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Therapeutic Value of *Hippophae rhamnoides* L. Against Subchronic Arsenic Toxicity in Mice

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The present study was planned to investigate the therapeutic efficacy of *Hippophae rhamnoides* L. against the toxic effects of arsenic in mice. *H. rhamnoides* L. is used as an herbal remedy for gastric ulcers, burns, and some skin and allergic diseases. Twenty-five Swiss albino mice were exposed to arsenic (25 ppm) in drinking water for 3 months. After 3 months different fruit extracts of *H. rhamnoides* L. (500 mg/kg for 10 days) were administered, the animals were sacrificed, and blood and tissues were assayed for various biochemical indicators of oxidative stress and whether arsenic was removed from tissues. Treatment with different fruit extracts of *H. rhamnoides* L. showed significant protection from arsenic inhibition of blood δ -aminolevulinic acid dehydratase activity and restored blood reduced glutathione levels. Other hematologic variables like white blood cell counts, hemoglobin, and hematocrit were partially protected by supplementation with a water extract of *H. rhamnoides* L. (HF-WRT). Significant protection was also observed in altered hepatic, renal, and brain reduced/oxidized glutathione ratio and thiobarbituric acid-reactive substances levels. The aqueous extract of *H. rhamnoides* L. (HF-WRT) also provided protection against parameters indicative of liver injury such as aspartate aminotransferase, alanine aminotransferase, and alkaline phosphatase activities. There was also no effect on blood and tissue arsenic concentrations observed except some moderate depletion of blood arsenic concentrations, suggesting that the drug has no ability to chelate intracellular arsenic. It can be concluded from these results that post-treatment with an aqueous extract of *H. rhamnoides* L. (HF-WRT) significantly protects against arsenic-induced oxidative stress but does not chelate arsenic, suggesting it may have a beneficial role as a supplementing agent during chelation of arsenic by other means.

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Therapeutic Value of *Hippophae rhamnoides* L. Against Subchronic Arsenic Toxicity in Mice

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ABSTRACT The present study was planned to investigate the therapeutic efficacy of *Hippophae rhamnoides* L. against the toxic effects of arsenic in mice. *H. rhamnoides* L. is used as an herbal remedy for gastric ulcers, burns, and some skin and allergic diseases. Twenty-five Swiss albino mice were exposed to arsenic (25 ppm) in drinking water for 3 months. After 3 months different fruit extracts of *H. rhamnoides* L. (500 mg/kg for 10 days) were administered, the animals were sacrificed, and blood and tissues were assayed for various biochemical indicators of oxidative stress and whether arsenic was removed from tissues. Treatment with different fruit extracts of *H. rhamnoides* L. showed significant protection from arsenic inhibition of blood δ -aminolevulinic acid dehydratase activity and restored blood reduced glutathione levels. Other hematologic variables like white blood cell counts, hemoglobin, and hematocrit were partially protected by supplementation with a water extract of *H. rhamnoides* L. (HF-WRT). Significant protection was also observed in altered hepatic, renal, and brain reduced/oxidized glutathione ratio and thiobarbituric acid-reactive substances levels. The aqueous extract of *H. rhamnoides* L. (HF-WRT) also provided protection against parameters indicative of liver injury such as aspartate aminotransferase, alanine aminotransferase, and alkaline phosphatase activities. There was also no effect on blood and tissue arsenic concentrations observed except some moderate depletion of blood arsenic concentrations, suggesting that the drug has no ability to chelate intracellular arsenic. It can be concluded from these results that post-treatment with an aqueous extract of *H. rhamnoides* L. (HF-WRT) significantly protects against arsenic-induced oxidative stress but does not chelate arsenic, suggesting it may have a beneficial role as a supplementing agent during chelation of arsenic by other means.

KEY WORDS: • antioxidant • arsenic toxicity • *Hippophae rhamnoides* L. • protection against arsenic

INTRODUCTION

ARSENIC IS A WIDESPREAD environmental toxicant that may cause neuropathy, skin lesions, vascular lesions, and cancer upon prolonged exposure.^{1–3} Millions of people are currently at risk all over the world because they drink water containing carcinogenic amounts of arsenic.^{4,5} The World Health Organization has recently revised the permissible level of arsenic in drinking water from 50 $\mu\text{g/L}$ to 10 $\mu\text{g/L}$.⁶ In West Bengal, India, the presence of arsenic at 0.1 mg/L or higher in the drinking water is associated with classic symptoms of skin lesions,⁷ which are similar to those of the Atacameno people of northern Chile.⁸ Until now the studies evaluating treatments of arsenic toxicity have been restricted to some sulfhydryl-containing chelating agents like meso-2,3-dimercaptosuccinic acid, 2,3 dimercapto-

propane-1-sulfonate, or British Anti-Lewisite (2,3-dimercaprol)^{9,10} either alone or in combination with a few antioxidants such as vitamin C, vitamin E,^{11,12} and zinc.¹³ These treatments result in the elimination of arsenic and recovery from altered biochemical variables. Since most of these conventional metal chelating agents are reported to possess toxic side effects or other disadvantages,¹⁴ there have been recent attempts to look for an alternate treatment.

In recent years, the clinical importance of herbal drugs has received considerable attention. As many synthetic drugs or antioxidants have been shown to have one or more side effects,^{15,16} there has been increasing interest in the therapeutic potential of medicinal plants having antioxidant properties in reducing free radical-induced tissue injury^{17–20} leading to better clinical recovery. Numerous plant products contain antioxidants, vitamins, flavonoids, and polyphenolic compounds that have been demonstrated to be scavengers of free radicals and inhibitors of lipid peroxidation.^{21–23}

Seabuckthorn (*Hippophae rhamnoides* L., Elaeagnaceae) is a thorny nitrogen-fixing deciduous shrub that grows up to 3–10 m in height and is native from northwestern Europe through Central Asia to the Altai Mountains, Western and

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