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TRADITIONAL MEDICINAL PLANTS AS HEPATOPROTECTIVE AGENTS: A REVIEW

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ABSTRACT

There are various medicinal plants which are traditionally used for their medicinal properties. Specific part of a plant is used to treat different types of disease and infections that targets the particular organ of human body. Hepatoprotective properties of some medicinal plants are known treat the liver diseases and maintains the increased biochemical levels that induce toxic effects to the liver. Different chemical constituents present in the plants plays crucial role in reducing the toxicity induced by the chemicals. Formulations of the hepatoprotective plants are available in different dosage forms that are administered with safe concentration of dose value up to which they show no signs of toxicity. Liver toxicity majorly affects the adjacent or distant cells, tissues and organs which reduces the overall functioning of the body that is why it is necessary to treat the hepatic diseases. In addition to hepatoprotective properties, these medicinal plants are also widely used for other properties such as anti-inflammatory, antidiabetic, anticancer, anti-tumour, anti-microbial, anti-bacterial, anti-oxidation, anti-helminthic, free radical scavenging etc.

KEYWORDS: Liver, Hepato-protective activity, Hepato-toxicity, Chemical constituents, formulations, Dose extracts, Safe concentration, Medicinal plants.

Because the Greek word for liver is hepar, many medical terminologies related to the liver begin with hepatic. The liver, which weighs around 1.5 kg and makes up 2% of an adult's total body weight, is the second-largest organ in the human body. Just below your ribcage, it is located on your right side. It is located in the right upper quadrant of the stomach. Its defence is Glisson's capsule, a visceral extension of the peritoneum. The liver has two main

lobes on the right and left, with accent lobes on the quadrate and caudate. The right lobe is six times as large as the left. It carries out incredible bodily functions such bile production and excretion, hormone excretion, bilirubin, cholesterol, and drug excretion.[1]

The liver is a gland that performs a wide range of physiological tasks and is crucial in preventing harm to other essential organs caused by any diseases brought on by drug use. The use of medicinal plants has been credited as a major factor in the treatment of numerous liver conditions.[2]

The primary metabolic organ involved in the metabolism of essential chemicals is the liver. In addition to its role in metabolic activity, it is essential for the detoxification and excretion of both internal and external molecules, which safeguards the body against dangerous pollutants. As a result of prolonged exposure to xenobiotics and their metabolites, liver damage resulted. Additionally, practically every biochemical route for development, disease prevention, nutrition absorption, and energy metabolism involve the liver. Because it may recover from a liver damage, the liver differs from the other organs in this regard.[1]

The main causes of liver damage or dysfunction include toxic substances like carbon tetrachloride, chemotherapy drugs, antibiotics, microorganisms, and chronic alcohol use. As a result, various liver diseases/disorders like hepatitis A, hepatitis B, hepatitis C, jaundice, cirrhosis, liver cancer, homolytic anaemia, etc. develop.[3]

There are various different types of liver diseases that continue to be a problem for global health, including acute or chronic hepatitis (Inflammatory liver diseases), hepatosis (non-inflammatory disorders), and cirrhosis (Degenerative disorder leading to liver fibrosis). The most effective treatments for liver problems are debatable because conventional or synthetic drugs for the treatment of these conditions are insufficient and may have detrimental side effects.[4]

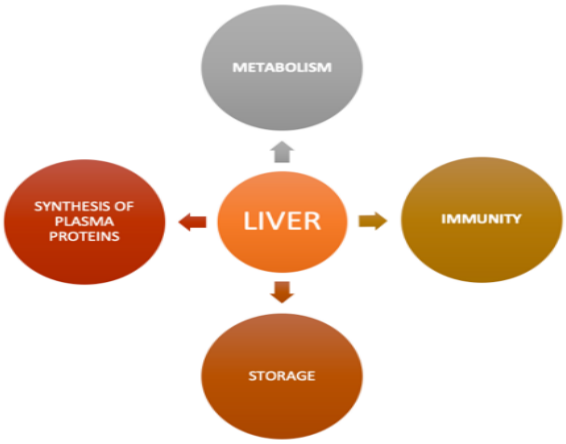

Figure: Main functions of liver.[2]

According to the ninth most prevalent cause of mortality in developed and developing nations, cirrhosis is the most drug-stimulated liver injury, making liver disease one of the world's major health concerns. Hepatotoxins are compounds that harm the liver and are caused by ingesting poisonous foods, chemicals, overdosing on medicines, or infectious agents.[5]

Damage to liver cells can be brought on by a number of dangerous substances, including certain antibiotics, chemotherapeutic medicines, carbon tetrachloride, thioacetamide, excessive alcohol consumption, and bacteria. Different medicinal plant extracts have been demonstrated to have hepatoprotective effects due to the presence of flavonoids, terpenoids, phenolic acids, stilbenes, alkaloids, anthraquinones, curcuminoids, capsaicinoids and chromenos. The hepatoprotective effects of these substances were mediated by several mechanisms. Because oxidative stress was a factor in the causes of liver damage, medicinal plants' antioxidant capacities were linked to the mechanism of their hepatoprotective action. They lessened hepatic oxidative stress in numerous ways. Superoxide dismutase, catalase, and glutathione peroxidase activities increased antioxidant defence in addition to lowering peroxidation. Some plant components reduced the activation of hepatic stellate cells while attenuating hepatic fibrosis by increasing matrix metalloproteinase production and removing collagen deposits. Through their anti-inflammatory properties and the reduction of numerous inflammatory processes, many medicinal herbs exhibited hepatoprotective effects.[6]

Liver diseases are mostly caused by inflammation, which is commonly triggered by excessive alcohol use, a poor diet, malnutrition, or drug use. Jaundice is one of the most common manifestations of the various liver diseases. It is a symptom of liver disease, which means the

liver is not functioning properly and is not a disease in itself. Jaune, which means “yellow” in French, is the root of the word “jaundice,” a disorder characterised by yellow pigmentation. Icterus, or a yellowing of the skin, mucous membranes, and sclera, is a disorder known as hyperbilirubinemia that results from an increase in bilirubin levels in the blood. Many conditions, including an irritated liver and a bile duct obstruction, may be to responsible for this.[3]

The presence of inflammatory cells In the liver's tissue distinguishes hepatitis, an inflammation of the organ. Types A, B, C, D, and E relate to the five basic types of viruses. The weight of illness and mortality is particularly concerning for these five categories. The ailment may self-limit (heal on its own) or it may worsen, leading to cirrhosis and fibrosis. Hepatitis can manifest with few or no symptoms, but it frequently results in anorexia (low appetite), jaundice, and general malaise. Acute hepatitis is defined as lasting less than six months, while chronic hepatitis lasts longer. Parasites, viruses, per oxidized fatty acids, autoimmune illnesses, industrial pollutants, fungal toxins, radioactive isotopes, alcohol, herbal remedies, and pharmaceuticals are all examples of xenobiotics that can cause hepatic problems. Particularly, types A and C are the most prevalent causes of liver cirrhosis and cancer, causing chronic disease in hundreds of millions of people.[7]

The majority of herbal treatments for different liver problems speed up the liver’s natural healing processes. In India’s traditional medical system and ethnomedical practises, a variety of medicinal plants and their formulations are utilised to treat liver diseases. A flavonolignan called silymarin has recently been made available as a hepatoprotective medication. Silybinin, Silychristine and Silydianine are the three structural components of silymarin, which is derived from the seeds and fruits of Silybum marianum. Silymarin is hepatoprotective against ethanol poisoning from Amanita phalloides, acute viral hepatitis, paracetamol intoxication, and carbon tetrachloride poisoning, according to clinical study. Numerous investigations have shown that silymarin therapy has positive hepatoprotective benefits.[1]

Testing on a variety of medicinal plants revealed the presence of active components with the potential to treat a variety of ailments. Liver-protective substances contain a variety of chemical elements, such as phenols, coumarins, lignans, essential oils, monoterpenes, carotenoids, lipids, alkaloids, glycosides, flavonoids, xanthine, organic acids. Because of this, a wide variety of plants and formulations have been said to possess hepatoprotective

properties, and the development of completely plant-based hepatoprotective medications has grown in significance on the global market. This review article lists a number of plants that have hepatoprotective properties, including, Ageratum conyzoides, Euphorbia tirucalli L., Gardenia gummifera Linn, Butea monosperma, Alchemilla mollis, Ceriops decandra (Griff.), Andrographis, Macrothelypteris torresiana, Rhus oxyacantha, and Polygonum.[1]

S. no.	Botanical name	Common name	Family	Parts used	Chemical constituents	Formulations	Dose Extract and Safe concentrations	Reference
1	*Alchornea cordifolia*	Christmas bush	Euphorbiaceae	Leaves	Terpenoids, flavonoids, phenolic acids, alkaloids	Liquid formulation	Cordifolia leaf extract. Maximum 60 g per litre of water,3.5cups daily	[8]
2	*Alocasia indica Linn*	Alocasia	Araceae	Leaves	Flavonoids, cyanogenetic glycosides, citric acid, ascorbic acid	Tablet formulation	Doses between 101 and 199 mg/kg BW exhibited a decrease in blood glucose	[9]
3	*Aloe barbadensis mill*	Aloe indica Royle	Liliaceae	Dried aerial parts	Anthraquinone and its glycoside derivatives	Gel formulations	5 mg, 10 mg, 15 mg of dry weight for 60 days each group	[10]
4	*Apium graveolens*	Celery	Apiaceae	Seeds	Flavonoids, steroids, glycosides, phenols, furocoumarins	Capsule	Capsules totalling 1.34 grams (g) per day or four placebo capsules	[11]
5	*Argemone mexicana*	Mexican prickly poppy	Papaveraceae	Plant materials	Alkaloids	Liquids	Take 10 drops in half cup of water three times a day	[12]
6	*Artemisia absinthium*	Wormwood	Asteraceae	Powdered aerial parts	Lactones, terpenoids	Powder	Powder is 502 mg to 3.5 grams. The maximum dosage of wormwood	[13]

							powder shouldn't exceed from 6.5 grams	
7	*Azadirachta indica*	Neem tree	Meliaceae	Leaf	Nimbidol, sodium nimbinate, gedunin, salannin, and quercetin	Powder formulations	Neem Churna: Neem Tablet: 2.1 tablets or capsules twice a day. Neem Juice: 3.4tsp twice a day	[14]
8	*Bixa orellana*	Anatto or Lipstick Tree	Bixaceae	Plant materials	Acetic acid	Oral uses	Orellana leaf in tablets or capsules twice daily. 10–20 mg daily	[15]
9	*Bupleurum kaoi*	Kakiskalae Greuter	Umbelliferae	Dried roots	Volatile oils, flavonoids, polyacetylenes, lignin, and coumarins	Oral	Oral pre-treatment of B. kaoi (100 and 500 mg/kg)	[16]
10	*Caesalpinia bonduc*	Gray Nicker	Fabaceae	Plant materials	Alkaloids, cassane-diterpenes, flavonoids	Powder	1.5 to 2.5 g seed powder, 1.5 to 2.5 g root powder, 11 to 19mL leaf infusion	[17]
11	*Capparis spinosa*	Caper bush	Capparidaceae	Root bark	Alkaloids, glycosides, tannins	Tablets	200 mg (400 mg 3 times daily) of caper fruit extract given over 2 months	[18]
12	*Carum copticum*	Ajwain	Apiaceae	Seed	Glucosides,	Tablets, liquids	250 and 500	[19]

					saponins and phenolic compounds		mg/kg doses healing gastric ulcers	
13	*Cassia fistula*	Golden Shower Tree	Leguminosae	Seeds	Anthraquinones, flavonoids	Syrups	Empty stomach in the dose of 20 ml in children and 40 ml in adults	[20]
14	*Casuarina equisetifolia*	Horsetail beefwood	Casuarinaceae	Plant materials	Alkaloids	Oral uses	*Casuarina equisetifolia* extract at a dose of 300mg/kg.	[12]
15	*Chamomile capitula*	M. recutita	Asteraceae	Fresh natural mature capitula	Sesquiterpenes, flavonoids, coumarins, and polyacetylenes	Liquid formulations	Typical oral doses are 1.5 to 16 g/day. Gargles made from 9 g.	[21]
16	*Cleome viscose Linn*	Dog mustard	Capparidaceae	Leaf powder	Viscocic and viscosin	Tablet formulations	Doses of 200, 300, and 400 mg/kg body weight	[22]
17	*Cochlospermum Planchoni*	False cotton	Coclospermaceae	Rhizomes	Saponins, alkaloids, phenolics, carbohydrates, flavonoids	Powder	2 g of soluble fibre extracted from Cassia semen 211 mg of a-tocopherol, 511 mg of ascorbic acid	[23]
18	*Decalepis hamiltonii*	Maredu kommulu	Asclepiadaceae	Roots	Alkaloids, flavonoids, phenols	Liquids	Traditionally consumed as pickles and juice for their health	[24]

							benefits	
19	*FructusSchisandrae chinensis*	Chinese magnolia vine	Magnoliaceae	Dried fruits	Alkaloids, flavonoids, phenols	Powder	Dosages of 1.7 to 6.5g/day of powdered product	[25]
20	*Fumaria indica*	Fumitory	Papaveraveae	Whole plant	Alkaloids principally with protopine (0.13%), tannins and sugars	Creams	Used in psoriasis at dosages up to 720 mg/day Contraindications	[26]
21	*Ganoderma lucidum*	Lingzhi mushroom	Polyporaceaes	Winter mushroom s	Polysaccharides, peptidoglycans, and triterpenes	Powder	A daily dose of 2,000mg (2g) of whole food mushroom powder	[27]
22	*Gentiana olivieri*	Stemless gentian	Gentianaceae	Aerial parts	Alkaloid; polyphenol and flavones	-	Antihyperlipidemic effects at 15.5 mg/kg b.w dose	[28]
23	*Glycosmis pentaphylla*	Gin berry	Rutaceae	Plant materials	Saponins, tannins and alkaloids and phenolics	Syrups	Used for cough, jaundice, inflammation, rheumatism	[12]
24	*Halenia elliptica*	Jiadiranguo	Gentianaceae	Whole plant	Triterpenes, polysaccharides, nucleosides, steroids	Tablet formulations	Mortality at doses up to 1950 g/kg body weight	
25	*Hibiscus sabdariffa*	Roselle	Malvaceae	Calyces	Polyphenols	Tablet formulations	100 mg daily, and 3.75 g daily for a duration of 15 days to 6 weeks	[29]

26	*Hygrophila auriculata*	Kokilaksha	Acanthaceae	Root	Lupeol, stigmasterol, isoflavone, glycoside, alkaloid	Powder formulations	110, 160 and 199mg kg doses to rats for a period of 27 days	[30]
27	*Kalanchoe pinnata Pers*	Miracle Leaf	Crassulaceae	Leaves	Tannins, cardiac glycosides, polyphenols	Liquid formulations	Pinnata leaf juice at doses of 126 mg/kg	[31]
28	*Kigelia africana*	Sausage Tree	Bignoniaceae	Leaves	Tannins, flavonoids	Oils	Dose of 110or 210 mg/kg of aqueous leaf extract	[32]
29	*Lactuca indica*	Indian Lettuce	Compositae	Aerial parts	Phenolic	Liquids	Concentration range of 0.35–1.1 mg/mL	
30	*Laggera pterodonta*	Curly Blumea	Asteraceae	Whole herb	Flavonoids, monoterpenes, sesquiterpenes, triterpenoids	Syrups	Medicine is taken 3 or 4 times a day, one hour after meal.	[33]
31	*Mallotus japonicas*	Food wrapper plant	Euphorbiaceae	Cortex	Flavonoids, glycosides, saponins	Tablet	Bergenin at a dose of 51, 110 or 198 mg/kg	[34]
32	*Mamoridca subangulata*	Wild bitter gourd	Cucurbitaceae Meliaceae	Leaf, whole Plant	Alkaloids, glycosides, flavonoids, phenols, saponins, steroids	Any	510 mg/kg, fresh weight; 46 mg/kg, dry weight	
33	*Ocimum snctum*	Tulsi	Lamiaceae	Leaf	Phenolics, flavonoids, phenyl propanoids	Liquids	Tulsi Root decoction – 45 to 99 ml Tulsi Seeds powder 3.5 to 6 g	[35]

34	*Cichorium intybus*	Blessed thistle	Asteraceae	Leaves	Tannins and flavonoids	Cream	Formulation is administered daily at doses of 54 mg/Kg b.w.	[35]
35	*Orthosiphon stamineus*	Kidneys Tea Plant	Lamiacea	Leaves	Terpenes, flavonoids, caffeic acid	Oral	Two doses of 101 and 210mg/kg body weight of the extract.	[36]
36	*Phyllanthus polyphullus*	Krishna nelli	Euphorbiaceae	Leaves	Tannins, phenylpropanoids, terpenoids	Liquids	Fruit juice (4,000 or 5,000 mg/kg)	[37]
37	*Physalis minima*	Bladder Cherry	Solanaceae	Plant materials	Phenols, flavonoids, tannins, alkaloids	-	410 mg/kg, and 210mg/kg of ethanol extract of P minima L. fruit	[12]
38	*Picrorrhiza rhizome*	Katuka, kutki	Scrophulariaceae	Dried Underground stem	Tannins, alkaloids	Powder	Powder at doses between 310 mg and 510 mg 2-3 times	[19]
39	*Pterocarpus marsupium Roxb*	Pitsal, Piyasal, Pitsal, Piyasal, Bija sal, Murga	Papilionaceae	Stem bark	Marsupin, tannins, pentosan	Formulations	Doses of 110 mg/kg and 210mg/kg	[38]
40	*Ptrospermum acerifolium*	Kanak Champa	Sterculiaceae	Leaves	Alkaloids	Powder	Flower Dosage-powder 3-6 g in divided doses per	[38]

41	*Ricinus Communis*	Castor oil plant	Euphorbiaceae	Leaves	Alkaloids, ricinoleic acid	Oils	23 mg ascorbic acid, 30 mg dehydroascorbic acid and 8.52 mg carotenoids/100	[37]
42	*Rubia cordifolia Linn*	Indian madder	Rubiaceae	Roots	Anthraquinones, iridoid glycoside, naphthoic acid esters	Liquid	Distilled water in doses of 105, 2010 and 405 mg/ kg	[39]
43	*Sarcostemma brevistigma*	Soma Plant	Asclepiadaceae	Stem	Alkaloids, glycosides, flavonoids, phenols, saponins, steroids	-	10 kg/plant at the time of plantation as basal dose	[40]
44	*Saururus chinensis*	Lizard's tail	Saururaceae	Whole plant	Flavonoids, iridoid glycosides and terpenoids	Oral	Oral dose of 0.25–2 g/kg	[41]
45	*Silybum marianum*	Milk thistle	Asteraceae	Leaves	Inulin, coumarins, tannins, monomeric flavonoids, and sesquiterpene lactones	Creams	Dose of 54 mg/kg BW per day	[42]
46	*Spondias pinnata*	Hog plum	Anacardiaceae	Stem heart wood	Tannins, flavonoids, sterols, triterpenes, saponins, essential oils	Oral	Dose of 40-50 ml to treat diarrhoea	[43]
47	*Tephrosia purpurea L*	Fish poison, wild indigo	Fabaceae	Aerial parts	Alkaloids, saponins, glycosides,	Powder formulations	Doses ranging from 5 to about 2000 mg/kg	[44][19]

					tannins, flavonoids			
48	*Thunbergia laurifolia Linn*	Blue trumpet vine	Acanthaceae	Leaves	Glucosides, grandifloric acid, glucopyranosides	Liquid	TL 100 and 200 mg/kg/day	[45]
49	*Tridax procumbens*	Coat buttons	Asteraceae	Leaves	--	Liquid	39 mg/kg orally to induce hypertension for a period of 3weeks.	[46]
50	*Zanthoxylum armatum*	Winged Prickly Ash	Rutaceae	Bark	Terpenoids, flavonoids, alkaloids, coumarins.	Tablets	Dose of 375 mg/kg	[47]
51	*Acacia catechu*	Black catechu	Leguminosae	Powdered pale catechu	Catechins, catechu tannic acid, quercetin	Tablets	Ethyl acetate extract in 1% sodium carboxy methylcellulose. Dose value is 250mg/Kg	[48][49]
52	*Acacia confuse*	Fine leaved wattle	Leguminosae	Bark	Tannins, gallic acid	Powder and Capsules	Dietary supplementation is given with 50mg/kg dose of gallic acid.	[50][51][48]
53	*Aerva lanata*	Knotgrass	Amaranthaceae	Roots	Flavonoids, alkaloids	Powder	Petroleum ether extractable fraction is used as formulation with 200mg/Kg body weight.	[52][48]
54	*Amaranthus*	Tassel	Amaranthaceae	Whole plant	Flavonoids,	-	Methanol extract	[53][54]

	caudatus	flower			saponins, glycosides, terpenoids, amino acids		of whole plant is used as hepatoprotective.	
55	*Anisochilus carnosus*	Thick leaved lavender	Lamiaceae	Stems	Alkaloids, flavonoids, glycosides	-	Ethanolic extracts of this plant are given in two dose values of 200mg and 400 mg/kg.	[55][54]
56	*Aphanamixis polystachya*	Rohituka tree	Meliaceae	Leaves	Saponins, glycosides, alkaloids, terpenes, polyphenols	-	Crude ethanolic extract from leaves is used as liposomal drug. (Solution of an ethanol with 10ml of its value is incorporate into water of 100 ml used in the manufacturing of liposomal batches)	[56]
57	*Artemisia capillaris*	Wormwood	Asteraceae	Whole plant	Essential oils	Capsules	Essential oils are obtained from Kangshen natural oils Co. Ltd and are administered in the dose Of 50mg/Kg and 100mg/Kg.	[57]

58	*Asparagus racemosus*	Buttermilk root	Liliaceae	Roots	Saponins, coumarin, Phenols, essential oils, ligans, lipids, alkaloids, xanthins, monoterpenes	Powder	Using the distilled water, the extracts of this plants were prepared which contains 2% v/v Tween 80 which act as a suspending agent. The LD50 is > 1g/kg. Safe concentration of doses is 150 and 250mg/Kg.	[58][54]
59	*Azima tetracantha*	Bee sting bush	Salvadoraceae	Leaves	Flavonoids, triterpenoids, glycosides, tannins, quinones, saponins	-	The LD50 of this plant comes under the class 4 according to OECD laws. 200 mg and 100 mg/kg are the fixed dose values and LD50 of this plant is more than 2000mg/kg.	[59][54]
60	*Baliospermum montanum*	Red physic nut OR Wild castor	Euphorbiaceae	Roots	Flavonoids, terpenoids, steroids	Ayurvedic Herbs in original form	Total 200mg/kg dose of methanolic extracts were prepared for the formulation of *B. montanum* and	[60][48]

							the results are compared with hepatoprotective drug i.e., Silymarin (100 mg/kg in vivo and in vitro are 100 ug/ml).	
61	*Berberis vulgaris*	Common barberry	Berberidaceae	Leaves	Berberine drug, alkaloids, isoquinoline, rich amount of Vitamin C	Capsules	120mg/kg dose is given to mask the hepatotoxic effect of CCl4.	[61]
62	*Boerhaavia diffusa*	Spreading hog weed	Nyctaginaceae	Roots	Flavonoids, Alkaloids, glycosides, rotenoids, steroids, triterpenoids, lipids, ligans, proteins, glycoproteins, carbohydrates	Capsules	Ethanolic extracts of roots are used to prepare the formulation with 100mg/100g dose value in hepatotoxicity induced by liquor consumption. The administration of *B. diffusa* decreases the rise in levels of lipid.	[62][48]
63	*Cajanus cajan*	Pigeon pea	Fabaceae	Leaves and Seeds	Flavonoids, stilbenes,	-	Formulation of *C. cajan* is made	[63][54]

					saponins, alkaloids		at given doses of 200mg, 800mg and 400mg/Kg which are correlated with the Silymarin given at 50mg/Kg out of which 800mg/Kg is the highest effective dose which decreases the liver weight and balances the ideal body weight.	
64	*Cajanus scarabaeoids*	Showy pigeon pea	Fabaceae	Whole plant	Flavonoids	-	50 mg/kg Flavonoid extracts reverse back the biochemical levels when compared with 100mg/Kg of Silymarin.	[64][54]
65	*Calotropis procera*	Sodom apple	Apocynaceae	Flowers	Alkaloids, flavonoids, cardiac glycosides, tannins, triterpenes, sterols	Powder	Hydroethanolic extracts of doses 200 and 400 mg/Kg are used.	[65][54][48]

66	*Carissa carandas*	Bengal currant	Apocynaceae	Leaves	Alkaloid, glycoside, volatile oils, tannins, saponins, flavonoids	-	The acetonic and methanolic (1:3) leaves extract with dose value of 50mg/kg of *C. carandas* are used.	[66][54]
67	*Cassia occidentalis*	Fedegoso	Fabaceae	Leaves	Flavonoids, triterpenoids, anthraquinones, saponins, glycosides	Tablets and Syrups	Liver tonics are administered at dose of 5ml/Kg body weight. Liv-52 Syrup is the most popular liver tonic by 'The Himalaya Drug Company' which used 8mg powder of *C. occidentalis* in it.	[67][48]
68	*Cassia tora*	Sickle Senna	Leguminosae	Whole plant	Phenols, ligans, coumarin, carotenoids, essential oils, monoterpenes, glycosides, flavonoids, organic acid, alkaloids, lipids, xanthins	Powder	Formulation of *C. tora* involves dried extracts of whole plant with the mixture of water and methanol in (50:50) respectively.	[68][48]
69	*Clitoria ternatea*	Butterfly pea	Fabaceae	Leaves	Anthocyanins glycosides, phytosterols,	Powder	Dose value of 200mg/kg body weight is ideal	[69][54]

					polyphenolic flavonoids, pentacyclic triterpenoids		for the treatment.	
70	*Cordia macleodii*	Macleod cordia	Boraginaceae	Leaves	Flavonoids	-	400mg, 200mg, 100mg/Kg dose formulations against increased levels of GPT, GOT, ALP of liver.	[70][48]
71	*Cucumis trigonus*	Bitter gourd	Cucurbitaceae	Fruits	Flavonoids	-	Aqueous, alcoholic and chloroform extract with 300mg/kg dose value is effective. Also, Liv-52 with a dose of 4ml/Kg is against the increased levels of bilirubin.	[71][54]
72	*Cuscuta australis*	Australian dodder	Convolvulaceae	Seeds and Stem	Coumaric acids, diterpenes, glucosides	-	125 mg/kg and 250mg/Kg dose is given orally for 7 days which reduces the liver damage.	[72]
73	*Embelia ribes*	Embelia	Myrsinaceae	Fruits	Embelin, quercitol, fatty acids, resinoid,	Powder	Fruit extract dose of this plant is used for the	[73][48]

					tannins, traces of volatile oils		treatment with dose values of 100, 200, 50mg/100gm/ day	
74	*Equisetum arvense*	Horsetail	Equisetaceae	Herbs	Triterpenoids, volatile oils, sterols, phenols, saponins, silicic acid, flavonoids, alkaloids and tannins	Homoeopathic Medicine	Methanolic extract of *E. arvense* shows the protective effect on liver.	[74][48]
75	*Ficus religiosa*	Sacred bo tree	Moraceae	Latex	Glycoside, alkaloids, methionine, tannin, flavonoids	Homoeopathic Medicine	Dose of 300 mg/Kg is made from latex extract of *F. religiosa*.	[75][54]
76	*Garcinia indica*	Goa butter tree	Clusiaceae	Fruits	Benzophenones, garcinols	Capsules	400mg/Kg and 800 mg/Kg of Dose formulation is given orally for 10 days.	[76][54]
77	*Ginkgo biloba*	Maidenhair tree	Ginkgoaceae	Leaves	Terpene trilactones, flavanol glycosides, biflavones, proanthocyanidins, phenolic acids, alkylphenols	Soft Gel Capsules	Formulation prepared by dried leaf extract from ginkgo tree by organic extracts of acetone and water in 70:30 mixture.	[77][48]

78	*Glycyrrhiza glabra*	Licorice	Fabaceae	Roots	Flavonoids, glycosides, glycyrrhizin	Homoeopathic Medicine	The dose of *G. glabra* is given at 2gm/kg/day orally for 7 days.	[78][48]
79	*Gmelina asiatica*	Asian bush beech	Lamiaceae	Aerial parts	Alkaloids, phenolic, glycosides, flavonoids	-	400 mg/Kg dose is administered orally once daily.	[79][54]
80	*Hoslundia opposita*	Orange bird-berry	Lamiaceae	Leaves	Tannins, steroids, flavonoids, terpenoids, saponins, glycosides	-	The safe formulation made of dose 400 mg/Kg body weight.	[80][48]
81	*Hyptis suaveolens*	Pignut	Lamiaceae	Whole plant	Alkaloids, flavonoids, tannins, phenolics, saponins	-	100mg/Kg dose formulation is considered as a safe and effective hepatoprotective treatment.	[81][54]
82	*Juncus subulatus*	The somerset rush	Juncaceae	Powdered tubers	Volatile oils, flavonoids, glycosides, quercetin	-	Formulation is given through intraperitoneal route with 50 mg dose value and extracts dissolved in 10% Tween 80.	[82][48]
83	*Leucas cilita*	Tufted leucas	Lamiaceae	Leaves	Flavonoids	-	Formulation of 400mg/Kg dose shows the reduced	[83][54]

							biochemical levels of liver.	
84	*Luffa echinata*	Bitter sponge gourd	Cucurbitaceae	Fruits	Alkaloids, glycosides, flavonoids, terpenes, reducing sugars, tannins	-	250 mg/kg dose value of fruit extracts are used as a hepatoprotective treatment.	[84][48]
85	*Mallotus repandus*	Climbing Mallotus	Euphorbiaceae	Stems	Phenolic, tannins, flavonoids	Herbal Powder	Formulation is given at dose values of 500mg, 250mg and 1000mg/kg.	[85]
86	*Melia azhadirecta*	Chinaberry tree	Meliaceae	Leaves	Tannins, alkaloids, terpenoids, phenols, glycosides, flavonoids	-	Dose of *M. azhadirecta* is given at 300mg/Kg and 500 mg/Kg from its leaves extract.	[86][54]
87	*Momordica dioica*	Spiny gourd	Cucurbitaceae	Fruits	Flavonoids, traces of glycosides, alkaloids, amino acids	-	Effective dose given with water is 2.5ml/Kg and effective dose given with proper balanced diet is 150mg/Kg taken after dilution.	[87][48]
88	*Morinda citrifolia*	Indian mulberry	Rubiaceae	Fruits	Anthraquinones, flavanol glycosides, lipid glycosides	Organic Juice	Pre-treatment with the formulation of 20% fruits	[88][54]

							extract in drinking water results in the reduced hepatotoxic lesions.	
89	*Myrtus communis*	Common myrtle	Myrtaceae	Leaves and flowers	Flavonoids, terpenoids, steroids, phenolic, essential oils	Myrtle Essential Oil	250mg/kg dose is administered for 14 days of duration which results in the reduction in liver complications.	[89][54]
90	*Phyllanthus niruri*	Gale of the wind	Euphorbiaceae	Aerial parts	Tannins, terpenoids, flavonoids, saponins, alkaloids	Homoeopathic Medicine	Formulation of *P. niruri* is administered orally at dose of 5000mg/Kg (10ml/Kg dosing volume).	[90][48]
91	*Picrorhiza kurroa*	Bitter root	Scrophulariaceae	Roots and rhizomes	Phenols, flavonoids, trace quantity of quercetin	Capsules	Herbal formulations are available in the form of capsules with dose of 200mg per capsule.	[91][48]
92	*Piper chaba*	Piper chilli	Piperaceae	Roots	Isoflavones, alkaloids	Powder	Dried roots extracts are used in the formulation of *P. chaba* with dose	[92][48]

							of 200mg/Kg and 400mg/Kg. Lower dose formulation is more effective in the treatment of toxicity in liver.	
93	*Piper longum*	Long pepper	Piperaceae	Fruits and roots powder	Essential oils, aliphatic hydrocarbons	Powder	Formulation of *P. longum* is administered with boiled milk which is in powder form of roots and fruits at dose of 200mg per day for 21 days.	[93][48]
94	*Plantago major*	Great plantain	Plantaginaceae	Seeds	Flavonoids, terpenoids, alkaloids, glycosides, fatty acids, vitamins	Homoeopathic Medicine	Dose of 25mg/Kg of *P. major* seen to be effective against carbon tetrachloride induced hepatotoxicity.	[94][48]
95	*Scoparia dulcis*	Licorice weed	Scrophulariaceae	Whole plant	Diterpenoids, tannins, flavonoids, triterpenes, hexacosonols	-	Formulation dose of 500mg/Kg is effective against carbon tetrachloride induced	[95][48]

							hepatotoxicity.	
96	*Solanum nigram*	Black nightshade	Solanaceae	Fruit	Alkaloids, flavonoids	Powder, Tablets and Syrups	Formulation of *S. nigrum* is composed an extract dose of 100ug/mL. Also, 16mg of *S. nigrum* powder is used in formulation of Liv-52 syrup and tablets.	[96][54]
97	*Trianthema decandra*	Horse purslane	Aizoaceae	Leaves	Tetraterpenoids, flavonoids, alkaloids	Homoeopathic Medicine	Homeopathic dilution of 6C, 30C, 200C, 1M, 10M is available as a formulation which exerts protective effect against PCM induced hepatocellular alterations.	[97][48]
98	*Trichosanthes cucumerina*	Snake Gourd	Cucurbitaceae	Leaves	Cucurbitacin B, cucurbitacin E, isocucurbitacin, dihydroisocucurbitacin	Capsules and Syrups	Dose formulation of 150mg/Kg body weight is effective against PCM induced hepatotoxicity and dose up to 2000mg/Kg is	[98][48]

							considered as safe with no signs of toxicity.	
99	*Tylophora indica*	Indian Sarsaparilla	Asclepidaceae	Leaves	Alkaloids, carbohydrates, saponins, steroids, triterpenes	Homoeopathic Medicine	Formulation includes non-toxic dose up to 5000mg/Kg and the LD50 is about 3162mg/Kg.	[99][48]
100	*Vitex trifolia*	Common chaste tree	Verbenaceae	Leaves	Flavonoids, saponins, glycosides, tannins, steroids, triterpenoids	Chooranam Powder	20mg/Kg and 40mg/Kg is the maximum dose formulations evaluated for antihepatotoxic effects.	[100][48]

Description of Traditional Medicinal plants used as Hepatoprotective and Other biological uses

Alchornea cordifolia

Alchornea cordifolia is commonly called as Christmas bush. It comes under the family Euphorbiaceae. Leaves cordifolia is used as hepatoprotective part which contains terpenoids, flavonoids, phenolic acids, alkaloids as main chemical components. Formulations is given in the form of Liquid as cordifolia leaf extract max 50 g per litre of water and 4 cups daily. It is used as the treatment of Gastrointestinal and urinary disorder.[8]

Alocasia indica Linn.

The *Alocasia indica* Linn, a member of the Araceae family with the popular name "alocasia" is a plant. Flavonoids, cyanogenetic glycosides, citric acid, and ascorbic acid are the major chemical components of leaves, which are employed as a hepatoprotective component. Tablet dosages of the formulations between 200 and 100 mg/kg BW resulted in a considerable drop in blood glucose levels. Used traditionally for inflammation, spleen, and abdominal illnesses.[9]

Aloe barbadensis mill

The Liliaceae family includes *Aloe barbadensis* mill, often known as Aloe indica Royle. The hepatoprotective properties of dried aerial parts are mostly derived from anthraquinone and its glycoside derivatives. Gel formulations containing 5 mg, 10 mg, and 15 mg of dry weight are administered to each group for 60 days. It is utilised as an anti-inflammatory, immunostimulatory, and immunomodulatory therapy.[10]

Apium graveolens

Celery, or *Apium graveolens*, is a plant of the Apiaceae family. The main chemical components of seeds, which are employed as a hepatoprotective component, are flavonoids, alkaloids, steroids, glycosides, phenols, furocoumarins, and volatile oils. The dosage of the formulation is four placebo capsules or a total of 1.34 grammes (g) per day. Utilised in Arab traditional medicine as anthelmintics, antispasmodics, carminatives, diuretics, laxatives, sedative stimulants, and more.[11]

Argemone mexicana

Argemone mexicana is known by its common name as Mexican prickly poppy which belongs to the family Asteraceae. Powdered aerial parts are used as hepatoprotective parts which

contains lactones, terpenoids as main chemical composition. Formulations is given as Powder as powder (leaves or flowers) is 500 mg to 3 grams. The maximum dosage of wormwood powder should not exceed from 6 grams. Used to treat infectious diseases, metabolic disorders and cancer.[12]

Artemisia absinthium

Wormwood or *Artemisia absinthium* is its common name. It comes under the Asteraceae family. Powdered aerial parts with lactones and terpenoids as their primary chemical constituents are used as hepatoprotective parts. Powdered formulations range from 502 mg to 3.5 grammes in weight. Wormwood powder has a maximum recommended dose of 6.5 grammes and is used to treat a number of conditions, including hepatocyte enlargement, hepatitis, gastritis, and jaundice.

Azadirachta indica

The neem tree, *Azadirachta indica*, is a member of the Meliaceae family and is frequently referred to as such. Nimbidone, sodium nimbinate, gedunin, salannin, and quercetin are the primary components of leaves, which are employed as a hepatoprotective part. Formulas are administered as Neem Churna Powder: ¼ to ½ tsp twice daily. Take 1-2 pills or capsules of neem twice daily. 2-4 teaspoons of neem juice twice daily. Used to treat skin conditions, malaria fevers, dental and gastrointestinal issues.[101]

Bixa orellana

Bixa orellana is commonly known as Anatto or Lipstick Tree which belongs to the family Bixaceae. Plant materials are used as hepatoprotective part which contains acetic acid as the main chemical components. Formulations is given as oral as leaf in tablets or capsules twice daily 10–20 mg daily. Used as antipyretic, aphrodisiac, antidiarrheal, antidiabetic, and insect repellent.[102]

Bupleurum kaoi

The plant *Bupleurum kaoi*, also known as kakiskalae Greuter, is a member of the Umbelliferae family. The principal chemical components of dried roots, which are employed as a hepatoprotective component, are volatile oils, flavonoids, polyacetylenes, lignin, and coumarins. B. kaoi is given formulations (100 and 500 mg/kg) orally as a pre-treatment. Used to treat the symptoms of depression as well as colds, fevers, gastrointestinal problems, and chronic liver ailments.[16]

Caesalpinia bonduc

Grey Nicker, also known as *Caesalpinia bonduc*, is a member of the Fabaceae family. Alkaloids, cassane-diterpenes, and flavonoids are the three main chemical components found in plant materials that are used as hepatoprotective parts. Formulations are administered as a powder consisting of 1–2 g of seed powder, 1–2 g of root powder, and 12–20 mL of leaf infusion. Used to treat cancer, diabetes, heart disease, inflammation, fever, and other conditions as well as for birth control.[17]

Capparis spinosa

Capparis spinosa is commonly known as caper bush which belongs to the family Capparidaceae. Root bark are used as hepatoprotective part which contains alkaloids, glycosides, tannins as the main chemical components. Formulations is given as Tablets as 200 mg (400 mg 3 times daily) of caper fruit extract given over 2 months. Used treatment of rheumatoid arthritis and gout.[18]

Carum copticum

Carum copticum is commonly known as Ajwain which belongs to the family of Apiaceae. Seeds are used as hepatoprotective part which contains glucosides, saponins and phenolic compounds as the main chemical components. Formulation is given as tablets and liquids as glucosides, saponins and phenolic compounds. Used as treatment of bloating, fatigue, diarrhoea, abdominal tumours, abdominal pain, respiratory distress.[19]

Cassia fistula

Cassia fistula is commonly known as Golden Shower Tree which belongs to the family Leguminosae. Seeds are the hepatoprotective parts which contains anthraquinones, flavonoids as the chemical components. Formulation is given as syrups empty stomach in the dose of 20 ml in children and 40 ml in adults. Used as relieving the symptoms of asthma, leprosy, ringworm.[20]

Casuarina equisetifolia

Casuarina equisetifolia is commonly known as horsetail beefwood which belongs to family Casuarinaceae. Plant material are used as hepatoprotective parts which contains alkaloids as main chemical components. Formulations is given as oral as Casuarina equisetifolia extract at a dose of 300mg/kg. used for shingles, fencing, and is said to make excellent hot-burning firewood.[12]

Chamomile capitula

Chamomile capitula is commonly known as M. recutita which belongs to family Asteraceae. Fresh natural mature capitula are used as hepatoprotective part which contains Sesquiterpenes, flavonoids, coumarins, and polyacetylenes as chemical components. Formulation is given as liquid as Typical oral doses are 1.1 to 15 g/day. Gargles made from 8 g. Used to treat inflammation, muscle spasms, menstrual disorders, insomnia, ulcers, wounds.[21]

Cleome viscose linn.

Cleome viscose Linn is commonly known as dog mustard which belongs to the family Capparidaceae. Leaves powder are used as hepatoprotective part which contains viscocic and viscosin as chemical components. Formulation is given as tablets at 400, 300, 200mg/kg dose values which are used to treat rheumatic arthritis, hypertension, malaria, neurasthenia, and wound healing.[22]

Cochlospermum planchoni

False cotton, or *Cochlospermum Planchoni*, is a plant in the Coclospermaceae family. Rhizomes, which contain saponins, alkaloids, phenolics, carbohydrates, and flavonoids as chemical constituents, are employed as a hepatoprotective component. The formulation is in powder form and contains 2 grammes of soluble fibre from Cassia semen (C. tora L.), 200 milligrams of a-tocopherol, and 500 milligrams of ascorbic acid. Anti-microbial, anti-bacterial, anti-carcinogenic, anti-oxidant, and hepato-protective action is used to treat.[23]

Decalepis hamiltonii

Maredu kommulu is the popular name for *Decalepis hamiltonii*, a plant of the Asclepiadaceae family. Alkaloids, flavonoids, and phenols are the primary chemical components of roots, which are employed as a hepatoprotective component. For their health benefits, formulations are administered as liquids like pickles and juice, which are typically ingested foods. Treating a variety of illnesses, including as uterine haemorrhages, persistent rheumatism, anaemia, coughs, and bronchitis.[24]

Fructus schisandrae chinensis

The Chinese magnolia vine, or *Fructus Schisandrae chinensis*, is a member of the Magnoliaceae family. Alkaloids, flavonoids, and phenols are the main chemical components of dried fruits, which are the hepatoprotective aspect of them. Powder dosages of 1.5 to 6

g/day of the formulation are administered. Used to treat conditions affecting the gastrointestinal (GI) tract, the respiratory system, the heart, the body's overall weariness and weakness, excessive perspiration, and sleeplessness.[25]

Fumaria indica

Fumaria indica is commonly known as Fumitory which belongs to Papaveraceae. Whole plant is used as hepatoprotective part which contains alkaloids principally with protopine (0.13%), tannins and sugars as main chemical components. Formulations are given as creams as used in psoriasis at dosages up to 720 mg/day Contraindications. Used to treat skin diseases, styptic and febrifuge and is also used in the disorder of liver in folk medicine.[26]

Ganoderma lucidum

Ganoderma lucidum is commonly known as lingzhi mushroom which belongs to the family Polyporaceaes. Winter mushrooms are the hepatoprotective parts which contains Polysaccharides, peptidoglycans, and triterpenes as main chemical components. Formulation as powder as A daily dose of 2,000mg (2g) of whole food mushroom powder. Used the immune system and by cancer patients along with conventional therapies.[27]

Gentiana olivieri

Gentiana olivieri is commonly known as stemless gentian which belongs to the family Gentianaceae. Aerial plant parts are used as hepatoprotective part which contains alkaloid; polyphenol and flavones as main chemical components. Formulations are oral as antihyperlipidemic effects at 15 mg/kg b.w. dose. Used as antipyretic, anticonvulsant, stomach ache, bitter tonic, stimulant of appetite and anti-diabetic.[28]

Glycosmis pentaphylla

Glycosmis pentaphylla is commonly known as Gin berry which belongs to the family Rutaceae. Plant material are used as hepatoprotective part which contains saponins, tannins and alkaloids and phenolics as main chemical component. Formulations are given as syrups as Used for cough, jaundice, inflammation, rheumatism. Used to anticancer, antimutagenic, antibacterial, antifungal, anthelmintic, mosquitocidal, antidiabetic.[12]

Halenia elliptica

Halenia elliptica is commonly known as Jiadiranguo which belongs to the family Gentianaceae. Whole plant is used as hepatoprotective part which contains triterpenes,

polysaccharides, nucleosides, steroids as the main chemical components. Formulation is given as tablet as mortality at doses up to 2000 g/kg body weight. Prevent chronic and acute hepatitis B.

Hibiscus sabdariffa

Hibiscus sabdariffa is commonly called as roselle which belongs to the family Malvaceae. Calyces is used as hepatoprotective part which contains polyphenols as the main chemical component. Formulation is given as tablets as 100 mg daily, and 3.75 g daily for a duration of 15 days to 6 weeks. Used to treat high blood pressure, high cholesterol, and many other conditions.[29]

Hygrophila auriculata

The Acanthaceae family member *Hygrophila auriculata*, often known as kokilaksha, goes by this common name. The root is used as the hepatoprotective component and its key chemical components include lupeol, stigmasterol, isoflavone, glycoside, and alkaloid. Rats receive the formulations as powder at dosages of 100, 150, and 200 mg kg-1 over the course of 28 days. Treatment for gout, jaundice, oedema, renal infections, rheumatoid arthritis, and as an aphrodisiac.[30]

Kalanchoe pinnata pers

Kalanchoe pinnata Pers is commonly known as Miracle Leaf which belongs to the family of Crassulaceae. Leaves are used as the hepatoprotective part which contains tannins, cardiac glycosides, polyphenols as the main chemical component. Formulations is given as liquid as pinnata leaf juice at doses of 125 mg/kg. medicine for treating peptic ulcers and inflammatory problems.[54]

Kigelia africana

Sausage Tree, also known as *Kigelia africana*, is a member of the Bignoniaceae family. The hepatoprotective component of leaves is their tannins and flavonoids, which make up the majority of their chemical makeup. Formulations are administered in doses of 100 or 200 mg/kg of aqueous leaf extract to treat STDs; in Nigeria, the bark of *K.africana* is used to treat cancer, inflammation, and diarrhoea.[32]

Lactuca indica

Lactuca indica is commonly known as Indian Lettuce which belongs to the family Compositae. Arial parts are used as the hepatoprotective part which contains phenolic as the main chemical component. Formulations is given as liquid as concentration range of 0.3–1.0 mg/mL. used as a medicine in antibacterial, antidiabetic, anti-inflammatory etc.

Laggera pterodonta

Laggera pterodonta is commonly known as Curly Blumea which belongs to the family Asteraceae. Whole herb is used as the hepatoprotective part which contains flavonoids, monoterpenes, sesquiterpenes, triterpenoids as the main chemical component. Formulations is given as syrups as medicine is taken three times a day, one hour after meals. Treatment of paediatric malaria and inflammations.[33]

Mallotus japonicas

Mallotus japonicas is commonly known as food wrapper plant which belongs to the family Euphorbiaceae. Cortex is used as the hepatoprotective part which contains flavonoids, glycosides, saponins as the main chemical component. Formulations is given as tablets as Bergenin at a dose of 50, 100 or 200 mg/kg. used as a prophylaxis to treat bacterial disease infections of fishes.[34]

Mamoridca subangulata

Mamoridca subangulata is commonly known as wild bitter gourd which belongs to the family Cucurbitaceae Meliaceae. Leaves and whole plant are used as the hepatoprotective part which contains alkaloids, glycosides, flavonoids, phenols, saponins, steroids as the main chemical component. Formulations is given as any of as 500 mg/kg, fresh weight; 50 mg/kg, dry wt. used as the treatment of liver.

Ocimum snctum

Tulsi, also known as *Ocimum snctum*, is a member of the Lamiaceae family. The main chemical components of leaves, which are employed as a hepatoprotective component, include phenolics, flavonoids, and phenyl propanoids. For the treatment of bronchitis, bronchial asthma, malaria, diarrhoea, dysentery, and skin illnesses, preparations including Tulsi Root decoction (50 to 100 ml) and Tulsi Seed powder (3 to 6 g) have been suggested.[35]

Cichorium intybus

The common name for *Cichorium intybus* is blessed thistle. It comes under the Asteraceae family. Tanning, flavonoids, and inulin are the three main chemical components of leaves, which are employed as a hepatoprotective component. Cream formulations are administered daily at doses of 54 mg/kg BW. Gallstones, gastroenteritis, nasal issues, wounds, and bruising are the main conditions it is used to treat.

Orthosiphon stamineus

Kidneys Tea Plant, also known as *Orthosiphon stamineus*, is a member of the Lamiaceae family. Terpenes, flavonoids, and caffeic acid are the main chemical components of leaves, which are used as the hepatoprotective part. Formulations are administered orally in two doses of 100 and 200 mg/kg body weight (BW) of the extract of O. These formulations are used in southern China, Malaysia, and Thailand to treat diabetes and chronic renal failure.[36]

Phyllanthus polyphullus

The plant *Phyllanthus polyphullus*, also referred to as Krishna nelli, is a member of the Euphorbiaceae family. Terpenes, flavonoids, and caffeic acid are the main chemical components of leaves, which are used as the hepatoprotective part. Formulations (4,000 or 5,000 mg/kg) are administered as liquids like fruit juice. Utilised as a treatment for jaundice, diabetes, malaria, and liver conditions in folk medicine.[37]

Physalis minima

Bladder Cherry, also known as *Physalis minima*, is a member of the Solanaceae family. Plant material, which mostly consists of phenols, flavonoids, tannins, and alkaloids, is employed as a hepatoprotective component. Formulas are administered as drinks containing 400 mg/kg of P minimum L. fruit ethanol extract. Has a wide range of uses in ethnomedicine and has anti-cancerous, anti-diabetic, analgesic, anti-inflammatory, and anti-pyretic potentials.[12]

Picrorrhiza rhizome

The *Picrorrhiza rhizome*, which is a member of the Scrophulariaceae family, is usually referred to as katuka or kutki. Alkaloids and tannins are the primary chemical components of dried subterranean stems, which are employed as a hepatoprotective component. In doses ranging from 300 mg to 500 mg, formulations are administered as powder two to three times. Utilised for a variety of diseases, including liver issues, fever, allergies, and many others, but none of these uses are well-supported by science.[19]

Pterocarpus marsupium Roxb

Pterocarpus marsupium Roxb is commonly known as Pitsal, Piyasal, Pitsal, Piyasal, Bija sal, Murga which belongs to the family Papilionaceae. Stem bark are used as hepatoprotective part which contains marsupin, tannins, pentosan as the main chemical component. Formulations is given doses of 100 mg/kg and 200 mg/kg. treat various diseases such as leprosy, diabetes, asthma, and bronchitis.[38]

Ptrospermum acerifolium

Ptrospermum acerifolium is commonly known as Kanak Champa which belongs to the family Sterculiaceae. Leaves are used as hepatoprotective part which contains alkaloids as the main chemical component. Formulations is given powder as Flower Dosage- powder 3-6 g in divided doses per. Used in treating headache, ulcers, wounds, cough, cold, bleeding disorders etc.[38]

Ricinus communis

Castor oil plants, also known as *Ricinus Communis*, are members of the Euphorbiaceae family. Ricinoleic acid is the primary chemical constituent of leaves, which are employed as a hepatoprotective part. Formulations contain ascorbic acid, dehydroascorbic acid, and carotenoids per 100 grams of powder or oil. Utilised in conventional medicine for conditions like sciatica, bilharziasis, persistent back pain, arthritis, backaches, and muscular aches.[37]

Rubia cordifolia linn.

Rubia cordifolia Linn, a member of the Rubiaceae family with the common name Indian madder, is a plant. Anthraquinones, iridoid glycoside, and naphthoic acid esters are the primary chemical components of leaves, which are employed as a hepatoprotective component. Formulas are administered in doses of 100, 200, and 400 mg/kg as liquids in distilled water. Treatment for allergic purpura, primary dysmenorrhea, irregular uterine haemorrhage, and other gynaecological conditions.[39]

Sarcostemma brevistigma

Sarcostemma brevistigma is commonly known as soma plant which belongs to the family Asclepiadaceae. Roots are the hepatoprotective part which contains alkaloids, glycosides, flavonoids, phenols, saponins, steroids as the main chemical components. Formulations are given as oral dosage as 10 kg/plant at the time of plantation as basal dose. The decoction of the plant is useful to gargle for throat and mouth infection.[40]

Saururus chinensis

Saururus chinensis is commonly known as lizard's tail which belongs to the family Saururaceae. Whole plant is used as hepatoprotective part which contains flavonoids, iridoid glycosides and terpenoids as the main chemical components. Formulation is given as oral as oral dose of 0.25–2 g/kg. used as a traditional medicine for diseases such as oedema, jaundice, gonorrhoea, and other inflammatory diseases.[41]

Silybum marianum

Silybum marianum plant also known as milk thistle, is a member of the Asteraceae family. The plant leaves, which mostly consist of inulin, coumarins, tannins, monomeric flavonoids, and sesquiterpene lactones, are utilised as a hepatoprotective part. Cream formulations are administered daily at a dose of 54 mg/kg BW. Possess antioxidant capability that lowers the number of free radicals. In diabetes, they serve as a protective factor.[103]

Spondias pinnata

Spondias pinnata is known by its common name as hog plum which comes under the family Anacardiaceae. Stem hard wood are used as the hepatoprotective part which contains tannins, flavonoids, sterols, triterpenes, saponins, essential oils as the main chemical components. Formulation includes oral as dose of 40-50 ml to treat diarrhoea. Used as a rubefacient for the treatment of painful joints.[104]

Tephrosia purpurea L.

Tephrosia purpurea L is known by its common name as Fish poison, wild indigo which comes under the family Fabaceae. Aerial parts are used as hepatoprotective part of the plant which contains alkaloids, saponins, glycosides, tannins, flavonoids as the main chemical components. Formulation is given as powder as doses ranging from 5 to about 2000 mg/kg. treat splenomegaly, cirrhosis, cough and cold, abdominal swelling and as an antidote in the Ayurvedic system of medicine.[47]

Thunbergia laurifolia Linn.

Thymus laurifolia Linn, a member of the Acanthaceae family and often known as the blue trumpet vine, is so named. The main chemical components of leaves, which are employed as a hepatoprotective part, are glucosides, grandifloric acid, and glucopyranosides. Liquid formulations are administered at TLs of 100 and 200 mg/kg per day. Traditional treatment for toxin detoxification, with hypoglycaemia on the list of potential side effects.[45]

Tridax procumbens

The Asteraceae family includes *Tridax procumbens*, sometimes known as coat button. The primary hepatoprotective component of the plant that is employed in this is its leaves. For a period of three weeks, liquid formulations containing (40 mg/kg) are administered orally to induce hypertension. Used as a beverage to treat liver disorders, diarrhoea, dysentery, and bronchial catarrh.[46]

Zanthoxylum armatum

Zanthoxylum armatum is known by its common name as Winged Prickly Ash which comes under the family Rutaceae. Bark is used as hepatoprotective part which contains as terpenoids, flavonoids, alkaloids, coumarins as the main chemical components. Formulations are given as oral as dose of 375 mg/kg. to cure gas trouble, fever, and appetizer. It is effective to relieve stomach pain, toothache and inflammation.[47]

Acacia catechu

Acacia catechu is known by its common name as Black catechu which belongs to Leguminosae family. Powdered pale catechu is used as hepatoprotective part which contains catechins, catechu, tannic acid, quercetin as main chemical components.[48] Formulation is given in the form of tablets of 250mg/Kg. Moreover, other medicinal effects of *A. catechu* are anti-inflammatory, anti-fungal and anti-bacterial.[49]

Acacia confuse

Acacia confuse is known by its common name as Fine leaved wattle. It comes under Leguminosae family.[48] Bark of *A. confuse* is used to mask the toxic effects of foreign substances that are harmful for the liver.[51] Tannins and gallic acids are the main chemical constituents present in its bark. Formulation is available in the form of powders and capsules given in the dietary supplement dose of 50mg/Kg. Other medicinal uses of this plant are anti-oxidants, radical scavenging, anti-hyperuricemia effect, anti-inflammatory activity.[50]

Aerva lanata

Aerva lanata is known by its common name as Knotgrass which comes under the family Amaranthaceae. Its root part is widely used as hepatoprotective.[48] The main chemical constituents present in it are flavonoids and alkaloids. Its powder formulation is available which is given at 200mg/Kg body weight. In addition to hepatoprotection *A. lanata* weed also has properties of nephroprotection, anti-asthmatic and anti-amoebic.[52]

Amaranthus caudatus

Amaranthus caudatus is known by its common name as Tassel flower which belongs to the family Amaranthaceae. Whole *A. caudatus* plant was screened to show hepatoprotective activity.[54] The active components in this medicinal plant are Flavonoids, glycosides, saponins, terpenoids and amino acids. Methanolic extracts of whole plant are used to treat the toxic chemical effects against the liver. It is also used in jaundice, blood purifier, amoebiasis, diuretic, kidney diseases, astringent and as a vermifuge.[53]

Anisochilus carnosus

Anisochilus carnosus is commonly known as Thick leaved lavender which comes under the family Lamiaceae. Its stem part is used to show the hepatoprotective activity.[54] Alkaloids, flavonoids and glycosides are the chemical components screened in this plant. 400mg/Kg and 200 mg/Kg are the two safe doses of A. carnosus given according to the severity of the toxicity level. This plant also shows its effectiveness in cold, cough, fever, gastrointestinal disorders and ulcer.[55]

Aphanamixis polystachya

Aphanamixis polystachya is known by its common name as Rohituka tree which comes under the family Meliaceae. Leaves of *A. polystachya* are used to treat the increased biochemical levels of liver in which active constituents present are saponins, glycosides, alkaloids, terpenes and polyphenols. Crude ethanolic extracts of leaves are used as liposomal drugs which is prepared by injecting the 10mL ethanolic extract into 100mL of distilled water. Extracts of this plant has also been medicinally used as anti-helminthic, spleen diseases, anti-microbial properties.[56]

Artemisia capillaris

Artemisia capillaris is known by its common name as Wormwood and it comes under the family Asteraceae. Whole plant of *A. capillaris* is used for hepatoprotection against toxicity induced chemicals. The main components screened are essential oils. Formulation is available in the form of soft gelatin capsules which contain essential oils are given orally in 50mg/Kg and 100mg/Kg dose value. This plant is also used in China for its anti-inflammatory, choleretic, anti-tumour activity.[57]

Asparagus racemosus

Asparagus racemosus is known by its common name as Buttermilk root. This plant comes under the family Liliaceae. Root part is known to mask the toxic effects that are harmful for the liver.[54] Chemical components of its root part are Saponins, coumarins, phenols, essential oils, monoterpenes, lipids, ligans, alkaloids and xanthins. Formulation of *A. racemosus* is available in the form of powders which are prepared by using distilled water which contains 2% v/v Tween 80 in which aqueous extracts are dissolved. Safe concentration of doses given are 150mg/Kg and 250mg/Kg. It is also commonly used to treat various diseases like diarrhoea, nervous breakdown, rheumatism and dysentery.[58]

Azima tetracantha

Azima tetracantha is known by its common name as Bee sting bush which comes under the family Salvadoraceae. Leaves of this plant are used which contains Flavonoids, glycosides, tannins, quinones, saponins and triterpenoids that shows the protective effect on the liver against increased biochemical levels.[54] The fixed safe concentration of ethanolic leaf extract doses of *A. tetracantha* are 100mg/Kg and 200mg/Kg. This plant is also used for its free radical scavenging properties.[59]

Baliospermum montanum

Baliospermum montanum is known by its common name as red physic nut or Wild castor. It comes under Euphorbiaceae family. Its roots are widely known for their hepatoprotective properties.[48] The active components present in roots are Flavonoids, terpenoids and steroids. 200mg/Kg is the total methanol extract dose prepared for the formulation of *B. montanum*. Ayurvedic herbs of this plant are available in its original form. Other properties of this roots are used to treat pains, enlarged spleen, inflammation, leukoderma, abdominal tumours and cancers.[60]

Berberis vulgaris

Berberis vulgaris is known by its common name as Common barberry which comes under family Berberidaceae. Leaves part of this plant is known for its hepatoprotective properties which contains active chemical constituents such as berberine drug, alkaloids, isoquinoline and rich amount of Vitamin C. Its formulation is available in the form of Capsules of dose 120mg/kg body weight which shows a decrease in lipid peroxidation. Leaves of the *Berberis vulgaris* also shows antioxidant properties.[61]

Boerhaavia diffusa

Boerhaavia diffusa is commonly known as Spreading hog weed. It comes under family Nyctaginaceae. Its root part is used as hepatoprotective part.[48] The main chemical component screened in *B. diffusa* are Flavonoids, alkaloids, glycosides, rotenoids, steroids, triterpenoids, lipids, ligans, proteins, glycoproteins and traces of carbohydrates. Its formulation is in the form of capsules with recommended dose value of 150mg/kg given orally for 30 days. This dose reverses the increase in the biochemical levels of liver. In Ayurvedic System of Medicines, additional to liver this plant is used for heart, kidney and cancer diseases.[62]

Cajanus cajan

Cajanus cajan is known by its common name as Pigeon pea. It comes under the Fabaceae family. Leaves and Seeds part of this plant is used to mask the toxic effects of the chemicals that affects the liver part.[54] The chemical components present in this plant are Flavonoids, stilbenes, saponins and alkaloids. Formulation is *C. cajan* is available in three doses values 800, 400 and 200 mg/Kg. Out of these 800 mg/Kg is the highest effective dose which lowers the liver weight and maintains the healthy body weight. Other medicinal uses of this plant including hepatoprotection are antioxidant and anthelmintic.[63]

Cajanus scarabaeoids

Cajanus scarabaeoids is known by its common name as Showy pigeon pea. It comes under the family Fabaceae. All the parts of this plants in powder form shows the hepatoprotective activity.[54] Other than hepatoprotective it is traditionally used for diarrhoea in cattle and sterility treatment in women. The main active chemical moiety present in this plant is Flavonoid. Therefore, flavonoid extract of *C. scarabaeoids* with dose value 50mg/kg is used to brought back the irregular levels of biochemical markers.[64]

Calotropis procera

Calotropis procera is known by its common name as Sodom apple which comes under Apocynaceae family.[48] Flower part of this plant is mainly used for its hepatoprotective properties which contains active constituent like alkaloids, flavonoids, cardiac glycosides, tannins, triterpenes and sterols.[54] Its formulation is available in powder form which is manufactured from hydroethanolic extract. 200mg/kg and 400mg/kg are the two effective doses of *C. procera*. Other properties shown by its flower are antipyretic, antimicrobial, anti-inflammatory, analgesic and larvicidal activity.[65]

Carissa carandas

Carissa carandas is known by its common name as Bengal currant. It comes under the Apocynaceae family.[54] Leaves of this plant are used for the protection of liver which contains alkaloids, glycosides, volatile oils, tannins, saponins and flavonoids as chemical constituents. Formulation of this plant is prepared by acetonic and methanolic solution (1:3) in which leaves extracts are dissolved from which 50mg/kg dose is used for treatment of liver. It is also used for blood purifier, fever, expectorant, syphilitic pain, soreness and poison antidote. There is many scientific research proof of its uses as cardiotonic, free radical scavenging, histamine releasing, antirheumatic, antibacterial, anticonvulsant and antiviral activity.[66]

Cassia occidentalis

Cassia occidentalis is known by its common name as Fedegoso and it comes under Fabaceae family. Leaves part of this plant is used to mask the toxic effects of chemicals on liver.[48] The main components present in this are triterpenoids, saponins, flavonoids, anthraquinones and glycosides. Formulation of *C. occidentalis* is in syrups and tablet form. Liv 52 syrup and Liv 52 tablets are the two most popular formulations manufactured by 'The Himalaya Drug Company'. In both of these formulations, 8mg powder of *C. occidentalis* is used. Other properties of this plant are anti-cancerous, antipyretic, antifungal, antibacterial, antimutagenic, antioxidant, anti-inflammatory, antidiabetic and wound healing.[67]

Cassia tora

Cassia tora is known by its common name as Sickle senna. It comes under family Leguminosae.[48] This whole plant shows its hepatoprotective properties in case liver toxicity which contains chemical components like ligans, essential oils, coumarin, monoterpenes, carotenoids, flavonoids, alkaloids, glycosides, lipids, organic acids and xanthins. Formulation of *C. tora* is available in powder form which are dried extracts of whole plant in the solution of water and methanol in (50:50) respectively. Other than hepatoprotective activities, *C. tora* shows antioxidant, antimicrobial, antimutagenic, antipyretic, anti-analgesic properties.[68]

Clitoria ternatea

Clitoria ternatea is known by its common name as Butterfly pea. It comes under Fabaceae family.[54] Leaves of this plant are known for their hepatoprotective activities which contain anthrocyanins glycosides, phytosterols, polyphenolic flavonoids, pentacyclic triterpenoids. Formulation of this plant is available in the form of powder and 200mg/kg is the effective

dose for the treatment of hepatotoxicity. Other uses of this plant include antipyretic, antimicrobial, anti-inflammatory, analgesic, diuretic, anti-diabetic, anaesthetic, insecticidal and smooth muscle relaxant properties.[69]

Cordia macleodii

Cordia macleodii is known by its common name as Macleod cordia. It comes under Boraginaceae family. Leaves of this medicinal plant are widely known to treat liver toxicity.[48] It contains high quantity of flavonoids which also shows antioxidant properties along with hepatoprotective properties. 100mg/kg, 200mg/kg and 400mg/kg are the formulated dose values of *C. macleodii* which are considered effective against the increased levels of GPT, GOT, ALP of liver.[70]

Cucumis trigonus

Cucumis trigonus is known by its common name as Bitter gourd and it comes under Cucurbitaceae family. Fruit of this plant are majorly used for the protection of liver against the toxic chemicals.[54] Flavonoid is the active chemical constituent present in its fruits. Formulation dose of 300mg/kg made from alcoholic, chloroform and aqueous extract is effective in treating hepatic diseases. Also, Liv 52 syrup with 4ml/kg of dose is administered for maintaining the increased levels of bilirubin. Other than hepatoprotective activity, *C. trigonus* is used in leprosy, jaundice, diabetes, bronchitis and amentia.[71]

Cuscuta australis

Cuscuta australis is known by its common name as Australian dodder. It belongs to the family Convolvulaceae. Seeds and stem both are known to treat toxicity against liver. This plant contains chemical constituents such as coumaric acids, diterpenes and glycosides. Formulation of dose 125mg/kg and 250mg/Kg dose is administered orally for 7 days which reduces the liver damage. *C. australis* also shows antioxidant effects.[72]

Embelia ribes

Embelia ribes is known by its common name as Embelia which comes under Myrsinaceae family. Fruit part is known to show the hepatoprotective properties.[48] It is containing active chemical constituents such as Embelin, quercitol, fatty acids, resinoid, tannins and traces of volatile oils. Formulation of this plant is given in the form of powders with extract dose values of 50, 100, 200 mg /day depending on severity of disease.[73]

Equisetum arvense

Equisetum arvense is known by its common name as Horsetail. It belongs to the Equisetaceae family. Herbs are used for the liver disease treatment and act as hepatoprotective.[48] The main constituents present in it are flavonoids, alkaloids, phenols, saponins, tannins, phytosterols, triterpenoids, sterols and volatile oils. Its formulation is available in Homeopathic medicines in which methanolic extract of *E. arvense* is given at a dose of 75mg/kg for ideal effect on liver. Other medicinal uses of this plant are anti-microbial, anti-inflammatory, antioxidant, anticancer.[74]

Ficus religiosa

Ficus religiosa is known by its common name as Sacred bo tree. It comes under the Moraceae family. Latex of this plant is used to mask the toxic effects of chemicals and it is useful in treating the liver diseases.[54] Active constituents present in *F. religiosa* are glycosides, alkaloids, tannins, flavonoids and methionine. Formulation of this plant is available in Homeopathic medicine system. Dose of 300mg/kg is considered to be effective against increased biochemical levels. Other medicinal uses of this plant are pain relief, impotency, menstrual disturbances, inflammation, toxicity in uterine and urine related problems.[75]

Garcinia indica

Garcinia indica is known by its common name as Goa butter tree which comes under the Clusiaceae family. Fruits of this plant are used to treat the liver diseases and gives a protective effect.[54] Benzophenones and garcinols are the chemical constituents screened to present in it. Formulation of this medicinal plant is available in the form of capsules. Capsules of dose value 400mg/kg and 800mg/kg are given orally for 10 days depending on the condition of the disease and severity. *G. Indica* also shows its potent effects in antioxidant, anti-lipid peroxidative, free radical scavenging properties.[76]

Ginkgo biloba

Ginkgo biloba is known by its common name as Maidenhair tree. It comes under the Ginkgoaceae family. Leaves of this medicinal plant are for liver diseases which shows hepatoprotective properties.[48] Chemical constituents present in this plant are flavanol glycosides, terpene trilactones, biflavones, phenolic acids, proanthocyanidins and alkylphenols. Formulation of this plant is available in the form of soft gel capsules. These

soft gel capsules are prepared from the dried leaf extract dissolved in a mixture of acetone and water in (70:30) respectively.[77]

Glycyrrhiza glabra

Glycyrrhiza glabra is known by its common name as Licorice. It comes under Fabaceae family. Root parts are known to reduce the increased biochemical levels of liver.[48] Chemical constituents present in this plant are glycyrrhizin, glycosides and flavonoids. Formulation of *G. glabra* is available in the form of homeopathic medicines which is given in a medicinal dose value of 2mg/kg/day administered for 7 days. Saponins present in this plant reduces the risk of coronary heart diseases.[78]

Gmelina asiatica

Gmelina asiatica is known by its common name as Asian bush beech. It comes under Lamiaceae family.[54] Aerial parts are known to reduce the toxicity of liver which contain active components such as phenolic compounds, alkaloids, flavonoids, glycosides. Formulation dose of *G. asiatica* is 400mg/kg which is administered orally once daily. Antioxidant and free radical scavenging are the other medicinal properties of this plant.[79]

Hoslundia opposite

Hoslundia opposite is known by its common name as orange bird-berry. It comes under the Lamiaceae family. Leaves part are known to be used for liver diseases due to its hepatoprotective properties.[48] The main components screened in this plant are steroids, flavonoids, terpenoids, tannins, saponins and glycosides. The safe effective dose of *H. opposite* is 400mg/kg body weight. This plant also shows the antioxidant properties.[80]

Hyptis suaveolens

Hyptis suaveolens is known by its common name as Pignut which comes under the Lamiaceae family. Whole plant of *H. suaveolens* is used for the protection of liver.[54] It is screened to contain active chemical component such as tannins, phenolics, alkaloids, flavonoids and saponins. 100mg/kg dose value of this plant is considered as safe and effective for hepatoprotective treatment. Other medicinal properties of this plant extracts are antioxidants and free radical scavenging.[81]

Juncus subulatus

Juncus subulatus is commonly known as the somerset rush. It comes under the Juncaceae family. Powdered tuber part of this traditional medicinal plant are known for treating the liver diseases because of its hepatoprotective properties.[48] It contains chemical constituents such as Volatile oils, flavonoids, glycosides and quercetin. Formulation of *J. subulatus* is given through the intraperitoneal route at an effective dose of 50mg/kg in which extracts are dissolved in 10% Tween 80. Anti-microbial, anti-allergic and anti-inflammatory are the other medicinal uses of this plant.[82]

Leucas cilita

Leucas cilita is known by its common name as Tufted leucas which comes under Lamiaceae family. Leaves of this plant are mainly used as hepatoprotective for the protection of liver.[54] Flavonoids are known to be present in this plant. The effective dose which shows the reduction in the biochemical levels of liver is 400mg/kg. It is also used as an antioxidant.[83]

Luffa echinata

Luffa echinata is known by its common name as Bitter sponge gourd. It comes under Cucurbitaceae family. Fruits part is widely known to treat the increased toxicity levels in the liver.[48] Active components known to present in this part are alkaloids, flavonoids, glycosides, terpenes, tannins and reducing sugars. Formulation made from the fruit extract of this plant are effective with the dose value of 250mg/kg.[84]

Mallotus repandus

Mallotus repandus is known by its common name as Climbing Mallotus. It comes under the Euphorbiaceae family. Stem part of this plant is mainly used for masking the toxic effects that damages the liver. It contains active chemical constituents such as phenolic compounds, tannins and flavonoids. Formulation is available in herbal powder which can be given at effective dose values of 500, 250 and 1000mg/kg. *M. repandus* also possess the properties of radical scavenging and anti-oxidation.[85]

Melia azhadirecta

Melia azhadirecta is known by its common name as Chinaberry tree. It comes under the Meliaceae family. Leaves of this plant are used to balance the increased biochemical levels of the liver due to its hepatoprotective activity.[54] Tannins, alkaloids, flavonoids, terpenoids, phenols, glycosides are the chemical moieties present in this plant. Dose formulation of *M.*

azhadirecta is made from leaves extract of 300mg/kg and 500mg/kg. Other medicinal properties of this plant are used for cardiac disorders, leprosy and inflammations.[86]

Momordica dioica

Momordica dioica is known by its common name as Spiny gourd. It comes under Cucurbitaceae family.[48] Fruit part are known for their hepatoprotective activities which contain Flavonoids, alkaloids, amino acids and traces of glycosides. Effective dose of the fruit extracts of this plant are given with water is 2.5ml/kg and 150mg/kg with proper balanced diet. This plant is also traditionally used as alexiteric, stomachic, laxative, cure asthma, tumours, leprosy and bronchitis.[87]

Morinda citrifolia

Morinda citrifolia is known by its common name as Indian mulberry. It comes under Rubiaceae family.[54] Fruits of this plant are used to cure liver diseases which contain chemical constituents such as Anthraquinones, flavanol glycosides and lipid glycosides. Formulation of this plant is given in orange juice which is a pre-treatment formulation with 20% Noni fruit extract in drinking water. This formulation reduces the hepatotoxic lesions on the liver. *M. citrifolia* is traditionally known for its anti-oxidant, anti-inflammatory nutritional supplement.[88]

Myrtus communis

Myrtus communis is known by its common name as Common Myrtle. It belongs to family Myrtaceae. Leaves and flowers of this plant are used to protect liver because of their hepatoprotective properties.[54] It contains various chemical constituents such as flavonoids, terpenoids, essential oils, steroids, phenolic compounds. Formulation is available in form of Myrtle essential oil which is administered in the dose value of 250mg/kg administered for 2 weeks. *M. communis* is also medicinally used as an antiseptic, disinfectant and hypoglycaemic agent.[89]

Phyllanthus niruri

Phyllanthus niruri is commonly known as Gale of the wind. It comes under Euphorbiaceae family. Aerial parts are mainly used to mask the hepatotoxic effects.[48] It contains chemical moieties such as tannins, terpenoids, saponins, flavonoids and alkaloids. Formulation of this plant is given in the form of Homeopathic medicines with effective dose value of 5000

mg/kg. This plant is traditionally used for its properties in kidney stones, influenza, jaundice and dyspepsia.[90]

Picrorhiza kurroa

Picrorhiza kurroa is commonly known as Bitter root. It comes under the Scrophulariaceae family. Root rhizomes are known for its hepatoprotective activities.[48] In this plant phenols, flavonoids and traces of quercetin are the active moieties present. Formulation is available in Herbal capsules of dose value 200mg/Kg. Anti-diabetic, anticancer and antiviral are the other pharmacological properties of this plant.[91]

Piper chaba

Piper chaba is known by its common name as Piper chilli which comes under the Piperaceae family. Its roots are used for prevention of diseases which harms the liver conditions.[48] Main chemical constituents screened in this plant are isoflavones and alkaloids. Formulation of this plant is available in the form of powder. Dried roots extract is used in the formulation of *P. chaba* with dose value of 200mg/kg and 400mg/kg. Lower dose formulation is more effective in the treatment of liver toxicity. It also shows the properties of anti-oxidation and prevention of free radical damage.[92]

Piper longum

Piper longum is known by its common name as long pepper. It comes under the Piperaceae family. Fruit powder and root powder of this plant is used to balance the abnormal levels of liver.[48] Chemical constituents present in this are essential oils and components of aliphatic hydrocarbons. Formulation of *P. longum* is available in the form of powder. 200 mg/kg/day dose is given with boiled milk for 3 weeks. It is also used in the treatment of jaundice.[93]

Plantago major

Plantago major is commonly known as great plantain. It comes under Plantaginaceae family. Seeds are used to treat and prevent liver diseases.[48] Flavonoids, terpenoids, alkaloids, glycosides, fatty acids and vitamins are chemical constituents present. Formulation of this plant is available in the form of Homeopathic medicines which is administered in dose value of 25mg/kg. It is also known for its anti-inflammatory, anti-diarrhoeal, anti-nociceptive effects.[94]

Scoparia dulcis

Scoparia dulcis is known by its common name as Licorice weed. It comes under Scrophulariaceae family. Whole plant parts of *S. dulcis* are used to mask the toxic effects of the disease which are harmful for liver.[48] The chemical moieties of this plants are Diterpenoids, tannins, flavonoids, triterpenes and hexacosonols. Formulation of this plant is given in the dose value of 500mg/kg. Other medicinal values are analgesic and anti-inflammatory.[95]

Solanum nigram

Solanum nigram is known by its common name as Black nightshade. It comes under the Solanaceae family.[54] Fruit part is known to treat various liver infections which consist of active chemical moieties such as flavonoids, alkaloids. Formulation of this plant is available in three dosage forms i.e., powder, tablets and syrups. 16mg of *S. nigram* powder is used in the formulation of Liv 52 syrup and tablets. Effective dose value of this plant is 100ug/ml. This medicinal plant is also widely used as anti-tumour, anti-inflammation, anti-ulcer and anti-oxidant.[96]

Trianthema decandra

Trianthema decandra is known by its common name as Horse purslane. It comes under Aizoaceae family. Leaves are widely used for its hepatoprotective activity.[48] Chemical constituents present in this plant are tetraterpenoids, flavonoids and alkaloids. Its formulation is available in the form of Homeopathic medicine. 6C, 30C, 200C, 1M, 10M are the effective homeopathic dilution for the protection of liver. This plant is also used in burn and wounds, infections, fever, tooth ache, diabetes and skin disorders.[97]

Trichosanthes cucumerina

Trichosanthes cucumerina is known by its common name as Snake gourd. It comes under Cucurbitaceae family. Leaves are surprisingly used for protection of liver.[48] The chemical moieties screened in this plant are Cucurbitacin B, cucurbitacin E, isocucurbitacin, dihydroisocucurbitacin. Formulation is this plant is available in Capsules and syrups. Dose value of 150mg/kg is considered as safe and effective for protection of liver and up to 2000mg/kg it shows no sign of overdose toxicity.[98]

Tylophora indica

Tylophora indica is known by its common name as Indian sarsaparilla. It comes under Asclepidaceae family. Leaves of this plant are effective against the increased levels biochemical levels of liver.[48] Alkaloids, carbohydrates, steroids, saponins and triterpenes are the main active chemical constituents present in this plant. Formulation of *T. indica* is available in the Homeopathic system of medicines. Dose value up to 5000 mg/kg shows no signs of overdose toxicity and LD50 dose value of this plant is 3162 mg/kg. Other pharmacological effects of this plant are anti-inflammation, anti-oxidant, anti-asthmatic, anti-convulsant and anti-rheumatic.[99]

Vitex trifolia

Vitex trifolia is known by its common name as Common chaste tree which comes under Verbenaceae family. Leaves of this hepatoprotective plant are known to treat and prevent the toxic effects that damages the liver.[48] Chemical constituents screened in this plant are Flavonoids, saponins, glycosides, tannins, steroids and triterpenoids. Formulation of this plant is available in the form of Chooranam powder. 20mg/kg and 40mg/kg are the maximum dose formulation effective for anti-hepatotoxic effects. Root part is also known to treat febrifuge, painful inflammations, cough, fever.[100]

CONCLUSION

The main objective of this study is to provide the knowledge about the medicinal plants that are traditionally used for their hepatoprotective properties to protect liver. It also highlights the common names and family of the hepatoprotective plants with their parts used, various chemical constituents present in it, type of dosage form in which its formulation is available and dose extracts with their maximum safe concentration. Overall, the study mainly shows the presence of alkaloids, flavonoids, saponins, glycosides in most of the plants. Therefore, these chemical constituents are known to provide the protection to the liver against paracetamol, carbon tetrachloride and other toxicity inducing chemical. These constituents are present in specific part of the plant which brought back the altered biochemical levels of the liver.

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