Sulfur determination in blood from inhabitants of Brazil using neutron activation analysis

Laura C. Oliveira and Cibele B. Zamboni

Citation: AIP Conf. Proc. **1529**, 73 (2013); doi: 10.1063/1.4804087
View online: http://dx.doi.org/10.1063/1.4804087
View Table of Contents: http://proceedings.aip.org/dbt/dbt.jsp?KEY=APCPCS&Volume=1529&Issue=1
Published by the American Institute of Physics.

Sulfur Determination in Blood from Inhabitants of Brazil Using Neutron Activation Analysis

Laura C. Oliveira and Cibele B. Zamboni

Instituto de Pesquisas Energéticas e Nucleares (IPEN-CNEN/SP)
Av. Professor Lineu Prestes 2242
05508-000 São Paulo, SP

Abstract. In this study the NAA technique was applied to analyze sulfur in blood from inhabitants of Brazil for the proposition of an indicative interval. The measurements were performed considering lifestyle factors (non-smokers, non-drinkers and no history of toxicological exposure) of Brazilian inhabitants. The influence of gender was also investigated considering several age ranges (18-29, 30-39, 40-49, >50 years). These data are useful in clinical investigations, to identify or prevent diseases caused by inadequate sulfur ingestion and for nutritional evaluation of Brazilian population.

Keywords: Sulfur, blood, reference value, NAA
PACS: 82.80 Jp

INTRODUCTION

There are hundreds of sulfur-containing compounds in the human body and the body synthesizes most of them. The sulfur in body participates in the repair and construction of tissues and cells and the formation of several vitamins and proteins. The major source of inorganic sulfate for humans is from biodegradation due to body protein turnover of the sulfur amino acids (such as, methionine and cysteine); the remainder is supplied from sulfate in water and foods. In Brasil, elemental-sulfur is used as a fertilizer in soils and sulfate salts are used as growth-promoting feed additives for farm animals (chickens, turkeys and pigs) highly consumed by Brazilian population [1-4]. Besides, dried fruit prepared commercially may contain sulfur dioxide, which is added for keeping the color and taste.

Gastrointestinal absorption of sulfate can occur in the stomach, small intestine, and colon. When soluble sulfate salts (mainly, potassium sulfate or sodium sulfate) are consumed, more than 80% are absorbed. For insoluble sulfate salts, (such as barium sulfate) almost no absorption occurs. There are some adverse effects of over consumption: osmotic diarrhea and loose stools, acidosis and ulcerative colitis. The hypersulfatemia (increased serum sulfate levels) can also occur in individuals with chronic renal failure. Symptoms of sulfur deficiency include acne, arthritis, gastrointestinal disorders, immune system dysfunction, muscle damage, memory loss and rashes. Symptoms of sulfur deficiency are often wrongly classified as protein

XXXV Brazilian Workshop on Nuclear Physics
AIP Conf. Proc. 1529, 73-75 (2013); doi: 10.1063/1.4804087

deficiency [5]. Despite these findings, sulfur intake requirements (recommended levels) or an adequate intake is not established for Brazilian population.

In this study the NAA technique was applied to analyze sulfur in blood from inhabitants of Brazil for the proposition of an indicative interval. The measurements were analyzed considering lifestyle factors (non-smokers, non-drinkers and no history of toxicological exposure) of Brazilian inhabitants.

EXPERIMENTAL

A group of volunteers constituted by males (n=84) and females (n=66), ages between 18 and 70 years and above 50 kg, were selected of the Blood Banks and Hematological Laboratories from different parts of Brazil. Two types of samples were prepared: 100 ± 5% μL of blood were dropped in filter paper (Whatman – nº 41) using a calibrated micropipette and dried for few minutes using an infrared lamp. Also aliquots of 500 ± 5% μL of blood were transferred to polyethylene bags and immediately frozen until used. Each biological sample was irradiated in a pneumatic station under a thermal neutron flux (range $3.5 \cdot 10^{11}$ to $8.4 \cdot 10^{12}$ n cm^{-2} s^{-1}) in the nuclear reactor IEA-R1 (2-5MW, pool type) at IPEN/CNEN-SP. Irradiation times of 240s (500μL) and 600s (100μL) were used and the activated samples were gamma-counted by 900s. The neutron flux has been determined using Au as monitor. The measurements were performed using HPGe detector (FWHM=1.88 keV) and the concentration was performed by *Activation* software. [6]

RESULTS and DISCUSSION

The sulfur concentration (mean value) determined in blood samples are presented in Table 1. The standard deviation (±1SD), median, mode, minimum and maximum values and the indicative interval are also presented.

TABLE 1. Blood concentrations of sulfur for inhabitants of Brazil

S, gL^{-1}	All	Female	Male
Mean	0.66	0.69	0.67
1SD	0.31	0.27	0.33
Indicative Interval	0.35 – 0.97	0.42 – 0.96	0.34 – 1.00
Median	0.64	0.65	0.52
Mode	0.48	0.64	0.52
Minimum Value	0.15	0.15	0.34
Maximum Value	1.25	1.25	1.09

In Figure 1 is shown the sulfur concentration proportions in blood of inhabitants from Brazil as a function of gender and age. The numbers of samples analyzed for gender were included (F: female; M: male).

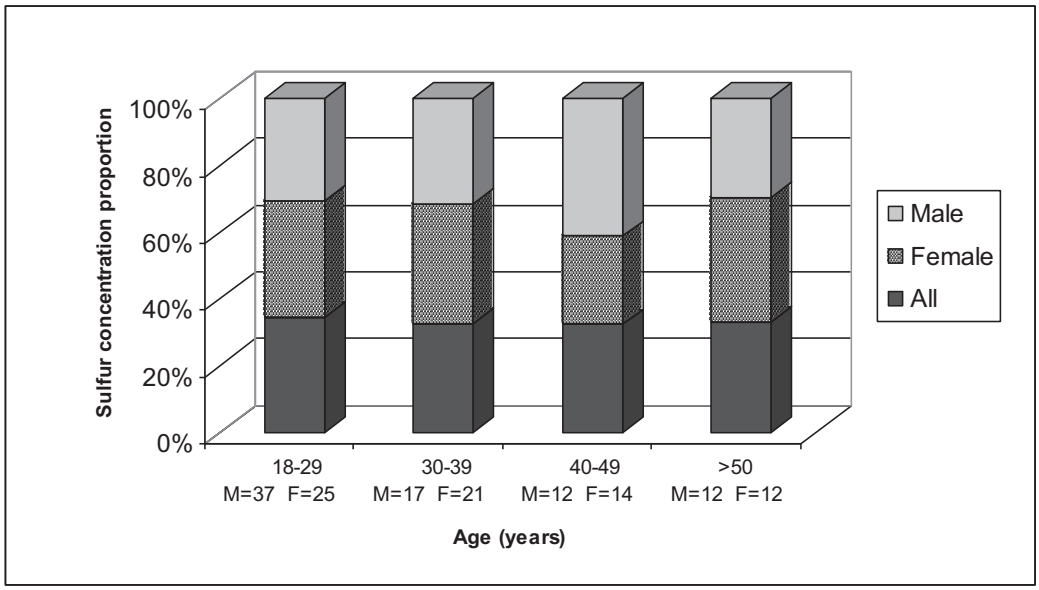

FIGURE 1. Sulfur concentration proportions (%) in function of gender and age

CONCLUSION

The data from the present report give an indicative interval for sulfur in blood (0.35 – 0.97 gL^{-1}). According to the Student's t-test only for women (40-49 years) the indicative interval (0.21 – 0.61 gL^{-1}) is statistically different ($p < 0.05$). We intend to improve the statistical data for this group for better follow-up of the decrease of sulfur concentrations in women in this age range.

REFERENCES

1. N. Horowitz, E.J. *Meurer, Cienc. Rural* **36**(3) 822-828 (2006).
2. http://www.nal.usda.gov/fnic/foodcomp/search.
3. United States Department of Agriculture .Nutrient. Data Laboratory. http://www.nal.usda.gov/fnic/foodcomp/search/
4. C.B. Zamboni, I.M.M.A. Medeiros, J.A.G. Medeiros, *Analysis of sulfur in dried fruits using NAA*. Proceedings INAC (2011).
5. http://www.nap.edu/openbook.php?record_id=10925&page=425
6. J.A.G. Medeiros, C.B. Zamboni, G.S. Zahn, L.C. Oliveira, L.J. Dalaqua L.J. Software para realização de análises hematológicas utilizando processo radioanalítico. Proceeding of 39º CBPC (2005).