Review Article
ISSN: 0974-6943

R. Arun Prabhu et al. / Journal of Pharmacy Research 2011,4(1),164-166

Available online through

http://jprsolutions.info

Review on Curative assets of Seabuckthorn

Rameshbabu Arun Prabhu*, Ganapathy Arun Prasad, Jothiramajayam Manivannan, Subramani Elavarasan, Sundaramoorthy Balaji

School of Bio Sciences and Technology,VIT University, Vellore, Tamil Nadu, India.

Received on: 15-09-2010; Revised on: 18-10-2010; Accepted on:17-12-2010

ABSTRACT

Over centuries, cultures around the world have learned how to use plants to fight illness and maintain health. These readily available and culturally important traditional medicines form the basis of an accessible and affordable health-care regime and are an important source of livelihood for indigenous and rural populations. Medicinal plants are being widely investigated owing to their ability to produce molecules of therapeutic significance. Seabuckthorn (*Hippophae rhamnoides L.*, *Elaegnaceae*) is a thorny nitrogen fixing deciduous shrub, native to several countries of Eurasia including India, China, Nepal, Russia, Britain, Germany, Finland, and France. Most parts of the plant are considered to be good source of large number of bioactive substances like vitamins (A, C, E, B2, B9 and K), carotenoids (a, b, d-carotene, lycopene), flavonoids (isorhamnetin, quercetin, myricetin, kaempferol and their glucoside compounds), organic acids (malic acid and oxalic acid), sterols (ergosterol, stigmasterol, lanosterol and amyrins) and some essential amino acids. The presence of these compounds makes the plant curatively rich. This review highlights the potential medicinal properties of Seabuckthorn which will be useful to encounter various health menaces and also for further investigation of creating efficient drug aimed at various therapeutic applications.

Key words: Seabuckthorn; Bioactive substances; Curatively rich; Therapeutic applications.

INTRODUCTION

Herbal formulations have been in use for many years not only in Asian countries but also globally for human well-being [1,2]. The herbal formulations claimed to enhance physical endurance; mental functions and non-specific resistance of the body have been termed as adaptogens [1]. It has been hypothesized that plants growing in adverse climatic conditions of high altitude acquire biomolecules which help them to sustain in such environment and supplementation of such plant products to the animals increase their performance during exposure to stressful cold and hypoxic environment [3]. Seabuckthorn belongs to the family ***Elaegnaceae*** [4] growing in North-West Himalayas at high altitude (7000–15,000 feet) is a dwarf to tall (3–15 feet), branched, and thorny nitrogen fixing deciduous shrub [5]. Seabuckthorn can withstand extremes of temperature from 43ºC to 55ºC, soil pH from 5.8 to 9.5 and grows well under drought conditions of about 250–800 mm annual rainfall. It harbours a symbiotic nodule forming mycorrhizal fungus Frankia that fixes atmospheric nitrogen [14]. All parts of the plant are considered to be good source of a large number of bioactive substances. The chemical and phytochemical composition of seabuckthorn has been reviewed and found to vary with origin, climate and method of extraction [6]. The ripe fruit has been reported to be a source of exceptionally high contents of vitamins (A, C, E, and K), carotenoids, flavonoids, and organic acids.

Extracts of whole fruit, fruit pulp, pulp oil, and seed oil has been reported to possess immunomodulatory, anti-oxidant, and anti-bacterial activity [7]. Seabuckthorn leaves are rich in flavonoids, tannins, and triterpenes [9]. Many medicinal effects of seabuckthorn against flu, cardiovascular diseases, mucosal injuries, and skin disorders have been suggested which might be due to its adaptogenic, anti-oxidative and immunomodulatory activity [6,8,10]. Its fruits are used for commercial scale production of medically important fatty oil (Oleum hippophae) [11,12,13]. All parts of the plant are rich in various biologically active compounds. Therefore this plant has all the property that are necessary to be used in medicinal applications. This review explores the medicinal assets of Seabuckthorn with respect to adaptogenic, antioxidant, antimicrobial and protective properties of seabuckthorn.

Adaptogenic property of seabuckthorn:

Stress can influence reproductive function, immune system and the brain. The following conditions such as Angina, Asthma, Auto-immune diseases, Cancer, Cardiovascular disease syndrome, Common cold, Depression, Diabetes (adult onset, type II), Headaches, Hypertension, Immune suppression, Irritable bowel disease, Menstrual irregularities, Premenstrual tension, Rheumatoid arthritis, Ulcerative colitis, Ulcers are commonly linked to stress [15,16]. An adaptogenic substance is one that demonstrates a nonspecific enhancement of the body's ability to resist a stressor [17]. Seabuckthorn is a well-known adaptogenic shrub. In a study by Geetha (2004), oral administration of single dose (100 mg/kg body weight) extract of seabuckthorn dry leaves extracted with 70% ethyl alcohol in a Soxhlet apparatus was found to possess anti-stress activity [18]. Saggu *et al.* (2006) studied the dose dependent adaptogenic activity of seabuckthorn dried leaves aqueous extract in rats using a passive cold (5ºC)–hypoxia (428 mm Hg)–restraint (C–H–R) animal model with the following experimental setup [19]. He has demonstrated with seabuckthorn leaf, after the lyophilized powder was dissolved in suitable volume of water to obtain the desired dose on body weight basis (mg/kg) of the animal in 0.5 ml volume for its oral administration. A single dose of seabuckthorn (***Hippophae rhamnoides***) dry leaf aqueous extract was given orally in a 0.5 ml volume through a gastric cannula to overnight fasted rats, 30 min prior to C–H–R exposure. Six rats were used for each dose. The different doses of the seabuckthorn leaf aqueous extracts used were 3.125, 6.25, 12.5, 25, 50, 100, 150 and 200 mg/kg body weight. Six control rats were administered an equivalent volume (0.5 ml) of water orally 30 min prior to C–H–R exposure [20]. The rats were exposed in a decompression chamber maintained at 5ºC and a low atmospheric pressure of 428mm Hg pressures equivalent to an altitude of 4572 m. The rats were restrained and rectal probe was inserted 2 cm past the rectum and retained there with the help of adhesive plaster. A constant room temperature was maintained in all experiments as recovery time also depended on the ambient temperature. The rats continued to be restrained during recovery period. The time taken to attain rectal temperature (Trec) 23ºC and its recovery to Trec 37 ºC were used as a measure of endurance [20]. The results obtained were shown in table 1. From the results it is clear that seabuckthorn comprehends adaptogenic property.

Table 1: Dose dependent adaptogenic activity of seabuckthorn leaf aqueous extract after single dose oral administration. Courtesy: Saggu *et al.* (2007)

Dose (mg/kg body weight)	Time taken (in min) to attain Trec 23 ºC	% Change from control values	Time taken (in min) to attain Trec 37 ºC	% Change from control values
Control rats	75.5± 0.6		157.0 ± 1.5	
3.125	73.5 ± 1.7	2.6	121.2 ± 1.2*	22.9
6.25	75.2 ± 1.1	0.4	99.8 ± 1.69*	36.4
12.5	92.5 ± 1.9*	22.5	98.5 ± 3.9*	37.3
25	102.7 ± 1.04*	36.0	99.5 ± 1.7*	36.6
50	104.8 ± 1.1*	38.8	98.8 ± 3.7*	37.1
100	125.7 ± 1.4*	66.4	91.0 ± 3.1*	42.0
150	122.8 ± 2.0*	62.6	98.2 ± 3.6*	37.5
200	107 ± 2.2*	41.7	92 ± 1.4*	41.4

Results are means ± SE of six rats in each group, Significance at $p < 0.05$*

***Corresponding author.**
R. Arun Prabhu
School of Biosciences and Technology, VIT University,
Vellore - 632 014, Tamil Nadu, India.
Tel.: *+ 91-09843236374*
E-mail:*dairyman_7777@yahoo.co.uk*

Antioxidant activities of seabuckthorn:

Antioxidants can interfere with the oxidation process by reacting with free radicals, chelating catalytic metals and also as reactive species scavenger. Antioxidant supplement can be used in order to reduce the oxidative damage induced from reactive species. Polyphenolic compounds, like flavonoids and phenolic acids, commonly found in plants, have been reported to have multiple biological effects, including antioxidant activity [21,22]. This makes seabuckthorn as a reliable antioxidant. Camelia papuc et al. (2008) studied the antioxidant property of seabuckthorn [23]. The dried fruits of seabuckthorn were powdered and successively extracted with ethanol and acetone in a Soxhlet extractor. The total antioxidant activity of sea buckthorn fruits extracts was determined according to the ferric thiocyanate method [24]. The inhibition of lipid peroxidation was calculated by the following equation:

$$\textbf{\% Inhibition} = \frac{(\text{Control- Test})}{\text{control}} \times 100$$

Control samples were, solutions without the addition of sea buckthorn extracts or standard antioxidant. Figure 1 shows that Sea buckthorn extracts exhibited antioxidant activity. Alcoholic extract was the most efficient antioxidant, 2,6-di-tert-butyl-p-hydroxytoluene (BHT) and tert-butyl-hydroxyanisole (BHA) showed a lower antioxidant activity. Antioxidant activity of sea buckthorn fruit extracts can be attributed to the property of capturing free radicals. Patro *et al.* (2001) also concluded that higher antioxidogenic activity of seabuckthorn berry is due to higher contents of flavonoids [25]. Rosch *et al*. (2003) observed that a few phenolic compounds present in seabuckthorn fruit juice have good antioxidant capacity; their contribution to the antioxidant effect is meagre in comparison to ascorbic acid [26]. These properties make sea buckthorn extracts applicable to be used as natural antioxidant in medical, pharmaceutical and food industry.

Antimicrobial activities of seabuckthorn:

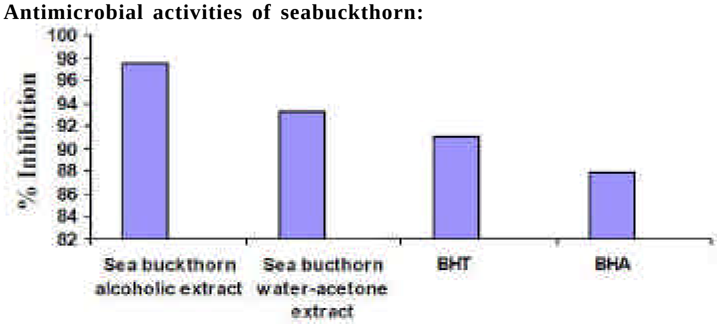

Figure 1: Antioxidant activity of sea buckthorn extracts compared with synthetic antioxidants BHT and BHA. Courtesy: Camelia papuc *et al*. (2008)

Phenolic compounds from the berries of sea buckthorn inhibit the growth of gram-negative but not gram-positive bacteria. Extracts from sea buckthorn seeds inhibited the growth of Bacillus cereus (minimum inhibitory concentration or MIC 200 ppm), ***Bacillus coagulans*** (MIC 300 ppm), ***Bacillus subtilis*** (MIC 300 ppm), ***Listeria monocytogenes*** (MIC 300 ppm), and ***Yersinia enterocolitica*** (MIC 350 ppm) [27,28]. Ethanol extracts of sea buckthorn inhibited the growth of Helicobacter pylori at a MIC around 60 mcg/mL [29]. Negi *et al*. (2005) have demonstrated the effect of seabuckthorn seed extracts on growth of different bacteria. Methanolic extract was found to be the most effective, followed by chloroform and acetone extracts [27]. Figure 2 shows that ***Yersinia enterocolitica*** was the most resistant to all the extracts, and higher MIC values were obtained for it. Higher resistance of Gram-negative bacteria to external agents has been earlier reported, and it is attributed to the presence of lipopolysaccharides in their outer membranes, which make them inherently resistant to antibiotics, detergent and hydrophilic dyes [30]. The reason for higher sensitivity of the Gram-positive bacteria than Gram-negative bacteria could be ascribed to the differences between their cell wall compositions. The Gram-positive bacteria contain an outer peptidoglycan layer, which is an ineffective permeability barrier [31]. Similar trend for inhibition of bacterial growth have been observed with seabuckthorn berry extracts [32].

Protective effects of seabuckthorn seed oil against carbon tetrachloride-induced hepatotoxicity in mice:

Hepatotoxins, such as ethanol, acetaminophen, and carbon tetrachloride (CCl_4), sparked off liver injury and it is characterized by varying degrees of hepatocyte

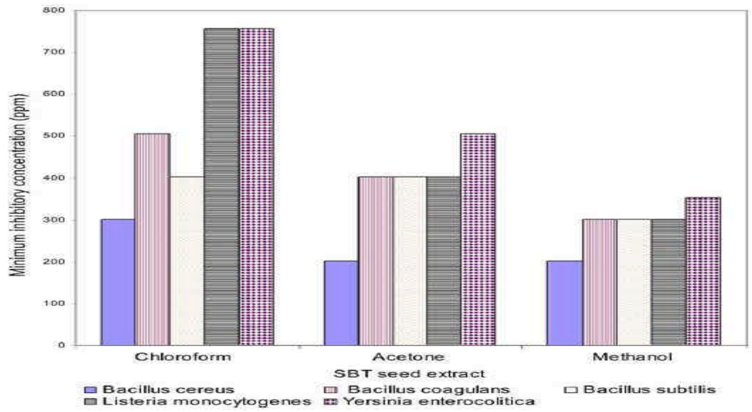

Figure 2: Effects of SBT (seabuckthorn) seed extracts on growth of different bacteria: *Bacillus cereus, Bacillus coagulans, Bacillus subtilis, Listeria monocytogenes, Yersinia enterocolitica.* Courtesy: Negi *et al.* (2005)

Table 2: Acute toxicity (LD50) of seabuckthorn leaf aqueous extract administered orally to rats

Dose (g/kg body weight)	D/T	Mortality latency (h)	Toxicity signs
1	0/12	-	None
2 g/kg	0/12	-	None
5 g/kg	1/12	>24	None
10 g/kg	1/12	>24	None

D/T, dead/treated rats; None, no toxic symptoms during the observed period; Mortality latency, time to death (in h) after the oral administration of the extract; rats in each dose group (n) = 12. Courtesy: Saggu et al. (2007)

degeneration and cell death [33]. Vitaglione *et al*. (2004) suggested that reactive oxygen species (ROS) including superoxide and hydroxyl radicals are known to play an important role in liver disease's pathology and progression, as well as ROS have been proved to associate with the intoxication by CCl_4 [34,35]. Yu-Wen Hsu *et al*. (2009) examined the protective effects of seabuckthorn seed oil on carbon tetrachloride (CCl_4)-induced hepatic damage in male ICR mice. Results showed that oral administration of seabuckthorn seed oil at doses of 0.26, 1.30, and 2.60 mg/kg for 8 weeks significantly reduced the elevated levels of alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALP), triglyceride (TG), and cholesterol at least 13% in serum, and the level of malondialdehyde (MDA) in liver at least 22%, that was induced by CCl_4 (1 mL/kg) in mice [36]. Yu-Wen Hsu *et al*. (2009) also concluded that the optimal dose of seabuckthorn seed oil was 0.26 mg/kg, as the minimum amount exhibiting the greatest hepatoprotective effects on CCl_4 induced liver injury [36]. Hepatoprotective effects of seabuckthorn seed oil could be attributed to contain several constituents with potentially healthy biological properties, such as unsaturated fatty, a-tocopherol, and b-carotene. Therefore, dietary seabuckthorn seed oil may be useful as a hepatoprotective agent against chemical-induced hepatotoxicity *in vivo*.

Safety evaluation of seabuckthorn:

Herbal medicines are used up by 80% of the population in the developing countries. Despite the widespread use, few scientific studies have been undertaken to ascertain the safety and efficacy of characterized and calibrated traditional remedies. Parallel with recent increasing interest in herbal medicine for the prevention and treatment of various illnesses, there is increasing concern about the safety of medicinal plants. There are general and herb-specific concerns regarding medicinal plants and their ability to produce toxicity and adverse effects. Acute toxicity refers the ability of the substance to do systemic damage as a result of a one-time exposure to relatively large amounts of a substance. The objective of acute toxicity studies is to determine the median lethal dose (LD50) after a single dose administration. LD50 value is used to show that 50% of the animals exposed to a specific amount of a substance died. The results on acute toxicity studies by Saggu *et al*. (2007) have been given in Table 2 [19]. In none of the four animal groups, treated with single oral dose of seabuckthorn leaves aqueous extract at 1, 2, 5 and 10 g/kg, 50% rats died within 24 h of treatment and even after 14 days of drug treatment. The oral LD50 of seabuckthorn leaf aqueous extract in rats was observed to be >10 g/kg body weight. This data suggested low toxicity of seabuckthorn leaf aqueous extract, the larger is the LD50 value the lower the toxicity.

CONCLUSION

The adaptogenic, antimicrobial, antioxidant and protective properties of seabuckthorn can add value to this plant. These properties make sea buckthorn extracts applicable to be used in medical, pharmaceutical and food industry. Further studies are needed for the characterization of individual compounds to elucidate the underlying mechanisms, bioactive properties and the existence of possible synergism among other compounds present in seabuckthorn. These medicinal properties of seabuckthorn can effectively replace the modern medicine for treating various health issues in future. Detailed studies on the antioxidant properties, hepatoprotective potentials, specificity, mode of action and phytochemical analysis of seabuckthorn in vivo are of major interests in scientific community.

REFERENCE

1. Brekhman II, Man and Biologically Active Substances. Pergamon Press, Oxford. 1980.
2. Fulder S, The drug that builds Russians. New Sci. 88, 1980, 576–579.
3. Divekar, HM, Radhey S, Gupta AK, Pahwa ML, Grover SK, Kumar R, Srivastava KK, Screening of Adaptogenic Activity of some Laddakhi Plants. DIPAS (Min. of Defence, India) Report No.1/96, 1996.
4. Rapoti J and Romavary V, Healing plants (in Hungarian), Medicina, Budapest, Hungary, 1987.
5. Rousi A, The genus Hippophae L, a taxonomic study, Ann. Bot., 8, 1971, 177–227.
6. Beveridge T, Li TSC, Oomah BD, Seabuckthorn products: manufacture and composition, J. Agric. Food Chem., 47, 1999, 3480–3488.
7. Geetha S, Sai RM, Singh V, Ilavazhagan G, Sawhney RC, Anti-oxidant and immunomodulatory properties of seabuckthorn (Hippophae rhamnoides) – an in vitro study, J. Ethnopharmacol., 79, 2002, 373–378.
8. Eccleston C, Baoru Y, Tahvonen R, Kallio H, Rimbach GH, Minihane AM,. Effect of an antioxidant rich juice (seabuckthorn) on risk factors for coronary heart disease in humans. J. Nutr. Biochem., 13, 2002, 346–354.
9. Kallio H, Yang B, Peippo P, Effects of different origins and harvesting time on vitamin C, tocopherols and tocotrienols in seabuckthorn (Hippophae rhamnoides L.) berries. J. Agric. Food Chem. 50, 2002, 6136–6142.
10. Geetha S, Antioxidant, immunomodulatory and adaptogenic potential of seabuckthorn (Hipphophae rhamnoides L) – in vitro & in vivo studies. Ph.D. Thesis, Delhi University, Delhi, 2004, 111pp, submitted.
11. Bazaron EG, Tsybikova DT, Seabuckthorn is the remedy of Indo-Tibet medicine, Rastit Resur., 14(1), 1978, 67 –69.
12. Matafonov II, Seabuckthorn (an influence on the animal organism) In: Khundanova LL. Novosibirsk7 Nauka, Sibirdiv; 1983, p. 165.
13. Shapiro DK, Garanovich IM, Anikhimovskaya LV, Narizhnaya TI, Vereskovskii VV, Biochemical and morphological characteristics of prospective forms of seabuckthorn populations of North Azerbaijan. Rastit Resur 14(1), 1978, 60 –64.
14. Lu R. Seabuckthorn a multipurpose plant for fragile mountains, ICIMOD occasional paper no. 20 Kathmandu, Nepal, 1992.
15. Padgett DA, Glaser R, How stress influences the immune system. Trends in Immunology 24, 2003, 444-448.
16. McEwen BS, and Stellar E, Stress and the Individual: Mechanisms Leading to Disease. Ach Intern Med 153, 1993, 2093-2101.
17. Brekhman II and Dardymov IV, New substances of plant origin which increase nonspecific resistance, *Annu Rev Pharmacol*, 9, 1969, 419-30.
18. Geetha S, Antioxidant, Immunomodulatory and Adaptogenic Potential of Sea buckthorn (Hipphophae rhamnoides L.) – in vitro & in vivo Studies. Ph.D. Thesis Submitted to Delhi University, Delhi, 2004, pp.111.
19. Saggu S, Divekar HM, Gupta V, Sawhney RC, Banerjee PK, Kumar R, Adaptogenic and safety evaluation of seabuckthorn (Hippophae rhamnoides) leaf extract: A dose dependent study. Food and Chemical Toxicology, 45, 2007, 609–617.
20. Ramachandran U, Divekar HM, Grover SK, Srivastava KK, New experimental model for evaluation of adaptogenic products, J. Ethnopharmacol., 29, 1990, 275–281.
21. Camelia P, Diaconescu C, Nicorescu V, Crivineanu C, Antioxidant activity of polyphenols from Sea buckthorn fruits *(Hippophae rhamnoides).* Revista de Chimie, **59**(4), 2008, 392-394.
22. Valentao P, Fernandes E, Carvalho F, Andrade PB, Seabra RM, Bastos ML, Antioxidant activity of Hypericum androsaemum Infusion: Scavenging Activity against Superoxide Radical, Hydroxyl Radical and Hypochlorous Acid. Biol. Pharm. Bull, 25(10), 2002, 1320-1323.
23. Papuc C, Diaconescu C, Antioxidant activity of sea buckthorn (Hippophae Rhamnoides) extracts compared with common food additives. Roum. Biotechnol. Lett., Vol. 13, No. 6, 2008, 4049-4053.
24. Gulcin I, Alici HA, Cesur M, Determination of in Vitro Antioxidant and Radical Scavenging Activities of Propofol., Chem. Pharm. Bull, **53**(3), 2005, 281-285.
25. Patro BS, Samuel R, Sreekanth A, Dwivedi SK, Chaurasia OP, Chattopadhyay S, Anti-oxygenic activity of Indian seabuckthorn (Hippophae rahmnoides L.). In V. Singh, P.K. Khosla (Eds.), Seabuckthorn – A resource for health and environment in twenty first century. Proceedings of international workshop on seabuckthorn 2001, (pp. 194–198), Feb. 18–21. CSKHPAU, Palampur and Indian Society of Tree Scientists, Solan, India.
26. Rosch D, Bergmann M, Knorr D, & Kroh LW, Structure-antioxidant efficiency relationships of phenolic compounds and their contribution to the antioxidant activity of seabuckthorn juice, Journal of Agricultural and Food Chemistry, 51, 2003, 4233–4239.
27. Negi P, Chauhan A, Sadia G, Rohinishree Y, Ramteke R, Antioxidant and antibacterial activities of various seabuckthorn (Hippophae rhamnoides L.) seed extracts, Food Chem., 92, 2005, 119-124.
28. Puupponen-Pimia R, Nohynek L, Meier C, Antimicrobial properties of phenolic compounds from berries J Appl Microbiol., 90, 2001, 494-507.
29. Li Y, Xu C, Zhang Q, Liu JY, Tan RX, In vitro anti- Helicobacter pylori action of 30 Chinese herbal medicines used to treat ulcer diseases, J Ethnopharmacol., 98, 2005, 329-333.
30. Nikaido H and Vaara M, Molecular basis of bacterial outer membrane permeability. Microbiological Reviews, 49, 1985, 1–32.
31. Scherrer R and Gerhardt P, Molecular sieving by the Bacillus megatrium cell wall and protoplast, Journal of Bacteriology, 107, 1971, 718–735.
32. Puupponen-Pimla R, Nohynek L, Meier C, Kahkonen M, Heinonen M, Hopia A, Antimicrobial properties of phenolic compounds from berries, Journal of Applied Microbiology, 90, 2001, 494–507.
33. Wu J, Danielsson A, Zern MA, Toxicity of hepatotoxins: new insights into mechanisms and therapy, Expert Opin. Invest. Drugs, 8, 1999, 585–607.
34. Vitaglione P, Morisc, F, Caporaso N, Fogliano V, Dietary antioxidant compounds and liver health, Crit. Rev. Food Sci. Nutr., 44, 2004, 575–586.
35. Slater TF, Sawyer BC, The stimulatory effects of carbon tetrachloride on peroxidative reactions in rat liver fractions in vitro Inhibitory effects of freeradical scavengers and other agents, Biochem. J, 123, 1971, 823–828.
36. Yu-Wen Hsu, Chia-Fang Tsai, Wen-Kang Chen, Fung-Jou Lu, Protective effects of seabuckthorn (Hippophae rhamnoides L.) seed oil against carbon tetrachloride-induced hepatotoxicity in mice, Food and Chemical Toxicology, 47, 2009, 2281–2288.

Source of support: Nil, Conflict of interest: None Declared