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Spectrophotometric determination of heavy metals in vita-biotic Fero-globin B12

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Abstract:

Fero-globin B12 is an ideal source of metals such as iron and other nutrients for the production of red blood cells, to help maintain energy levels, health and vitality. (Cu, Mn, Fe and Zn) were determined by using atomic absorption spectroscopy AAS. Sample was vaporized at 2000 - 8000 K decompose into atoms. Concentrations of atoms in the vapor are measured by emission or absorption of characteristic wavelengths of radiation and the obtained results were similar to stated value a part of Zn.

Keywords: Fero-globin B12, nutrients, health and atomic absorption spectroscopy.

Introduction

Atomic absorption spectroscopy is an important tool for the measurement of metallic elements at trace level, which is widely used in industrial and environmental chemistry. AAS uses radiation (with frequencies which are specific for each element) which is passed through the gaseous sample element and is absorbed causing excitation of the element's electrons with the specific transition relating to the frequency of radiation. The amount of absorbed radiation is then measured and is proportional to the concentration of the sample element. The AAS process starts with the liquid sample being aspirated through a tube and transferred into the flame where it is vaporized. [Hollas, J. (2013), Hibbert, D. (2007)]

A hollow-cathode lamp (specific to each element being analyzed) is shone on the flame to provide the radiation for the atoms to absorb. A mono-chromator selects the right wavelength that will reach the detector. Analyte samples at ppm levels can be analyzed with a precision of 2%. Fero-globin B12 is an ion supplement formula produced by Vita-biotics which contain trace amount of Fe, Cu, Mn and Zn as well as several other components. [Hollas, J. (2013), Svanberg, S. (2013), Nonova, D. and Stoyanov, K. (1982)]

Fe, Cu, Mn and Zn are essential metals for human health as they provide important roles in various Biological processes and absence of them could lead to biological functional abnormalities. Fe is a vital constituent of haemo-globin, myoglobin and several enzymes. Cu is an important catalyst for several enzymes and is a component of hair and elastic tissue. Zn is a constituent of many enzymes found within the body and Mn also acts as a catalyst in several enzyme processes. [Nonova, D. and Stoyanov, K. (1982), Topuz, B. (2019)]

Material and Methods

Apparatus and solution provided

- Stock copper solution 1000 ppm

- Stock iron solution 1000 ppm

- Stock zinc solution 1000 ppm

- Stock manganese solution 1000 ppm

- 1 bottle of Vita-biotics Fero-globin B12 - Pipettes - 8 clean 100 ml volumetric flasks

Preparation of standard and sample solution

A master stock solution (100 ml) containing exactly 100 $\mu g/g$was prepared for each cation by taking 10 ml of each stock metal solution 1000 ppm into a 100 ml volumetric flask and continued with deionized water. Then, four calibration standard solutions of mix metals were dissolved in nitric acid (2% by volume).

A blank solution of (2% nitric acid) was made by taking 2 ml of nitric acid into a 100 ml volumetric flask before making to volume with deionized water. 11.7002 mg of sample (Fero-globin B12) was Weighted and added into a 100 ml volumetric flask that was equivalent to 10 ml of sample. The neck of flask was rinsed by using deionized water and then made up to volume using deionized water.

The approximate amounts of Cu and Mn in 10 ml of sample was 0.5 mg. Thus, the concentration of Cu and Mn in the 100 ml sample solution was 5 ppm. Each analyte concentration was required to fall within the calibration range from 0.5 $\mu g/g$ to 2.0 $\mu g/g$ so that the sample solution was required to dilute 1:5 by taking 20 ml of sample solution into 100 ml volumetric flask before adding 2 ml of nitric acid and making to volume with deionized water. The approximate amounts of Fe and Zn in 10 ml of sample was 14 mg and 10 ml respectively. The sample solution was also required to dilute 1:100 by taking 1 ml of sample solution into 100 ml volumetric flask before adding 2 ml of nitric acid and making to volume with deionized water.

The standard and the diluted sample solutions were measured on the atomic absorption instrument.

Each instrumental measurement was set to replicate five times. [Fifield, F., & Kealey, D. (2000)]

Results and Discussion:

Table (1) indicates the results of the absorbance measurements for Cu cation of 4 standard solutions and 2 diluted sample solutions

Method Cu		
Solution	Mean absorbance	SD
0.5 $\boldsymbol{\mu g}/g$	0.0553	0.0006
1.0 $\boldsymbol{\mu g}/g$	0.1037	0.0011
1.5$\boldsymbol{\mu g}/g$	0.1510	0.0016
2.0 $\boldsymbol{\mu g}/g$	0.2081	0.0015
Diluted solution 1 for Cu and Mn	0.1000	0.0006
Diluted solution 2 for Cu and Mn	0.1031	0.0008

Table (1)

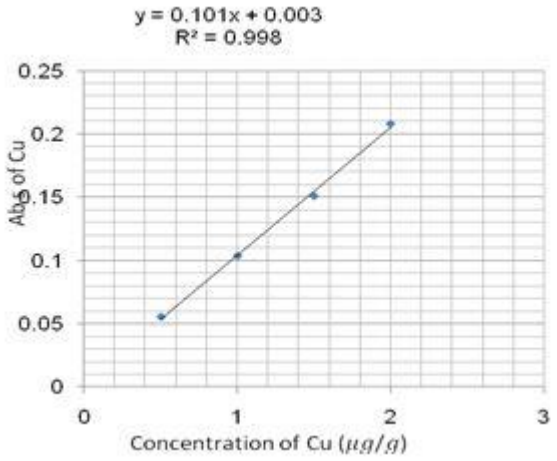

Figure (1) above shows the calibration curve of four standard solutions data (average absorbance of Cu cation vs concentration of Cu ($\mu g/g$)).

Table (2) demonstrates the results of the absorbance measurements for Mn cation of 4 standard solutions and 2 diluted sample solutions

Method Mn		
Solution	Mean absorbance	SD
0.5 $\mu g/g$	0.0226	0.0006
1.0 $\mu g/g$	0.0406	0.0017
1.5$\mu g/g$	0.0633	0.0025
2.0 $\mu g/g$	0.0851	0.0015
Diluted solution 1 for Cu and Mn	0.0383	0.0013
Diluted solution 2 for Cu and Mn	0.0392	0.0011

Table (2)

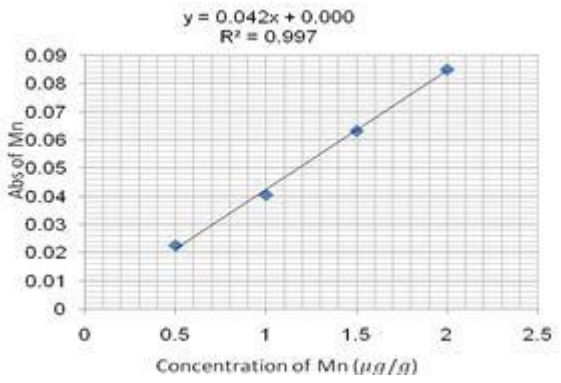

Figure (2) shows the calibration curve of four standard solutions data (average absorbance of Mn cation vs concentration of Mn ($\mu g/g$)).

Table (3) illustrates the results of the absorbance measurements for Fe cation of 4 standard solutions and 2 diluted sample solutions.

Method Fe		
Solution	Mean absorbance	SD
0.5 $\boldsymbol{\mu g}/g$	0.0042	0.0004
1.0 $\boldsymbol{\mu g}/g$	0.0103	0.0006
1.5$\boldsymbol{\mu g}/g$	0.0203	0.0006
2.0 $\boldsymbol{\mu g}/g$	0.0292	0.0014
Diluted solution 1 for Fe and Zn	0.0195	0.0007
Diluted solution 2 for Fe and Zn	0.0166	0.0005

Table (3)

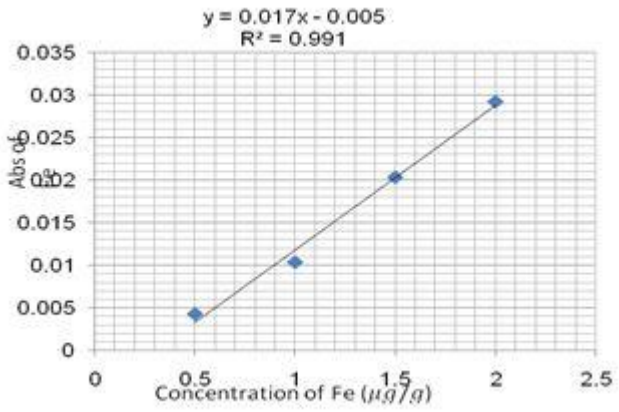

Figure (3) shows the calibration curve of four standard solutions data (average absorbance of Fe cation vs concentration of Fe ($\mu g/g$)).

Table (4) illustrates the results of the absorbance measurements for Zn cation of 4 standard solutions and 2 diluted sample solutions

Method Zn		
Solution	Mean absorbance	SD
0.5 $\boldsymbol{\mu g}/g$	0.0032	0.0024
1.0 $\boldsymbol{\mu g}/g$	0.0058	0.0061
1.5$\boldsymbol{\mu g}/g$	0.0083	0.0078
2.0 $\boldsymbol{\mu g}/g$	0.0115	0.0071
Diluted solution 1 for Fe and Zn	0.0166	0.0022
Diluted solution 2 for Fe and Zn	0.0150	0.0018

Table (4)

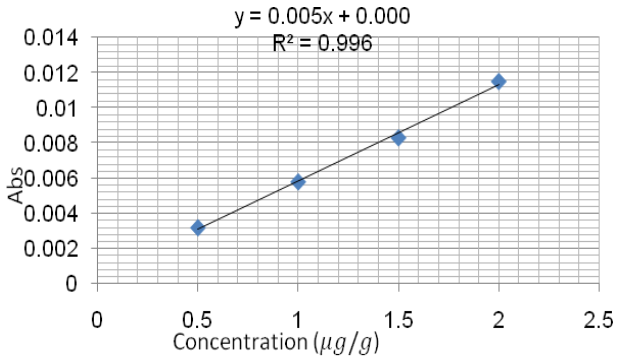

Figure (4) shows the calibration curve of four standard solutions data (average absorbance of Zn cation vs concentration of Zn ($\mu g/g$)).

Calculations

Calculated the mass in mg of the Cu metal in the Fero-globin sample

The regression equation of Cu calibration curve was

y = 0.1011x + 0.0031

The mean absorbance of Cu in the diluted sample solution 1 for Cu and Mn was y = 0.1000 so the Cu concentration in diluted sample was x = (0.1000 - 0.0031)/0.1011 = 0.958 $\mu g/g$.

The mass of Cu in 10 ml original Fero-globin sample 1 was $0.958 \times 10 \div 20 = \mathbf{0.479}$ mg

While the mean absorbance of Cu in the diluted sample solution 2 for Cu and Mn was y = 0.1031 so the Cu concentration in diluted sample was x = (0.1031 - 0.0031)/0.1011 = 0.989 $\mu g/g$.

The mass of Cu in 10 ml original Fero-globin sample 2 was $0.989 \times 10 \div 20 = \mathbf{0.494}$ mg

Calculated the mass in mg of the Mn metal in the Fero-globin sample

By following the same procedure as Cu:

The mass of Mn in 10 ml original Fero-globin sample 1 was $0.902 \times 10 \div 20 = \mathbf{0.451}$ mg

The mass of Mn in 10 ml original Fero-globin sample 2 was $0.923 \times 10 \div 20 = \mathbf{0.461}$ mg

Calculated the mass in mg of the Fe metal in the Fero-globin sample

--> The mass of Fe in 10 ml original Fero-globin sample 1 was $1.459 \times 10 \div 1 = \mathbf{14.588}$ mg

--> The mass of Fe in 10 ml original Fero-globin sample 2 was $1.288 \times 10 \div 1 = \mathbf{12.882}$ mg

Calculated the mass in mg of the Zn metal in the Fero-globin sample

--> The mass of Zn in 10 ml original Fero-globin sample 1 was $2.945 \times 10 \div 1 = \mathbf{29.454}$ mg

--> The mass of Zn in 10 ml original Fero-globin sample 2 was $2.655 \times 10 \div 1 = \mathbf{26.545}$ mg

from the calculation above, it was determined that sample 1 containing 0.479 mg of Cu, 0.451 mg of Mn, 14.85 mg of Fe and 29.454 mg of Zn. sample 2 contained 0.494 mg of Cu, 0.461 mg of Mn, 12.82 mg of Fe and 26.545 mg of Zn. All these results are comparable to the levels stated on the fero-globin box, except for Zn which showed 2-3 times the amount stated. This could have been due to interference in AAS from Cu and Fe. The spectroscopy wavelength for Zn 213.856 nm is very close to the wavelength of Cu (213.8507) and Fe (213.8589). [Topuz, B. (2019), Miller, J. (1991), Miller, J., & Miller, J. (2018)]

Conclusion

Fero-globin B12 is a unique iron supplement with zinc and vitamin B complex, formulated to deliver an optimum amount of iron to the body while remaining gentle on the stomach. It provides an ideal source of iron and other nutrients for the production of red blood cells, to help maintain energy levels, health and vitality. Iron is required for the formation of hemoglobin in red blood cells, for normal energy metabolism and also for metabolism of drugs and foreign substances which require excretion from the body. Copper is an essential trace element present in the diet and in the human body. It is needed to absorb and utilize iron. It is also part of the antioxidant enzyme, superoxide dismutase (SOD). Synthesis of some hormones required copper, as does the synthesis of collagen. The enzyme tyrosinase which plays a role in the production of skin pigment, required copper to function.

Manganese is a constituent of enzymes such as pyruvate carboxylase, mitochondrial superoxide dismutase and arginase helps prevent free radical- mediated cellular damage. Manganses is required in the body for bone formation and for energy metabolism. Zinc is present in many enzymes, is essential for growth, tissue repair and normal reproductive development. Zinc is also needed in the efficient functioning of the immune system and in the structure and function of the skin. A calibration graph was obtained and used to determine the amount of 4 cations (Cu, Mn, Fe, and Zn) in the Vita-biotic Fero-globin sample. The amount of Cu, Mn and Fe were similar to the stated value. Never the less, the amount of Zn was dramatically different with the stated value.

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