Plant Archives Vol. 20, Supplement 2, 2020 pp. 3032-3040 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

HEPATOPROTECTION BY NATURAL PRODUCTS: A RECENT UPDATE

Neha Morya[1], Ahmad Farid Habibyar[2], Manish Vyas[1], Sazal Patyar[1], Navneet Khurana[1], Neha Sharma[1*]
[1]School of Pharmaceutical Sciences, Lovely Professional University, Phagwara, Punjab, India, PIN- 144 411
[2]Department of Pharmacology, Faculty of Pharmacy, Kabul University, Kabul, Afghanistan
[*]Corresponding author: c4nehagautam@gmail.com

Abstract

Liver is the largest gland in human body. It plays vital role in clearing the various toxic and chemical agents. It is also susceptible to diseases from these toxic and chemical agents. There are numerous commercially accessible medicine, ingestion of these medicine leads to consequences in medicine induced liver injury. Hepatotoxicity by drug is one of most leading cause of mortality and its prevalence increase exponentially day by day. Irrespective of enormous improvements in targeted drug, there are no entirely active drugs supportive liver function and provide safety of the organ without producing toxic effect. As a consequence, it is necessary to identify low toxic substitutes for the management of hepatotoxicity. There are many natural medicine such as plants source and nutraceuticals play essential characters in human health care: various scientific studies have showed that positive properties on liver protection can be recognized to the existence of phytochemicals. This review focuses on management of hepatotoxicity by the natural product.

***Keywords*:** Hepatoprotection, hepatotoxicity, phytochemicals.

Introduction

Liver is the major organ in the human body. It perform numerous function including carbohydrate, lipid and protein metabolism and also help in clearing of many medicine, xenobiotic and synthetic compounds present in the body. Throughout this cleansing action, the toxic metabolite form that cause the hepatotoxicity rigorously (Dey *et al*., 2013). These detoxification of the harmful chemicals, which results in various liver disease such as hepatotoxicity (Thompson *et al*., 2017).

There are various reason for hepatotoxicity such as chemicals (pollution, carbon tetrachloride), (Dua *et al*., 2019) drugs (anti-tubercular drug, anti-viral drug, opoids) and metals (Bawa *et al*., 2019). During the hepatotoxicity cytokines are activated by the macrophages which is signal for hepatocytes inflammation (Mehta *et al*., 2019). The usage of herbal product and ingesting of various nutraceutical play an important role in the well-being and many research has been specified in the, herbal product and nutraceutical have advantageous properties can be attributed to the existence of natural product which are known as phytoconsitutents (Madrigal-santillán *et al*., 2014).

There are many floras show a significant character in the social well-being protection. About more than 80% of the global community depend in the usage of conventional medication that is primarily basis on herbal resources(Areefa Shaik, A Elumalai, 2012). The approximately 7,500 floras have utilize in native well-being societies in the, ethnic communities of India. In short, the approximately 4,000 plants still unknown to population (Roy *et al*., 2014). From the previous year nutraceutical also gain the popularity for the treatment of hepatotoxicity. “Nutraceutical” is defined as the diet or amount of diet that offers therapeutic or well-being benefits and also help in management of various disorder. There are various nutraceutical sources such as green vegetables, diary product (Nagpal *et al*., 2012), fruits, nuts, grains, phytoconsitutents and many more. Fisetin is one of the major constituents found in approximately all nutraceuticals (Kumar *et al*., 2019a). From these nutraceuticals sources various constituents are extract such as fisetin, vanillin (Abhinav Anand *et al*., 2019), betaine (Kaur *et al*., 2019), quercetin (Chellappan *et al*., 2019; Prashar *et al*., 2019; Khursheed *et al*., 2020), crocin (from stigmas of Crocus sativus) (Dar *et al*., 2017), curcumin (Som *et al*., 2020; Garg *et al*., 2019; Kaur *et al*., 2018) for making herbal medicine. Screening of various phytoconsituents is importance to for treatment of hepatotoxicity and other disease also (Anand *et al*., 2017). These phytoconsitutents contain various activity such as antioxidants (Willd *et al*., 2018; Kumar *et al*., 2018a; (Farooq and Sehgal, 2018), antimicrobials (Sarma *et al*., 2018), anti-inflammatory activity (Kumar *et al*., 2018b; Prasad *et al*., 2013; Kumar *et al*., 2019b). All these activity are determine by in vivo method. Apart from this now days various software are available which detect these activity (Rao *et al*., 2020) Currently 470 herbal medicine with well standard form are available in the markets (Gupta *et al*., 2019). These herbal medicine help in treatment of liver disease and also improve nutrition level in body (Rajasekaran *et al*., 2008). These nutraceutical also help to treat various kind of cancer patients (Muthuraman *et al*., 2011; Kumar *et al*., 2010; Patel, 2014).

Nutraceutical such as various citrus fruits like orange, grapes, lemons, lime, kiwi, tangerine these all are increase vitamins, minerals, antioxidants level in body (Motawe *et al*., 2015). Moreover, the experimental evidence of the natural medications for treating the liver disease has a long history, and the use of traditional medicinal plants and nutraceuticals by a many individuals and the diverse constituents extract from these plant and nutraceuticals. Generally, hepatoprotective nutraceutical and plants contain a variety of chemical constituent like alkaloids, glycoside phenols, coumarins, essential oils, monoterpenes, vitamins, minerals, carotenoids, flavonoids and xanthenes (Madrigal-Santillán E, Madrigal-Bujaidar E and S, Valadez-Vega MC, 2013). There are numerous herbal product existing in the medicine system. Generally, this plant product and nutraceutical have utilize with combination with medicine for the treatment of hepatotoxicity (Saha *et al*., 2019). So the present review is to explore the hepatoprotective effect by the natural product including plant and nutraceutical.

Table 1: Hepatoprotective plants evaluated using various *in vivo* animal models (continued)

S. No.	Botanical name	Family	Parts used	Screening method	Reference
1	*Aerva lanata*	Amaranthaceae	Root and flower	Carbon tetrachloride induced	(Ramachandra *et al*., 2011)
2	*Amaranthus caudatus* Linn	Amaranthaceae	Whole plant	Paracetamol induced	(Kumar *et al*., 2011)
3	*Anisochilus carnosus* Linn	Lamiaceae	Stem	Alcohol induced	(Nissar Ahmad Reshil, 2018)
4	*Asparagus racemosus*	Liliaceae	Root	Paracetamol induced	(Rahiman *et al*., 2014)
5	*Azima tetracantha*	Salvadoracaeae	Leaves	Carbon tetrachloride induced	(T.Nargis Begum, 2016)
6	*Aegle Marmelos*	Rutaceae	Leaf	Alcohol induced	(Malairajan *et al*., 2007)
7	*Azadirachta indica*	Meliaceae	Aerial parts	Paracetamol induced	(Chattopadhyay, 2005)
8	*Berberis aquifolium,*	Berberidaceae	Rhizome	Carbon tetrachloride induced	(Feng *et al*., 2010)
9	*Commiphora wightii*	Burseraceae	Stem	Carbon tetrachloride induced	(Harjeet Singh *et al*., 2019)
10	*Carissa carindas*	Apocyanaceae	Root	Carbon tetrachloride induced + Paracetamol induced	(Hegde and Joshi, 2008)
11	*Cucumis trigonus Roxb.*	Cucurbitaceae	Fruit	Carbon tetrachloride induced	(Patil and Shaikh, 2015)
12	*Cassia fistula*	Fabaceae	Leaves	Carbon tetrachloride induced	(Kaur *et al*., 2020)
13	*Cajanus cajan Linn*	Leguminosae	leaves	Carbon tetrachloride induced + N-Nitrosodiethylamine induced	(Singh *et al*., 2011) Eze *et al*., 2019)
14	*Cajanus scarabaeoides* Linn	Fabaeceae	Whole plant	Paracetamol induced	(Pattanayak *et al*., 2011)
15	*Clitoria ternatea* Linn	Fabaeceae	Leaves	Paracetamol induced	(Nithianantham *et al*., 2011)
16	*Calotropis procera*	Asclepediaceae	Root bark	Paracetamol induced	(Setty *et al*., 2019)
17	*Curcuma xanthorrhiza Roxb.*	Zingiberaceae	Rhizome	Carbon tetrachloride induced + Paracetamol induced	(Devaraj *et al*., 2014) Pramono *et al*., 2018)
18	*Guazuma tomentosa*	Sterculiaceae	Leaves	Carbon tetrachloride induced	(Sharma *et al*., 2014)
19	*Ficus carica*	Moriaceae	Leaf	Rifampicin induced	(Gond and Khadabadi, 2008)
20	*Ficus religiosa Linn.*	Moriaceae	Stem bark	Paracetamol induced	(Pawar and Jhade, 2016)
21	*Fumaria officinalis*	Fumariaceae	Aerial parts	Carbon tetrachloride induced	(Udya Raj *et al*., 2012)
22	*Garcinia morella*	Clusiaceae	Fruit	Carbon tetrachloride induced	(Desr *et al*., 2017)
23	*Gmelina asiatica* Linn	Verbenaceae	Aerial parts	Carbon tetrachloride induced	(Ar and Gs, 2016)
24	*Euphorbia hirta*	Euphorbiacea	Aerial parts	Carbon tetrachloride induced	(Dubey and Mehta, 2014)
25	*Habiscus cannabinus*	Malvaceae	Leaves	Carbon tetrachloride induced + paracetamol induced	(Agbor and Oben, 2005)
26	*Hyptis suaveolens* Linn	Lamiaceae	Leaves	Acetaminophen induced	(Babalola *et al*., 2011)
27	*Ipomoea staphylina Linn.*	Convolvulaceae	Aerial Parts	Carbon tetrachloride induced	(Jeyadevi *et al*., 2019)
28	*Melia azedarach* Linn	Piperaceae	Leaves	Simvastatin induced	(Rao *et al*., 2012)
29	*Moringa oleifera*	Moringaceae	leaves	Cadmium induced	(Toppo *et al*., 2015) (Biswas *et al*., 2019) Farooq and Koul, 2019)
30	*Morinda citrifolia*	Moraceae	Fruit	Carbon tetrachloride induced	(Nayak *et al*., 2011)
31	*Myrtus communis*	Myrtaceae	Leaves	Paracetamol induced	(Rupesh *et al* .,)
32	*Myoporum lactum* Linn	Myoporaceae	Leaves	Carbon tetrachloride induced	(Venkat, 2017)

33	*Nelumbo nucifera*	Nelumbonaceae	Seed	Alcohol induced	(Pa and Meenakshi, 2017)
34	*Otostegia persica*	Lamiaceae	Aerial parts	Carbon tetrachloride induced	(Toori *et al*., 2015)
35	*Picrorrhiza kurroa*	Scrophulariaceae	Rhizome	Galactosamine induced	(Negi *et al*., 2007)
36	*Rubia tinctorum*	Rubiaceae	Root	Carbon tetrachloride induced	(Marhoume *et al*., 2017)
37	*Leucas cilita* Linn	Lamiaceae	Whole plant	Carbon tetrachloride induced	(Qureshi *et al*., 2010)
38	*Luffa echinata*	Cucurbitaceae	Fruit	Carbon tetrachloride induced	(Kumar *et al*., 2012)
39	*Piper longum*	Piperaceae	Fruit	Isoniazid+ Rifampicin + Pyrazinamide induced	(Joseph, 2014)
40	*Silybium marianum*	Asteraceae	Seeds	Thioacetamide induced	(Asgary, 2014)
41	*Sida cordifolia*	*Malvaceae*	Roots	Alcohol induced	(Rejitha *et al*., 2012; Khurana *et al*., 2016)
42	*Solanum nigram*	Solanaceae	Fruit	Carbon tetrachloride induced	(K.R Subash, K.S Ramesh, 2017)
43	*Sphaeranthus indicus*	Asteraceae	leaves	Carbon tetrachloride induced	(Mansoori *et al*., 2018)
44	*Tinospora cordifolia*	Menispermaceae	Aerial parts	Carbon tetrachloride induced	(B. T. Kavitha1, S. D. Shruthi, 2011 ;Harjeet Singh *et al*., 2019)
45	*Thunbergia laurifolia*	Acanthacaceae	Leaves	Alcohol induced	(Palipoch *et al*., 2019)
46	*Ocimum tenuiflorum*	Lamiaceae	Seed, Leaves	Paracetamol induced	(Chattopadhyay *et al*., 1992) Sharma *et al*., 2017)

Table 2: List of commonly consumed hepatoprotective nutraceutical evaluated using various *in vivo* models (continued)

S. No.	Biological Source	Family	Parts Consumed	Screening method	Reference
1	Carrot *(Daucus carota)*	Umbelliferae	Root	Paracetamol induced	(Jain *et al*., 2017)
2	Cabbage *(Brassica oleracea)*	Brassicaceae	Leaves	Simvastatin induced	(Mohammed *et al*., 2013)
3	Sugar leaf *(Stevia rebaudiana)*	Simvastatin	Leaves	Thioacetamide induced	(Das and Kathiriya, 2012)
4	Coconut oil (Cocos nucifera)	Arecaceae	Kernel	Paracetamol induced	(Zakaria *et al*., 2011)
5	Tomato (*Solanum lycopersicum)*	Solanaceae	Pulp	Carbon tetrachloride induced	(Weremfo and Asamoah, 2011)
6	Cactus Pear (*Opuntia ficus-indica)*	Cactaceae	Fruit	Carbon tetrachloride induced	(Albano *et al*., 2015)
7	Corn silk (Zea Mays Linn.)	Gramineae	stigmata	Isolated Rat Liver Perfusion	(Karami *et al*., 2013)
8	Blueberry (Vaccinium corymbosum)	Ericaceae	Fruit	Carbon tetrachloride induced	(Liu *et al*., 2019)
9	Lemon *(Citrus limon)*	Rutaceae	Fruit	Carbon tetrachloride induced	(Bhavsar *et al*., 2008)
10	Chilly *(Capsicum annuum)*	Solanaceae	Fruit	Lipopolysaccharide Induced	(Vasanthkumar *et al*., 2017)
11	Red rice *(Oryza sativa)*	Poaceae	Seed	Paracetamol induced	(Sinthorn *et al*., 2016)
12	Mango(Mangifera indica)	Anacardiaceae	Fruit	Carbon tetrachloride induced	(Motawe *et al*., 2015)
13	Wheat (Triticum aestivum)	Poaceae	Grain	Carbon tetrachloride induced	(Motawe *et al*., 2015)
14	Fennel (*Foenculum vulgare) Linn.*	Umbelliferae	Bulbs	Carbon tetrachloride induced	(Yuan *et al*., 2011)
15	*Turmeric (Curcuma longa)*	Zingiberaceae	Rhizome	Thioacetamide induced	(Salama *et al*., 2013)
16	Garlic *(Allium sativum)*	Liliaceae	Bulb	Lead Induced	(Wu *et al*., 2011)
17	Onion (*Allium cepa)*	Liliaceae	Bulb	Paracetamol induced	(Ozougwu and Eyo, 2014)
18	Red grapes (*Vitis vinifera)*	Vitaceae	Seed	Ethanol-Induced	(Hassan *et al*., 2018)

19	*yam (Amorphophallus campanulatus)*	Araceae	Tubers	Carbon tetrachloride induced	(Sanjay jain, vinod k. dixit, 2009)
20	*Winter melon (Benincasa Hispida)*	Cucurbitaceae	fruits	Diclofenac sodium	(Rose *et al*., 2015)
21	Beetroot *(Beta vulgaris)*	Amaranthaceae	Root	Carbon tetrachloride induced	(Rose and Sudha, 2014)
22	*Mustard seeds (Brassica juncea)*	Brassicaceae	Seed	Carbon tetrachloride induced	(Walia *et al*., 2011)
23	Papaya *(Carica papaya)*	Caricaceae	Fruits	Carbon tetrachloride induced	(Mohammed *et al* ., 2017)
24	*Colocasia (Colocasia Antiquorum)*	Araceae	leaves, Corm	Carbon tetrachloride induced+ Paracetamol induced	(T. A. Tuse, 2009)
25	Taro (*Colocasia Esculenta)*	Araceae	Tender leaves, Corm	Thioacetamide induced	(Chinonyelum *et al*., 2015)
26	*Coriander (Coriandrum sativum)*	Umbelliferaeae	Seed	Carbon tetrachloride induced	(A. Pandey, P. Bigoniya, V. Raj, 2014)
27	Cucumber (*Cucumis sativus)*	Cucurbitaceae	Fruits & Seeds	Paracetamol induced	(Palanisamy *et al*., 2015)
28	Cumin (*Cuminum cymin)*	Apiaceae	Seed	Cisplatin induced	(Abbas and Naz, 2017)
29	Liquorice *(Glycyrrhiza glabra)*	Leguminosae	Root	Carbon tetrachloride induced	(Maksoud *et al*., 2019)
30	Gooseberry(*Phyllanthus emblica)*	Phyllanthaceae	Fruit	Cisplatin induced	(Abbas and Naz, 2017)
31	Mint*(Mentha arvensis)*	Lamiaceae	leaves	Carbon tetrachloride induced	(Patil and Mall, 2012)
32	Curry leaf (*Murraya koenigii)*	Rutaceae	leaves	Carbon tetrachloride induced	(M. S. Pande, S. P. B.N Gupta, 2015)
33	Cardamom (*Elettaria cardamomum)*	Zingiberaceae	Seed	Gentamicin induced	(Aboubakr and Abdelazem, 2015)
34	Sesame *(Sesamum Indicum)* Linn.	Pedaliaceae	Seed	Carbon tetrachloride induced	(Cengiz and Kavak, 2012)
35	Clove(Syzygium aromaticum)	Myrtaceae	Bud	Paracetamol induced	(Sadia Kazi, 2016)
36	Bitter gourd *(Momordica charantia)*	Cucurbitaceae	Fruit	Acetaminophen Induced	(Zahra *et al*., 2012)
37	Broccoli (*Brassica oleracea*)	*Brassicaceae*	Fruit	Carbon tetrachloride induced	(El-baz, 2012)
38	Pumpkin *(Cucurbita maxima)*	*Cucurbitaceae*	Fruit	Carbon tetrachloride induced	(Haldar *et al*., 2011)
39	Pineapple *(Ananas comosus)*	Bromeliaceae	Fruit	Isoniazid induced	(Yantih and Harahap, 2017)
40	custard apple *(Annona squamosal)*	Annonaceae	Fruit	Isoniazid+ rifampicin induced	(Ts *et al*., 2008)
41	Spinach (Spinacia oleracea)	Chinopodiacea-e	leaves	Carbon tetrachloride induced	(Hr *et al*., 2015)
42	Eggplant (*Solanum melongena*)	Solanaceae	Fruit	Carbon tetrachloride induced	(Raj *et al*., 2016)
43	Avocado (Persea Americana)	Lauraceae	Fruit	Carbon tetrachloride induced	(Raj *et al*., 2016)
44	Cucumber (Cucumis sativus)	Cucurbitaceae	Fruit	Alcohol induced	(Kumar *et al*., 2019)

Conclusion

The rising attention in the scientific estimation of several herbal and nutraceuticals utilize in Ayurvedic structure of medication. Plants and nutraceuticals now days gain the devotion as the strength advantageous nutrition and also a basis for the drug design procedure. Various natural drug obtain from nutraceutical abstract that are actually used to management of an extensive diversity of liver disorder.

During the previous senescence, the usage of natural product supplementation remained improved from 2.6% to 13%.

With the advancement of the herbal product and data-based studies prove that plant made medicine comprise various constituents that prevent from various kinds of hepatotoxicity. The usage of these herbal product also improve the quality of life. However, the rich antioxidant potential of the plant and nutraceutical essential to be explored in detail so that more hepatoprotective drugs can be formulated in an effective manner.

Reference

Pandey, A.; Bigoniya, P.; Raj, V. (2014). Pharmacological screening of Coriandrum sativum Linn. for hepatoprotective activity. J. Pharm. Bioallied Sci. 3: 435–441.

Abbas, N. and Naz, M. (2017). Comparitive study of hepatoprotective effect produced by Cuminum, Cyminum fruit of Phyllaethus emblicus and silymarin against cysplatin-induced hepatotoxicity. Int. J. Pharm. Sci. Res. 8: 2026–2032.

Abhinav Anand, R.K. (2019). Vanillin: A comprehensive review of pharmacological activities. J. Plant Arch. 19: 1000–1004.

Aboubakr, M.; and Abdelazem, A.M. (2015). Hepatoprotective effect of aqueous extract of cardamom against gentamicin induced hepatic damage in rats. Int. J. Basic Appl. Sci. 5: 1–5.

Agbor, G. and Oben, J. (2005). Hepatoprotective Activity of *Hibiscus cannabinus* (Linn.) Against Carbon Tetrachloride and Paracetamol Induced Liver Damage in Rats. J. Biol. Sci. 8(10): 1397–1401.

Albano, C.; Negro, C.; Tommasi, N.; Gerardi, C.; Mita, G.; Miceli, A.; et al. (2015). Betalains, Phenols and Antioxidant Capacity in Cactus Pear [Opuntia ficus-indica (L.) Mill.] Fruits from Apulia (South Italy) Genotypes. J. Phytochem. 4: 269–280.

Anand, A.; Sharma, N.; and Khurana, N. (2017). Prediction of activity spectra of substance assisted prediction of biological activity spectra of spectra of potential anti-alzheimer's phytoconsitutent's. Asian J. Pharm. Clin. Res. 11: 48–56.

Ar, F.; and Gs, R.B. (2016). Phytochemical analysis of Gmelina asiatica L . leaves. Int. J. Chem. Stud. 4: 78–82.

Areefa Shaik, A Elumalai, M.C.E. (2012). An updated review on hepatoprotective medicinal plants. J. Drug Deliv. Ther. 2: 2–4.

Asgary, S. (2014). Hepatoprotective Activity of Silybum marianum and Cichorium intybus Against Thioacetamide in Rat. J. Nutr. 7: 172–176.

B. T. Kavitha1, S. D. Shruthi, S.P.R. and Y.L.R. (2011). Phytochemical analysis and hepatoprotective properties of Tinospora cordifolia against carbon tetrachloride-induced hepatic damage in rats. J. Basic Clin. Pharm. 002: 139–142.

Babalola, O.O.; Ojo, O.E.; and Oloyede, F.A. (2011). Hepatoprotective activity of aqueous extract of the leaves of Hyptis suaveolens (l .) Poit on acetaminophen Induced hepatotoxicity in rabbits. Res. J. Chem. Sci. 1: 85–88.

Bawa, G.; Mahajan, R.; Mehta, M.; Satija, S.; Vyas, M.; and Sharma, N. (2019). Herbal drugs for the treatment of opioid withdrawal syndrome□: A mini review. J. Plant Arch. 19: 1005–1011.

Bhavsar, S.K.; Joshi, P.; Shah, M.B.; Santani, D.D.; Bhavsar, S.K.; Joshi, P.; et al. (2008). Investigation into Hepatoprotective Activity of Citrus limon. J. Pharm. Sci. 45: 303–311.

Biswas, D.; Nandy, S.; Mukherjee, A.; Pandey, D.K.; and Dey, A. (2019). Moringa oleifera Lam. and derived phytochemicals as promising antiviral agents: A review. South African J. Bot. 2: 1–11.

Cengiz, N.; and Kavak, S. (2012). Investigation of the Hepatoprotective Effects of Sesame (Sesamum indicum L.) in Carbon Tetrachloride-Induced Liver Toxicity. J. Biol. 246: 1–6.

Chattopadhyay, R.R.; Sarkar, S.K.; Ganguly, S.; Medda, C.; and Basu, T.K. (1992). Hepatoprotective activity of Ocimum sanctum leaf extract against paracetamol hepatic damage in rats. Indian J. Pharmacol. 24: 163–165.

Chellappan, D.K.; Yee, N.J.; Kaur Ambar Jeet Singh, B.J.; Panneerselvam, J.; Madheswaran, T.; Chellian, J.; et al. (2019). Formulation and characterization of glibenclamide and quercetin-loaded chitosan nanogels targeting skin permeation. Ther. Deliv. 10: 281–293.

Chinonyelum, A.N.; Uwadiegwu, A.P.; Nwachukwu, O.C.; and Emmanuel, O. (2015). Evaluation of hepatoprotective activity of Colocasia esculenta (L. Schott) leaves on thioacetamide-induced hepatotoxicity in rats. J. Pharm. Sci. 28: 2237–2241.

Dar, R.A.; Brahman, P.K.; Khurana, N.; Wagay, J.A.; Lone, Z.A.; Ganaie, M.A.; et al. (2017). Evaluation of antioxidant activity of crocin, podophyllotoxin and kaempferol by chemical, biochemical and electrochemical assays. Arab. J. Chem. 10: S1119–S1128.

Das, K.; and Kathiriya, A.K. (2012). Original article Hepatoprotective activity of stevia rebaudiana Bert. leaves against against thioacetamide induced toxicity. J. Med. Res. 9: 343–351.

Desr, G.; Gogoi, N.; Gogoi, A.; Neog, B.; Baruah, D.; and Singh, K.D. (2017). Antioxidant and hepatoprotective activity of fruit rind extract of Garcinia Antioxidant and hepatoprotective activity of fruit rind extract of Garcinia morella (Gaertn.) Desr. Indian J. Nat. Prod. Resour. 8(2),: 132–139.

Devaraj, S.; Ismail, S.; Ramanathan, S.; and Yam, M.F. (2014). Investigation of Antioxidant and Hepatoprotective Activity of Standardized Curcuma xanthorrhiza Rhizome in Carbon Tetrachloride-Induced Hepatic Damaged Rats. Sci. World J. 2014: 1–8.

Dey, P.; Saha, M.R.; and Sen, A. (2013). Hepatotoxicity and the present herbal hepatoprotective scenario. Int. J. Green Pharm. 2: 265–273.

Dua, K.; Wadhwa, R.; Singhvi, G.; Rapalli, V.; and Satija, S. (2019). The potential of siRNA based drug delivery in respiratory disorders□: Recent advances and progress. J. Drug Dev. Res. 2: 1–17.

Dubey, S.; and Mehta, S.C. (2014). Hepatoprotective Activity of Euphorbia Hirta Linn . Plant against Carbon Tetrachloride -Induced Hepatic Injury in Rats. Int. Conf. Food, Biol. Med. Sci. 8–11.

El-baz, F.K. (2012). Evaluation of hepatoprotective effect of broccoli (Brassica oleracea)extract against carbon tetrachloride in rats. Int. J. Med. Biol. Front. 18: 321–535.

Eze, E.; Iweala, J.; and Evbakhavbokun, W.O. (2019). Antioxidant and Hepatoprotective E ff ect of Cajanus cajan in N-Nitrosodiethylamine-Induced Liver Damage. J. Sci. Pharm. 87: 1–16.

Farooq, B.; and Koul, B. (2019). Comparative analysis of the antioxidant, antibacterial and plant growth promoting potential of five Indian varieties of Moringa oleifera L. South African J. Bot. 1–9.

Farooq, S.; and Sehgal, A. (2018). Current Research in Nutrition and Food Science Antioxidant Activity of Different Forms of Green Tea: Loose Leaf , Bagged and Matcha. Curr. Res. Nutr. Food Sci. 06: 4–9.

Feng, Y.; Siu, K.; Ye, X.; Wang, N.; Yuen, M.; Leung, C.; et al. (2010). Hepatoprotective effects of berberine on carbon tetrachloride-induced acute hepatotoxicity in rats. J. Chinese Med. 1–6.

Garg, V.; Kaur, P.; Gulati, M.; Singh, S.K.; Kumar, B.; Pandey, N.K.; et al. (2019). Coadministration of Polypeptide-k and Curcumin Through Solid Self-Nanoemulsifying Drug Delivery System for Better Therapeutic Effect Against Diabetes Mellitus: Formulation, Optimization, Biopharmaceutical Characterization, and Pharmacodynamic Assessment. Assay Drug Dev. Technol. 17: 201–221.

Gond, N.Y.; and Khadabadi, S.S. (2008). Hepatoprotective Activity of Ficus carica Leaf Extract on Rifampicin-Induced Hepatic Damage in Rats. Int. Pharm. Sci. 70(3): 364–366.

Gupta, V.; Kumar, R.; Kumar, R.; Mahajan, R.; Mehta, M.; and Satija, S. (2019). Pharmacological action of sinomenium acutum: A brief review. J. Plant Arch. 19: 1732–1736.

Haldar, P.K.; Kar, B.; and Naskar, S. (2011). Evaluation of hepatoprotective activity of Cucurbita maxima aerial parts. J. Herb. Med. Toxicol. 5: 17–22.

Harjeet Singh et al. (2019). Novel drug delivery approaches for guggul. J. Plant Arch. 19: 983–993.

Harjeet Singh, M.M. (2019). Recent patent technologies of Tinospora cordifolia for anti-diabetic potential□: A review. J. Plant Arch. 19: 994–999.

Hassan, H.M.M. (2018). Hepatoprotective Effect of Red Grape Seed Extracts Against Ethanol-Induced Cytotoxicity Hepatoprotective Effect of Red Grape Seed Extracts. Glob. J. Biotechnol. Biochem. 7: 30–37.

Hegde, K.; and Joshi, A.B. (2008). Hepatoprotective effect of Carissa carandas Linn root extract against CCl4 and paracetamol induced hepatic oxidative stress. Indian J. Exp. Biol. 47: 660–667.

Hr, M.H.R.; Pn, S.; and Sudhakar, K. (2015). A study on the hepatoprotective activities of Methanol Extract of Spinacia oleracea (Linn .) to the Induced Hepatotoxicity in wistar rat models Original Article. Int. J. Pharma Res. Heal. Sci. 2: 287–301.

Jain, P.K.; Khurana, N.; Pounikar, Y.; Patil, S.; and Gajbhiye, A. (2017). Hepatoprotective Effect of Carrot (Daucus carota L .) on Paracetamol Intoxicated Rats. Int. J. Pharmacol. Pharm. Technol. 1: 115–120.

Jeyadevi, R.; Ananth, D.A.; and Sivasudha, T. (2019). Hepatoprotective and antioxidant activity of Ipomoea staphylina Linn. J. Clin. Phytoscience 5: 2–11.

Joseph, S. (2014). Hepatoprotective effect of aqueous extract of Piper longum and piperine when administered with antitubercular drugs. Int. Q. J. Life Sci. 7: 661–663.

K.R Subash, K.S Ramesh, B.V. (2017). Study of Hepatoprotective Activity of Solanum nigrum and Cichorium intybus. IIternational J. Pharmacol. 2: 1–6.

Karami, M.; Saeidnia, S.; and Naghshvar, F. (2013). The Hepatoprotective Effects of Corn Silk against Dose-induced Injury of Ecstasy (MDMA) Using Isolated Rat Liver Perfusion. Iran. J. Toxicol. 7: 809–815.

Kaur, P.; Garg, V.; Bawa, P.; Sharma, R.; Singh, S.K.; Kumar, B.; et al. (2018). Formulation, systematic optimization, in vitro, ex vivo, and stability assessment of transethosome based gel of curcumin. Asian J. Pharm. Clin. Res. 11: 41–47.

Kaur, S. (2019). A Review on pharmacological activities of betaine. J. Plant Arch. 19: 1021–1034.

Kaur, S.; Kumar, A.; Thakur, S.; Kumar, K.; Sharma, R.; Sharma, A.; et al. (2020). Antioxidant, antiproliferative and apoptosis-inducing efficacy of fractions from cassia fistula l. Leaves. J. Antioxidants 9: 1–33.

Khurana, N.; Sharma, N.; Patil, S.; and Gajbhiye, A. (2016). Phyto- Pharmacological properties of Sida cordifolia: A review of folklore use and pharmacological activities. Asian J. Pharm. Clin. Res. 9: 52–58.

Khursheed, R.; Singh, S.K.; Wadhwa, S.; Gulati, M.; and Awasthi, A. (2020). Enhancing the potential preclinical and clinical benefits of quercetin through novel drug delivery systems. Drug Discov. Today 25: 209–222.

Kumar, A.; Veerapur, V.; and Shivanandappa, T.B. (2011). Hepatoprotective activity of methanol extract of Amaranthus caudatus Linn . against paracetamol-induced hepatic injury in rats. J. Chinese Integr. Med. 9: 194–200.

Kumar, J.S.; Sourabh, R.; Singh, G.K.; Pranjali, J.; and Nagori, B.P. (2012). Investigation of Herbal Extract as Hepatoprotective. J. Pharm. Sci. 1: 16–18.

Kumar, M.; Kumar, A.; Nagpal, R.; Mohania, D.; Behare, P.; Verma, V.; et al. (2010). Cancer-preventing attributes of probiotics: An update. Int. J. Food Sci. Nutr. 61: 473–496.

Kumar, R.; Khursheed, R.; Kumar, R.; Awasthi, A.; Sharma, N.; Gowthamarajan, K.; et al. (2019a). Journal of Drug Delivery Science and Technology Self-nanoemulsifying drug delivery system of fisetin: Formulation , optimization , characterization and cytotoxicity assessment. J. Drug Deliv. Sci. Technol. 54: 101252.

Kumar, V.; Kushwaha, R.; Goyal, A.; Tanwar, B.; and Kaur, J. (2018a). Process optimization for the preparation of antioxidant rich ginger candy using beetroot pomace extract. Food Chem. 245: 168–177.

Kumar, V.; Singh, S.; Singh, A.; Dixit, A.K.; Srivastava, B.; Sidhu, G.K.; et al. (2018b). Phytochemical, Antioxidant, Antimicrobial, and Protein Binding Qualities of Hydro-ethanolic Extract of Tinospora cordifolia. J. Biol. Act. Prod. from Nat. 8: 192–200.

Kumar, V.; Singh, S.; Srivastava, B.; Bhadouria, R.; and Singh, R. (2019b). Green synthesis of silver nanoparticles using leaf extract of Holoptelea integrifolia and preliminary investigation of its antioxidant, anti-inflammatory, antidiabetic and antibacterial activities. J. Environ. Chem. Eng. 7: 103094.

Liu, B.; Fang, Y.; Yi, R.; and Zhao, X. (2019). Preventive Effect of Blueberry Extract on Liver Injury Induced by Carbon Tetrachloride in Mice. J. Food Sci. 8: 1–13.

M. S. Pande, S. P. B.N Gupta, A.P. (2015). Hepatoprotective activity of Murraya koenigii Linn. J. Herb. Med.

Toxicol. 3: 69–71.

Madrigal-Santillán E, Madrigal-Bujaidar E, C.-J.; and S, Valadez-Vega MC, S.-M.M. (2013). The Chemoprevention of Chronic Degenerative Disease Through Dietary Antioxidants: Progress, Promise and Evidences. J. Intech Open Sci. 2: 155–185.

Madrigal-santillán, E.; Madrigal-bujaidar, E.; Álvarez-gonzález, I.; Sumaya-martínez, M.T.; Gutiérrez-salinas, J.; Bautista, M.; et al. (2014). Review of natural products with hepatoprotective effects. World J. Gastroenterol. Gastroentrology 20: 14787–14804.

Maksoud, H.A.A.; Abdel, A.D.; Mostafa, Y.M.; Elharrif, M.G.; Sorour, R.I.; and Ibrahim, M. (2019). Ameliorative effect of liquorice extract versus silymarin in experimentally induced chronic hepatitis□: A biochemical and genetical study. Clin. Nutr. Exp. 23: 69–79.

Malairajan, S.; Begum, H.; and Mohideen, V. (2007). The Hepatoprotective Effect of Bael Leaves (Aegle Marmelos) in Alcohol Induced Liver Injury in Albino Rats The Hepatoprotective Effect of Bael Leaves (Aegle Marmelos) in. Int. J. Sci. Technol. 2: 83–92.

Mansoori, M.H.; Gupta, M.K.; Dr, V.M.; Yadav, N.; and Vyas, M. (2018). Estimation of antioxidant and hepatoprotective activity of Sphaeranthus indicus Linn leaves extract. Int. J. Green Pharm. 12: S855–S862.

Marhoume, F.; Zaid, Y.; Boufous, H.; and Errafiy, N. (2017). Hepatoprotective Activity of Rubia tinctorum's Extract against CCl4 Induced Hepatic Injury in Rats Hepatoprotective Activity of Rubia tinctorum's Extract against CCl 4 Induced Hepatic Injury in Rats. European J. Med. Plants 20(4): 1–10.

Mehta, M.; Sharma, N.; Vyas, M.; Khurana, N.; Kumar, P.; Singh, H.; et al. (2019). Chemico-Biological Interactions Interactions with the macrophages: An emerging targeted approach using novel drug delivery systems in respiratory diseases. Chem. Biol. Interact. 304: 10–19.

Mohammed, A. (2017). Hepatoprotective effect of aqueous leaf extract of Carica papaya Linn. against CCL 4-induced hepatic damage in rats. Int. J. Pharm. Sci. Rev. Res. 11: 2–6.

Mohammed, B.; Ahmed, F.; Rao, A.S.; Ahmed, M.F.; and Rao, A.S. (2013). Comparative Hepatoprotective Activities of Selected Indian Medicinal Plants. Glob. J. Med. Res. 13: 1–9.

Motawe, E.H.; Gibriel, A.A.Y.; and Elbehairy, S.A. (2015). Journal of the American College of Nutrition Hepatoprotective and Antioxidant Effects of Wheat, Carrot , and Mango as Nutraceutical Agents against CCl 4 -Induced Hepatocellular Toxicity. J. Am. Coll. Nutr. 34: 228–231.

Muthuraman, A.; Ramesh, M.; and Chauhan, A. (2011). Mitochondrial dependent apoptosis: Ameliorative effect of flunarizine on ischemia-reperfusion of celiac artery-induced gastric lesions in the rat. Dig. Dis. Sci. 56: 2244–2251.

Nagpal, R.; Behare, P. V.; Kumar, M.; Mohania, D.; Yadav, M.; Jain, S.; et al. (2012). Milk, Milk Products, and Disease Free Health: An Updated Overview. Crit. Rev. Food Sci. Nutr. 52: 321–333.

Nayak, B.S.; Marshall, J.R.; Isitor, G.; and Adogwa, A. (2011). Hypoglycemic and Hepatoprotective Activity of Fermented Fruit Juice of Morinda citrifolia (Noni) in Diabetic Rats. J. Hindwai 11: 1–5.

Negi, A.S.; Kumar, J.K.; Luqman, S.; Shanker, K.; Gupta, M.M.; and Khanuja, S.P.S. (2007). Recent Advances in Plant Hepatoprotectives□: A Chemical and Biological Profile of Some Important Leads. J. Med. Res. Rev. 28: 746–772.

Nissar Ahmad Reshil, S.M.S. and G.V.H. (2018). Evaluation of Hepatoprotective potential of leaf and leaf Evaluation of hepatoprotective potential of leaf and leaf callus extracts of Anisochilus carnosus (L) wall. Int. J. Phytomedicine 10: 156–161.

Nithianantham, K.; Shyamala, M.; Chen, Y.; Latha, L.Y.; Jothy, S.L.; and Sasidharan, S. (2011). Hepatoprotective Potential of Clitoria ternatea Leaf Extract Against Paracetamol Induced Damage in Mice. J. Mol. 16: 10134–10145.

Ozougwu, J.; and Eyo, J. (2014). Hepatoprotective effects of Allium cepa (onion) extracts against paracetamol-induced liver damage in rats. African J. Biotechnol. 13:.

Pa, R.; and Meenakshi, C. (2017). Food Science and Nutrition Technology Antioxidant and Hepatoprotective Activity of Lotus (Nelumbo Nucifera) Seed Extract. 2: 1–7.

Palanisamy, V.; Shanmugam, S.; and Balakrishnan, S. (2015). Hepato protective activity of Cucumis sativus Linn . Int. J. Pharm. Sci. 6: 85–88.

Palipoch, S. (2019). Effect of aqueous leaf extract of Thunbergia laurifolia on alcohol-induced liver injury in rats. Trop. J. Pharm. Res. 18: 823–828.

Patel, S. (2014). Cereal bran: The next super food with significant antioxidant and anticancer potential. Med. J. Nutrition Metab. 5: 1–17.

Patil, K.; and Mall, A. (2012). Hepatoprotective activity of Mentha arvensis Linn . leaves against CCL 4 induced liver damage in rats. Asian Pacific J. Trop. Dis. (2012)S223-S226 S223–S226.

Patil, K.; and Shaikh, G. (2015). Hepatoprotective Activity of Cucumis trigonus Roxb . Fruitagainst CCl4 Inducesd Hepatic Damage in Rats. Iran. J. Pharm. Res. 10: 295–299.

Pattanayak, S.; Nayak, S.S.; Panda, D.P.; and Dinda, S.C. (2011). Hepatoprotective Activity of Crude Flavonoids Extract of Cajanus scarabaeoides (L) in Paracetamol Intoxicated Albino Rats. Asian J. Biol. Res. 1: 22–27.

Pawar, R.S.; and Jhade, D. (2016). Hepato-Protective Activity of Stem Bark Extracts of F . religiosa Linn in Rats. Int. J. Biomed. Res. 8: 466–475.

Pramono, S.; Mada, U.G.; Arifah, F.H.; Mada, U.G.; Nugroho, A.E.; and Mada, U.G (2018). Hepatoprotective Activity of Curcuma xanthorrhiza Roxb. on Paracetamol- induced Liver Damage in Rats and Correlation with Their Chemical Compounds. Thai J. Pharm. Sci. 42: 188–195.

Prasad, S.B.; Yashwant, and Aeri, V. (2013). In vitro anti-inflammatory activity of Raupya (Silver) Bhasma. J. Chem. Pharm. Res. 5: 194–197.

Prashar, P.; Mahajan, R.; Mehta, M.; Satija, S.; Vyas, M.; Sharma, N.; et al. (2019). Prediction of Prospective Anti-Parkinson Phytochemicals using Prediction of Activity Spectra of Substances Software to Justify 3R's Ethics of. Asian J Pharm Clin. Res. 13: 1–5.

Qureshi, M.N.; Kuchekar, B.S.; Logade, N.A.; and Haleem, M.A. (2010). In-vitro Antioxidant and In-vivo Hepatoprotective activity of Leucas ciliata leaves. J. Nat. Prod. 2: 124–130.

R. R. Chattopadhyay, M.B. (2005). Possible mechanism of hepatoprotective activity of Azadirachta indica leaf extract against paracetamol- induced hepatic damage in rats. Indian J. Pharmacol. 37: 184–185.

Rahiman, F.; Kumar, R.; and Trust, B.E. (2014). Hepatoprotective Activity of 'Asparagus Racemosus Root' On Liver Damage Caused By Paracetamol in Rats. Indian J. Nov. Drug Deliv. 3(2): 112–117.

Raj, K.; Balasubramanian, S.; and Nataraj, S. (2016). Comparative evaluation of hepatoprotective effects of exotic fruits and common vegetables extracts on CCl4 induced hepatotoxicity: An in vitro study. Int. J. Pharm. Sci. Res. 7: 3388–3393.

Rajan Kumar, R.K. (2019). Fisetin: A phytochemical with various pharmacological activities. J. Plant Arch. 19: 1012–1016.

Rajasekaran, A.; Sivagnanam, G.; and Xavier, R. (2008). Nutraceuticals as therapeutic agents□: a review. Res. J. Pharm. Tech 1: 328–340.

Ramachandra, Y.L.; Shilali, K.; Ahmed, M.; Sudeep, H. V, Kavitha, B.T.; Gurumurthy, H.; et al. (2011). Hepatoprotective properties of boerhaavia diffusa and Aerva lanata against carbon tetra chloride induced hepatic damage in rats. J. Pharmacol. 3: 435–441.

Rao, A.S.; Ahmed, M.F.; Ibrahim, M.; and Ahmed, M.F. (2012). Hepatoprotective activity of Melia azedarach leaf extract against simvastatin induced Hepatotoxicity in rats. J. Appl. Pharm. Sci. 02: 144–148.

Rao, B.S.; Lakshmi, V.; and Kaushik, V. (2020). An In Silico Comparative Study of Anti-inflammatory Role of Biochanin A and Genistein with 9 Omega-3-fatty Acids Using Complex Docking Analysis with PPARγ and GPR120. Int. J. Pept. Res. Ther. 2: 1–17.

Rejitha, S.; Prathibha, P.; and Indira, M. (2012). Amelioration of alcohol-induced hepatotoxicity by the administration of ethanolic extract of Sida cordifolia Linn . Br. J. Nutr. 108: 1256–1263.

Rose, M.H.; and Sudha, P.N. (2014). Effect of antioxidants and activity of methanol extract of beet root (Beta vulgaris) aginst carbon tetrachloride induced hepatotoxicity in rat models. Int. J. Pharm. Sci. Res. 5: 2536–2545.

Rose, M.H.; and Sudha, P.N. (2015). A Review on Hepatoprotective Activity of Commonly Consumed Vegetables. J. Phytomedicine 5: 290–304.

Roy, A.; Bhoumik, D.; Sahu, R.K.; and Dwivedi, J. (2014). Medicinal Plants Used in Liver Protection - A Review. UK J. Pharm. Biosci. 2: 23–33.

Rupesh Kumar. M, Pasumarthi.Phaneendra, Surendra Bodhanapu, F.; and Rahiman.O.M, Mohamed 0iyas K, T.. (2011). Antioxidant and Hepatoprotective Activity of the Aqueous Extract of Myrtus. J. Pharmacol. 1090: 1083–1090.

Sadia Kazi, P.A.& A.A.A. (2016). Syzygium Aromaticum: A potential hepato protective agent. J. Biol. Res. 7: 956–959.

Saha, P.; Talukdar, A. Das, Nath, R.; Sarker, S.D.; Nahar, L.; Sahu, J.; et al. (2019). Role of natural phenolics in hepatoprotection: A mechanistic review and analysis of regulatory network of associated genes. Front. Pharmacol. 10:.

Salama, S.M.; Abdulla, M.A.; Alrashdi, A.S.; Ismail, S.; and Alkiyumi, S.S. (2013). Hepatoprotective effect of ethanolic extract of Curcuma longa on thioacetamide induced liver cirrhosis in rats. J. Biosci. Med. 1: 13–56.

Sanjay Jain, Vinod K. Dixit, N.M. (2009). Antioxidant and hepatoprotective activity of ethanolic and aqueous extracts of Amorphophallus campanulatus Roxb . tubers. J. Pharm. Sci. 6: 423–428.

Sarma, C.; Rasane, P.; Kaur, S.; Singh, J.; Singh, J.; Gat, Y.; *et al.* (2018). Antioxidant and antimicrobial potential of selected varieties of piper betle L. (Betel leaf). An. Acad. Bras. Cienc. 90: 3871–3878.

Setty, S.R.; Ahmed, A. and Swamy, A.H.M.V. (2019). Hepatoprotective activity of Calotropis procera flowers against paracetamol- induced hepatic injury in rats. Asian Pac. J. Trop. Med. 78: 451–454.

Sharma, J.; Khurana, N.; Sharma, N.; and Garg, R. (2017). Phytochemical evaluation and antioxidant screening studies of Ocimum tenuiflorum Linn seeds. Asian J. Pharm. Clin. Res. 76–82.

Sharma, M.; Yashwant, and Prasad, S.B. (2014). Hepatoprotective activity of guazoma tomentosa leaf extracts against ccl4 induced liver damage in rats. Int. J. Curr. Pharm. Rev. Res. 4: 128–138.

Singh, S.; Mehta, A.; and Mehta, P. (2011). Hepatoprotective activity of *Cajanus cajan* against carbon tetrachloride induced liver damage. Int. J. Pharm. Pharm. Sci. 3: 3–4.

Sinthorn, W.; Chatuphonprasert, W.; and Chulasiri, M. (2016). Thai red rice extract provides liver protection in paracetamol-treated mice by restoring the glutathione system. J. Pharm. Biol. 54: 770–779.

Som, S.; Singh, S.K.; Khatik, G.L.; Kapoor, B.; Gulati, M.; Kuppusamy, G.; et al. (2020). Quality by Design-Based Crystallization of Curcumin Using Liquid Antisolvent Precipitation: Micromeritic, Biopharmaceutical, and Stability Aspects. Assay Drug Dev. Technol. 18: 11–33.

T.A. Tuse, U.N.H. &V. V.B. (2009). Hepatoprotective activity of Colocasia antiquorum experimentally induce liver injury in rats. Malaysian J. Pharm. Sci. 7: 99–112.

Nargis Begum, M.. M.I. and A.V.A. (2016). Hepatoprotective Activity of Azima tetracantha Lam . in Experimental animals. J. Pharm. Resaech 4: 2359–2360.

Thompson, M.; Jaiswal, Y.; Wang, I.; and Williams, L. (2017). Hepatotoxicity: Treatment, causes and applications of medicinal plants as therapeutic agents. J. Phytopharm. 6: 186–193.

Toori, M.A.; Joodi, B.; Sadeghi, H.; and Sadeghi, H. (2015). Hepatoprotective activity of aerial parts of Otostegia persica against carbon tetrachloride-induced liver damage in rats. Adv. J. Phytomedicine 5: 238–246.

Toppo, R.; Roy, B.K.; Gora, R.H.; Baxla, S.L.; and Kumar, P. (2015). Hepatoprotective activity of Moringa oleifera against cadmium toxicity in rats. J. Vet. Sci. 8: 537–540.

Ts, M.S.; Ajm, C.; Chidambaranathan, N.; and Ravi, V. (2008). Hepatoprotective activity of Annona squamosa Linn . on experimental animal model. Int. J. Appl. Res. Nat. Prod. 1: 1–7.

udya Raj, A.; Tigari, P.; and Surendra, V. (2012). Hepatoprotective Activity of Fumaria officinalis against CCl4-induced Liver Damage in Rats. J. Pharmacol. 3(1): 9–14.

Vasanthkumar, T.; Hanumanthappa, M.; and Hanumanthappa, S.K. (2017). Hepatoprotective Effect of Curcumin and Capsaicin against Lipopolysaccharide Induced Liver Damage in Mice. J. Pharmacogn. 9: 947–951.

Venkat, S. (2017). A Review on hepatoprotective activity. Int. J. Curr. Res. 9: 51876–51881.

Walia, A.; Malan, R.; Saini, S.; Saini, V.; and Gupta, S. (2011). Hepatoprotective effects from the leaf extracts of Brassica juncea in CCl 4 induced rat model. J. Pelagia Res. Libr. 2: 274–285.

Weremfo, A.; and Asamoah, K.A. (2011). Preliminary Study on Hepatoprotective Activity of Tomato (Solanum lycopersicum L .) Pulp Against Hepatic Damage in Rats. J. Biosci. Med. 5: 248–250.

Willd, R.; Mansoori, M.H.; Gupta, M.K.; Mishra, V.;and Yadav, N. (2018). Evaluation of the antioxidant activity of fruit extracts of indigenous medicinal plant,. Int. J. Green Pharm. 12: 863–869.

Wu, C.; Chu, Y.; and Sheen, L. (2011). Allicin modulates the antioxidation and Detoxification Capabilities of Primary Rat Hepatocytes. J. Tradit. Complement. Med. 2: 323–330.

Yantih, N.; and Harahap, Y. (2017). Hepatoprotective Activity of Pineapple (Ananas comosus) Juice on Isoniazid-induced Rats. J. Biol. Sci. 17: 388–393.

Yuan Wanga, Dan Lia, Ni Chenga, Hui Gaoa, Xiaofeng Xueb, Wei Cao, a, L.S. (2011). Antioxidant and hepatoprotective activity of vitex honey against paracetamol in duced liver damage in rats. J. Chem. 2: 1–30.

Zahra, K.; Malik, M.A.; Mughal, M.S.; Arshad, M.; and Sohail, M.I. (2012). Hepatoprotective role of extracts of Momordica charantia L . in acetaminophen- induced toxicity in rabbits. J. Anim. Plant Sci. 22: 273–277.

Zakaria, Z.A.; Rofiee, M.S.; Somchit, M.N.; Zuraini, A.; Sulaiman, M.R.; Teh, L.K.; et al. (2011). Hepatoprotective Activity of Dried- and Fermented-Processed Virgin Coconut Oil. J. Biosci. Med. 3: 1–9.