

Evaluation of Trace Elements in Whole Blood and its Possible use as Reference Values

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Abstract. Trace elements in whole blood of human have been determined through Neutron Activation Analysis (NAA), using Au as flux monitor. The estimation for reference values of Br, Cl, K, Mg and Na were evaluated in the 95 % confidence interval for normal population.

Keywords. NAA, reference value, whole blood, gamma spectrometry

1 Introduction

The availability of accurate reference values for trace elements in human tissues represents an important indicator of the health status of the general population. In addition, such values provide the scientific basis for biomedical research in trace elements related diseases, forming the basis of setting legal limits of exposure for public protection and occupational health. In Brazil there is a lack of such data for whole blood. Therefore, the project: "Evaluation of Trace Element in Body Fluids for the Brazilian population using nuclear methodology: Determination of reference values", have been proposed in collaboration with Research Centers, Blood Banks and Universities from several Brazilian regions, aiming to establish reference values for trace elements in human blood for clinical diagnosis.

2 Nuclear Analysis

The basic principle of the NAA technique is the irradiation of the biological material with neutrons followed by the measurement of γ -ray activities induced in the biological sample, where the elements can be identified by its nuclear properties. In order to determine the concentration of the trace elements in whole blood each biological sample is sealed into individual polyethylene bags, together with the flux monitor (small metallic Au foil ~ 1 mg) and irradiated in a pneumatic station in the nuclear reactor (IEA-R1, 2.4MW, pool type) at IPEN, allowing the simultaneous activation of these materials [1]. Using this procedure, the γ -ray activity induced in the Au detector as well as in the biological sample was obtained under the exact same irradiation conditions. After the irradiation, the activated materials (blood and Au detectors) were γ -counted using an HPGe spectrometer and the areas of the peaks, corresponding to γ transitions related to the nuclides of interest, were evaluated. The energy spectra analysis was performed using the IDF code [2] and the concentration were calculated using the software developed by Medeiros *et al.* [3]. The samples were irradiated for 2 minutes. The counting period was of 1 minute for Au detector and 10 minutes for each biological sample and the background radiation.

3 Collection and Preparation of the Biological Samples

The biological samples came from several Brazilian Blood Banks. Ethical approval for this study was obtained from the Ethics Committee of the Blank Blood authority. The whole blood samples were collected from healthy group (male and female blood donors), with ages varying from 25 to 60 years, weighing from 50 to 85 kg, select from Blood Banks following a procedure developed for the nuclear performance.

About 2ml of whole blood were collected in a vacuum plastic tubing attached to the donor's arm and immediately after the collection an amount of 100 μ l of whole blood, using a calibrated pipette, was transferred to the filter paper. After that, the sample was dried for a few minutes exposed to an infrared lamp.

4 Results

The reference values of Br, Cl, K, Mg and Na were evaluated for whole blood in the 95% confidence interval for normal population (± 2 SD). A total of 170 samples (collected in replicate) were analyzed. The mean values and the basic statistical treatment results are shown in Table 1.

Table 1 Mean values and the basic statistical treatment results for the trace elements Br, Cl, K, Mg and Na in whole blood by using the NAA technique.

<i>Element Concentration (g l⁻¹)</i>	Br	Cl	K	Mg	Na
Mean	0.0118	2.87	1.57	0.057	1.64
1 SD (67%)	0.0079	0.46	0.27	0.017	0.21
Minimum Value	0.0028	2.10	1.07	0.046	1.24
Maximum Value	0.0362	3.94	2.27	0.069	2.10
2 SD (95%)	0.0158	0.92	0.54	0.034	0.42

5 Conclusion

Using NAA it was possible to perform several clinical analysis simultaneously in whole blood in an agile, fast and economic way. Of course, larger scale studies and the participation of other Institutions, associated with Hospitals, Analysis Laboratories and also with Health Public Services, must be incorporated to the project providing the scientific basis for research in more detailed reference values and to study the common deficiencies in Brazilian population helping its diagnostics.

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