toxins. Since excessive or extended use of paracetamol causes hepatic damage in humans, it is frequently utilized as a hepatotoxic drug to produce liver injury in hepatoprotective research. First documented in 2006, paracetamol-induced hepatotoxicity in rats is still a well-established experimental paradigm that is frequently characterized by increased liver weight and volume as a result of tissue edema and water buildup. Through a variety of pharmacological processes, many plants have hepatoprotective properties. Tinospora cordifolia, Phyllanthus niruri, and Curcuma longa are examples of antioxidant plants that lower lipid peroxidation and boost endogenous antioxidant defenses (SOD, CAT, and GSH). Pro-inflammatory mediators (TNF-α, IL-6, NF-κB) are inhibited by anti-inflammatory substances, such as flavonoids and terpenoids from Andrographis paniculata and Azadirachta indica. Antiviral species like Phyllanthus niruri show efficacy against HBV and HCV, whereas antifibrotic compounds like Picrorhiza kurroa and Curcuma longa decrease collagen deposition. As a sign of hepatocellular defense, many of these plants also stabilize liver enzymes (ALT, AST, ALP, and bilirubin). Traditional healers in Chhattisgarh, India—also referred to as the "Herbal State of India"—use medicinal plants such as Tinospora cordifolia, Eclipta alba, and Boerhavia diffusa to treat liver problems and jaundice. These practices are backed by both scientific confirmation and ethnomedical expertise. Ayurvedic polyherbal preparations like Liv-52 are common in Asia and Africa, while hepatoprotective botanicals like silymarin from Silybum marianum are well-known worldwide, especially in Europe and the USA. Advances in formulation methods (e.g., nanoparticle curcumin, silymarin phytosomes, liposomal extracts) have improved bioavailability despite standardization issues restricting their clinical acceptance in the West.

Conclusion:

The results of this investigation show that C. dicoccum has a strong protective effect against hepatotoxicity caused by paracetamol. Because of its capacity to scavenge free radicals, MECD's

hepatoprotective impact is mainly mediated through the mitigation of lipid peroxidation, which in turn strengthens the body's natural antioxidant defense system. This review-of-reviews highlights the significant therapeutic potential of hepatoprotective medicinal plants and their polyherbal formulations, which are backed by strong preclinical data and traditional ethnomedical practices in India, especially in areas like Chhattisgarh. Agents like curcumin, Phyllanthus species, and silymarin continue to be the most thoroughly validated on a global scale. However, clinical validation is still needed for a wide range of intriguing botanicals. Future research should focus on carefully planned clinical trials, thorough pharmacokinetic characterization, and the creation of cutting-edge drug delivery methods to improve bioavailability and guarantee standardization in order to achieve worldwide recognition and integration into modern treatment regimens. By boosting antioxidant defense and lowering lipid peroxidation by free radical scavenging, C. dicoccum showed significant hepatoprotection against paracetamol-induced toxicity. Overall,hepatoprotective herbs have significant preclinical and ethnomedical support; curcumin, silymarin, and phyllanthus have been validated worldwide. To increase bioavailability and standardization, future research should focus on pharmacokinetics, clinical trials, and sophisticated administration methods.

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