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Remediation of nitrite contamination in ground and surface waters using aquatic macrophytes

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Abstract

The study was carried out to determine the seasonal variation of nitrite levels in drinking and surface waters of urban, peri-urban and rural areas of Lucknow, during 2007-2008, and to evaluate the nitrite removal and accumulation potential of certain native aquatic macrophytes. Most of the drinking and surface water samples were collected from urbanized region of the city. All drinking water samples detected, showed higher nitrite level in winter, when compared with that in summer and rainy seasons. However, in drinking water samples nitrite level was below the permissible limit *i.e.* 3.29 mg l^{-1} NO_2. The surface water showed more than 3 fold higher levels of nitrite over the permissible level *i.e.* 0.06 mg l^{-1}, and the level was higher during rainy season than in summer and winter seasons. Eight macrophytes *viz. Peltandra virginica, Utricularia vulgaris, Eichhornia crassipes, Trapa natans, Mimulus glabratus, Marsilea quadrifolia, Pistia stratiotes* and *Polygonum persicaria* were studied for phytoremediation potential of nitrite from the water under simulated laboratory conditions. The gradual diminution in the level of nitrite in the water and simultaneously it's increase in the plant tissues was recorded at 5th, 10th and 15th d after plant culture. All the plants selected, removed nitrite from water but *Polygonum persicaria, Mimulus glabratus, Trapa natans* and *Pistia stratiotes* were found more efficient and removed nitrite upto 60.91, 58.09, 60.97 and 72.28%, respectively. Observations revealed that *Pistia stratiotes* can be used for the effective removal of nitrite from the contaminated water.

Key words

Drinking water, Nitrite level, *Pistia stratiotes*, Surface water, Aquatic macrophytes

Introduction

Nitrite is a natural component of the nitrogen cycle in ecosystems, and its presence in the environment is a potential problem due to its well documented toxicity to animals (Sinha and Nag, 2010). It has been reported in various water sources (Bingbing *et al.*, 2009). It is therefore, necessary to remove it from water in order to reduce it's harm to the animal and human consumers of the water which cannot assimilate nitrite like bacteria and plants (Alonso and Camargo, 2009). Nitrite can damage aquatic life, causing hypoxia, where oxygen concentration declines below 2 mg l^{-1} (Taylor *et al.*, 2005), and is recognized as a toxic compound that can induce a number of physiological disturbances, when its concentration in the organism is high (Jensen, 2007). Nitrite is however, also a natural constituent in the body, and recent research has suggested that nitrite has important biological functions at its natural low endogenous concentrations and thus, nitrite may participate in blood flow regulation (hypoxic vasodilation), may act as a signaling molecule and regulate gene expression (Gladwin *et al.*, 2006; Fago and Jensen, 2007). Nitrite physiology therefore, seems to be a balance between toxic disruptions of functions at high concentrations and beneficial effects at low concentrations (Taylor *et al.*, 2006).

Most of ammonium in surface waters is oxidized to nitrite by *Nitrosomonas* bacteria. Being an intermediate compound nitrite is very unstable, it's excessive amount deplete dissolved oxygen in water column as the oxidation of nitrite to nitrate consumes oxygen (Lam *et al.*, 2007). The major metabolites of nitrites are nitric oxide