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Spectrophotometric Determination of Iron in Food Grains & Vegetables

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Research Paper

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ABSTRACT

Iron is one of the many minerals required by the human body. It is used in the manufacture of the oxygen carrying proteins, hemoglobin and myoglobin. The analysis of Iron present in the food material is extracted to form a solution containing Fe^{3+} ions to make the presence of these ions in solution. In this method thiocyanate ions react with Iron (III) ions to form a blood red coloured complex. The intensity of these complex is measured at maximum wavelength at 490nm.The system obey's Beer's Law in the concentration range of 0.32 - 3.23ppm.and molar absorptivity of the complex is2.9×10^4 l mol^{-1} cm^{-1}.The conditions as well as the various experimental parameters affecting the stability of the complex in food samples.

Introduction

The majority of people consume food grains and vegetables as their main source of essential nutrients, antioxidants, and metabolites. Proteins, iron, calcium, vitamins, and other vital micronutrients that are sometimes lacking in regular diets are all provided by these priceless dietary components. Metals from contaminated soils or polluted environments can be absorbed by vegetables. More biological functions are performed by iron than by any other metal, making it the most prevalent transition metal in the living system. Diet is the main source of iron in the body. Heme and nonheme are the two primary forms of iron. The molecular mechanisms behind the absorption and bioavailability of these forms of iron vary greatly. The latter came from plant sources, whereas the former came from meat, fish, and poultry. According to reports, heme iron is well absorbed and is not significantly impacted by other dietary

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components consumed at the same meal. The content of meals has a significant impact on the absorption of non-heme iron. Therefore, the types of iron in dietary nutrition as well as the total amount of iron are very important[1.] About two thirds of the about 4 grams, or 70 mmol, of iron that make up an adult's body is found in hemoglobin. Just 0.1 percent of the body's iron is found in plasma, where nearly all of it is bonded to the transport protein transferrin. Iron is found in many foods, and the average person absorbs 1 mg of iron per day from their diet.[2]. Phylates and oxalates, which obstruct iron absorption, are the cause of the low bioavailability of iron in plant foods.Anemia, a condition caused by a lack of iron in the body, can make a person feel exhausted a nd lethargic.iron is present in trace amounts in many of the foods we eat.However, too much iron can lea d to a number of health issues.An excess of iron raised the risk of diabetes, heart disease, cancer, arthriti s, and lived disease[3].Liquid-liquid extraction, cpprecipitation, ion exchange, and other conventional preconcentration and separation techniques for metal ions frequently call for significant amounts of pure solvents. Some of which generate environmental issues and are detrimental to health.4.Compared to certain existing methods (Table 1)5–10, the current method is more straightforward and sensitive[5-10].

Instruments & reagents

UV- Spectrophotometer

Preparation of1mol L^{-1} ammonium thiocyanate solution:-Weigh 38gm. of ammonium thiocyanate into a 500ml volumetric flask and make up to the mark with distill water.

Preparation of 0.15mol L^{-1} potassium permanganate solution :-Weigh 2.4 gm. of solid $KMnO_4$ into a 100ml volumetric flask and make up to the mark with distill water.

Preparation of food sample for analysis:- Accurately weigh 2-5gm. of food sample into a crucible. Heat the crucible over a Bunsen burner until the sample is reduced completely to ash. After cooling the sample and crucible, use stirring rod to crush the ash to a fine powder. Use measuring cylinder add 5ml of distill water and then filter the solution into a 100ml conical flask to remove the ash. This filtrate solution will be used for analysis.

Procedure:- Accurately measure the 10ml of sample solution in a dry boiling test tube. Next measure the 10ml of each Fe^{3+} standard solution into separate boiling test tube in order of increasing concentration, beginning with the 2 x 10^{-1}mol L^{-1}.Labelled the each test tube .Add 10ml of ammonium thiocyanate solution in each iron solution in sequence, with 2 minutes between each addition .These

additions must be carefully timed so that all samples react for the same period of time. Mix the solutions by swirling a stable red colour will appear over the next few minutes. As near as possible to 15 minutes after adding thiocyanate, measure the absorbance at a wavelength of 490nm.for each coloured solution using spectrophotometer. The measured absorbance of light is a direct measure of the intensity of the solution's colour.

Result & discussion

In this analysis iron present in food sample is extracted to form a solution containing Fe^{3+} ions, thiocyanate ions (SCN^-) are added .After the addition of thiocyanate blood red colored complex is formed. The intensity of these complex is measured at wavelength 490nm.

$$Fe^{3+} + SCN^- \dashrightarrow [Fe(SCN)]^{2+}_{aq}$$

By comparing the intensity of these coloured solution with the colour of a series of standard solution of known (Fe^{3+}) concentration .If the absorbance value for our unknown iron sample is greater than the absorbance value for highest conc. of known/standard solution then we should repeat the analysis using a smaller mass of food. Reducing agents like oxalates, nitrite, and thiosulphate can interfers. These are masked by adding a small quantities of $KMnO_4$.

Conclusion

The analysis indicates the coloured complex has high molar absorptivity and is made a basis of the spectrophotometric determination of the metal ion. The proposed method is very simple, highly selective, reproducible and relatively selective.

Table:- Comparison of the present method with the other spectrophotometric

Methods for the determination of Iron

SN0.	Reagents	pH	Wavelength,nm	Molar absorptivity	Ref. no
1	2,6 bis(1-hydroxy-2-naphthol)pyridine	6	550	$2.65x10^4$	2
2	2-Diethylamino-4-hydroxy-5-nitroso - 6-aminopyrimidine	10.3	660	$3.0x10^4$	3

3	Diformylhydrazine	7.3-9.3	470	$0.32x10^4$	4
4	1,2-dihydroxy-3,4-diketo-cyclobutane(squaric acid)	2.7	515	$3.95x10^3$	5
5	2-carb0ethoxy-1,3-indandione sodium salt	3-6	490	$0.65x10^4$	6
6	3-(2-pyridyl)-5,6-bis(4-phenyl sulfonic acid)-1,2,4-triazine	5	-	$2.8x10^4$	7

References

1. Hallu T,Solomon D, Worku E,Sisay S and Demissie K(2019),Chem.Sci. J,10;1,DOI:10.4172/2150-3494.10000198.

2. Cook J D,Finch CA,Smith NJ(1979)Evaluation of the iron metabolism in man,Blackwell,Oxford.

3. C.Niederau et al.,Long term survival in patients with hereditary hemochromatosis,Gastroenterology(1996).

4. Y. Liu et al.,Solid phase extraction and preconcentration of Cadmium (II) in aqueous solution with Cd(II)-imprinted resin(poly-Cd(II)-DAAB-VP) packed columns,Analytical Chimica Acta(2004).

5. Sharma ashok k,singh Ishwar (2009)Food Anal.Method,2,221-225 .

6. Tsuchiya M,Iwanami Y(1990) Anal Sci.6(5):701doic:10.2116/analsci 6.701 UK Office for National Statistics(2003) The National Diet & Nutrition Survey(NDNS).s

7. Nagabhushna B,Chandrappa G,Nagappa B,Nagaraj N(2002)Anal Bioanal Chem.373(4-5):299 doi:1007/s00216-002-1343-6.

8. Stalikas CD,Pappas ACH,Karayannis MI,Veltsistas PG(2003) Microchim Acta 142:43 doi:10,1007/s00604-002-0950-4.

9. Ghazy SE(1995) Anal sci.11(1):33.

10. Akl MA,Mori Y,Sawada K (2006) Anal Sci 22(9):1169 doi:2116/ananscі22,1169.