NAA For Human Serum Analysis: Comparison With Conventional Analyses

Laura C. Oliveira[a], Cibele B. Zamboni[a], José A.G. Medeiros[a] and Maria R. Azevedo[b]

[a] *Instituto de Pesquisas Energéticas e Nucleares (IPEN / CNEN - SP)*
Av. Professor Lineu Prestes 2242
05508-000 São Paulo, SP
[b] *Universidade de Santo Amaro – SP*
R. Professor Enéas de Siqueira Neto, 340
04829-300 São Paulo, SP

Instrumental and Comparator methods of Neutron Activation Analysis (NAA) were applied to determine elements of clinical relevancy in serum samples of adult population (São Paulo city, Brazil). A comparison with the conventional analyses, Colorimetric for calcium, Titrymetric for chlorine and Ion Specific Electrode for sodium and potassium determination were also performed permitting a discussion about the performance of NAA methods for clinical chemistry research.

Keywords: serum, neutron activation, gamma spectrometry, clinical analyses
PACS: 87.10.Jp, 29.30.Kv

INTRODUCTION

The metals and ions presence in the human's body can be evaluated by chemistry analyses of body fluids mainly serum/plasma and urine being that the accuracy of each method of analysis varies in function of the element. Atomic and nuclear techniques have been intensively used to detect metals in biological materials with the purpose to relate them with biochemical disturbs. Considering the multi elemental character of NAA and its potential for determining element content in biological samples, we intend to check its performance for clinical practice. The concentrations of the elements Ca, Cl, K and Na were determined by the comparator (NAA) and instrumental (INAA) methodologies of activation. A comparison with the conventional analyses was also performed permitting a discussion about advantages and disadvantages of using each method.

MATERIALS AND METHODS

In this study the samples came from Ipiranga Hospital Laboratory at São Paulo city. For sample preparation about 8-10ml of whole blood was collected in a vacuum plastic tube attached to the donor's arm. The biological material was centrifuged and 200 µl of serum was then transferred to filter paper Whatman No. 42 (~2.5 cm^2) and dried for few minutes using an infrared lamp. Considering that the NAA technique is not destructive the same serum sample was used for both analyses with neutron. The serum yet in the plastic tube (at least 7ml) was

CP1265, *VIII Latin American Symposium on Nuclear Physics and Applications*
edited by R. Alcaron, H. F. Arellano, P. L. Cole, and A. J. Kreiner

then used for preparation of conventional procedure. All the activated materials were gamma-counted using HPGe detector. In the Instrumental procedure (INAA) convenient aliquots of standard solutions of Ca, Cl, K and Na were prepared in a similar way as the serum samples. Samples and standards were irradiated at the IEA – R1 reactor of IPEN/SP. For Ca and K determination the samples and standard were irradiated for 5 minutes and after decay time of 60s they were counted by 10 minutes followed by 2h of counting for K. For Cl and Na determination an irradiation time of 2 minutes and 5 minutes of counting was used. In the Comparator procedure (NAA) the neutron flux distribution has been determined using Au as monitor. The concentrations of the elements, Ca, Cl, K and Na were simultaneously determined.

RESULTS AND DISCUSSION

The results in table 1 are the mean value and the correspondent standard deviation ($\pm 1\sigma$). The *t-test* was used to evaluate the different concentrations between the NAA methodologies as well as between them and the conventional procedure.

TABLE1. Comparison of elements concentration (gL^{-1}) in serum samples

Element	Colorimetric	INAA	NAA
Ca	0.216 ± 0.066	0.212 ± 0.061	0.232 ± 0.074
	t-test	t = 0.20 P >0.05	t = 0.72 P >0.05
	Titrymetry	INAA	NAA
Cl	4.01 ± 0.53	4.02 ± 0.46	4.25 ± 0.35
	t-test	t = 0.06 P >0.05	t = 1.69 P >0.05
	Ion Specific Electrode	INAA	NAA
K	0.17 ± 0.04	0.16 ± 0.03	0.19 ± 0.06
	t-test	t = 0.89 P >0.05	t = 1.24 P >0.05
	Ion Specific Electrode	INAA	NAA
Na	3.23 ± 0.17	3.38 ± 0.39	3.56 ± 0.32
	t-test	t = 1.58 P >0.05	t = 4.07 P <0.05

According to this table the results of NAA techniques are compatible for all elements. This agreement is also observed between the conventional and the activation neutron techniques considering a confidence interval of 95% adopted as reference for clinical practice[1].

CONCLUSION

The performance of these activation procedures (Instrumental and Comparator) for biochemistry analyses present potential for utilization when small quantities of biological material are available.Yet, considering that uncertainty around 5 to 10 % is acceptable in clinical work, both nuclear methodologies can be applied.

REFERENCE

1. L. Versieck et al, *Anal. Chim. Acta*, **204**, 63 (1988).