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Research Article

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Determination of Iron (III) in Natural Food Samples by Solvent Extraction Studies

Ch Sudhakar*, AVLNSH Hariharan and S Allabakshu

Department of Chemistry, GIT, GITAM, Visakhapatnam, Andhra Pradesh, India

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ABSTRACT

Effect of various diverse ions on the extraction of iron (III) with chloroform solutions of Tetra butyl ammonium bromide (TBAB) has been studied. Based on the results obtained, iron (III) was determined in natural food samples like Ragi, Green gram, Soya beans, Dextrin, and dried ferrous sulphate using solvent extraction studies. Iron (III) was estimated spectrophotometrically as thiocyanate complex at 480 nm in all the samples.

Keywords: Extraction-iron (III); Tetra butyl ammonium Bromide (TBAB); Hydrochloric acid; Natural food samples

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INTRODUCTION

In nature, one of the most essential elements for human metabolism for oxygen transport is iron, a vital element in life and also playing in immune function. It is usually available for supplement of heme and nonheme parts. In many natural food materials iron has been found as richly available element. Deficiency of iron causes anemia and is one of the world's most common nutritional deficiency diseases. Biologically it plays an important and in human body, mainly the cause of low iron is due to fewer intakes of iron rich foods. There are few reports on the estimation of iron in natural samples by different methods [1,2]. Sometimes high concentration of iron gives toxic nature [3] also. Using solvent extraction technique iron (III) has been extracted from aqueous hydrochloric [4-9] and sulphuric acid [10,11] solutions by various amines. But very few studies were reported on its extraction from quaternary ammonium salts. In our earlier studies we have reported the extraction of iron (III) with TBAB in chloroform from hydrochloric, sulphuric, nitric and perchloric acid solutions [12]. Based on the success met with in the extraction of iron (III) an attempt has been made in the present communication to determine iron (III) in natural food samples (Ragi, Green gram, Soya beans, Dextrin, Dried ferrous sulphate) following extraction by Tetra butyl ammonium Bromide (TBAB) dissolved in chloroform. The results obtained are presented here.

EXPERIMENTAL SECTION

Equipment

An ELICO SL 191 UV-Visible Double beam Spectrophotometer with matched 10 mm corex glass cuvetts was used to determine iron content.

Procedure for Iron (III) Extraction

The samples are perfectly dried were weighed accurately by analytical balance and were finely powdered in a mortar. A known weight of the powdered samples was transferred quantitatively to 100 mL volumetric flasks

separately and then 70.0 mL of 0.01 M HCl was added. The samples were shaken thoroughly for about 15 min. for compete dissolution. These were then diluted up to the mark by 0.01 M HCl solution and then filtered by 40 numbered Whatmann filter. The first portion of filtrate was discarded. The clear solutions thus obtained were used as stock sample solutions. The above prepared solutions of different aliquots were acidified with hydrochloric acid. The pH of the samples was kept at 7.0 (max. extraction occurred at pH 7). 10.0 mL of each iron (III) sample solution was shaken for five minutes with an equal volume of 5.0×10^{-2} M of TBAB. After separation of two phases, iron (III) from the organic phase was stripped with 10.0 mL of 2.0 M hydrochloric acid and was determined spectrophotometrically [13] at 480 nm as its colored complex with thiocyanate.

RESULTS AND DISCUSSION

Effect of Stripping Agent

After the extraction, the iron (III) was stripped with 10.0 mL portions of 2.0 M hydrochloric acid as the stripping agent. Maximum amount of iron (III) was stripped back with 3 contacts of the stripping process.

Effect of Diverse Ions

The effect of various cations and anions on the extraction of iron (III) by TBAB has been studied in order to test the validity of the present method. Iron (III) was extracted in presence of large number of diverse ions. The tolerance limit was set as the amount of foreign ion causing ± 1.5% error in recovery. The 412.5 µg of alkali metals were tolerated in the ratio of 1:5 with 82.5 µg of iron (III), while the main group elements were tolerated in the ratio of 1:4 but transition metals such as Mn, Co and Zn were tolerated in the ratio of 1:2 only. However anions like phosphate and cations like vanadium(V), aluminum(III), chromium(III), nickel(II), copper(II), molybdenum(VI) were not tolerated in any ratio as mentioned in Table 1.

Results obtained on the estimation of Iron (III) in natural food samples (Table 2) indicate that the average % recovery of iron (III) was found to be 96.97%.

Table 1: Separation of iron (III) from a binary mixture (Fe=82.5 µg): [TBAB]=5.0×10^{-2} M (From HCl medium)

Foreign ions	Amount tolerated (µg)	Ratio
Li^+, Na^+, Cs^+, Sr^{2+}	412.5	01:05
Sb^{3+}, Sn^{4+}, Bi^{3+}, As^{3+}, Ti^+, Ag^+	330	01:04
Pd^{2+}, Co^{2+}, Pb^{2+}	247.5	01:03
Zn^{2+}, Mn^{2+}, Cd^{2+}	165	01:02
K^+, Zr^{4+}	82.5	01:01
Al^{3+}, V^{5+}, Cr^{3+}, MoO_4^{2-}, Ni^{2+}	0	Interfere
Br^-, CH_3COO^-, PO_4^{3-}, $C_2O_4^{2-}$ and $S_2O_3^{2-}$	0	Interfere

Table 2: Analysis of natural samples for iron

Sample	% of Fe (III) Present	% of Fe (III) Found	% Recovery
Ragi	3	2.81	93.66
Green gram	4.05	3.94	97.28
Soya beans	20	19.45	97.25
Dextrin	100.22	98.42	98.2
Dried ferrous sulphate(67mg)	20.07 g	19.76 g	98.46

CONCLUSION

The proposed method is simple, rapid and selective for the determination of iron in natural food samples. It can be concluded that this determination can be achieved with efficiently in minimum amount of time.

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