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NOTE

Removal of Thallium(I) Using Saffron as Complexing Agent

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In this work, the potential of saffron for complex formation with thallium(I) is investigated. The saffron was adsorbed onto XAD-4 Amberlite resin and then passed the sample solution containing Tl^+ through it. Tl^+ can be remained on the modified resin in the pH range of 3.5-7.5. The solution was examined before and after passing through saffron adsorbed XAD-4 resins and finally the concentration of Tl^+ were determined by flame atomic absorption spectrometry. The concentration of Tl^+ is found very low after passed through the resin. These results were compared with a column containing unmodified XAD-4 resin which showed that unmodified XAD-4 resin don't retain Tl^+. Therefore, saffron can be complex with Tl^+ in the pH range of 3.5-7.5. The analytical potential of saffron adsorbed onto XAD-4 Amberlite resin for the removal of Tl^+ from the biological body was also performed.

Key Words: Thallium(I), Removal, Saffron.

Toxicity of metal ions has received considerable attention in recent years because industrial effluents frequently contain metals that can have adverse effects on human health and the environment[1]. Saffron is the commercial name of the dried stigmas of *Crocus sativus* L. flowers. It is used both as a spice in food sand as a drug in traditional medicine. In addition, the biological activity of saffron as a natural preventing substance in anticancer research is in development[2]. Saffron has been used as a sedative and analgesic in traditional medicinal preparations and has recently been shown to have distinct anticancer activities[3]. Thallium is a toxic heavy metal with lethal dose of 15-20 mg/kg for human. Thallium is quickly distributed from the blood to the tissues. One of the possible toxic mechanisms of thallium includes ligand formation with blood proteins[4,5].

People are poisoned by intake of rat poisons (homicidal and suicidal attempts) by chronic exposures in occupations to thallium such as the workers in cement factories or workers handling pyrites and by contact to ash from coal-combustion power plants[6,7]. Symptoms of thallium intoxication

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in humans include nausea, vomiting, abdominal pain, hair loss, alopecia, tachycardia and cardiac arrhythmias.

The determination of thallium in environmental samples is of interest because of the high toxicity of its compounds. Due to new concerns regarding the toxicity of thallium, there are growing needs for improved analytical methods for monitoring this metal[8]. Haffman *et al.*[9] demonstrated that activated carbon could adsorb thallium *in vitro* and the similarity between thallium and potassium has led some authors to consider the use of sodium polystyrene sulfonate a potential adsorbent. Ghezzi and Marrubini[10] showed that the patients, including a newborn baby with transplacentar intoxication, were successfully treated with Prussian Blue. In the present work, the potential of saffron for complex formation with thallium(I) is investigated.

A Varian model SpectrAA 220 flame atomic absorption spectrophotometer was used in following conditions: wavelength: 276.8 nm, lamp current: 10.0 mA, slit width: 0.5 nm, Acetylene flow: 1.5 L min^{-1}, air flow: 3.5 L min^{-1}. A Beckman pH meter was employed for pH measurements. All glassware and columns were washed with mixture of conc. HCl and HNO_3 (1:1) before use. A standard thallium solution was prepared from thallium (I) nitrate in a minimum volume of conc. HNO_3 and then diluted to 1000 mL with distilled water in a standard flask and standardized by known methods. Buffer solutions of pH 3-6, 6-8 were prepared by mixing appropriate ratios of a 0.5 M acetic acid and 0.5 M sodium acetate solution, 0.1 M sodium dihydrogen phosphate solution and 0.1 M disodium hydrogen phosphate solution.

Preparation of amberlite XAD-4 column loaded with saffron: Amberlite XAD-4 was treated with an ethanol:HCl:water (2:1:1) solution overnight. Then resin was rinsed with deionized water until neutral pH obtained. Packing of the column must be done using ethanol as eluent since water makes resin beads float. The resin was saturated with the saffron 1 % (v/v) solution in ethanol at a flow rate of 1 mL min^{-1}. Afterwards, it was washed with water until reagent excess was eliminated from the resin. All experiments were done in a funnel-tipped glass tube (60 × 6 mm) was used as a column. It was plugged with polypropylene fibers and then filled with the XAD-4. Before sample loading the column must be preconditioned by passing a buffer solution. The column could be used repeatedly for at least ten times.

Procedure for the sorption of thallium on the column: An aliquot of thallium solution (containing 0.5 to 75 µg) placed in a 100 mL beaker and 5 mL of buffer solution (pH 4) was added and then diluted to *ca.* 30 mL with distilled water. This solution was passed through the column at a flow rate of 15 mL min^{-1}. For this work, the solutions before and after passing through XAD-4 resins that modified with saffron and concentration of Tl^+ were determined by flame atomic absorption spectrometry and the concentration of Tl^+ is found very low in the passed solution. These results were compared with a XAD-4 resin that unmodified therefore saffron can be complex with Tl^+ in the pH range of 3.5-7.5.

It is found that 1 g of saffron can be complexed with 3.75 mg of Tl^+. The two groups of rats were made, in the first group, 0.2 mg of Tl^+ was added in the rat food. In second group, 0.2 mg of Tl^+ and 200 mg of the saffron were added in the rat food. Then after 20 days, the concentration of Tl^+ in the blood were determined by graphite furnace atomic absorption spectrometry. The results showed that the concentration of thallium(I) ions is very low in second group (282 ppb) than first group (541 ppb). Therefore, saffron can be used as an complexing agent for the removal of Tl^+ in human body.

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