

# THE MAGNESIUM REFERENCE VALUE IN WHOLE BLOOD USING NUCLEAR ACTIVATION

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## ABSTRACT

The aim of the present study is to establish an indicative interval for reference value for Mg in whole blood, using the Absolute Neutron Activation Analysis Technique. The necessity of this measurement is related to the fact that the conventional clinical analysis for Mg quantification is performed using plasma, so there is no reference values established for Mg in whole blood for Brazilian population. Ours results provide information which can help in diagnosis of patients and permit to perform a discussion about the advantages and limitations of using this nuclear methodology in hematological examinations.

## 1. INTRODUCTION

In the present study we used the semi-parametric procedure of Neutron Activation Analysis (NAA) to perform hematological analysis in human beings using whole blood aiming its application, in the future, for studying in more details the common deficiencies in Brazilian population helping their diagnostic. Basically, the idea is to determine the concentration of the element that could be activated in whole blood using neutrons for establishing their reference values.

The reference values for trace elements in human specimens can facilitate the interpretation of data deriving from clinical practice because they reflect the findings in a select group of individuals [1]. The necessity to perform measurements in whole blood is related to the fact that most of conventional clinical analyses in the biochemistry area are performed using mainly serum or plasma [2], which demand time and is expensive because different apparatus must be used [2,3], consequently there are no reference values established in whole blood. In the last years we have performed several investigations in whole blood of Brazilian population aiming to obtain the reference value for elements relevance for clinical practices [4,5].

In the present work we selected Mg to be analyzed in whole blood because it takes part in the human being metabolism and it is important to much physiological processes, such as the evaluation of hydro-electrolyte disorders, so its variations are generally associated to pathological processes.

## 2. EXPERIMENTAL PROCEDURE

In this study the samples came from Blood Banks and Hematological Laboratories from different parts of Brazil. The biological samples were obtained from a select healthy group (male and female blood donors), age between 25 and 60 years above 50 kg, following the procedure conventionally establish for blood donation. About 2 mL of whole blood were collected in a vacuum plastic tubing attached to the donor's arm and immediately after the collection, before its coagulation, a small quantity (100  $\mu$ L) was transferred to the filter paper and dried for few minutes using an infrared lamp. Aliquots of standard solutions of Mg were shaped in a same manner as the biological sample.

To determine the concentration of Mg in whole blood, each biological sample was sealed into individual polyethylene bag, together with the Au monitor (small metallic foil) used for measurement of the neutron flux, and irradiated for few minutes in a pneumatic station in the nuclear reactor (IEA-R1, 3MW, pool type) at IPEN, allowing the simultaneous activation of these materials.

Using this procedure the  $\gamma$ -ray activity induced in the Au monitor as well as in the biological sample was obtained under the exact same irradiation conditions. After the irradiation, the activated materials (blood and monitor) were gamma-counted using an HPGe Spectrometer and the areas of the peaks, corresponding to gamma transitions related to the nuclides of interest, were evaluated. The gamma spectra analysis was performed using the IDEFIX computer software [6] and the concentration using the ATIVAÇÃO software developed by Medeiros [7].

To perform this investigation a total of 20 whole blood samples were collected in duplicate. The irradiation time of 3 minutes, counting time of 1 minute for the Gold activation detector and 10 minutes for the biological sample and background radiation (Bg) allowed us to conclude the analysis of each sample in about one hour.

## 3. RESULTS AND DISCUSSION

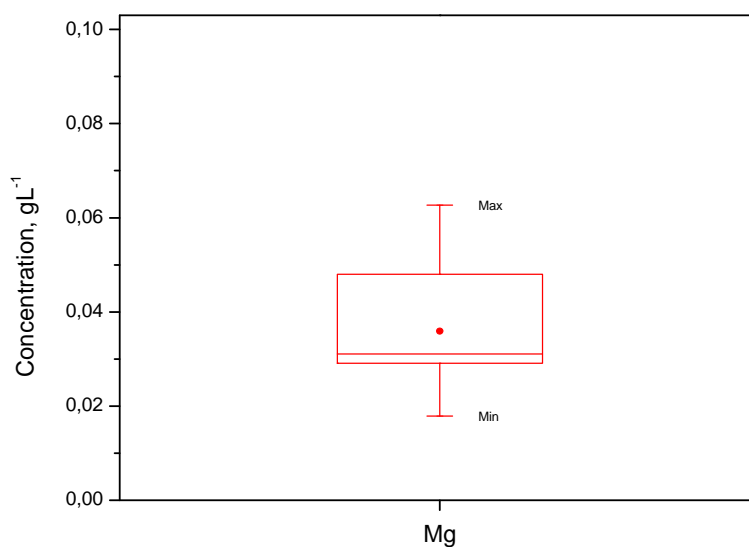
Magnesium concentration in whole blood is shown in Table 1 as well as the results related to the basic statistical treatment of the data. In Fig. 1 the Box-plot representation of the data is presented and in Fig. 2 the concentrations results in whole blood are shown as well as the indicative interval considering one and two standard deviations (SD).

**Table 1. Indicative interval for the reference values of Mg in whole blood by using the NAA technique.**

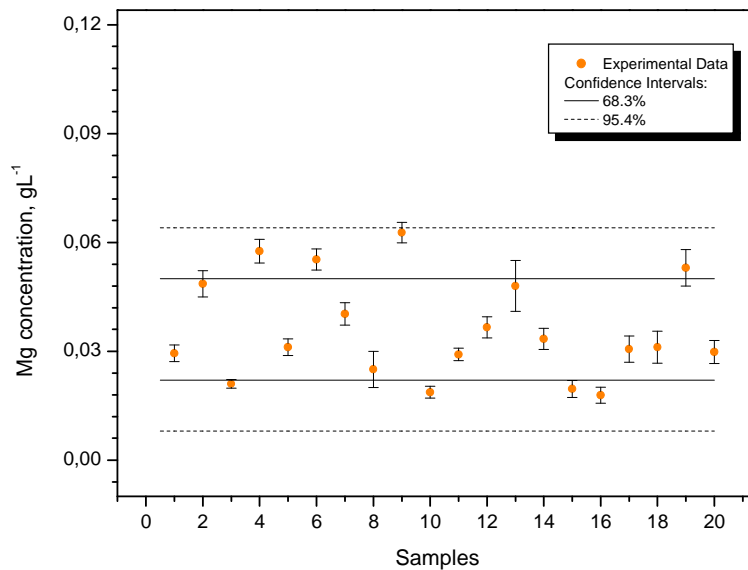
Element concentration	Mg (gL <sup>-1</sup> )
Mean	0.036
1 SD (67%)	0.014
Minimum Value	0.018 0.0271 <sup>a</sup>
Maximum Value	0.063 0.0455 <sup>a</sup>
Median	0.031
Mode	0.031
Range	0.040 – 0.074 g/L 0.0531 – 0.0655 g/L <sup>b</sup>

<sup>a</sup> From reference [8]

<sup>b</sup> From reference [9]



**Figure 1. Box-plot representation for Mg.**



**Figure 2. Mg concentration in whole blood and the indicative interval for the reference value; the individual error bars represent the propagated uncertainty associated with each measurement.**

In this study the NAA technique was applied to analyze Mg in whole blood for the proposition of an indicative interval. A comparison with the literature data is in agreement.

Related to the use of this nuclear methodology to perform biochemistry analyses, some advantages could be appointed: it does not require the serum-plasma separation; it allows the storage of the sample, for long periods, without the need for refrigeration and, due to the short irradiation time and to the use of small amounts of biological material, low activity is induced, therefore no shielding is necessary after just a few days.

#### 4. CONCLUSIONS

The data from the present report give an indicative interval for Mg in whole blood but, more systematic and large scale studies are needed to establish reference value with high precision aiming its application in clinical investigations helping the diagnostic of common deficiencies in Brazilian population.

#### ACKNOWLEDGMENTS

The authors thank the clinical staff at Blood Banks for technical assistance given during the blood collection.

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