

# Synthesis of environmental friendly chelating biopolymers for the selective adsorption of metal ions to be used in effluent treatment

Mamta Ahuja and Anu Agarwal

Professor, Department of Chemistry, Govt. Meera Girls College, India

## Abstract

Chemical modification of naturally occurring polysaccharide, guaran has been made by incorporating 5- amino salicylic hydroxamate moiety to improve its selectivity and capacity for heavy metal ions. 5- Amino salicylic acid hydroxamate derivative of guaran (ASAH-G) was synthesized, characterized and its adsorption behaviour with Fe(II), Co(II), Ni(II), Cu(II), Zn(II), Cd(II), U(VI), W(VI), Cr(VI) and Ca(II) metal ions was studied at equilibrium in terms of molar distribution coefficient values (K<sub>d</sub>). The metal adsorption ability of the resin was compared with the hydroxamate derivative of dialdehyde guaran (HADA-G). Separation of a mixture of Fe(II) and Co(II) was achieved using column chromatography.

## Keywords

5- Amino salicylic acid hydroxamate, Selective metal adsorption, Guarant.

## INTRODUCTION

During the past few decades, increase in both industrial activities and urbanization has led to huge increase in the amount of various wastes including heavy metal inputs into the environment. Most of them are toxic and represent a serious threat to human population as well as flora and fauna. Chelating resins find great applications as selective ion-exchanger in separation and pre-concentration of metal ions. Chelating resins have been found to be more useful than chelating agents because they combine the advantageous properties of the polymer backbone and the functional group both. Guarant, a naturally occurring polysaccharide having linear chains of  $\beta$ -(1 $\rightarrow$ 4) - D - mannopyranose units with  $\alpha$ -D- galactopyranosyl units attached by a (1 $\rightarrow$ 6) linkage, possesses excellent flocculating properties. It is cheap, hydrophilic, easy to get structurally modified and biodegradable. Incorporation of chelating groups into the guarant polymer provides required selectivity for the separation of metal ions. Therefore, in continuation of our work on naturally occurring chelating biopolymers and their adsorption behaviour, we report here the synthesis of 5- amino salicylic acid hydroxamate derivative of guarant (ASAH-G), its adsorption behaviour and comparison of its adsorption ability with hydroxamic acid derivative of dialdehyde guarant (HADA-G).

## MATERIALS AND METHODS

**Reagents:** Guarant Powder (200 mesh size) was obtained from the local guar gum industry. 5- Amino salicylic acid, hydroxylamine hydrochloride, epichlorohydrin, metal salts and all the reagents were analytical grade chemicals.

**Physical measurements:** Infrared spectra of the synthesized resins were recorded on the Shimadzu IR-400 spectrophotometer using KBr pellets. A Perkin Elmer-2380 atomic absorption spectrophotometer was used for the quantitative determination of metal ions. Nitrogen analysis was done by Vario EL III CHN analyser. The resin characteristics, viz., bulk density, moisture content and total ion-exchange capacity were determined by the standard methods.

## Synthesis of Guarant-5- Amino salicylic Acid Hydroxamate (ASAH-

**G) Resin:** Guarant was cross linked with epichlorohydrin into epoxy ether of guarant which was further used for derivatization. Synthesis was carried out in following three steps:-

- Preparation of methyl ester of 5- amino salicylic acid 0.1 mol of acid was taken in a round bottom flask. To the acid, excess of methanol was added and then dry HCl gas was passed into the mixture until the saturation was complete. The reaction mixture was refluxed for 3 hrs. The methyl ester of 5- amino salicylic acid was thus formed.
- Preparation of hydroxamate of 5- amino salicylic acid 0.05 mol of methyl ester prepared in step and methanol solution of hydroxylamine hydrochloride (0.05 mol) were stirred on magnetic stirrer for 5 hrs at 30°C. The pH of the reaction mixture was adjusted by sodium ethyl ate to 9.2 - 9.3. The hydroxamate of 5-aminosalicylic acid was formed which was filtered and washed with 80% methanol solution.
- Incorporation of hydroxamate of 5-aminosalicylic acid in guarant. 0.02 mol of hydroxamate of 5-aminosalicylic acid was taken in 10 ml methanol and stirred at 45°C for 5 hrs. During the process of stirring 0.01 mol of epoxy ether of guarant was added. The product formed was filtered and the resin was successively treated with 0.1 N HCl, 0.1 N NaOH and 0.1 N HCl and was finally suspended in 200 ml 0.1 N HCl. Supernatant liquid was decanted and resin was washed 5-6 times with 80% methanol to remove the suspended impurities. Washing was continued till the supernatant liquid was clear from acid. Lastly, the product was washed with absolute alcohol and dried in vacuum

## RESULTS AND DISCUSSION

The resin characteristics viz. bulk density, nitrogen content, moisture content and total ion exchange capacity are given. Two bands due to N-H stretching vibrations of amine group at 3550 and 3460 cm<sup>-1</sup> transformed into a single medium band at 3360 cm<sup>-1</sup> in the infrared spectra of ASAH-G resin. The (C=O) peak present in the spectra of carboxylic acid near 1700 cm<sup>-1</sup> shifted near 1680 cm<sup>-1</sup> in the spectra of hydroxamate resin. A band present at 3600 cm<sup>-1</sup> region was attributed to phenolic (O-H) stretching vibrations.

## Conclusion

Therefore, we can conclude that this naturally occurring environmental friendly resin can be utilized for toxic & heavy metal ion separations from effluents of different industries.

Email: [mamtaahuja@gmail.com](mailto:mamtaahuja@gmail.com)