



Unique Research Journal of Chemistry

Available online: www.ujconline.net

Research Article

SPECTROPHOTOMETRIC DETERMINATION OF SELENIUM USING CURCUMIN AS CHROMOGENIC REAGENT

Dinesh M^{*1}, Naveen Kumar GS¹, Harish KH¹, Ganesh Prasad² and Hanumanthachar Joshi¹

¹Sarada Vilas College of Pharmacy, Mysore

²Zeus Biotech, Mysore

Received: 14-08-2013; Revised: 12-09-2013; Accepted: 11-10-2013

*Corresponding Author: **Dinesh M**, Sarada Vilas College of Pharmacy, K M Puram, Mysore-570004, Karnataka State, India., E-mail: md.svcp@gmail.com

ABSTRACT

A simple and sensitive visible spectrophotometric method has been developed for the quantitative estimation of selenium. The proposed method is based on the complexation reaction of selenium with curcumin in methanol. The red color of chromogen measured at λ_{max} 507 nm. This increase in absorbance is directly proportional to selenium concentration. Beer's Law was obeyed in the range 0.2 – 1.0 $\mu\text{g/ml}$ of selenium. The molar absorptivity, Sandell's sensitivity, quantitation limit and detection limit of the method were found to be 0.9887. The developed methods were found to be precise and accurate. The results obtained were statistically validated and found to be reproducible.

Keywords: Selenium, Spectrophotometry, Curcumin, Estimation, Validation.

INTRODUCTION

Selenium (Se) has been recognized as an essential nutrient for plant, animal, and human body, but at high concentration it can become toxic. The range between the concentration in which selenium is essential and toxic is very narrow^{1,2}. This element plays an important role in elderly people as well as in the prevention of many age-associated diseases and in maintenance of normal immune function. Se is potent antioxidant involved in cellular defense against free radical reactions, and the risk of deficiency seems to increase in proportion to the age. Evidence is accumulating that most of the degenerative diseases have their origin in deleterious free radical reactions. These diseases include atherosclerosis, cancer, inflammatory joint, asthma, diabetes, senile dementia, and degenerative eye disease³. But high Se concentrations in human can cause loosing hair and nails and irritation of skin and eye¹. Se is essential nutrient for human health. The required daily amount of Se is 20 mcg day⁻¹ and 40–70 mcg day⁻¹ for 4–6 years old and adult males, respectively. The essential role of the Se is due to its presence in the active site of some enzymes (i.e., glutathione peroxidase and iodotironine-5-deiodinase) and the catalytic effect of selenium compounds on the reaction of intermediate metabolism and inhibition of the toxic effect of heavy metals. It has been established that diets with deficit in Se are associated with some human diseases, but diets with Se contents higher than 5 mg/kg are toxic and cause important symptoms in humans and

animals⁴. Selenium is present as selenocysteine (Se-Cys) in at least 30 proteins⁵.

Because of its significance, several analytical techniques have been reported concerning the determination of selenium. Many spectrophotometric methods for the determination of selenium have been reported with some chromogenic reagents. A literature survey showed that no attempt had been made to study the colour reaction of selenium with curcumin which forms a red color on the complexation with selenium at room temperature. A method has been developed for the rapid spectrophotometric determination of selenium.

MATERIALS AND METHODS

Instrumentation:

A Shimadzu UV/visible double beam spectrophotometer (Model 2450) with 1cm matched quartz cells were used for all the spectral measurements.

Preparation of Standard and Sample Solutions:

About 100 mg of Selenium was accurately weighed and dissolved in water and volume made up to 100 ml with water (1 mg/ml). The final concentration of Selenium was made to 100 $\mu\text{g/ml}$ with water by dilution.

Method:

Aliquots of Selenium ranging from 0.2 – 1.0 ml (1 ml = 100 μg) were transferred into a series of 10 ml volumetric flasks. To each flask 0.5 ml of Curcumin (0.5% w/v in methanol) was

added. The volumes were made up to the mark with methanol. The absorbance of the red colored chromogen was measured at 507 nm against reagent blank. The colored species was stable for more than 4 hrs. The amount of Selenium present in the sample was computed from calibration curve.

RESULTS AND DISCUSSION

The optical characteristics such as absorption maxima, Beer's law limits, molar absorptivity and Sandell's sensitivity are presented in Table 1. The regression analysis using method of least squares was made for the slope (b), intercept (a) and correlation (r) obtained from different concentrations and the results are summarised in Table 1. The percent relative standard deviation and percent range of error (0.05 and 0.01 level of confidence limits) calculated from the eight measurements at $\frac{3}{4}$ of the upper Beer's law limits of Selenium are shown in Table 1. The results showed that this method has reasonable precision. The proposed method was found to be simple, sensitive, selective, accurate, precise and economical and can be used for determination of Selenium.

Table 1: Optical characteristics and precision

Parameters	Method
λ_{\max} (nm)	507
Beer's law limits ($\mu\text{g/ml}$)	0.2-1.0
Molar absorptivity ($\text{L}/\text{mol}^{-1}\cdot\text{cm}^{-1}$)	4.425×10^3
Sandell's sensitivity ($\mu\text{g}/\text{ml}/\text{cm}^2/0.001$ absorbance unit)	0.0103
Regression equation (Y*)	
Slope (b)	0.0491
Intercept (a)	0.0161
Correlation coefficient (r)	0.9887
% RSD**	1.150
Range of errors**	
Confidence limits with 0.05 level	0.00562
Confidence limits with 0.01 level	0.00825

$Y = bC + a$ where C is the concentration of Selenium in $\mu\text{g/ml}$ and Y is he absorbance at the respective λ_{\max} .

** For eight measurements.

CONCLUSION

The proposed method for the spectrophotometric determination of selenium samples is simple, rapid and sensitive. The method does not require any heating for the

development of colour. The statistical analysis of the results indicates that the methods have good precision and accuracy.

ACKNOWLEDGEMENT

The authors are thankful to The Management, Sarada Vilas College of Pharmacy for their kind help and providing necessary facilities.

REFERENCES

1. Stoica AI, Babaua G., Iorgulescu EE, Marinescu D, and Baiulescu G E. Differential pulse cathodic stripping voltammetric determination of selenium in pharmaceutical products. *Journal of Pharmaceutical and Biomedical Analysis.*, 2002; 30 (4): 1425–1429.
2. Masson P, Orignac D, and Prunet T. Optimization of selenium determination in plant samples by hydride generation and axial view inductively coupled plasma atomic emission spectrometry. *Analytica Chimica Acta.*, 2005; 545(1): 79– 84.
3. Savarino L, Granchi D, Ciapetti G et al. Serum concentrations of zinc and selenium in elderly people: results in healthy nonagenarians/centenarians. *Experimental Gerontology.*, 2001; 36(2): 327–339.
4. G'amiz-Gracia L and Luque De Castro MD. Determination of selenium in nutritional supplements and shampoos by flow injection-hydride generation-atomic fluorescence spectrometry. *Talanta.*, 1999; 50(4): 875–880.
5. Suchocki P, Jakoniuk D, and Fitak BA. Specific spectrophotometric method with trifluoroacetic acid for the determination of selenium (IV) in selenitetriglycerides. *Journal of Pharmaceutical and Biomedical Analysis.* 2003; 32(4-5): 1029–1036.
6. Mohammad Hosein Soruraddin, Rouhollah Heydari, Morteza Puladvand, And MirMehdi Zahedi. A New Spectrophotometric Method for Determination of Selenium in Cosmetic and Pharmaceutical Preparations after Preconcentration with Cloud Point Extraction. *International Journal of Analytical Chemistry.* 2011; 1-8.

Source of support: Nil, Conflict of interest: None Declared