The Effect of Urine Matrix on Absorption Signal of Trace Elements in Flame Atomic Absorption Spectrometry

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Abstract

Analysis of trace elements in highly interfering matrices such as urine usually accompanied with erroneous readings because of high concentration of some salts in this matrix. The optimization of the instrumental parameters of flame atomic absorption including effect of burner height, flame stoichiometry of fuel to oxidant were studied. To examine the effect of matrix concentration on the absorption signal and the reality of the absorbance values given by the instrument in presence of highly interfering matrix such as urine on of cadmium, chromium, and nickel were investigated, hence the sensitivity and reproducibility of the instrument readings and then sensitivity and reproducibility of the analysis were tested. Improvements of analysis in presence of highly interfering matrices using ethanol, citric acid and EDTA as a releasing agents were investigated.

Key words: atomic absorption spectrometry, interferences, sensitivity, trace element analysis

1. Introduction

The importance of trace metals in biological samples derives from their essentiality and toxicity effects on lining organisms. Determination of trace elements by flame atomic absorption spectrometry (FAAS) is one of the most important methods in analysis [1]. Due to low concentration and higher interfering effects of many biological sample such as urine, blood serum, and other related samples like seawater and soil background correction system to overcome the interference problems by matrix [2]. number of analytical steps is reduced and limits of detection are reduced [3],[4].The nebulization of a washing solution prior to and after each sample efficiently washes both the nebulizer and burner, which has a favorable effect on the analysis of samples of high salt content [5]. Analytical chemist uses many samples pretreatments methods such as separation, preconcentration and extraction. The classical extraction and separation methods are usually time consuming and labor intensive and require large volumes of light purity solvents and environmental problems, because of solvent disposal because of the former difficulties accompanied with the extraction and pre-concentration methods these step maybe avoided [6]. Direct analysis of highly interfering matrices by flame atomic absorption spectrometry (FAAS) limited by the matrix affection on the absorption signals of the analyte. Attenuating or increasing of this signal was common problem during the analysis. Direct determination of some trace elements in urine matrix investigated. The higher concentration of urine matrix attenuates the absorption signal of analyte into some extents [7-8].

2. Aim of study

The aim of this work is to study the effect an artificial urine matrix on the absorption signal of some trace elements with known concentration as compared with the determination of some trace elements in standard solution, also addition of some releasing agents to enhance the sensitivity and reduce the matrix effect on the signal. Optimization of some instrumental parameters such as burner height and fuel to oxidant flow rate.

3. Experimental

All glassware's were socked with deionized water and 0.2% purified nitric acid. The standard solutions were prepared from highly pure stock solutions specially made for analysis by flame atomic absorption spectrometer. A novAA350 double beam flame atomic absorption spectrometer equipped with deuterium lamp background correction was used , with computer control for the different components in the instrument like slit width fuel flow , intensity of light by controlling lamp currant applied ,burner height , wavelength , and Stoichiometry of fuel to oxidant , In all experiments an air/acetylene flame was used. An artificial urine solution was prepared according to the recipe provided by Brooks and Keevil.61 The artificial urine solution contained 0.1g lactic acid, 0.96g citric acid, 6.625g $NaHCO_3$, 25.525g urea, 0.9175g $CaCl_2$, 13.15g NaCl, 1.23g $MgSO_4$, 3.55g $NaSO_4$, 6.25g K_2HPO_4, and 3.35g NH_4Cl all mixed in 1 L deionized water.

3. **Results and discussion**

3.1 Optimization of cadmium analysis in presence of artificial urine solution:

Optimization of cadmium analysis in presence of artificial urine matrix is investigated using 0.5 ppm Cd in artificial urine solution, the results obtained for fuel-oxidant Stoichiometry and burner height are shown in figures (1 a and 1 b) respectively. Better absorption values are obtained at 40-fuel oxidant and 7 mm burner height of instead of 40 and 9 mm for standard solution.

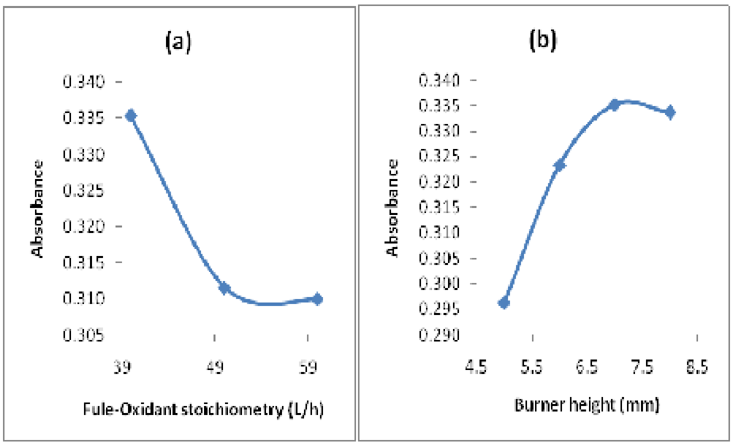

Figure 1: The effect of two parameters on absorbance signal of cadmium analysis presence in artificial urine solution (a): effect of fuel-oxidant stoichiometry at burner height 7 (b): effect of burner height at 40 fuel-oxidant stoichiometry.

3.1.1 Effect of some additives on absorption of Cadmium in artificial urine matrix:

The effects of additives such as releasing agents on the absorption signal of Cadmium in artificial urine matrix were investigated and then compared with that of standard solution at 800C.Figures (2) below show the effects of addition of some releasing agents to 0.5 ppm cadmium solution in presence of artificial urine matrix at 800C. From the figure below, better enhancement for absorption signals in all cases at higher temperatures obtained, with ethanol the signal becomes even better than that for the standard solution, the same effects were obtained with sodium chloride matrix[9].

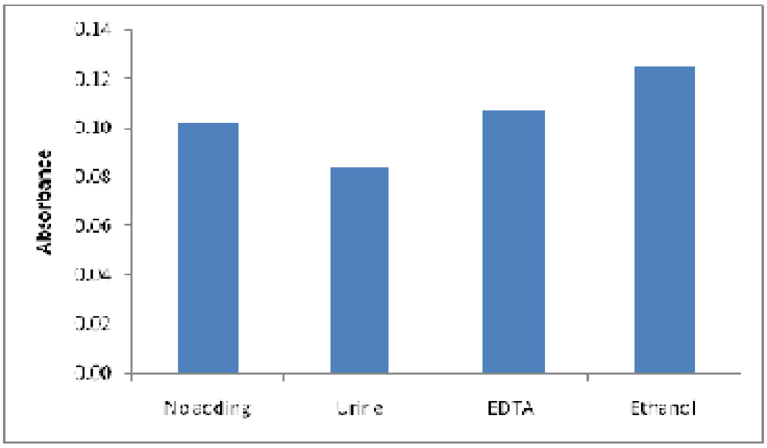

Fig. 2: The absorbance of 0.5 ppm Cd in artificial urine solution with different additives at 80^0 C.

3.2 **Optimization of nickel analysis in presence of artificial urine solution:**

Optimization of nickel analysis in presence of artificial urine matrix is investigated using of 1 ppm Ni in artificial urine solution , the results obtained for fuel-oxidant Stoichiometry and burner height are shown in figures (3 a and 3b) respectively. Better absorption values obtained at 50 fuel oxidant and 10 mm burner height instead of 50 and 9 mm for standard solution.

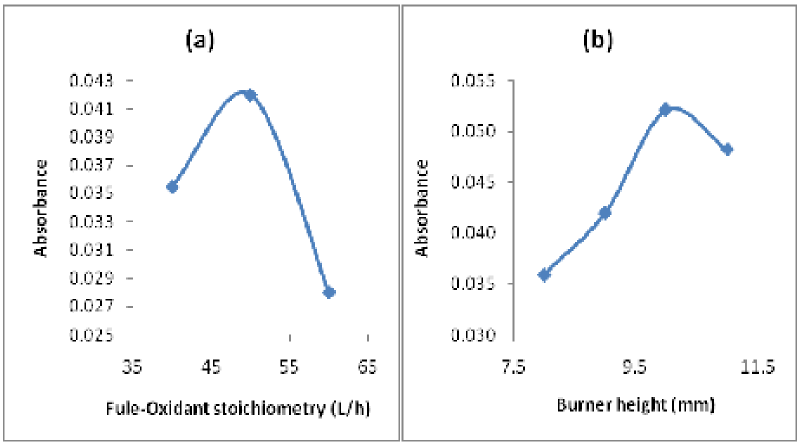

Figure 3: The effect of two parameters on absorbance signal of nickel analysis
Presence in artificial urine solution (a): effect of fuel-oxidant stoichiometry at burner height 9
(b): effect of burner height at 50 fuel-oxidant stoichiometry.

3.2.1 Effect of some additives on absorption of nickel in artificial urine matrix:

The effects of some additives such as releasing agents on the absorption signal of nickel in artificial urine matrix investigated and compared with that of standard solution at 800C. Figure (4) below show the effect of addition of some releasing agents to 1 ppm nickel presence of artificial urine matrix at 800C. From the figure below, better enhancement for absorption signal in all cases at higher temperatures obtained.

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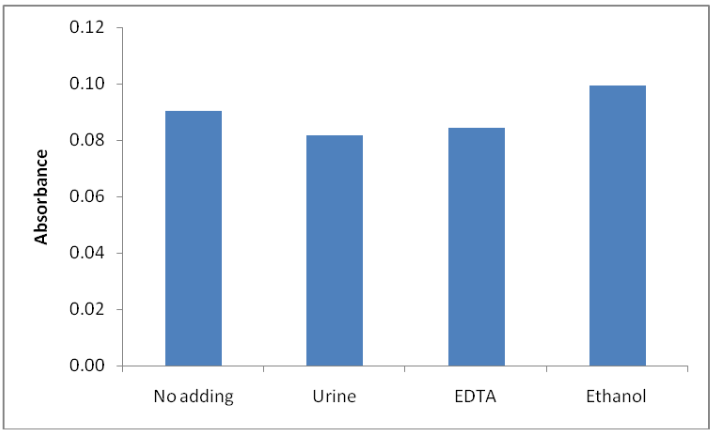

Figure 4: absorbance of 1 ppm Ni in artificial urine solution with different additives at 80^{0}C**.**

3.3 Optimization of chromium analysis in presence of artificial urine solution:

Optimization of chromium analysis in presence of artificial urine matrix is investigated using 1.5 ppm Cr in artificial urine solution , the results obtained for fuel-oxidant Stoichiometry and burner height are shown in figures (5a and 5b) respectively. Better absorption values are obtained at 90 fuel-oxidant stoichiometry and 11 mm burner height of instead of 100 and 10 mm for standard solution.

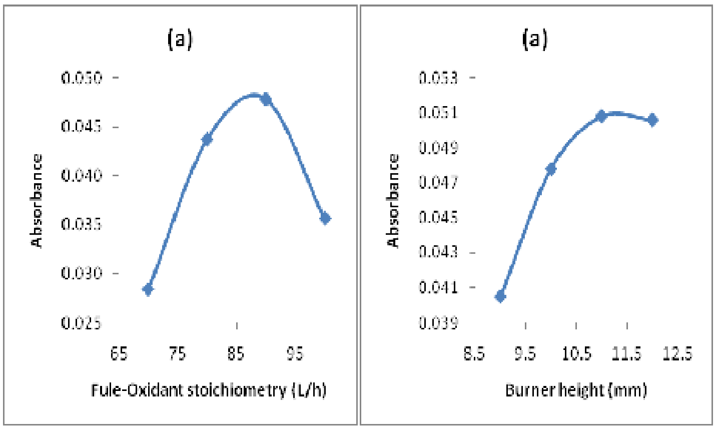

Figure 5: The effect of two parameters on absorbance signal of chromium analysis
In presence of artificial urine solution (a): effect of fuel-oxidant stoichiometry at burner height 10
(b): effect of burner height at 90 fuel-oxidant stoichiometry.

3.3.1 Effect of some additives on absorption of chromium in artificial urine matrix:

The effects of some additives such as releasing agents on the absorption signal of chromium in artificial urine matrix are investigated and compared with that value in case of standard solution at 800C. Results obtained at 800C shown in figure (6). As can be seen from the figure below show the effect of addition of some releasing agents to 1.5 ppm chromium presence of artificial urine matrix at 800C. From the figure below, better enhancement for absorption signal in all cases at higher temperature. Generally EDTA works better with chromium in presence of urine matrix than ethanol.

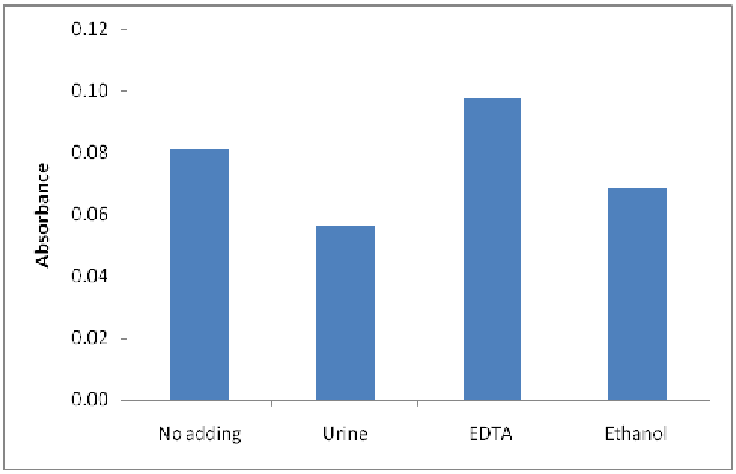

Figure 6: The absorbance of 1.5 ppm Cr in artificial urine solution with different additives at 80^0 C.

4. Conclusion

During the analysis of trace elements in presence of highly interfering matrices such as seawater, very high attention paid in order to get real absorbance values and then real concentration values. Dilution of the sample may done if the trace element high enough and can be detected, otherwise addition of releasing agents or more advanced techniques maybe used instead.

5. References:

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