Liver Problems and Natural Cure

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Abstract: The liver is the largest and one of the most vital organs in the body of mammals. All of our blood flows through it. When the liver is damaged scar tissue forms and stops the flow of blood in healthy cells. Much liver damage is caused by drinking excessive alcohol. Alcohol is the common cause for the development of cirrhosis in liver and unfortunately is very often fatal. Functions of liver which are important for maintenance and performance of the body include carbohydrate, protein and lipid metabolism, detoxification and secretion of bile. Unfortunately the liver is often abused by environmental toxins, poor eating habits, alcohol and some time due to overdose of the counter drug, which can damage and weaken the liver and eventually lead to hepatitis & cirrhosis. Conventional medicine is now persuing the use of natural products such as herbs to provide the support that the liver needs. Many herbs such as Eclipta alba, Boerhaavia diffusa, Andrographis paniculata Phyllanthus amarus, Terminalia arjuna and many more have a long history of traditional use in revitalizing the liver. The paper deals with documentation of plants which possess hepatoprotective properties.

Keywords: Liver, Natural cure, Hepatoprotective, Conventional medicine

1. Introduction

The liver is largest glandular organ in the body. It is responsible for detoxifying the poisonous substances in the body by transforming and removing toxins and wastes. The liver serves a variety of functions. The most crucial is its role in the body’s metabolism. There is no organ is more important to healthy metabolism than the liver in many ways (Robbins et al., 2003).

Some of the major functions include –

- Carbohydrates metabolism – Produces & stores glycogen (glycogenogenesis), produces liver glucose from liver glycogen & other molecules (gluconeogenesis) and release it in to the blood.
- Lipid metabolism – synthesizes cholesterol, phospholipids & bile salts.
- Protein metabolism.
- Formation & storage of vitamins & minerals.
- Detoxification of blood- bio-transform endogenous & exogenous compounds via phase -1 & phase-2 pathway of detoxification.

It is involved in the intermediary metabolism of proteins, fats, carbohydrates and foreign bodies and is responsible for the synthesis of a number of plasma proteins. It also plays an important role in the production of various enzymes and the formation and excretion of bile. It acts as a storehouse of proteins, glycogen, various vitamins and minerals. Hence, any injury to it or impairment of its function has grave influence on the health of the affected person.

Liver disease is a collective term for a whole group of problems that afflict the tissues, structures and cells of the human liver. The liver performs a multitude of important functions, so there’s plenty of opportunity for something to go wrong. One of the most common causes of liver disease is inflammation, which often results from abuse of alcohol, poor diet or even malnutrition (Arias et al., 1989). In the absence of a reliable liver protective drug in modern medicine there are a number of medicinal preparations in Ayurveda recommended for the treatment of liver disorders.

Due to severe undesirable side effects of synthetic drugs used in liver disorder (Guntupalli et al., 2006), there is growing focus to follow systematic research methodology and to evaluate scientific basis for the traditional herbal medicines that are claimed to possess hepatoprotective activity. A single drug cannot be effective for all types of liver diseases. Therefore an effective formulation has to be developed using indigenous medicinal plants, with proper pharmacological experiments and clinical trials.

Hepatotoxicity inducing agents- Several chemicals have been known to induce hepatotoxicity. CCl₄ (carbon tetrachloride), Galactosamine, d- Galactosamine / lipopolysachharide (Gal N/ LPS), Thioacetamide, antitubercular drugs, paracetamol, arsenic etc. are used to induce experimental hepatotoxicity in laboratory animals. CCl₄ has been widely and successfully used by many investigators. During its metabolism in endoplasmic reticulum and mitochondria CCl₃O, a reactive oxidative free radical is formed which initiates lipid peroxidation.

Paracetamol, a widely used analgesic and antipyretic drug produces acute liver damage in high dose. Paracetamol administration causes necrosis of the centrilobular hepatocytes characterized by the nuclear pyknosis and eosinophilic cytoplasm followed by large excessive hepatic lesion.

Arsenicles are wide spread in the environment as a result of natural or anthropogenic activities arsenic forms strong complexes with various sulf-hydryl groups and exerts its activity by generating reactive oxygen species (ROS), such as superoxide, hydroxyl and peroxyl radicals during its metabolism in cells. Arsenic exposure was shown to depress the antioxidant system leading to oxidative damage to cellular macromolecules including DNA, proteins and lipids in biological system by tissue damage, altering biochemical compounds and corroding cell membrane.

Medicinal herbs are significant source of pharmaceutical drugs. Latest trends have shown increasing demand of phyto drugs and some medicinal herbs have proven
hepatoprotective potential. Medicinal herbs and extracts prepared from them are widely used in the treatment of liver diseases like hepatitis, cirrhosis and loss of appetite (Nadkarni and Nadkarni, 1954). The table shows list of plants which are proven to be hepato-protective by their pharmacological studies on experimental animals.

2. Discussion

Not only the plants but even the results of herbal formulations which contain more than one herb also studied for their hepatoprotective activity. The pretreatment in low doses (2.6 ml/kg/day) with liquid formulations of Liv 52 and Livergen reversed the PCM induced liver toxicity. At higher doses (5.2 ml/ kg/day), all the six herbal formulations namely Liv 52, Livergen, Livokin, Octogen, Stimuliv and Tefroliv conclusively showed marked beneficial effects in the studied pharmacological, biochemical and histological parameters (Girish et al., 2009).

The efficacy of any hepatoprotective drug is essentially dependent on its capability to either reduce harmful effects or to maintain the normal hepatic physiological mechanisms that have been unbalanced by the hepatotoxin (Sen et al., 1993). The results of the present studies reveal that the different plant extract possesses significant hepatoprotective and antioxidant activities against CCI4, or other compound induced liver damage in rats. It has been observed that CCI4 is bio-transformed by the cytochrome P-450 system to the trichloromethyl free radical. This free radical may react again with oxygen to form a trichloromethyl peroxy radical, which may attack lipids on the membrane of endoplasmic reticulum. The trichloromethyl peroxy free radical leads to lipid peroxidation, the disruption of Ca++ homeostasis and finally, results in cell death (Clawson, 1989; Recknagel et al., 1989). Therefore, leakage of large quantities of enzymes into the blood stream often associated with massive necrosis of the liver (Rees and Spector, 1961). Administration of CCI4 results in a rapid increase of serum GOT, GPT and ALP levels (Lin et al., 1997). Serum GOT can be found in the liver, cardiac muscle, kidney, brain, pancreas, lungs, skeletal muscle, leukocytes and erythrocytes (in decreasing concentrations) (Rafatullah et al., 1991), whereas the highest concentration of Serum GPT is found in the liver. In tissues, Serum GPT occurs in two locations, the cytosol and mitochondria (Rej, 1978). Serum GPT appears to be a more sensitive and specific test of acute hepatocellular damage than Serum GOT (Lin et al., 1997). Therefore, the possible hepatoprotective mechanism of these plant extract on CCI4-induced liver injuries may be due to the following factors: (i) inhibition of cytochrome P-450 activity; (ii) prevention of lipid peroxidation; (iii) stabilization of the hepatocellular membrane and (iv) enhancement of protein synthesis (Al-Howiriny et al., 2003).

Furthermore, alkaline phosphatase (ALP) is the prototype of these enzymes that reflects the pathological alteration in biliary flow (Plaa and Hewitt, 1981). CCI4-induced elevation of this enzymatic activity in serum is in line with the high level of serum bilirubin content (Al-Howiriny et al., 2003). The extract-mediated suppression of the increased ALP activity with the concurrent depletion of raised bilirubin level suggests the possibilities of the extract being able to stabilize biliary dysfunction in the rat liver, thereby indicating its effectiveness in maintaining the normal functional status of the liver (Klassen, 1969). Different observations in the various studies also indicate that treatment with CCI4 caused a significant reduction in NP-SH concentration in the rat liver. Plant extracts however, offered a significant replenishing of the NP-SH level. Thus, sulfhydryl seems to have a role hepatoprotection through its antioxidant potential (Burk, 1983; Ahmed and Khater 2001). Phytochemical studies also showed that all plants possess different secondary metabolites including flavonoids, saponin, volatile oils, sterol and/or triterpenes. All of these constituents are known to exhibit antioxidant activity, offer protection against cell damage and possess free radical scavenging effects (Vogel, 1977; Kikuzaki et al., 2000). In Andrographis paniculata the bioactive compounds are andrographolide and neoandrographolide, in Bacopa monniera bioactive compound is bacside-A, in Rubia cordifolia bioactive compound is rubiadin, in Terminalia catappa bioactive are punicalagin and punicalin (Deshwal et al., 2011), all these compounds show hepatoprotective activity in experimental models.

3. Conclusion

This review demonstrates that a large number of plants have significant hepatoprotective and antioxidant properties. Some of them are part of Ayurvedic medicines also. Further studies are necessary to isolate the active chemical component(s) and to elucidate its exact mechanism(s) of action.

References


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**Table: Medicinal Plants Having Hepatoprotective Activity**

| Name of plant          | Family               | Plant part used | Extract          | Animal model | Hepatotoxic agent used | Remark                                                                 | Reference
|------------------------|----------------------|----------------|------------------|--------------|------------------------|----------------------------------------------------------------------|-----------
| *Achyranthes aspera* Linn. | Amaranthaceae.       | Seeds          | Ethanolic extract 100 mg/kg. | Rats. | CCl4 | Pretreatment with extract inhibited the increase in serum levels of total bilirubin, total protein, serum ALT, AST and ALP reflecting the liver protection by crude drug. | Manjunatha *et al.*, 2012.
| *Aegle marmelos* (L.) Correa | Rutaceae             | Leaves         | Ethanolic extract 500 mg/kg. | Rats. | CCl4 | Lowering of levels of enzymes like serum glutamate pyruvate, transaminase serum glutamate oxaloacetate, transaminase, alkaline phosphatase, bilirubin total cholesterol, triglycerides, low density lipoprotein and very low density lipoprotein but increase in the level of high density lipoprotein. Antioxidant enzymes were also increased. These biochemical observations were supported by histopathological examination of liver. | Sumitha and Thirunalamarasi, 2011.
| *Alternanthera sessilis* (L.) DC. | Amaranthaceae.       | Aerial parts   | Ethanol extract. | Wistar albino rats. | Paracetamol | Decrease in the activity of serum enzymes, bilirubin, total cholesterol and in vivo lipid peroxidation and significant increase in the levels of GSH, SOD, CAT and HDL cholesterol suggests that EAS could protect the liver cells from paracetamol induced liver damage by its antioxidative effect on hepatocytes. | Das *et al.*, 2014.
| *Amaranthus spinosus* Linn. | Amaranthaceae.       | Whole plant.   | 50% ethanolic extract. | Rats. | CCl4 | SGOT, SGPT, ALP and TB. decreased to near normal level. The presence of flavonoids and phenolics compound may be responsible for hepatoprotective activity. | Zeashan *et al.*, 2008.
<table>
<thead>
<tr>
<th>Plant Name</th>
<th>Family</th>
<th>Part Used</th>
<th>Extract Type</th>
<th>Concentration</th>
<th>Activity</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacopa monnieri (L.) Pennel.</td>
<td>Scrophulariaceae</td>
<td>Whole plant</td>
<td>Ethanol extract</td>
<td>50%</td>
<td>Significant reduction in serum marker enzymes of hepatic damage viz. SGPT, SGOT, bilirubin.</td>
<td>Gudipati et al., 2012</td>
</tr>
<tr>
<td>Beta vulgaris Linn.</td>
<td>Chenopodiaceae</td>
<td>Root</td>
<td>Ethanol extract</td>
<td>Rats</td>
<td>Significant reduction in ALT, AST, ALP and bilirubin.</td>
<td>Agrawal et al., 2006.</td>
</tr>
<tr>
<td>Bryophyllum pinnatum Lam.</td>
<td>Gentianaceae</td>
<td>Aerial part</td>
<td>Aqueous extract</td>
<td>Rat</td>
<td>The level of cholesterol, triglyceride, HDL, LPO, SOD, CAT, SGPT, SGOT and ALP significantly reversed.</td>
<td>Muhammad Afzal et al, 2013</td>
</tr>
<tr>
<td>Cajanus cajan Linn.</td>
<td>Leguminosae</td>
<td>Aerial parts</td>
<td>Hydroalcoholic extract</td>
<td>Wistar albino rats</td>
<td>Significant lowering of serum marker parameters like ALT, AST, ALP, total bilirubin and increase in serum total proteins and albumin.</td>
<td>Singh et al., 2011.</td>
</tr>
<tr>
<td>Celotropis procera (Ait.) R.Br.</td>
<td>Asclepiadaceae</td>
<td>Flower</td>
<td>70% hydroalcoholic extract</td>
<td>Rats</td>
<td>Reversed the enhanced SGOT, SGPT, ALP, bilirubin and cholesterol levels; reduced the serum level of HDL and tissue level of GSH.</td>
<td>Setty et al., 2007.</td>
</tr>
<tr>
<td>Celosia argentea Linn.</td>
<td>Amaranthaceae</td>
<td>Seeds</td>
<td>70% ethanolic extract 200 and 400mg/kg.</td>
<td>Wistar strain male rats</td>
<td>Significant reduction in the marker enzymes ALT, AST levels, reduction in cholesterol, triglycerides, and bilirubin all these blood bio chemical assays showed that the plant through free radicals scavenging activity play important role in regeneration of liver cells.</td>
<td>Jain, 2005.</td>
</tr>
<tr>
<td>Centella asiatica (L.) Urban.</td>
<td>Apiaceae</td>
<td>Whole plant</td>
<td>Aqueous slurry</td>
<td>Wistar albino rats</td>
<td>Significant reduction in the marker enzymes ALT, AST levels, reduction in cholesterol, triglycerides, and bilirubin all these blood bio chemical assays showed that the plant through free radicals scavenging activity play important role in regeneration of liver cells.</td>
<td>Pingale, 2008.</td>
</tr>
<tr>
<td>Cuscuta reflexa Roxb.</td>
<td>Convolvolacea</td>
<td>Whole plant</td>
<td>Chloroform and ethanol extract 200 and 400 mg/kg.</td>
<td>Male wistar albino rats</td>
<td>Reduction in the serum trasaminase ALP, ACP and bilirubin. The total triglyceride and cholesterol levels VLDL, LDL HDL, ALPQ4 and LDH were also reduced. Histopathological studies also provide supportive evidence necrosis and fatty changes were prevented.</td>
<td>Chatterjee et al., 2010.</td>
</tr>
<tr>
<td>Daucus carota Linn.</td>
<td>Apiaceae</td>
<td>Root</td>
<td>Carrot extract 25 ml/kg</td>
<td>Rats</td>
<td>Decreasing the level of serum enzymes (AST, ALT/ALP, TBARS, cholesterol, TG and LDL-cholesterol. Carrot extract also restored the depressed antioxidants and HDL-cholesterol levels to near normal.</td>
<td>Balasubramaniam et al., 1998 et al., 1998</td>
</tr>
<tr>
<td>Eclipta alba (Linn.) Hassk</td>
<td>Asteraceae</td>
<td>Whole plant</td>
<td>50% ethanolic extract 100 and 250mg/100gm.</td>
<td>Albino mice.</td>
<td>Significant reduction in the elevated serum ALT levels. Histopathological studies showed marked reduction in fatty degeneration and centrilobular necrosis.</td>
<td>Tabassum and Agrawal, 2004</td>
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<tr>
<td>Emblica officinalis Gaertn.f.</td>
<td>Euphorbiaceae</td>
<td>Fruits</td>
<td>50% hydroalcoholic extract</td>
<td>Rats</td>
<td>Reversal of serum enzyme activity i.e.(AST, ALT, ALP, bilirubin and LPO and recovery of GSH content, CAT and GSH activities were restored,</td>
<td>Tasduq et al., 2005.</td>
</tr>
<tr>
<td>Plant</td>
<td>Family</td>
<td>Part</td>
<td>Extract</td>
<td>Animal</td>
<td>Compound</td>
<td>Notes</td>
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<tr>
<td>Euphorbia hirta Linn.</td>
<td>Euphorbiacae</td>
<td>Whole plant</td>
<td>Alcoholic extract 100&amp;200 mg/kg b.wt.</td>
<td>Albino rats</td>
<td>CCl₄ intraperitonial injection</td>
<td>Biochemical and histopathological parameters shows the protective activity of 200mg/kg p.o. dose, there was significant reduction in serum pyruvate transaminase, serum oxalate transaminase and serum bilirubin. Histopathological results were also favourable.</td>
</tr>
<tr>
<td>Glorilgloria superba L.</td>
<td>Liliaceae</td>
<td>Tuber</td>
<td>Aqueous 500mg/kg</td>
<td>Female albino rats</td>
<td>Paracetamol</td>
<td>Decrease in lipid peroxidation, increase in glutathione and vitamin –C, catalase and glutathione peroxidase were also increased. The plant contains alkaloids, carbohydrates, proteins and thiols. Thus results shows that antioxidant activity is responsible for recovery of hepatotoxicity damage.</td>
</tr>
<tr>
<td>Jatropha curcas Linn.</td>
<td>Euphorbiacae</td>
<td>Leaves</td>
<td>Methanolic extract</td>
<td>Rats</td>
<td>Aflatoxin B₁</td>
<td>Increase in lipid peroxide level and decrease in antioxidant enzyme level is reversed to near normal. liver histopathology showed that plant extract reduced the incidence of liver lesions lymphatic infiltration and hepatic necrosis induced by AFB₁.</td>
</tr>
<tr>
<td>Lawsonia inermis Linn.</td>
<td>Lytheraceae</td>
<td>Seeds</td>
<td>Aqueous</td>
<td>Rats</td>
<td>Paracetamol</td>
<td>Significant reduction in serum enzymes alkaline amino transferase(ALT), aspartate amino transferase (AST), alkaline phosphatase (ALP), acid phosphatase (ACP), protein and bilirubin. The phytochemicals present are tannins, saponins, steroids, flavonoids, terpenoids and phlobatannins.</td>
</tr>
<tr>
<td>Mimosa pudica Linn.</td>
<td>Mimosaceae</td>
<td>Leaves</td>
<td>Methanolic extract 200mg/kg</td>
<td>Wistar albino rats</td>
<td>CCl₄ 1.25ml/kg i.p.</td>
<td>Significant reduction in SGOT, SGPT, ALP TBL, CHL, and increase in TPTN and ALB.</td>
</tr>
<tr>
<td>Moringa oleifera Lamk</td>
<td>Moringaceae</td>
<td>Fruit</td>
<td>Aqueous and alcoholic extract</td>
<td>Rats</td>
<td>CCl₄</td>
<td>SGOT, SGPT level decreases significantly.</td>
</tr>
<tr>
<td>Phyllanthus amarus Schumach &amp; Than.</td>
<td>Euphorbiacae</td>
<td>Whole plant</td>
<td>Ethanolic 200mg/kg</td>
<td>Male Wistar albino rats</td>
<td>Alcohol</td>
<td>Great change in the biochemical parameters in the ethanol intoxicated rats and maintained well to the normal level.</td>
</tr>
<tr>
<td>Picrorhiza kurroa Royle ex.</td>
<td>Scrophulariaceae</td>
<td>Whole plant</td>
<td>Ethyl acetate, ethanol and aqueous 30,100 and 300 mg/kg b.wt.</td>
<td>Swiss albino mice</td>
<td>Galactosamine (Gal-N),400 mg/kg b.wt. along with lipopolysaccharide (LPS) (0.5µg/kg) b.wt. i.p.</td>
<td>Pre treatment with ethylacetate100mg/kg b.wt. and aqueous extract 30 and 100mg/kg b.wt. shows significant reduction in SGOT, SGPT, total bilirubin, cholesterol and triglycerides.</td>
</tr>
<tr>
<td>Ricinus communis Linn.</td>
<td>Euphorbiacae</td>
<td>Leaves</td>
<td>Ethanolic extract 100mg/kg b.wt.</td>
<td>Mice</td>
<td>Ketoconazole</td>
<td>Total protein and albumin/globulin ratio was increased, and reduction in AST, ALT, ALP and total bilirubin.</td>
</tr>
<tr>
<td>Scoparia dulcis L. Linn.</td>
<td>Scrophulariaceae</td>
<td>Whole plant</td>
<td>Aqueous extract 500mg/kg</td>
<td>Wistar albino rats</td>
<td>DEN (N-nitrosodimethyl amine).</td>
<td>An oral dose of 500mg/kg exhibited significant decrease in marker enzymes level ALT, AST, ALP, ACP was observed, a significant increase in the level of superoxide dismutase, catalase, glutathione peroxidise.</td>
</tr>
<tr>
<td>Plant Name</td>
<td>Family</td>
<td>Part Used</td>
<td>Extract Type</td>
<td>Species</td>
<td>Biochemical parameters</td>
<td>Methodology</td>
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<tr>
<td>Nigella sativa L.</td>
<td>Ranunculaceae</td>
<td>Seeds</td>
<td>Ethanolic extract</td>
<td>wistar albino rats</td>
<td>D-Galactosamine (GalN)/Lipo-polysahharide</td>
<td>The Nigella sativa alcoholic extract (NSE) used in the study showed significant protection and maintained the levels of AST, ALT and ALP near to normal level. Gani and John, 2013.</td>
</tr>
<tr>
<td>Swertia Chirata</td>
<td>Gentianaceae</td>
<td>Stem</td>
<td>Ethanolic extract 100, 200 and 400 mg/kg</td>
<td>Albino rats</td>
<td>Paracetamol</td>
<td>Significantly altered serum marker enzymes aspartate amino transferase (AST), alanine amino transferase (ALT), alkaline phosphatase (ALP), total bilirubin levels to normal against paracetamol treated rats. 2014 Cheedella et al.</td>
</tr>
<tr>
<td>Sida acuta Burm. f.</td>
<td>Malvaceae</td>
<td>Whole plant and Root</td>
<td>Methanolic extract</td>
<td>Wistar rats.</td>
<td>Paracetamol</td>
<td>Decrease in serum levels of glutamate pyruvate transaminase, glutamate alkaline oxaloacetate transaminase, alkaline phosphatase and bilirubin. Pretreatment with Sida acuta acuta extract shortened the acuta extract shortened the duration of necrosis in mice indicating 2009 Sreedevi et al.</td>
</tr>
<tr>
<td>Solanum nigrum Linn.</td>
<td>Solanaceae</td>
<td>Fruits</td>
<td>Hydroalcoholi c extract.</td>
<td>Wistar albino rats.</td>
<td>CCl₄</td>
<td>Mark reduction in serum ALT, AST and bilirubin and increase in antioxidant activity enzymes SOD, GSH were increased. Histopathological analysis also provides favourable results. 2011 Subash et al.</td>
</tr>
<tr>
<td>Solanum xanthocarpum</td>
<td>Solanaceae</td>
<td>Fruits</td>
<td>Ethanolic extract 100, 200 and 400 mg/kg b. wt.</td>
<td>Spargue Dawley rats.</td>
<td>CCl₄</td>
<td>Significant reduction in biochemical parameters AST, ALT, ALP, total bilirubin. Antioxidant enzyme markers increased GSH, SOD, CAT etc. Histopathological studies also show favourable results. 2011 Gupta et al.</td>
</tr>
<tr>
<td>Tephrosia prupurea Linn.</td>
<td>Fabaceae.</td>
<td>Aerial parts</td>
<td>Aqueous, ethanolic extract 100, 300&amp;500mg/kg</td>
<td>Albino rats</td>
<td>Thioacetamide e.</td>
<td>Oral administration of Tephrosia purpurea at 500mg/kg dose resulted in a significant reduction in serum aspartate amino trasaminase, alanine amino trasaminase, gamma glutamyl transpeptidase alkaline phosphatase, total bilirubin and liver MDA levels and significant improvement in liver glutathione. Histology of the liver section of the animal treated with extracts also showed dose dependent reduction of necrosis. 2009 Khatri et al.</td>
</tr>
<tr>
<td>Terminalia arjuna (Roxb.) Wight &amp; Arn.</td>
<td>Combretaceae.</td>
<td>Bark</td>
<td>Aqueous extract 200 mg/kg b.wt.</td>
<td>Female albino rats.</td>
<td>Isoniazid 100 mg/kg b.wt.</td>
<td>Significant reduction in serum elevated biochemical markers ALP, ACP, SGOT, SGPT and increased level of SOD and GSH. The hepatoprotective activity of aqueous extract may be due to antioxidant principles in it. Phytochemical present are steroids, tannins, phenolics compound, quinone, terpenoids, sugar, alkaloids and flavonoids. alkaloids and flavonoids phenolics, quinine, terpenoids sugar, alkaloids and flavonoids. 2012 Doorika and Ananthi.</td>
</tr>
<tr>
<td>Terminalia chebula Retz.</td>
<td>Combretaceae.</td>
<td>Leaves</td>
<td>1%gum accacia suspension of leaves</td>
<td>Male wistar rats.</td>
<td>Paracetamol</td>
<td>Significant decrease was observed in elevated biochemical parameters SGOT, SGPT, ALP, bilirubin (total and direct) cholesterol, triglycerides and 2011 Vidy et al.</td>
</tr>
<tr>
<td>Plant Name</td>
<td>Family</td>
<td>Part Used</td>
<td>Extract</td>
<td>Treatment</td>
<td>Findings</td>
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<tr>
<td><em>Tinospora cordifolia</em> (Willed.) Miers ex. Hk. f &amp; Th.</td>
<td>Manispermaceae</td>
<td>Aerial parts</td>
<td>Aqueous extract 1-2ml/100g</td>
<td>Wistar albino rats</td>
<td>CCl₄</td>
<td>Lipid peroxidation and increase in GSH. Histopathological findings were also supportive.</td>
</tr>
<tr>
<td><em>Tridex procumbens</em></td>
<td>Asteraceae</td>
<td>Aerial parts</td>
<td>Chloroform insoluble fraction from ethanolic extract</td>
<td>Rats</td>
<td>d-GalN /LPS</td>
<td>Pretreatment altered increase in the activities of marker enzymes AST, ALT, ALP and total bilirubin decreased to near normal level in experimental rats.</td>
</tr>
<tr>
<td><em>Vitex negundo</em></td>
<td>Verbenaceae</td>
<td>Leaves</td>
<td>Ethanol extract 300mg/kg</td>
<td>Rats</td>
<td>Paracetamol</td>
<td>Significant reduction in serum enzymes ALT, AST, ALP. The histopathological result also shows protective action.</td>
</tr>
<tr>
<td><em>Withania frutescents</em></td>
<td>Solanaceae</td>
<td>Leaves</td>
<td>Ethanol extract</td>
<td>Rat or mice</td>
<td>CCl₄</td>
<td>Alteration in the modification of Nembutal-induced sleep, bile flow, serum transaminase and hepatic fatty acids levels and histopathological studies.</td>
</tr>
<tr>
<td><em>Zingiber officinalis</em></td>
<td>Zingiberaceae</td>
<td>Rhizome</td>
<td>Ethanol extract of essential oil</td>
<td>Rats</td>
<td>CCl₄</td>
<td>Lowered the elevation of ALT, ALP, AST, LDH, SDH and GDH/direct bilirubin level in dose dependent manner. Histopathological studies also provide favourable results.</td>
</tr>
</tbody>
</table>

Note – ACP (Acid Phosphatase), ALB (Albumin), ALP (Alkaline Phosphatase), ALT (Alanine Amino Transf erase), AST (Aspartate Transaminase), CAT (Catalase), CHL (Cholesterol), GDH (Glutamate Dehydrogenase), GSH (Glutathione), GPx (Glutathione Peroxidase), HDL (High-Density Lipoprotein), LDH (Lactate Dehydrogenase), LDL (Low-Density Lipoprotein), SDH (Sorbitol Dehydrogenase), SGOT (Serum Glutamic Oxaloetic Transaminase), SGPT (Serum Glutamic-Pyruvic Transaminase), SOD (Superoxide Dismutase), TBARS (Thiobarbituric Acid Reactive Substances), TBL (Total Bilirubin), TPTN (Total Protein), (VLDL (Very Low-Density Lipoprotein).