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Taurine Ameliorates Renal Oxidative Damage and Thyroid Dysfunction in Rats Chronically Exposed to Fluoride

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Abstract Excessive exposure to fluoride poses several detrimental effects to human health particularly the kidney which is a major organ involved in its elimination from the body. The influence of taurine on fluoride-induced renal toxicity was investigated in a co-exposure paradigm for 45 days using five groups of eight rats each. Group I rats received normal drinking water alone, group II rats were exposed to sodium fluoride (NaF) in drinking water at 15 mg/L alone, group III received taurine alone at a dose of 200 mg/kg group IV rats were co-administered with NaF and taurine (100 mg/kg), while group V rats were co-administered with NaF and taurine (200 mg/kg). Administration of taurine significantly reversed the fluoride-mediated decrease in absolute weight and organo-somatic index of the kidney in the exposed rats. Taurine significantly prevented fluoride-induced elevation in plasma urea and creatinine levels in the exposed rats. Moreover, taurine restored fluoride-mediated decrease in the circulatory concentrations of triiodothyronine, thyroxine, and the ratio of triiodothyronine to thyroxine. Taurine ameliorated fluoride-mediated decrease in renal antioxidant status by significantly enhancing the antioxidant enzyme activities as well as glutathione level in the exposed rats. Additionally, taurine inhibited fluoride-induced renal oxidative damage by markedly decreasing the hydrogen peroxide and malondialdehyde levels as well as improved the kidney architecture in the treated rats. Collectively, taurine protected against fluoride-induced renal toxicity via enhancement of thyroid gland function, renal antioxidant status, and histology in rats.

Keywords Fluoride · Taurine · Renal toxicity · Thyroid hormones · Rats

Introduction

Fluoride is an important electronegative anion widely used in the pharmaceutical and agrochemical industries [1]. Fluoride is an essential element for the growth and development of humans and animals. Although fluorine does not exist freely found in nature, the major sources of fluoride pollution in environment are linked to natural activities including volcanic eruption and weathering of fluoride-containing ores, industrial activities resulting in the release of fluoride dust and fumes, and anthropogenic activities such as metal mining and smelting and fertilizer production [2]. The acceptable limit of fluoride in drinking water ranged from 0.7 to 1.0 mg/L [3]. However, the average daily intake of fluoride in countries like China ranged from 0.3 to 2.3 mg via air and from 1.8 to 8.9 mg via food due to combustion of coal with high fluoride content in houses with poor ventilation [4]. The estimated intakes of fluoride in Indian population living where the groundwater is highly contaminated with fluoride were 27 mg/day [5]. Moreover, some fluoride preparations have been reported to contain about 1000–1500 mg of fluorine per kilogram of toothpaste (tablet) or 10,000 mg of fluorine per liter for liquid preparations [3]. Fluoride was detected at 96.8 mg/L in industrial wastewater [6] and up to 3000–5000 mg/L in extreme cases [7]. Thus, drinking water has been implicated as the single main source of daily intake of fluoride [8].

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