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Serum concentration of selenium among healthy adult in the west of Algeria

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ABSTRACT

Selenium is of fundamental importance to human health. Differential pulse cathodic stripping voltammetry was used to determine the selenium concentrations in (140) samples of human serum from a control group of inhabitants in Tlemcen city (Algeria), the detection limit was 29 µg/L. The concentration of selenium in human organism varies widely between geographical areas depending on its content in soil and plants, dietary Selenium intake, bioavailability and retention, mineral interactions and other factors. The mean selenium concentration in serum was 68.57 µg/L. Serum selenium concentration in healthy Tlemcenian adult that found in this study is very close to serum concentration of other countries. The results from the analysis of two Seronorm standard reference materials showed good agreement with the certified values.

Key words: Selenium, Serum, Healthy Algerian, DPCSV, HMDE

INTRODUCTION

Until the late 1950s, selenium was recognized as an essential element for animals [1], and final proof to its essentiality for humans was the discovery of its preventive potency against Keshan disease [2, 3]. In addition, insufficiency of dietary Selenium might be associated with increased risk of cancers of several sites in humans [4]. The trace mineral selenium (Se) is an essential nutrient of fundamental importance to human health, but it is required only in small amounts [5]. Selenium is an essential trace element for humans and animals, and selenium deficiency is associated with several disease conditions such as immune impairment [6]. It has several structural and enzymatic roles, of which the best-known are as an antioxidant through the enzyme glutathione peroxidase and as a catalyst for the production of active thyroid hormone [7]. At present, a number of at least 25 protein compounds containing selenium in their structure have been discovered, most of them being enzymes and known under the generic designation of selenoproteins [8]. Se is naturally present in many foods, added to others, and available as a dietary supplement. The daily intake of selenium depends on its concentration in food and the amount of food consumed [9]. The most commonly used measures of selenium status are plasma and serum selenium concentrations [10].

The electrochemical methods have many advantages compared with the spectrometric methods, the equipment being less expensive and measurements being able to be realized in difficult mediums of access [11]. These methods ensure the transformation of a concentration of species into solution into an electric quantity measured by means of

simple mathematical relations [12]. The stripping voltammetry is the most sensitivity one because it has a preconcentration step on the electrode surface prior to recording the voltammogram [13].

MATERIALS AND METHODS

Study Area

Serum samples were collected from 140 inhabitants of Tlemcen city. The selection of the healthy adults who are between 20 and 72 years of age. Age and gender distributions were similar to the entire population, except for those over 60 years, who were underrepresented. An informed consent was acquired, All the subjects were disease-free and did not take any medication. They had to answer to a standardized questionnaire. The ethic committee at the University of Tlemcen approved the study. The department of Tlemcen is situated in the northwest of Algeria. It is characterized by four big natural groups which are distinct and can be identified as follows: the littoral group, the sublittoral plain, the mountainous group, and the high steppe plains.

Apparatus

Selenium analysis was performed using differential pulse cathodic stripping voltammetry (DPCSV) with a POL150 potentiostat linked to a polarographic stand MDE 150 and monitored by the Tracemaster-5 software (Radiometer Analytical, Copenhagen). Measurements were carried out with a hanging mercury drop electrode, in a three-electrode arrangement. The Working electrode was a Hanging Mercury Dropping Electrode (HMDE). The Reference Electrode was (Ag|AgCl, 3M KCl) and The auxiliary electrode was a wire of platinum with a considerably larger surface area than that of HMDE. The solutions were deoxygenated with high-purity argon for 5 min prior to each experiment. The DPCSV used in this work was optimized by attar et al [14].

Digestion

The procedure consisted in placing 0.5 mL of serum in a long-necke d 50-ml flask together with 2 mL HNO3/HClO4 mixture (3:1 v/v). The temperature of this mixture was slowly increased to 150°C for 4 h in a hot plate, and then the temperature was maintained at 180°C until the evaporation of half of the acids. After cooling, 0.5 mL of conc. HCl was added and heated at 150° C to reduce the Se (VI) to Se (IV) and evaporated to nearly dryness. After cooling, the digested serum samples were made up to 5 mL using 0.25% nitric acid. Special care was taken to avoid all contaminations. All the chemicals used were of suprapur quality.

Reagents and samples

All reagents and standards were of analytical grade. Stock standard solutions for selenium (1000 ppm, atomic adsorption standard, Aldrich). The working standard solutions were prepared weekly by appropriate dilution and kept refrigerated at 4 °C. Acids used for the analysis were the nitric acid (69.5%, Fluka), the perchloric acid (70−72%, Merck) and hydrochloric acid (37%, Merck). Deionized water was used in all operations.

Accuracy and Precision

The accuracy and precision of the method used were tested in 10 replicate tests with a reference materiel (Seronorm Trace Elements Serum, levels 1 and 2, Billingstad, Norway) (Table 1). All samples and standards were analyzed by duplicates.

Table 1: Accuracy and precision of the method against a standard reference material

Material	Mean ± SD (µg/L)	Certified	Measured	Accuracy (%)	Precision (%) R.S.D
(level 1, M10181)	81±1.50	79.20±2.90		97.73	3.66
(level 2, NO0371)	136±4.50	133±5.80		97.80	4.36

R.S.D. Relative standard deviation, SD standard deviation

Statistics were calculated with the SPSS statistics version 17 Windows. The Kolmogorov–Smirnov's test was applied to check if the variables have a normal distribution. The mean values obtained in the different groups were compared by one-way ANOVA and *t* test. The Dunnett post hoc test was applied to compare the individual subgroups. Statistical significance was set on $P<0.05$.

RESULTS AND DISCUSSION

The method was applied to the determination of Se in serum samples of (140) presumably healthy (75 female and 65 male) with average age of (39) years. Table 2 summarizes the measured selenium concentrations of the healthy adults according to age. The mean of the individual selenium levels in the studied population was 68.57±16.43 µg/L. The range for all samples was 31.10 to 105.21 µg/L. No significant difference has been revealed between men

70.63±17.47 (31.96-105.21) µg/L and women 66.1±15.34 (31.10-104.59) µg/L. The age group of 30–39 years had the highest mean serum selenium concentration; however, the age group of 60 years and more had the lower mean selenium concentration at a significant difference (P<0.05).

Table 2: Age and Sex of the studied individuals with corresponding selenium levels

Age	Mean ± SD (µg/L)	Range (µg/L)
20-30	69.95±16.60	36.12-105.21
30-40	70.75±16.85	36.87-100.23
40-50	68.60±18.85	31.10-102.22
50-60	66.03±16.81	31.96-89.53
>60	62.01±16.12	32.32-91.42
Male	70.63±17.47	31.96-105.21
Female	66.51±15.34	31.10-104.59
All	68.57±16.43	31.10-105.21

These values are comparable with those in serum of adults in, in Croatia (69±17 µg/L) [15], in Bulgaria (66.5±15.5 µg/L) [16] and is considerably lower than that of the in Spanish population 76.6 ± 17.3 µg/L [17] and Swiss population 98.4 µg/L [18].

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