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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 runners blood at LABEX (Laboratório de Bioquímica do Exercício - UNICAMP, Brazil), using Neutron Activation Analyses (NAA) technique. The range established at rest (162 – 410 mgL^{-1}) when compared with control group (51 – 439 mgL^{-1}) suggests that there is a dependency of these limits in the function of the adopted physical training.

Keywords: Ca, blood, neutron activation, gamma spectrometry, athletes.
PACS: 87.10.Jp

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 [1,2]. 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 [3-5]. In this study Ca levels were determined using Neutron Activation Analyses technique, in amateur runners blood, which were submitted to a constant exercise on the treadmill at LABEX. This procedure was applied due some advantages: it uses small quantities of blood (50μL); 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) [6]. 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, 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

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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 cm^2) 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 50 μL (dropped in filter paper) were collected from each donor.

To determine the Ca concentration each sample and standard (certified solution) were irradiated for 300 s in a pneumatic station in the nuclear reactor (IEA-R1, 3-4.5 MW, pool type) at IPEN, with a thermal neutron flux ranged from $5.12 \cdot 10^{12}$ to $7.10\ 10^{12}$ n cm^{-2} s^{-1}. After a decay time of 60 s, a gamma counting of 600 s was used to determine ^{49}Ca ($T_{1/2}$ = 9 min, Eγ = 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=1.87 keV for 1.33 MeV of ^{60}Co), calibrated for energy through the measurements of standard sources of ^{56}Co, ^{137}Cs and ^{152}Eu, 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 [7].

RESULTS AND DISCUSSION

For analytical quality control IAEA-A13 animal blood was used as standard. The certified value for Ca is 286±54 mg kg^{-1} and the result obtained in this study for Ca is 291±29 mg kg^{-1}. The Z score value obtained was |Z score| < 2, indicating that our result is satisfactory and is within the range of certified data at the 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 amateur runners and compared with the control group.

TABLE 1. Ca results for Amateur Runners (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 runners (AR) are showed considering ±2SD. A confidence interval for a control group (CG) was also included for comparison.

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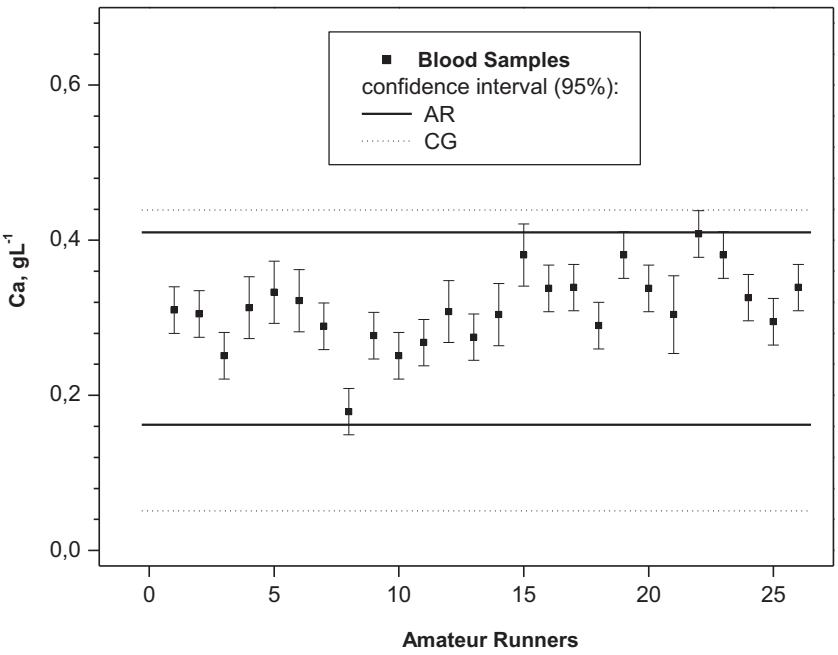

FIGURE 1. Results of Ca concentrations for amateur runners

According to Student's t-test there is a significative difference between these groups ($p<0.05$); about 85% of Ca results for amateur runners 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 amateur runners blood samples. The reference value for amateur runners suggests a dependency of this limit in function of the adopted physical training.

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