

Concentration of Ca in Blood of Amateur runners using NAA

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Abstract: In this study the Ca levels were determined in amateur athlete's blood at LABEX (Laboratório de Bioquímica do Exercício - UNICAMP, Brazil), using Neutron Activation Analyses (NAA) technique. The range established at rest ($162 - 410 \text{ mgL}^{-1}$) when compared with control group ($51 - 439 \text{ mgL}^{-1}$) suggesting that there is a dependency of these limits in the function of the adopted physical training.

Keywords: Ca, blood, neutron activation, gamma spectrometry, athletes.

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INTRODUCTION

The role of calcium is highly important for growth, maintenance and repair of bone tissue, controls of vascular tonicity, blood coagulation, nerve impulses propagation and muscle and heart contraction. A low dietary calcium intake can lead problems to the athlete. There seems to be some kind of a correlation between a low calcium intake diet and the occurrence of stress-fractures in sports. These are the most common small fractures that appear in the foot and tibia bones. Besides that, low dietary calcium levels seem to correlate with the osteoporosis onset [1,2]. In this study the Ca levels were determined in amateur athlete's blood, which were submitted to a constant exercise on the treadmill at LABEX using Neutron Activation Analyses (NAA) technique. This procedure was applied due some advantages: it uses small quantities of blood ($50\mu\text{L}$); agile execution (it is not necessary waiting for blood coagulation procedure neither performing the serum-plasma separation) and it is not destructive (the blood sample can be storage for future reexamination, for a long period, without refrigeration) [3]. These data can be considered for a preparation of balanced diet and can also be useful for evaluating the performance of athletes during the preparation period for competitions, as well as to propose new evaluation protocols.

EXPERIMENTAL PROCEDURE

Twenty six male amateur runners (AR), age 18 to 36 years, participated of this study. They have a balanced diet without mineral supplements or fortified food. The blood samples were collected before (at rest) the physical training. For the blood collection, a small capillary pin (Clinitubes®, Radiometer Copenhagen®; 210 µL) was inserted in the athlete's finger and exactly 50(±0.015)µL were dropped on to Whatman n° 41 filter paper (~2 cm²) using a calibrated micropipette, and then dried for a few minutes using an infrared lamp. The same procedure was used for standard solution preparation. The control group samples were collected from 58 male healthy donators, with the same age (18-36 years) with no occupational physical activity, weighting from 50 to 85 kg, selected from Paulista Blood Bank at São Paulo, Brazil. Blood samples of 50µL (dropped in filter paper) were collected from each donor.

To determine the Ca concentration each sample and standard (certified solution) were irradiated for 300s in a pneumatic station in the nuclear reactor (IEA-R1, 3-4.5MW, pool type) at IPEN, with a thermal neutron flux ranged from $5.12 \cdot 10^{12}$ to $7.10 \cdot 10^{12}$ n cm⁻² s⁻¹. After a decay time of 60s, a gamma counting of 600s was used to determine ⁴⁹Ca (T_{1/2} = 9 min, E_γ = 3098 keV). The IAEA A-13 certified reference material was investigated for quality control.

A γ-spectrometer system composed by a ORTEC HPGe detector (Model GEM-60195, FWHM=1.87keV for 1.33MeV of ⁶⁰Co), calibrated for energy through the measurements of standard sources of Co⁵⁶, Cs¹³⁷ and Eu¹⁵², coupled to a MCA ORTEC Model 919E and a PC, were used to measure the induced gamma-ray activity. The filter paper (blank) was also analyzed using the same irradiation conditions. The Ca concentrations were calculated using in-house software [4].

RESULTS AND DISCUSSION

The Z-score values obtained for IAEA A-13 certified material indicated that our results are satisfactory considering 95% confidence level. Some impurity of Ca was identified in the filter paper but they do not interfere. In table 1, Ca results are presented for AR and compared with the CG.

Table 1. Ca results for Amateur Runner (AR); the results of Control Group (CG) were also included for comparison

Ca, mgL ⁻¹	AR	CG
MV	286	245
±1SD	62	97
range*	162 – 410	51 – 439
median	304	255
mode	304	252
minimum	179	168
maximum	408	427

MV: Mean Value

SD: Standard Deviation

* for a confidence interval of 95%

In figure 1 Ca concentrations for amateur runner (AR) are showed considering $\pm 2SD$. A confidence interval for a control group (CG) was also included for comparison.

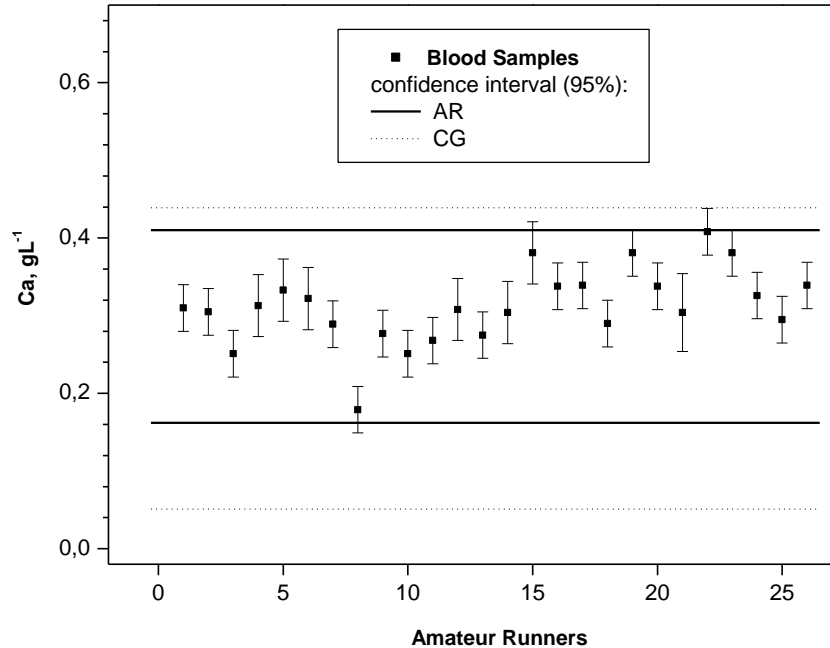


FIGURE 1. Results of Ca concentrations for amateur runner (AR)

According to Student's t-test there is a significative difference between these groups ($p < 0.05$); about 85% of Ca results for AR are near to upper limit of the control group. It suggests that athlete's limits can differ from people with no occupational physical activity.

CONCLUSION

The use of the NAA technique allowed a quantitative estimation of Ca in AR blood samples. The reference value for AR suggests a dependency of this limit in function of the adopted physical training.

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