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AN UPDATED REVIEW ON HEPATOPROTECTIVE MEDICINAL PLANTS

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Abstract

Liver is the chief site for digestion and discharge in body. Liver helps in metabolizes the substances by different biochemical pathways including reduction, oxidation, condensation, hydration, hydrolysis, and isomerization. Disorder of any of the before referenced cycle might prompt liver cell injury, what we call as hepatotoxicity which thusly prompts numerous sicknesses. Such infections are answerable for higher death rates around the world. Hepatotoxicity can be because of drugs, synthetic compounds, dietary aggravations or spice initiated liver harm through hepatotoxins. Various home grown and herbomineral arrangements are accessible in the Ayurveda, the conventional Indian Medicine which have been examined for their hepatoprotective potential to treat various sorts of liver problems. This review is centered around various medicinal plants that can possibly cure the hepatotoxicity.

Keywords : Herbal plants, Hepatotoxicity, Herbal drugs, Indian Liver disease, Phytochemical

INTRODUCTION

The liver endures greatest affront in detoxifying the large number bof toxins are present in the food, beverages, medications and climate. Many danger factors incline a person to hepatic drug injury like previous liver sickness, female sex, aging and hereditary qualities. Liver being a significant site of digestion assumes a vital part in detoxification of different toxins ingested or potentially delivered during retention of the food material [1-3]. The liver generally channel all the blood from the digestive tract, prior to passing it to the remainder of the body to try not to enter poisons in the other body framework [4]. It uses diverse metabolic pathways for metabolism, energy production and reproduction to control practically all frameworks of the body [5]. Liver likewise integrates many supplement frameworks and proteins for supporting immune system [6].Therefore, healthy liver is key to healthy individual.

HEPATOTOXICITY INDUCING AGENTS

A few synthetics have been known to instigate hepatotoxicity. Galactosamine, dgalactosamine/lipopolysachharide (GalN/LPS), antitubercular drugs,Carbon tetrachloride (CCl4), paracetamol,thioacetamide, arsenic and so forth, are utilized to initiate exploratory hepatotoxicity in research laboratory on animals.[7]

HEPATOPROTECTIVE PLANTS

Medicinal plants are especially valued worldwide as a rich tool for bioactive disease prevention and treatment concepts. Plant remedies for preventing and maintaining anarchy to liver, hyperglycaemia, immune systems and other aging-related problems that are unable to cure with medical treatments also have been listed in the prehistoric medical system, in which only calming therapy is still provided.

The current survey is pointed toward compiling information dependent on reported research work on assuring phytochemicals from medicinal herbal plants that have been tried in hepatotoxicity models. The hepatoprotective activity of following plants.

Andrographis paniculata

S S Handa et al. Indian J Med Res showed that the Andrographolide is the active constituent of Ethanolic extract of Andrographis paniculata (Acanthaceae) antagonized the toxic results of Carbon tetrachloride. Biochemical parameters like serum transaminases—GOT and GPT, serum alkaline phosphatase, serum bilirubin and hepatic triglycerides were estimated and showed that elevated levels of the biochemical parameters has declined. [8]

Agrimonia eupatoria

The hepatoprotective benefits of aqueous extract in chronic ethanol-induced hepatic damage in animals were investigated. Rats were injected AE oral at doses ranging from 10-300 mg/kg every day. Serum enzyme activity and pro-inflammatory mediators rose significantly following prolonged ethanol intake, and these changes was mitigated by aqueous extract. The findings show the AE protects against persistent ethanol-induced liver disease, and this preservation is most probably due to suppression of oxidative stress and Activation of t inflammation activation. [9, 10]

Alhagi maurorum

Rats were used to study the hepatoprotective effect on the plant components ethanolic extracts. When contrasted to silymarin, treatment of 660 mg/kg of a ethanol extracts to animals resulted in a substantial decrease of liver enzymes in treated animals with such a mixture of ethanol extracts with (CCl4) or acetaminophen, as opposed to group treated CCl4 and alone. [11]

Allium Sativum

In such a study of garlic's antihepatic injury in rats, CrCl3 only raised blood levels of ALT and AST.Garlic, from the other hand, prevented CrCl3 toxicities, and simultaneous usage of CrCl3 and garlic reduced ALT and AST levels if garlic was administered at doses of 60 and 120 mg/kg, respectively. [12]

Anchusa strigosa

The ethanolic and aqueous extracts was tested for their ability to suppress aryl hydrocarbon hydroxylase function and (3H-BP) adherence to liver microsomal proteins. The water extracts would have no inhibition, whereas the ethanol extracts had a substantial inhibition activity upon adsorption of 3H-BP and AHH to a cytochrome protein. [13-14]

Arctium lappa

Burdock has been found to protect against CCl4 or acetaminophen-induced liver disease in rats, and also alcohol + CCl4-induced liver problems in rats. Burdock's basic hepatoprotective effect may be connected to down - regulation on cells by boosting GSH, cP-450 content, and NADPH reducing activity and lowering MDA material, therefore reducing the degree of liver disease. [15-17] **Astragalus hamosus**

The liver protective effect of rhamnocitrin 4'—D galactopyranoside as a flavonoid derived in leaf versus N-diethylnitrosamine-induced liver carcinoma in albino Wistar rats was demonstrated. [18] **Bauhinia variegata**

In mice, an ethanol extract of stems demonstrated chemoprevention of N- nitrosodiethylamineinduced exploratory tumour cells. The ethanol extracts of a bark extract of (at a dosage of 100-200 mg/kg daily) shown hepatoprotective efficacy in mice versus CCl4 hepatotoxicity, lowering the levels of ALT, ALP, ALT, and GGT.[19-20]

Bryophyllum calycinum

In animals, either juice of leaflets as well as the ethanol extracts of a marc remaining following expression are tested for CCl4-induced liver damage. In vivo, in vitro, and histopathology investigations revealed that they are now efficient hepatoprotections. These were discovered that the pulp is much more beneficial than ethanol extracts. [21-22]

Canna indica

Methanolic activity was tested for its efficacy towards CCl4 liver damage. All blood markers, such as SGOT and SGPT, that were increased in CCl4-treated rats, were recovered by the extracts. A 10percentage hepatic sample was utilized to estimate catalase, LPO, and GSH levels in vivo.In extract-treated mice, all LPO, lowered GSH, and enzyme concentrations was generally considered acceptable. [23-24]

Capparis spinosa

Ethanol root bark extracts protects the liver from CCl4-induced liver injury. Tissue samples from treated animals with ethanolic bark preparations revealed a substantial drop in serum levels, indicating liver cell survival. Aqueous extract therapy of pcm-induced liver damage in rats for 7, 14, 21 days reduced ALT, AMT, and Total bilirubin. [25-27] **Capsella bursa-pastoris** demonstrated hepatoprotective activity in rats were exposed to CCl4 exposure. At a dosage of 500 mg/kg weight, the blood levels bilirubin and SGOT in animals treated decreased significantly (26.8 and 31.78 percent, significantly) (p0.05). The lesser dosage of an extracts, while lowering the values of all variables, could not use it clinically significant. [28-29]

Celosia cristata

Semenoside A, a novel triterpenes saponin derived from Semen Celosia cristatae, been discovered. The hepatoprotective efficacy of semenoside A at oral doses of 1-4.0mg/kg, sequentially, was studied in rats using (CCl4)-induced toxicities. It exhibited substantial protective activity ($p < 0.01$), according to the findings. [30, 31]

Citrullus colocynthis

The preventive effect of methanol extracts on nitrosodiethylamine-induced liver disease in rats treated also investigated. Rats given DEN/PB had higher cholesterol and triglyceride levels (TG, $p<0.01$), cholesterol ($p<0.05$), free fatty acids ($p<0.01$), VLDL ($p<0.05$), LDL ($p<0.01$), and lower levels of urea, HDL, and creatinine. [32-34]

Convolvulus arvensis

The liver protective effect was investigated in mice with paracetamol-induced liver damage. The analysis indicates the ethanol extract reduced paracetamol-induced increases in antioxidant enzymes and bilirubin by a substantial (p0.05) amount. Histological analysis confirmed the liver-protective benefits. [35]

Clerodendron inerme

The ethanol extract was tested for hepatoprotective efficacy in Swiss normal mice with paracetamolinduced liver injury at such a dosage of 200 mg/kg bw. The ethanol extract provided substantial protection by decreasing SGOT, GPT, ALP, and total bilirubin levels. [36-37]

Ephedra species

Albino rats were used to test the hepatoprotective effect. CCl4 caused liver damage in animals. As just a representation of a liver's state, the virulence factors SGPT, SGOT, ALP, and total bilirubin were assessed. The extract's hepatoprotective impact was shown to be substantial throughout all measures at 500 mg/kg dosages. [38-39]

Fumaria officinalis

Liver protective effect was shown in rats with CCl4-induced liver injury. The ethanol extract, administered oral at doses of 500 and 200 mg/kg, had a substantial therapeutic potential by lowering blood indicator proteins such as SGOT, SGPT, and ALP. The extraction significantly decreased high concentrations of free and total bilirubin, lipids, and cholesterol in the blood. [40]

CONCLUSION

From this investigation, it is clearly proven that various diseases can be treated by medicinal plants. Various natural plants extracts have critical hepatoprotective activity in animal models. The hepatoprotective action is most likely because of the presence of flavonoids in medicinal plants. The consequences of this examination show that concentrates of leaves and plants concentrates of some restorative plant have great possibilities for use

in hepatic illness. The current survey study give evidential investigate instrument of activity of restorative plants against actuated hepatotoxicity. Consequently the survey study is presumed that the medicinal plants has hepatoprotective action and it has been demonstrated by various animal models give many connects to develop the future preliminaries study.

Table 1: List of Hepatoprotective plants

Botanical name	Family	Parts used	Solvent used	Screening method
Amaranthus caudatus Linn. [41]	Amaranthaceae	Whole plant	Methanol	CCl_4
Anisochilus carnosus Linn. [42]	Laminaceae	Stems	Ethanol	CCl_4
Calotropis procera R. Br [43]	Asclepediaceae	Root bark	Methanol	CCl_4
Cajanus scarabaeoides Linn. [44-45]	Fabaeceae	Whole plant	n-butanol, ethanol	Paracetamol
Carissa carindas Linn. [46]	Apocyanaceae	Root	Ethanol	CCl_4
Clitoris ternatea Linn. [47]	Fabaceae	Leaves	Methanol	Paracetamol
Cucumis trigonus Roxb. [48]	Cucurbitaceae	Fruit	Pet. Ether, chloroform, alcohol aqueous	CCl_4
Ficus religious Linn. [49]	Moraceae	Stem bark	Methanol	Paracetamol
Garcinia indica Linn [50]	Clusiaceae	Fruit rind	Ethanol	CCl_4
Gmelina asiatica Linn [51]	Verbenaceae	Aerial parts	Ethanol	CCl_4
Hyptis suaveolens Linn [52]	Lamiaceae	Leaves	Aqueous	Acetaminophen
Leucas cilita Linn [53]	Lamiaceae	Whole plant	Ethanol	CCl_4
Melia azhadirecta Linn [54]	Piperaceae	Leaves	Ethanol	CCl_4
Morinda citrifolia Linn [55]	Rubiaceae	Fruit	Aqueous	Streptozotocin
Myoporum lactum Linn [56]	Myoporaceae	Leaves	Methanol,n-Butanol	Profenofos
Myrtus communis Linn [57]	Myrtaceae	Leaves	Silymarin	Paracetamol

Solanum nigram Linn [58]	Solanaceae	Fruits	Ethanol	CCl_4

REFERENCES

1. Rane J, Kadhai R, Bakal RL (2016) Liver diseases and herbal drugs: A review. J innov pharm biol Sci 3: 24-36.
2. Osadebe PO, Okoye FB, Uzor PF, Nnamani NR, Adiele IE, et al. (2012) Phytochemical analysis, hepatoprotective and antioxidant activity of Alchornea cordifolia methanol leaf extract on carbon tetrachloride induced hepatic damage in rats. Asian Pacific J Trip Med 5: 289-93.
3. Chattopadhyay RR, Bhattacharya SK (2006) Terminalis chebula: Anupdate. Pharmacogenetics 1: 439-45.
4. Dienstag JL, Isselbacger KJ (2001) Toxic and drug induced hepatitis, 15th edn. Chapter 296, In: Harrison's Principles of Internal Medicine 2: 737-1742.
5. Ward FM, Daly MJ (1999) Hepatic disease. In: Walker R, Edwards C, editors. Clinical pharmacy and therapeutics. Churchill Livingstone, New York 195-212.
6. Dey P, Saha MR, Sen A (2013) Hepatotoxicity and the present herbal hepatoprotective scenario. Int J Gr Pharm 7: 265-273.
7. Bhakunietal Animal models of hepatotoxicity. Inflammation Research. 65. 10.1007/s000110150883-0, 2015.
8. S S Handa et al. Hepatoprotective activity of andrographolide from Andrographis paniculata against carbontetrachloride, Indian J Med Res. 1990 Aug
9. Al-Snafi AE. The pharmacological and therapeutic importance of Agrimonia eupatoria- A review. Asian Journal of Pharmaceutical Science and Technology 2015; 5(2): 112-117.
10. Yoon SJ, Koh EJ, Kim CS, Zee OP, Kwak JH, Jeong WJ, Kim JH and Lee SM. Agrimonia eupatoria protects against chronic ethanol-induced liver injury in rats. Food Chem Toxicol 2012; 50(7): 2335-2341.
11. Gargoum HM, Muftah SS, Al Shalmani S, Mohammed HA, Alzoki A, Debani, Al Fituri AHO, El Shari F, El Barassi I, Meghil SE and Abdellatif AG. Phytochemical screening and investigation of the effect of Alhagi maurorum (camel thorn) on carbon tetrachloride, acetaminophen and adriamycin induced toxicity in experimental animals. Journal of Scientific and Innovative Research 2013; 2(6): 1023-1033.
12. Ghalehkandi JG , Sis NM and Nobar RS. Anti-hepatotoxic Activity of Garlic (Allium sativum) Aqueous Extract compared with chromium chloride in male rats. Australian Journal of Basic and Applied Sciences 2012; 6(7): 80-84.
13. Alwan AH, Al-Gaillany KAS and Naji A. Inhibition of the binding of 3H-Benzo (a) pyrene to rat liver microsomal protein by plant extracts. Pharmaceutical Biology 1989; 27(1): 33-37.
14. Al-Snafi AE. The pharmacology of Anchusa italica and Anchusa strigosa – A review. International Journal of Pharmacy and Pharmaceutical Sciences 2014; 6(4): 7-10.
15. Lin SC, Chung TC, Lin CC et al. Hepatoprotective effects of Arctium lappa on carbon tetrachloride- and acetaminopheninduced liver damage. American Journal of Chinese Medicine 2000; 28: 163-173.
16. Lin SC, Lin CH, Lin CC et al. Hepatoprotective effects of Arctium lappa Linne on liver injuries induced by chronic ethanol consumption and potentiated by carbon tetrachloride. J Biomed Sci 2002; 9: 401-40.
17. Al-Snafi AE. The Pharmacological importance and chemical constituents of Arctium lappa. A review. International Journal for Pharmaceutical Research Scholars 2014; 3(1-1): 663-670
18. Al-Snafi AE. Chemical constituents and pharmacological effects of Astragalus hamosus and Astragalus Tribuloides grown in Iraq. Asian J of Pharm Sci & Tech 2015; 5(4): 321-328.
19. Surendra BH and Alpana R. Hepatoprotective properties of Bauhinia variegata bark extract. The Pharmaceutical Society of Japan 2007; 127(9): 1503-1507.
20. Al-Snafi AE. The Pharmacological importance of Bauhinia variegata. A Review. International Journal of Pharma Sciences and Research 2013; 4(12): 160-164.

21. Al-Snafi AE. Therapeutic properties of medicinal plants: a review of their detoxification capacity and protective effects (part 1). Asian Journal of Pharmaceutical Science & Technology 2015; 5(4): 257-270.
22. Devbhuti D, Gupta JK, Devbhuti P and Bose A. Phytochemical and acute toxicity study on Bryophyllum calycinum SALISB. Acta Poloniae Pharmaceutica-Drug Research 2008; 65(4): 501504.
23. Al-Snafi AE. The constituents and pharmacological properties of Calotropis procera - An Overview.International Journal of Pharmacy Review & Research 2015; 5(3): 259-275.
24. Joshi Y M, Kadam V J, Patil Y V and Kaldhone P R. Investigation of Hepatoprotective activity of Aerial Parts of Canna indica L. on carbon tetrachloride treated rats. Journal of Pharmacy Research 2009; 2(12): 1879-1882.
25. Aghel N, Rashidi I and Mombeini A. Hepatoprotective activity of Capparis spinosa root bark against CCl4 induced hepatic damage in mice. Iranian Journal of Pharmaceutical Research 2007; 6(4): 285-290.
26. Alnuaimy RJM and Al-Khan HIA. Effect of aqueous extract of Capparis spinosa on biochemical and histological changes in paracetamol-induced liver damage in rats. Iraqi Journal of Vet Sciences 2012; 26(1): 1-10.
27. Al-Snafi AE. The chemical constituents and pharmacological effects of Capparis spinosa - An overview.Indian Journal of Pharmaceutical Science and Research 2015; 5(2): 93-100.
28. Al Qasoumi S I.. Isolation and chemical structure elucidation of hepatoprotective constituents from plants used in traditional medicine in Saudi Arabia. PhD thesis, College of Pharmacy- King Saud University, 2007.
29. Al-Snafi AE. The chemical constituents and pharmacological effects of Capsella bursa-pastoris - A review.International Journal of Pharmacology and Toxicology 2015; 5(2):76-81.
30. Sun Z L, Gao G L, Xia Y F, Feng J and Qiao ZY. A new hepoprotective saponin from Semen Celosia cristata. Fitoterapia 2011; 82(4): 591-594.
31. Wang Y , Lou Z, Wu Q B and Guo M L. A novel hepatoprotective saponin from Celosia cristata L. Fitoterapia 2014; 81(8): 1246-1252.
32. Pan Y, Morikawa T, Ninomiya K, Imura K, Yuan D, Yoshikawa M and Muraoka O. Bioactive constituents From chinese natural medicines. XXXVI. Four new acylated phenylethanoid oligoglycosides, kankanosides J1, 2, K1, and K2, from stems of Cistanche tubulosa. Chem Pharm Bull (Tokyo) 2010; 58(4):575-578.
33. Jayaraman R and Christina AJM. Evaluation of Citrullus colocynthis fruits on in vitro antioxidant activity and In vivo DEN/PB induced hepatotoxicity. International Journal of Applied Research in Natural Products 2013; 6 (1): 1-9.
34. Al-snafi AE. Chemical constituents and pharmacological effects of Citrullus colocynthis – A review. IOSR Journal of Pharmacy 2016; 6(3): 57-67.
35. Ali M, Qadir MI, Saleem M, Janbaz KH, Gul H, Hussain L and Ahmad B. Hepatoprotective potential of Convolvulus arvensis against paracetamol-induced hepatotoxicity. Bangladesh J Pharmacol 2013; 8: 300-304
36. Al-Snafi AE. Chemical constituents and pharmacological effects of Clerodendrum inerme- A review. SMU Medical Journal 2016; 3(1): 129-153.
37. Rabiul H, Subhasish M, Sinha S, Roy MG, Sinha D and Gupta S. Hepatoprotective activity of Clerodendron inerme against paracetamol induced hepatic injury in rats for pharmaceutical product International Journal of Drug Development & Research 2011; 3(1): 118-126.
38. Alqasoumi SI, Al-Rehaily AJ, Abdulmalik MA, Maged, and Abdel-Kade S. Evaluation hepatoprotective effect of Ephedra foliate, Alhagi maurorum, Capsella bursapastoris and Hibiscus sabdariffa experimentally induced liver injury in Rats. Natur Prod Sci 2008; 14: 95-99.
39. Al-Snafi AE. Therapeutic importance of Ephedra alata and Ephedra foliata- A review. Indo Am J P Sci 2017; 4(02): 399-406.
40. Sharma UR, Prakash T, Surendra V, Roopakarki N and Goli D. Hepatoprotective activity of Fumaria officinalis against CCl4-induced liver damage in rats. Pharmacologia 2012; 3(1): 9-14.
41. Bagepalli Srinivas, Ashok Kumar, Kuruba Lakshman,Paresandra Avalakondarayppa Arun Kumar, Gollapalle Lakshminarayana Shastry Viswanpha, Veeresh, Prabhakar Veerapur, Boreddy, Shivanadpea, Thippeswamy, Bachappaa,Manoj. Hepatoprotective activity of methanol Extracts of Amaranthus caudatus Linn. Against paracetamol-Induced hepatic injury in rats, Journal of Chinese Integrative Medicine 2011, 9(2), 194-200.
42. Venkatesh P, Dinakar A, Senthilkumar N, Hepatoprotective Activity of an ethanolic extract of stems of Anisochilus Carnosus against carbon tetrachloride induced hepatotoxicity In rats, International Journal of Pharmacy and Pharmaceutical Sciences 2011, 3(1), 243-245.

43. Patil Prakash, Prasad K, Nitin M, Vinay Kumar M, Sreenivasa Rao K, Evaluation of hepatoprotective effect of Calotropis procera R.Br root extract against CCL4 induced Hepatooxidative stress in albino rats, International Journal In Ayurveda & Pharmacy 2011, 2(1), 319-324.
44. Oluseyi Adeboye Akinloye, Moshood Olajire Olaniyi, Hepatoprotective effect of Cajanus cajan on tissue defense System in D-galactosamine-induced hepatitis in rats, Turk J Biochem 2011, 36(3), 237–241.
45. Suman Pattanayak, Siva Sankar Nayak, Durga Prasad Panda, Subas Chandra Dinda, Vikas Shende, Amol Jadav, Hepatoprotective activity of crude flavonoids extract of Cajanus scarabaeoides (L) in paracetamol intoxicated Albino rats, Asian J Pharm Biol Res 2011, 1(1), 22-27.
46. Balakrishanan N, Balasubaramaniam A, Sangameswaran B, Bhaskar VH, Hepatoprotective activity of two Indian Medicinal plants from Western Ghats-Tamil nadu, Journal Of Natural Pharmaceuticals 2011, 2(2), 92-98.
47. Kuppan Nithianantham, Murugesan Shyamala, Yeng Chen, Lachimanan Yoga Latha, Subramanion L. Jothy, Sreenivasan Sasidharan, Hepatoprotective potential of Clitoria ternatea leaf extract against paracetamol induced damage in mice, Molecules 2011, 16, 10134-10145.
48. Kalpana Patila, Shaikh Mohammed Imtiaza, Anoop Singha, Varsha Bagewadia, Shaikh Gazib, Hepatoprotective activity of Cucumis trigonus Roxb. fruit against CCL4 induced hepatic damage in rats, Iranian Journal of Pharmaceutical Research 2011,10(2), 295-299.
49. Kavita Suryawanshi, Sanjay Khakre, Ashish Chourasia, Chaurasiya PK, Pawar RS, Deenanath Jhade, Hepato-protective activity of stem bark extracts of Ficus religiosa Linn in rats, International Journal of Biomedical Research 2011, 2(8), 466-475.
50. Amol Bhalchandra Deore, Vinayak D Sapakal, Nilofer SNaikwade, Antioxidant and Hepatoprotective activity of Garcinia indica Linn fruit rind, Pharmacie Globale International Journal of Comprehensive Pharmacy 2011,2(6), 1-5.
51. Merlin NJ and Parthasarathy V, Antioxidant and Hepatoprotective activity of chloroform and ethanol extracts of Gmelina asiatica aerial parts, Journal of Medicinal Plants Research 2011, 5(4), 533-538.
52. Babalola O, Ojo E, Oloyede F, Hepatoprotective activity of aqueous extract of the leaves of Hyptis suaveolens (L.) on acetaminophen induced hepatotoxicity in rabbits, Research Journal of Chemical Sciences 2011, 1(7), 85-88.
53. Mohammad N. Qureshi, Bhanudansh S. Kuchekar, Nadeem A. Logade, Majid A. Haleem, In-Vitro antioxidant and in-vivo hepatoprotective activity of Leucas ciliata leaves, Academy of Chemistry of Globe Publications 2010, 4(2),124-130.
54. Rajeswari H, Vasuki R, Samudram P, Geetha A, Hepatoprotective action of ethanolic extracts of Melia azedarach Linn and Piper longum Linn and their combination on CCL4 induced hepatotoxicity in rats, Indian Journal of Experimental Biology 2011, 49, 276-281.
55. Shivananda Nayak B, Julien R.Marshall, Godwin Isitor, Andrew Adogwa, Hypoglycemic and hepatoprotective activity of fermented fruit juice of Morinda citrifolia (Noni) in diabetic rats, Evidence-Based Complementary and Alternative Medicine 2011, 1-5.
56. Samy M. Mohamed, Emad M. Hassan, Khaled A. Abd Elshafeek, Azza M. Mohamed, Investigation of flavonoidal constituents and hepatoprotective activity of Myoporum lactum, International Journal of Academic Research 2011,3(3), 528-533.
57. Rupesh Kumar M, Pasumarthi Phaneendra, Surendra Bodhanapu, Fasalu Rahiman OM, Mohamed oiyas K, Tamizmani T, Antioxidant and Hepatoprotective activity of the aqueous extract of Myrtus communis (Myrtle) Linn leaves, Pharmacologyonline 2011, 1, 1083-1090.
58. Subash KR, Ramesh KS, Binoy Vargheese Charian Francis Britto, Jagan Rao N, Vijayakumar, Study of Hepatoprotective activity of Solanum nigrum and Cichorium intybus, International Journal of Pharmacology 2011, 7(4),504-509.