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A Case Study

Trianthema portulacastrum (L.): An important traditional herb

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ABSTRACT

Trianthema portulacastrum (L.) is a potential traditional herb belongs to Aizoaceae family. It is rapidly growing, much branched, succulent, prostrate and annual terrestrial weed. Traditionally it is used for treatment of various ailments like stomachic, laxative, analgesic, anemia, antiulcer, jaundice and abortifacient etc. Various phytoconstituents like alkaloids, glycosides, tannins, flavonoids, steroids, fat, carbohydrates, β-sitosterol, stigmasterol and phenolic compounds has been isolated from different plant parts. A range of pharmacological activity have been reported from different plant extracts namely hypoglycemic, hypolipidemic, analgesic, hepatoprotective, anthelmintic, anticancer, diuretic and mosquito larvicidal activity etc. The present paper deals with review of traditional uses, phytoconstituents and pharmacological action of plant *T. portulacastrum* (L.).

Key words : Aizoaceae, Phytoconstituents, Ailments, Pharmacological activity

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INTRODUCTION

Herbal drugs have immense growth prospective in the global market. Natural product research continues to explore Indian traditional medicines to develop novel drugs. According to the World Health Organization (WHO), because of poverty and lack of access to modern medicine, about 65-80 per cent of the world's population in developing countries depends essentially on plants for primary health care. Currently, the developed as well as developing countries have demonstrated renewed interest in herbal medicines as sources for new lead structures and also for the development of standardized phytotherapeutic agents with proved efficacy, safety margin, quality than the synthetic drugs and lower cost (Grabley and Thiericke,1999). Extensive research has been conducted in last few decades on traditional plants. *Trianthema portulacastrum* (L.) (*TP*) is a weed and its infestation is very common in various agricultural and vegetable crops, such as mustard, maize, moong bean, potato, onion, cotton, pearl millet, and sugarcane, especially during the rainy seasons (Balyan and Bhan, 1986 and Randhawa *et al.*, 2009). In India it is used as green leaf vegetable and is considered to be useful for

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the purpose of medicinal value (Gupta *et al.*, 2005). The plant parts of *TP* such as roots, leaves and fruits are used for numerous medicinal purposes such as analgesic, antipyretic, anti inflammatory and antibacterial properties (Vohora *et al.*, 1983 and Almeida *et al.*, 2001). This review provides botany, taxonomy, geographical distribution, traditional values, phytochemistry and pharmacological activity of *TP*.

Taxonomy :

Kingdom: Plantae; Division: Magnoliophyta; Class: Magnoliopsida; Subclass: Caryophyllidae; Order: Caryophyllales; Family: Aizoaceae; Genus: *Trianthema* L.; Species: *Trianthema portulacastrum* L.

Vernacular name :

English: Horse Purslane; Hindi: Sabuni, Santhi, Vishakhapara; Sanskrit: Shvetapunarnava; Tamil: Sharunnai, Shavalai; Telugu: Ambatimadhu; Punjab: Bishkapra; Bengali: Gadabani; Kannada: Muchchugoni; Malayalam: Sharunnau; Marathi: Pundharighetntuli (Vocks, 1996).

Botany of *T. portulacastrum* (L.) :

The plant is often much branched, glabrous, succulent, prostrate and annual terrestrial weed with the firm tap root. Leaves are opposite, simple, petiolated (0.5-3 cm) ovate - obovate to obcordate-oblong (1-5cm x 0.5- 4.5cm) in shape, entire margin, purple or green in colour. Flowers are solitary, bisexual, regular, pale pink, rarely white in colour. Flowers have 10-25 stamens, filaments white, ovary superior and turbinate. Fruit is a circumsessile capsule (5 x 3 mm), partly exerted from the persistent perianth, 2-8 seeded. Seeds are reniform, 1.5-2.5 mm long, seedings with epigial germination (Anonymous, 2003 and Kirtikar and Basu, 1997).

Geographical distribution :

TP indigenous to tropical America and widely distributed in South America, West Indies, South and tropical Africa and several tropical countries of Asia including India, Bangladesh, Pakistan, Sri Lanka, Baluchistan and Ceylon (Kirtikar and Basu, 1997; Nasir and Ali ,1973 and Duthie,1999).

Traditional uses :

TP has been traditionally used for remedy of a broad spectrum of ailments. It is hot, bitter and used as analgesic, stomachic, laxative, alexiteric, anemia and inflammation (Chopra *et al*., 1956), antiulcer, cough, utralgia cardioprotective, abortifacient, migraine, night blindness and piles (Kirtikar and Basu, 1997; Duthie, 1999 and Wahid and Siddiqui, 1961). A decoction of the herb is used in rheumatism, as an antidote to alcoholic poison and vermifuge (Chatterjee and Pakrashi, 1994). Leaves are considered as diuretic and useful in the treatment of edema in liver and spleen, ascites, laxative, emmenagogue, diaphoretic and dropsy. The root is antipyretic, analgesic, spasmolytic, deobstruent and anti-inflammatory,cathartic and abortifacient with irritant properties. The plant is used as lithotriptic for kidney and bladder. An infusion of the roots is administered in jaundice, stranguary and dropsy (Khan, 1903; Chadham, 1976 and Khare, 2006). Root decoction is used internally to treat constipation and asthma (Muthu *et al.*, 2006).

Phytochemistry :

Dichloromethane extraction of dried plant material revealed the presence of several constituents including flavonoid, 5,2-dihydroxy-7-methoxy-6,8-dimethylflavone (C-methyl flavone) along with 5,7-dihydroxy-6,8-dimethylchromone (leptorumol). Upon chromatography of dried plant with methylene chloride on silica long chain esters, a mixture of C_{14}, C_{16}, C_{18}, C_{20}, and C_{22} long chain alcohols (β-sitosterol, stigmasterol and their β-glucopyranosides) were isolated. Saponin glycoside, quercetin and ferulic acid have been detected in roots of fungus-affected plants. High level of oxalic acid branched and straight chain alkanes have also been identified from plant (Udom *et al.*, 1997). Extraction of air-dried plant with chloroform has led to the isolation of an antifugal tetraterpenoid 15-hydroxymethyl-2,6,10,18,22,26,30-heptamethyl-14-methylene-17-hentriacontene (trianthenol) and four other compounds like 5-hydroxy-2-methoxy benzaldehyde, 3-acetyl aleuritolic acid, p-methoxy benzoic acid and p-propoxy benzoic acid were identified (Nawaz *et al*., 2001). Ecdysterone has been isolated from the whole plant (Banerji *et al.*, 1971). Beta-cyanin and 3,4-dimethoxy cinnamic acid also have been reported from *TP* (Sundera *et al.*, 2009). The plant contains an alkaloid trianthemine, potassium nitrate and vitamin C but punarnavine is absent (Javed *et al.*, 2000).

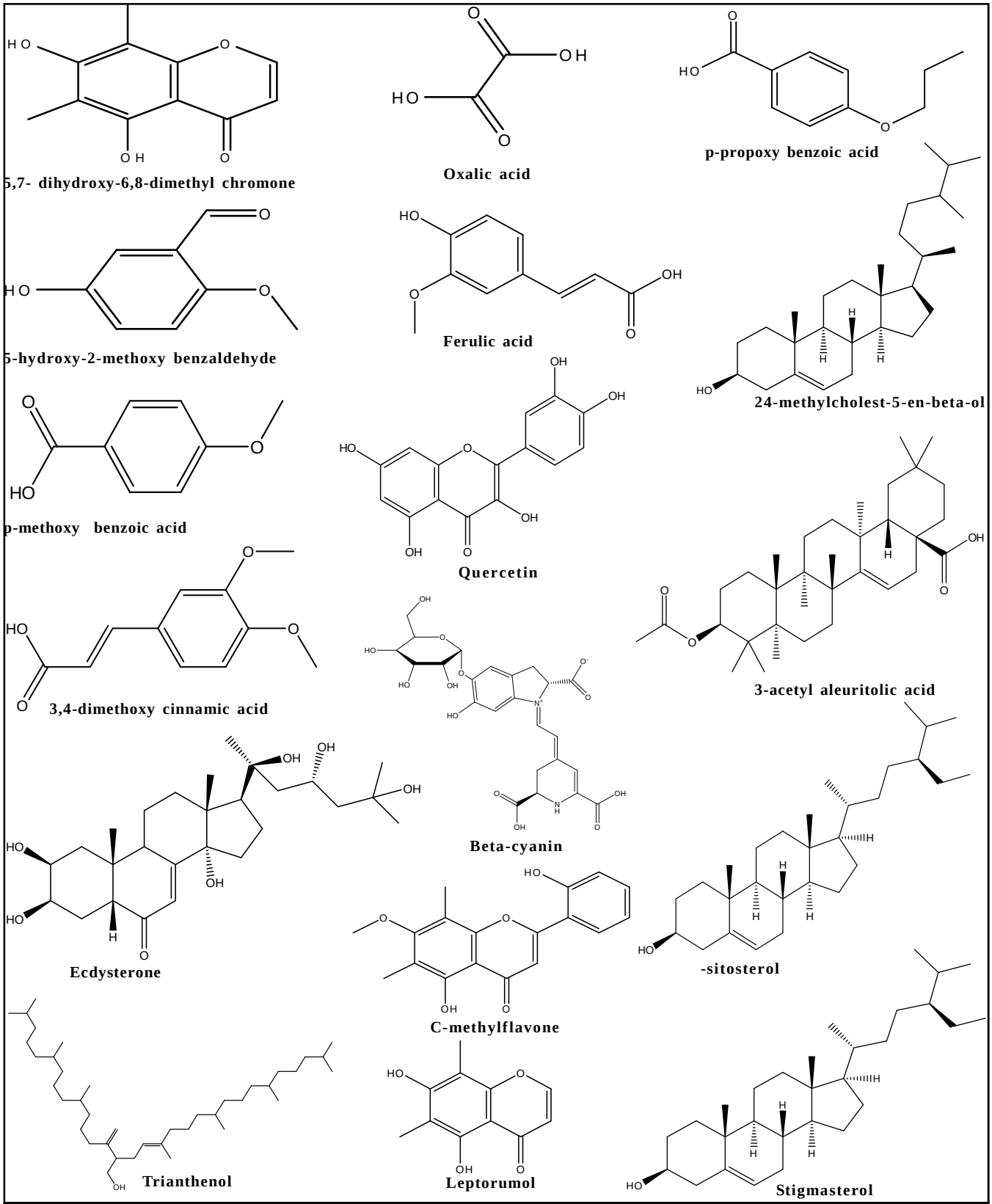

Fig. 1 : Pharmacological uses

Hypoglycemic and hypolipidemic activity :

Methanolic extract of *TP* whole plant was evaluated for hypoglycemic and hypolipidemic activity by alloxan induced diabetic model. The extract was administered for 7 days at a dose level of 100,200 and 300 mg/kg B.W. The blood glucose level, total cholesterol (TC), triglyceride (TG), LDL-Cholesterol, HDL-Cholesterol were estimated from blood samples at initial and final stages. Maximum significant effect was observed at a dose level of 300 mg/kg B.W in terms of reduction in blood glucose level, fall in level of TG, TC and improvement in the level of HDL in normal as well as alloxan induced diabetic rats (Anreddy *et al.,* 2010).

Hepatoprotective activity :

Ethanolic extract of leaves of *TP* were evaluated for hepatoprotective activity against two well known hepatotoxins, *viz.,* paracetamol and thioacetamide in albino rats. The extract was administered at two dose levels 100 mg, 200 mg/kg p.o. The level of protection was measured by using biochemical parameters like serum glutamate oxaloacetate transaminase (SGOT), serum glutamate pyruvate transaminase (SGPT), alkaline phosphatase (ALP) and bilirubin (BRN). Pretreatment of rats with ethanolic extracts of *TP* exhibited a significant reduction in the paracetamol-induced as well as thioacetamide- induced increase in SGOT, SGPT, ALP and BRN levels. The maximum degree of protection was observed with the higher dose (200 mg/kg p.o.) of the extract (Kumar *et al.,* 2004).

Ethanolic extract of the whole plant of *TP* (excluding the roots) was evaluated against alcohol-carbon tetra chloride (CCl_4) induced acute liver damage in mice for antihepatotoxic potential. The extract at dose of 50,100 or 150 mg/kg was administered for successive three days simultaneous with alcohol- CCl_4 treatment. Due to alcohol-CCl_4 treatment there was substantial increase in serum enzymatic activities of glutamate oxaloacetate transaminase, glutamate pyruvate transaminase, lactate dehydrogenase, alkaline phosphatase, sorbitol and glutamate dehydrogenase were dose-dependently restored towards normalization following the extract pretreatment. There was a marked inhibition of serum bilirubin, urea levels, hepatic malondi aldehyde formation and depletion of reduced glutathione content in liver of mice in the plant extract-treated groups which were otherwise drastically increased in alcohol-CCl_4 control animals (Bishayee *et al.,* 1996).

The hepatoprotective effect of ethanolic extract of *TP* leaves evaluated on aflatoxin B1 (AFB1)-induced hepatic damage in rat model. It was noticed that marked decrease in the levels of SGPT, SGOT, ALP and total bilirubin in a dose dependent manner. Minimum and maximum effective dose of extract was found to be 100 and 800mg/kg body weight, respectively. This study indicated the extract of *TP* offers comparable protection to aflatoxin induced liver damage as compared to silymarin (Banu *et al.,* 2009).

Analgesic activity/antinociceptive activity :

The ethanol extract of whole plant of *TP* was evaluated for analgesic potential by using acetic acid-induced writhing and hot plate models. The extract was administered at dose levels 250 mg/kg p.o. in mice. It was observed that the extract caused an inhibition on the writhing response induced by acetic acid in a dose-dependent manner. A dose of 250 mg/kg extract and aspirin blocked the writhing response by 50.92 per cent and 67.68 per cent, respectively. The extract also showed significant antinociceptive action in hot plate reaction time model in mice. This effect was comparable to that of standard drug aspirin-treated group, signifying the central activity of extract (Shanmugam *et al.,* 2007).

Antioxidant activity :

Ethanolic extract of leaves of *TP* showed the antioxidant activity in relation to hepatotoxins-paracetamol and thioacetamide in rats. Extract was administered at two dose levels *i.e.* 100 mg and 200 mg/kg p.o. for 10 days in male wistar albino rats. The blood glutathione, superoxide dismutase (SOD), catalase (CAT) and glutathione peroxidase (GPX) assayed and activity of Glutathione-S-tranferase (GST), glutathione reductase (GSH-R) and liver Na-K-ATPase were measured from blood plasma .The concentration of TBARS (TBAreactive substances) in liver was measured. Pretreatment with plant extract prevented GSH-R, GST, GPX, SOD and CAT reductions to a considerable extent in hepatotoxin -treated rats when compared with those of normal control animals. It significantly reduced the elevated levels of TBARS and increased the concentration of hepatic and blood GSH. Ethanolic leaves extract of the plant increased the activity of SOD and CAT and it scavenged free radicals and reduced hepatic damage.

So it might be accomplished that the hepatoprotective action of extract is due to its antioxidant activity (Kumar *et al.*, 2005).

Hydrolysates of *Trianthema portulacastrum* root, shoot, and leaf fractions in acidified methanol were evaluated by using in vitro assays (*i.e.*, 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging activity, per cent inhibition of linoleic acid peroxidation, and ferric reducing power) for their total phenolic (TP) constituents and respective antioxidant activities. The study indicated that root, shoot and leaf fractions of *T. portulacastrum* are potential source of antioxidants as it contain 50.75~98.09 mg gallic acid equivalents/g dry weight of TP. In addition, these fractions have substantial reducing potentials (0.10~0.59), abilities to inhibit peroxidation (43.26~89.98%) and DPPH radical scavenging capabilities (6.98~311.61 µg/mL IC50). The results indicate that for the enhanced recovery of phenolic compounds with retained biological potential for the food and pharmaceutical industry. acidified methanol may be a good option (Yaqoob *et al.*, 2014).

Anthelmintic activity :

Evaluation of anthelmintic effects of crude aqueous methanolic extract (CAME) of *TP* whole plant was perfomed by *in vitro* as well as *in vivo* methods against prevalent gastrointestinal nematodes (GINs) of sheep. *In vitro* anthelmintic activity was determined using mature female *Haemonchus contortus* and their eggs in adult motility assay (AMA) and egg hatch test (EHT), respectively. *In vivo* anthelmintic activity was determined at increasing doses (1.0–8.0 $g.kg^{-1}$) in sheep, which was naturally infected with mixed species of nematodes by using fecal egg count reduction test (FECRT) and larval counts. *TP* (LC_{50}= 2.41$g.L^{-1}$) exhibited dose and time dependent anthelmintic effects on live worms as well as egg hatching in EHT. However, *in vivo*, maximum reduction in eggs per gram (EPG) of faeces was recorded as 80.7 per cent with CAME of *TP* (8.0 $g.kg^{-1}$) as compared to that of Levamisole (7.5 $mg.kg^{-1}$) that caused 97.0 per cent reduction in EPG. The results revealed that different doses of CAME of *TP* were susceptible for all the species of GINs (*i.e. Haemonchus contortus*, *Trichostronglyus* spp., *Oesophagostomum columbianum* and *Trichuris ovis*) (Hussain *et al.*, 2011).

Diuretic activity :

The crude aqueous extract of aerial part of *TP* in a rat model was evaluated for diuretic activity by calculating Total volume of urine, Diuretic index and Lipschitz values . The plant extract were given in different doses at 10, 30 and 50 mg/kg by intraperitoneal route. Maximum significant effect of *TP* extract has been observed at the dose of 50 mg/kg considerably increased the urinary volume (3.21±0.15), diuretic index (5.09) and concentration of urinary electrolytes as compare to control group with no signs of toxicity. The plant extract produced natriuretic and kaliuretic effects in a dose dependent manner (Asif *et al.*, 2013).

Mosquito larvicidal activity :

Crude aqueous and acetone extract of leaves of *TP* were evaluated for mosquito larvicidal activity against the larvae of four vector species of mosquito under laboratory condition. Both extract showed good larvicidal activity. Plant extract at concentration of 1.0, 0.25, 0.75 and 1.0 per cent showed 100 per cent mortality in third instar larvae when observed in larval bioassay test with *Anopheles culicifacies*, *Anopheles stephensi*, *Culex quinquefaciatus* and *Aedes aegypti*, respectively. The LD_{50} and LD_{90} values were estimated for both extracts against larvae of *Anopheles culicifacies*, *Anopheles stephensi*, *Culex quinquefaciatus* and *Aedes aegypti*. On the basis of these values it was anticipated that acetone extract of *TP* is more effective than crude aqueous extract (Singh *et al.*, 2011).

Hepatocarcinogenesis activity :

Aqueous, ethanolic and chloroform fractions of aerial part of the *TP* was tested for hepatocarcinogenesis activity by chemical rat hepatocarcinogenesis model. Hepatocarcinogenesis was induced by the potent carcinogen diethylnitrosoamine (DENA). Plant extracts were administered in male Sprague–Dawley rats at a dose of 100 mg/kg body weight once daily for 22 weeks. Nodule incidence, numerical preponderance, multiplicity and size distribution of visible neoplastic nodules were estimated. It was observed that animals treated with chloroform extract effectively reduced the nodule incidence (25%), numerical preponderance, multiplicity and size distribution of visible neoplastic nodules, nodular volume (0.75 cm^3). Morphometric evaluation of focal lesions showed a reduction in altered liver cell foci

(58.3%), the average focal area and in the percentage of liver parenchyma occupied by foci as compared to other extracts (Bhattacharya and Chatterjee, 1998).

Mammary tumorigenesis :

Ethanolic extract of *TP* was evaluated for tumorigenic activity against 7,12-dimethylbenz (a) anthracene (DMBA) initiated rat mammary gland carcinogenesis model. Rats were administered with three dietary doses of plant extract, *i.e.*, 50, 100 and 200 mg/kg body weight admixed with basal diet. DMBA (50 mg/kg body weight) was orally administered to induce mammary tumorigenasis after two weeks of *TP* treatment subsequently. In a dose dependent manner, plant extract exhibited a significant decline of DMBA-induced mammary tumor incidence, total tumor burden and average tumor weight and reversed intratumor histopathological alterations. *TP* concealed proliferating cell nuclear antigen and cyclin D1 expression, induced apoptosis, upregulated proapoptotic protein Bax, downregulated antiapoptotic protein Bcl-2 and diminished the expression of nuclear and cytosolic -catenin in mammary tumors. On the basis of this study, it was concluded that *TP* have potential of diminishing activated canonical Wnt/β-catenin signaling to exhibit antiproliferative, proapoptotic and oncostatic effects during an early-stage breast cancer (Bishayee and Mandal, 2014).

Early DNA damage and chromosomal abression inhibition :

The ethanolic extract of *TP* was observed to estimate its effect on mouse liver DNA-chain break, sugar-base damage and chromosomal aberrations during chronic or acute carbon tetrachloride (CCl_4) induced hepatotoxicity. The plant extract was given at 150 mg/kg basal diet, *per os* 2 weeks before CCl_4 treatment and continued until the end of the experiment (13 weeks). *TP* extract showed significant protection against the induction of liver-specific structural-type chromosomal anomalies compared to control mice after 15, 30 or 45 days of last CCl_4 treatment. This was additionally verified by extract-mediated protection (15 days prior feeding following a single necrogenic dose of CCl_4) of generation of DNA chain-break and Fe-sugar-base damage assays. The hepatoprotective mechanism could be due to its ability to counteract oxidative injury to DNA in the liver of mouse (Sarkar *et al*., 1999).

Conflict of interest statement :

The authors declare no conflicts of interest related to this work.

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