2009 International Nuclear Atlantic Conference - INAC 2009
Rio de Janeiro,RJ, Brazil, September27 to October 2, 2009
ASSOCIAÇÃO BRASILEIRA DE ENERGIA NUCLEAR - ABEN
ISBN: **978-85-99141-03-8**

ANALYSIS OF Ca AND Mg IN BLOOD OF GOLDEN HAMSTER USING NAA TECHNIQUE

Rodrigo O. Aguiar, Cibele B. Zamboni, and José A. G. Medeiros

Instituto de Pesquisas Energéticas e Nucleares (IPEN / CNEN - SP)
Av. Professor Lineu Prestes 2242
05508-000 São Paulo, SP
rodrigoaguiar@usp.br
czamboni@ipen.br
jageiros@yahoo.com.br

ABSTRACT

Neutron Activation Analysis (NAA) technique has been used to determine simultaneously Ca and Mg concentrations in whole blood of *Golden Hamster*. The reference values for Ca (0.17 – 0.29 gL^{-1}) and Mg (0.042 – 0.074 gL^{-1}) can be used to performed biochemistry investigation using whole blood.

1. INTRODUCTION

*Golden Hamster*s are currently used as animal model due to the low cost and facilities related to medico-legal implications. Considering that blood represents the most important biological referential to the circulatory system its biochemistry analysis can be used an indication of the health status as well as for checking anomalies. Considering that the NAA technique has been successfully used by us for the investigation of elements in urine, bones and organs of small and medium-sized animals [1-5], is this study its was extended to analyze whole blood. First the Br, Cl, K and Na concentrations in whole blood were investigated. Now, we intend to complement these analyses by evaluation of Ca and Mg. These elements were selected because they are very useful for clinical practical.

2. EXPERIMENTAL PROCEDURE

For this study were collected whole blood samples from 7 female adult and 13 male adult *Golden Hamster*. These biological samples were from Centro de Pesquisas Aggeu Magalhães in Recife. Less than 0.1 ml of whole blood was collect of each animal and aliquots of 100 μL (in duplicate) were immediately transferred to the filter paper and dried for few minutes using an infrared lamp. Each sample was sealed into an individual polyethylene bag and irradiated together with the activation detectors at the IEA -R1 nuclear reactor [6]. Using this experimental procedure it was possible to activate simultaneously the following radioactive nuclides: ^{49}Ca ($T_{1/2}$ = 8.7 min, Eγ = 3084 keV) and ^{27}Mg ($T_{1/2}$=9.4min, Eγ =843 keV). The concentration of each element was then obtained by using in- house software [7].

To determine the concentration of the elements in the biological samples the Cd Ratio Technique was used for the measurement of thermal flux distribution [5]. In this technique, Au foils (~1mg), both bare and Cd covered (1mm thick), are irradiated together with the biological sample in the IEA-R1 nuclear reactor at IPEN/SP (IEA-R1, 2-4MW, pool type), for few minutes, allowing the simultaneous activation of these materials under the exact same irradiation conditions. Using this procedure the γ-ray activities induced in the Au foils by

both the thermal and epithermal neutrons were obtained as well as the activation of biological samples. A gamma-spectrometer with a semiconductor detector connected to an ADCAM multichannel analyzer and to a PC computer was used to measure the induced gamma-ray activity. The detector was an HGPe (FWHM=1.87 keV) calibrated for energy and efficiency through the measurements of standard sources of Co^{56} and Eu^{152}.

3. RESULTS AND DISCUSSION

The indicative interval and mean value taken at one Standard Deviations (±1SD) are shown in Table I for the elements Ca and Mg. All the results are a mean of duplicate analyses. In addition, the indicative intervals for human being whole blood estimation (also taken at ±1SD) were presented for comparison.
Equations should be centered and sequentially numbered to the flush right of the formula. That is, we write for example the steady-state equation of continuity

Table 1. Indicative interval for the reference values of the elements Ca and Mg in whole blood samples of *Golden Hamster* using NAA.

Elements	Mean	SD (68%)	Minimum Value	Maximum Value	Indicative Interval (68%)
Ca, gL^{-1}	0.23	0.06	0.14	0.35	0.17 – 0.29 0.150 – 0.316 [a] 0.080 – 0.258 [b]
Mg, gL^{-1}	0.058	0.016	0.041	0.088	0.042 – 0.074 0.040 – 0.0074 [c] 0.0531 – 0.0 655 [d]

[a] from ref [8]

[b] from ref [9]

[c] from ref [10]

[d] from ref [11]

For illustrative visualization figures 1 and 2 show the element concentrations in whole blood samples of *Golden Hamster.* The indicative intervals (±1 and ±2SD) were also included.

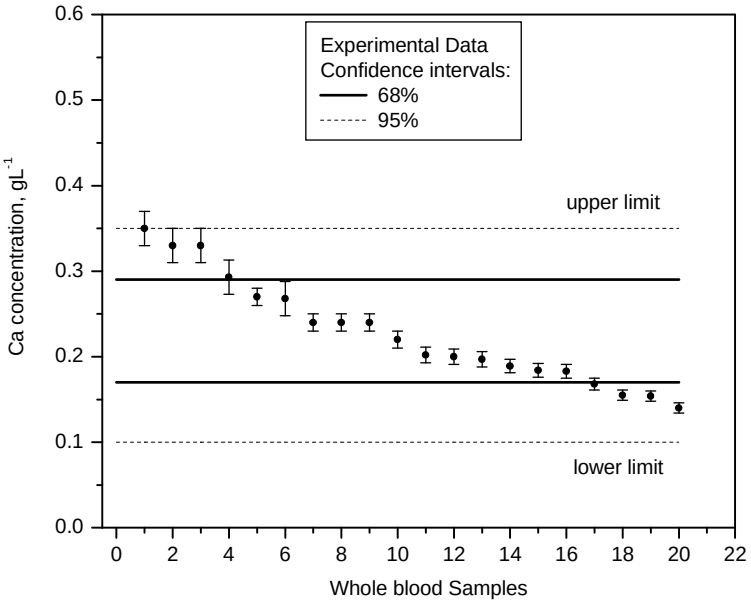

Figure 1. Concentration of Ca in whole blood samples of *Golden Hamster* .The values are arranged by decreasing concentration.

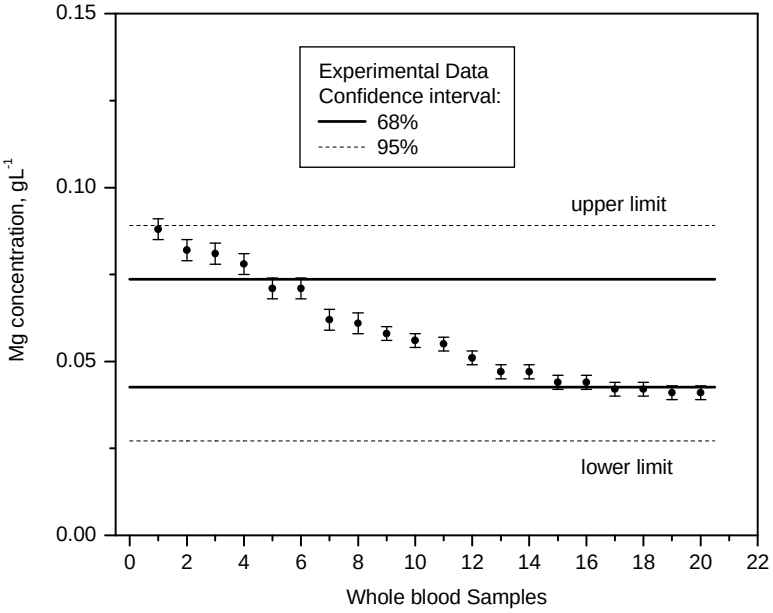

Figure 2. Concentration of Mg in whole blood samples of *Golden Hamster.* The values are arranged by decreasing concentration.

4. CONCLUSIONS

For the first time NAA technique was applied for measurement of Ca and Mg blood concentrations in *Golden Hamster*. The use of this technique it is an alternative to perform biochemistry analysis when the biological material is scarce because only 100 µL are collected from each animal. The Ca and Mg concentrations results in whole blood could be used for information about the clinical status of this animal model during clinical investigation.

In addition, no significant difference was observed for male and female and the comparison with the human being whole blood estimation emphases the physiologic similarities, an important data for animal experimentation.

REFERENCES

1. L.C. Oliveira, C.B. Zamboni, A.C. Cestari, L. Dalaqua Jr., M.V. Manso, A.M.G. Figueiredo, J.T. Arruda-Neto**.** Nuclear methodology for studying biological functions of mammalians submitted to uranium ingestion. *Revista Brasileira de Pesquisa e Desenvolvimento*, **4,** pp.1035-1039 (2002).
2. L.C. Oliveira, C.B. Zamboni, G.S. Zahn, M.A. Maschio, M.P. Raele. Use of Thermal Neutrons to Perform Analyses in Body Organs of Small-Sized Animals. *Brazilian J. of Physics*, **34,** pp 811-813 (2004).
3. C.B. Zamboni, L.C. Oliveira, L. Dalaqua Jr, J. Mesa. Application of neutron activation analysis to bone. *Journal of Radioanalitical and Nuclear Chemistry*. **269**, pp.331-334 (2006).
4. C.B. Zamboni, G.S. Zahn, O.A. Sant'Anna.Trace elements at whole blood of distinct mouse lines by using NAA. *American Institute of Physics*, **884**, pp.507-509 (2007).
5. C.B. Zamboni, M.F. Suzuki, and O.A. Sant'Anna. Simultaneous determination of five elements in whole blood of dystrophin-deficient mdx mouse by NAA. *Journal of Radioanalitical and Nuclear Chemistry*, **278**, pp.585-589 (2008).
6. W.R. Filho, C.B. Zamboni. Determination of the thermal neutron flux in a Nuclear Reactor. In: Proc. *XXVIII RTFNB*, Brazil (2005).
7. J.A.G. Medeiros, C.B. Zamboni, G.S. Zahn, L.C. Oliveira, L. Dalaqua Jr, M.R.A. Azevedo. Desenvolvimento de Software para realização de análises hematológicas utilizando processo radioanalitico, *39º Congresso Brasileiro de Patologia Clínica* (CBPC), CD-ROM, (2005).
8. L.C. Oliveira, PhD. Thesis. *Universidade de São Paulo* USP-SP, Brasil (2008).
9. S. Mousavi-Yeganeh, F. Ebrahimy-Faklar, F. Enayati, Nuclear instruments and Methods in Physics Research B, **3,** pp. 364-367(1984).
10. C.B. Zamboni, L.C. Oliveira, M.R. Azevedo, E.C. Vilela, F.L. Farias, P. Loureiro, R. Mello, J. Mesa, L Dalaqua Jr., In: Proc. *XXVIII RTFNB*, Brasil (2005).
11. M.R. Redigolo, C.B. Zamboni, V.L.R. Salvador, I.M. Sato. Determinação de elementos inorgânicos em sangue total de população brasileira pela técnica de EDXRF. In: *I Encontro de Pós-graduação do Instituto de Química*, USP, São Paulo, Brasil, (2009).