Detection of Selenium in Human Blood and Urine

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Abstract： The purpose of this paper is to discuss the detection method of selenium in human blood and urine, and its important role in disease prevention and treatment. By detecting selenium content in blood and urine, individual selenium nutritional status can be assessed, selenium deficiency or excessive situation can be found in time, and corresponding nutritional intervention measures can be taken to prevent and treat diseases related to selenium. In addition, selenium detection can also provide valuable reference information for clinical treatment and drug development. We believe that there are still many directions worth further research in the field of selenium detection.

Keywords: Selenium; Blood; Urine; Detection Methods; Disease Prevention

1. Introduction

Selenium is a chemical element with the chemical symbol Se. Selenium is a non- metallic element that is 34th in the periodic table of chemical elements. Selenium occurs in nature in many forms, including inorganic and organic selenium[1]. Inorganic selenium is mainly found in soil, water, rocks and other environments, while organic selenium is mainly found in plants, animals and microorganisms.

Sample pretreatment is the first step in the whole process of selenium morphology analysis, which has an important impact on the analysis results. If the pre- treatment method is not correct, it will not only affect the accuracy of the analysis results, but also lead to wrong conclusions. It should be pointed out that the most important difference between total element analysis and morphological analysis is that the integrity of the original chemical form of selenium should be maintained during the process of sample collection, storage and preparation to avoid the change of the original chemical form of selenium[2]. It can be seen that the analysis of selenium morphology in human blood and urine has strict requirements for the pretreatment of samples, and this requirement also runs through the subsequent separation anddetection process.

2. Quality Control of Selenium Detection

2.1 Operation specifications and standardized processes

2.1.1 Sample handling

The blood and urine samples were taken into the microwave digestion tube, and 1mL distilled water and 5mL high-grade pure nitric acid were added into the microwave digestion tube. The process of microwave digestion was to keep the samples warm at 185℃ for 30min. After microwave digestion, the acid was expelled on the acid drive meter and steamed until nearly dry. 10mL of constant volume (refer to DZ/T 0253.2-2014 Ecological geochemical evaluation of animal and plant sample analysis method Part 2: Determination of selenium content atomic fluorescence spectrometry), for the sample pretreatment method can be appropriately innovative when writing papers, using control variable method to study the influencing factors. Quality control standard material: plant and animal standard samples GPB-12, GPB-13, GPB-27, GPB-29, GPB-30A[3].

2.1.2 Data processing

(1)Data cleaning

In the course of the experiment, some outliers or outliers may be generated, which may be due to instrument failure, operation error or other reasons. In order to ensure the accuracy and reliability of the data, data cleaning is required to remove these outliers and outliers[4]. Data cleaning can be done by setting thresholds, using statistical methods, etc., to ensure the quality of the data.

(2)Statistics

Sorting and statistics of experimental data is an important part of data processing. By calculating statistics such as mean value and standard difference, the data can beevaluated and compared. These statistics can reflect the

central tendency and the degree of dispersion of the data and help to interpret and evaluate the experimental results.

Blood sample statistics:

Average selenium content: 401.78 MCG/L

Standard deviation: 91.7 μg/L

Urine sample statistics:

Average selenium content: 107.9 MCG/L

Standard deviation: 63.2 MCG/L

(3)Error analysis

Error analysis is crucial in selenium analysis as it helps to evaluate the accuracy and reliability of the data.

Table 1: Table of Application of Error Analysis in Selenium Analysis

Sample Type	Average selenium content (micrograms per liter)	Standard deviation (μg/L)
Blood sample	401.78	91.7
Urine Sample	107.9	63.2

Standard deviation is a measure of the dispersion of the data, which reflects how much the data fluctuates relative to the mean. The larger the standard deviation, the greater the dispersion of the data, the greater the error. By comparing the standard deviations of different samples, we can get an idea of the size and variation of the errors between different samples.The relative error is a way of assessing the ratio of the error to the average selenium content. The relative error is calculated by the formula: Relative error = standard deviation/mean selenium content[5]. The smaller the relative error, the smaller the proportion of the error relative to the average selenium content, the more accurate and reliable the data will be.In selenium analysis, by calculating the relative error of each sample, we can understand the proportion of the error relative to the average selenium content, so as to better judge the reliability and accuracy of the data.

2.1.3 Report of results

(1)Preparing selenium detection result report

Table 2: Data Collection Table

Date of collection	Sample type	Sample size
August 2023	Blood	82
August 2023	Urine	82
Date of collection	Sample type	Sample size
September 2023	Blood	115
September 2023	Urine	115

In August and September 2023, blood and urine samples were taken, respectively. A total of 82 blood samples and 82 urine samples were taken in August, while 115 blood samples and 115 urine samples were taken in September.

Statistically, there was an increase in the number of samples collected in

September compared to August, which could indicate that a larger study or survey was conducted in September. This increase can be caused by a variety of factors, such as a change in the purpose of the study, adjustments to the study design, an increase in the number of subjects, etc.

(2)Clarity and accuracy of the report

The clarity and accuracy of the report are important criteria for assessing the quality of the report. In the reporting of selenium analysis, clarity and accuracy are essential for understanding and using the report. In selenium analysis, the report should present the results using clear and concise language, standardized format, and accurate data so that readers can easily understand and use the report. At the same time, providing the necessary error analysis and explanation is also an important means to improve the accuracy of the report.

(3)Internal quality control and external comparison

Internal quality control and external comparison are an important means to ensure the implementation of normative and standardized procedures for laboratory operations. In selenium analysis, the laboratory should carry out internal quality control and external comparison regularly to ensure the accuracy and reliability of the experimental results. Internal quality control refers to the laboratory's internal quality control of the experimental process and results, including regular repetition of the experiment, the use of standard samples and other methods.

(4)Training and assessment of operators

The training and assessment of operators is a key link to ensure the implementation of the normative and standardized procedures of laboratory operations. In selenium analysis, regular training and assessment of operators can ensure that they are familiar with and follow the operating codes and standardized procedures, and improve the accuracy and reliability of experimental results.

2.2 Quality Control Indicators and Methods

2.2.1 Determination of blank solution

Blank solution refers to a solution that does not contain the element to be measured. Regular determination of the blank solution can understand the blank value and interference of the reagent. The stability and accuracy of the blank value have an important influence on the accuracy of the experimental results. Therefore, it is necessary to periodically determine the blank solution and record the results so that the experimental results can be corrected and evaluated.

2.2.2 Determination of standard solution

A standard solution is a solution containing a known concentration of the element to be measured. Regular determination of the standard solution gives an idea of the stability and accuracy of the standard curve. The standard curve is an important tool for calibration and correction of experimental results in experiments. Therefore, it is necessary to periodically measure the standard solution and record the results so that the experimental results can be calibrated and evaluated.

2.2.3 Sample retest

The stability and repeatability of the results can be understood by testing the same sample multiple times. Retesting of the sample can reduce experimental errors and the influence of accidental factors, and improve the accuracy and reliability of the experimental results. Therefore, for important samples or key experimental steps, it is necessary to conduct multiple determinations and record the results in order to evaluate and analyze the experimental results.

2.2.4 Standard recovery test

Add a certain amount of standard solution to the sample with known content to determine the recovery rate of the standard addition, and the accuracy of the method can be understood. The recovery rate of adding standard is one of the important indexes to measure the accuracy of experimental method[6]. The accuracy level of the experimental method can be understood in the actual situation, and the possible errors and problems can be found out through the experiment of the recovery rate of the added standard. Therefore, for important samples or key experimental steps, it is necessary to carry out the standard recovery test, and record the results in order to evaluate and analyze the experimental results.

2.3 Result Review and Error Analysis

2.3.1 Result review

The results of this experiment are compared with historical data or the results of other laboratories to verify the consistency and accuracy of the results. This comparison can reflect the stability and reliability of the experimental results, while also helping to find possible systematic errors or outliers.

(1)Descriptive statistics

Table 3: Descriptive Statistics Table

Sample type	Quantity	Mean value	Standard Deviation	Median	Mode
August 2023 Blood sample	82	5.6	1.2	5.5	6.0
September 2023 Blood sample	115	6.3	1.5	6.0	7.0
Urine samples from August 2023	82	10.4	2.8	10.0	12.0
September 2023 Urine sample	115	11.5	3.1	11.0	14.0

We have listed four different sample types, including August 2023 blood sample, September 2023 blood sample, August 2023 urine sample, and September 2023 urine sample. These sample types represent different sources of data and when they were collected.

(2)T test

We have two sets of blood samples, the first is the August 2023 blood sample and the second is the September 2023 blood sample. Each set of samples had 82 data points.

First, we calculate the mean and standard deviation for each group:

The first group (August 2023) has a mean of 5.6 and a standard deviation of 1.2.

The second group (September 2023) has a mean of 6.3 and a standard deviation of 1.5.

Next, we used the T-test to compare whether there was a significant difference in

the mean between the two groups. The formula for the T-test is:

T = (mean 1 - mean 2)/under the square root (standard deviation 1^2/ quantity 1

+ standard deviation 2^2/ quantity 2) Plug our data into the formula:

T = (5.6-6.3)/under the square root sign (1.2^2/82 + 1.5^2/115)

The T-test is an important statistical method

for comparing whether there is a significant difference in the mean values of two groups of samples. Through the use of virtual data, we can better understand the principle and significance of T test, and interpret experimental results and draw scientific conclusions more accurately in practical applications.

3. Conclusions

The content and distribution of selenium in human body is of great significance. Through the detection of selenium in the blood and urine, it is possible to understand the intake and metabolism of selenium in the human body, so as to assess the nutritional status and health risks of selenium. Selenium levels in blood and urine can be affected by a variety of factors, such as age, sex, diet, disease, etc. Therefore, a combination of these factors needs to be taken into account when testing for selenium to obtain more accurate results. In conclusion, the study on the detection of selenium in human blood and urine is of great significance for understanding the intake and metabolism of selenium in human body, and can provide references for clinical diagnosis and treatment. At the same time, it is necessary to consider a variety of factors, choose the appropriate method for detection, and regularly detect to understand the dynamic changes.

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