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A Colorimetric Analysis of Iron Content in some Vegetables and Herbs

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ABSTRACT

For nearly all living organisms, iron is an essential element as it participates in a wide variety of metabolic processes, including oxygen transport, electron transport and deoxyribonucleic acid (DNA) synthesis. It is involved in basic processes, such as respiration and photosynthesis. Iron content is rather low in all organisms, amounting in plants to about 0.009% of dry weight. As Iron is an important element to the human body. Blood loss can lead to a lack of iron and Anemic symptoms. Iron supplements can boost iron levels in the human body. In present study, colorimetric thiocyanate method is used to find out the iron content in some vegetables and herbs. The amount of iron in samples was determined using a set of standard solutions, a photoelectric colorimeter, and Beer's law, $A = \varepsilon l c$. Iron content of vegetables and herbs commonly consumed was found which was highest in Spinach (9.325 mg) and lowest in mint (1.579 mg) among test samples taken. These observations may serve as indicator on selection of vegetables and herbs that can be consumed to fulfil the requirement of Iron.

Keywords: Metabolic process, Iron content, Vegetables, Herbs, Colorimeter, Thiocyanate method.

I. INTRODUCTION

As Iron is one of the many minerals required by the human body. It is used in the manufacturing of the oxygen-carrying proteins, haemoglobin and myoglobin. Main functions of iron include: increase in energy production, reduce fatigue, improve cognitive function, keep immune system strong, create red blood cells and to maintain healthy cell division [1]. For the normal production and function of various cells and hormones and for healthy brain development and growth in children, iron is important.

The recommended daily allowance (RDA) of iron for adults (19-50) years is 8 mg daily for men, 18 mg for women, 27 mg for pregnancy, and 9 mg for lactation [2]. A deficiency of iron in the body can leave a person feeling tired and restless, and can lead to a disorder called Anemia. Many of the food we eat

contain small quantities of iron. Main source of iron is food. In food products, iron comes in two forms: heme and non-heme. Heme is found only in animal flesh like meat, poultry, and seafood. Non-heme iron is found in plant foods like leafy greens, whole grains, seeds, legumes, and nuts. In animal flesh, non-heme iron is also present because animals consume plant foods with non-heme iron. Iron is stored in the body as ferritin (in the liver, spleen, muscle tissue, and bone marrow) and is delivered throughout the body by transferrin (a protein in blood that binds to iron) [3].

In present work, some vegetables and herbs were chosen to find out the iron content in them, which are consumed locally in Gujarat. For determination of amount of iron in plant tissues till date, one of the most accurate methods is flame absorption atomic spectroscopy. However, this approach is time-consuming and expensive and requires specific equipment not commonly found in all laboratories. Therefore, a simpler, yet accurate method that can be routinely used is required.

Colorimetric analysis is useful for the systems in which substances or their solutions are colored. Colorimeters are provided with the arrangements to select appropriate wavelength of light with the help of filter and grating. A light of proper wavelength is allowed to pass through a coloured test solution. The light transmitted from this solution is made to pass through photocell and proportional to the amount of light the solution transmits. In the photocell, a current is produced. A meter is calibrated to demonstrate the absorbed light fraction proportional to the colored substance concentration in the sample solution. From the measurements concentrations of coloured solution can be obtained by using Lambert-Beer law. When a substance is colorless, then a suitable complexing agent is added to the solution so that a colored complex is obtained. The ortho phenanthroline colorimetry and thiocyanate colorimetry method are fast, simple, sensitive & cost beneficial. In this analysis, the iron present in an iron tablet (dietary supplement) or a sample of food is extracted to form a solution containing Fe^{3+} (ferric) ions. To make the presence of these ions in solution visible, thiocyanate ions (SCN^-) are added. These react with the Fe^{3+} ions to form a blood-red coloured complex:

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

By comparing the intensity of the colour (optical density) of this solution with a series of standard solutions, with known Fe^{3+} concentrations, the concentration of iron in the tablet or food sample may be determined [4]. Optical density or absorbance was measured at a wavelength of 490 nm for each coloured solution using colorimeter and Standard curve method is used for determination of iron in samples taken.

II. METHODS AND MATERIAL

Material:

- Ferric ammonium sulfate $FeNH_4(SO_4)_2 \cdot 6H_2O$ standard solutions: 0.005, 0.010, 0.015, 0.021, 0.026, 0.031….mg/ml
- Samples of the vegetables and herbs (Fenugreek, Spinach, Coriander, Mint, Cabbage, Curry Leaves, Basil, Broccoli, and Kale)
- 1 mol L^{-1} Potassium thiocyanate solution
- 1 mol L^{-1} Sulfuric acid
- 1 mol L^{-1} Hydrochloric acid
- 100 mL beaker, 100 mL volumetric flasks, 5 mL, 10 mL pipette, 10 mL measuring cylinder and 100 mL conical flask
- Boiling tubes and Distilled water

Preparation of Fe^{3+} standard solutions:

About 3.0 g of ferric ammonium sulfate (FAS) was weighed out. A mortar and pestle was used to grind the salt to a fine powder. Accurately weigh 0.264 g of the powder into a 100 mL beaker and 20 mL of concentrated sulfuric acid was added. Powder was left

to soak in acid overnight. The next day, the acid/powder slurry was carefully poured into a 100 mL volumetric flask, rinsing the beaker into the flask a few times with water, then made up to the mark with distilled water. The solution was allowed to stand for several days until the ferric ammonium sulfate powder was fully dissolved. After 3 days, a magnetic stirrer bar was used and stirred the solution to speed up this dissolving process.

2 mL of FAS solution was transferred to a 100 mL volumetric flask using a pipette and volume was made up to the mark with distilled water to give a solution with $[Fe^{3+}]$ = 0.005 mg/mL solution. For Calibration curve solutions, different concentration having stock solution 2, 4, 6, 8,10, 12, 14…..mL were prepared by proper dilution method.

Preparation of 1 mol L^{-1} ammonium thiocyanate solutions

7.6 g of solid ammonium thiocyanate was weighed and transferred into a 100 mL volumetric flask and volume was made up to the mark with distilled water.

Apparatus and Principle:

Photoelectric colorimeter

It measures the intensity or concentration of the coloured solution based on two important laws for its working: Lambert's law and Beer's law.It is used for measuring the transmittance and absorbance of light passing through a liquid sample.

Colorimetric Analysis of standard:

For Calibration curve solutions, different concentration having stock solutions 2, 4, 6, 8,10, 12, 14…..mL were prepared by proper dilution method.

Using a 10 mL measuring cylinder, 10 mL of 1 mol L^{-1} ammonium thiocyanate solution was added to 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.

Solutions were mixed by swirling. A stable red colour was appear over the next few minutes.

15 minutes after adding thiocyanate, the absorbance was measured at a wavelength of 490 nm for each coloured solution using photoelectric colorimeter. These measurements were made in sequence–one sample every two minutes–reflecting the timing of the thiocyanate additions above.

Calibration Curve (Figure -1) : Optical Density or absorbance (y-axis) vs Volume (mL) (x-axis):

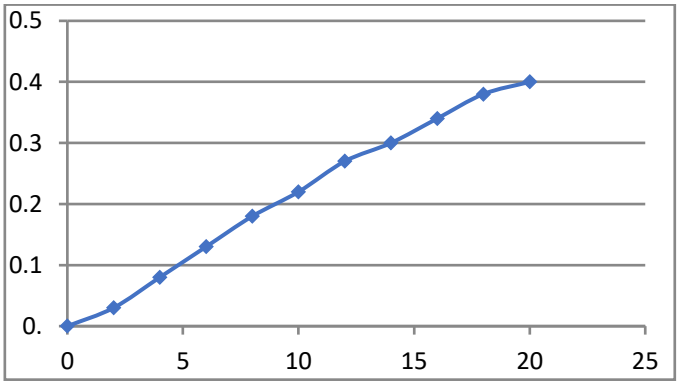

Figure -1

Preparation of sample for analysis:

Samples of the vegetables and herbs (Fenugreek, Spinach, Coriander, Mint, Cabbage, Curry Leaves, Basil, Broccoli, and Kale) were collected from Gandhinagar (Gujarat) local market, 250 Gms of each .

Air dried samples were accurately weighed 2 grams into a crucible and reduced completely to ash. Precautions and care should be taken with the Bunsen flame while heating/combusting the sample. When the sample and crucible were cooled, a stirring rod was used to crush the ash to a fine powder. 10 mL of 1 mol L^{-1} hydrochloric acid was added by using a measuring cylinder, and stirred for 5 minutes (making sure that all the ash is soaked). 5 mL of distilled water

was added and then the solution was filtered into a 100 mL conical flask to remove the ash. This filtered solution was used for colorimetric analysis.

III. RESULTS AND DISCUSSION

Figure 1 indicates a linear feature, as expected by Beer's Law, upon plotting absorbance in form of optical density versus volume taken (normal concentration calculated by formula)) at 490 nm, and using the calibration curve equation and absorption of the unknown sample treated under the same experimental circumstances, absorbance was measured and concentration of the unknown sample were calculated.

Table-1 : Optical density of sample solutions and calculated amount:

Sr. No.	Name	Botanical Name [5]	O. D.	Concentration (mg/mL)	Amount of iron (mg)
1	Fenugreek	Trigonella foenum- Graecum	0.420	0.05	7.44
2	Spinach	Spinacia oleracea	0.522	0.065	9.325
3	Coriander	Coriandrum sativum	0.200	0.023	3.384
4	Mint	Mentha piperita L.	0.119	0.011	1.579
5	Cabbage	Brassica oleracea	0.193	0.022	3.234
6	Curry Leaves	Murraya koenigii	0.214	0.025	3.61
7	Basil	Ocimum basilicum	0.148	0.014	2.106
8	Broccoli	Brassica oleracea var. italica	0.294	0.035	5.038
9	Kale	Brassica oleracea var. sabellica	0.207	0.023	3.384

Representation of variation of amount of iron content among various vegetables and herbs examined (mg/100 gm):

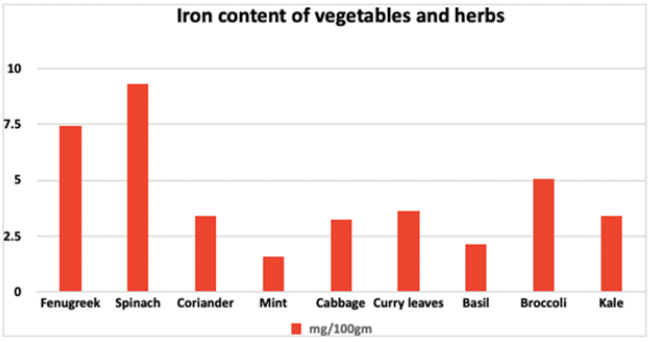

Figure-2: Iron Content of vegetables & herbs

IV. CONCLUSION

In present study a simple colorimetric method was used to determine iron content in different vegetables & herbs. It was found by using standard curve method that all the samples contained a fair amount of iron. This study revealed that Spinach had maximum and Mint had minimum Iron content with comparison to other samples taken.

So it can be concluded that herbs & vegetables which were taken from the Gandhinagar local market are good source of Iron. Further studies on other nutrients should be done on these herbs & vegetables. This will help the consumers in obtaining information and promoting knowledge about high value of nutrients

rich vegetables which could potentially address some health challenges.

V. REFERENCES

[1]. Abbaspour N, Hurrell R, Kelishadi R. Review on iron and its importance for human health. J Res Med Sci. 2014 Feb;19(2):164-74.

[2]. Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium, and Zinc. Washington (DC): National Academies Press (US); 2001. 9, Iron.

[3]. Atri Deo Tripathi1, K.A. Gupta2 Shally Malik, 'Iron Determination by Colorimetric Method Using O-Phenanthroline' Bulletin of Pure and Applied Sciences. Vol.38 C (Chemistry), No.2, 2019: P.171-175.

[4]. https://www.canterbury.ac.nz/media/documents/science-outreach/iron_colorimeter.pdf.

[5]. Simpson MG. 2010. Plant Systematics. 2nd ed. San Diego, CA: Elsevier Inc. 740 p.

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