Potassium Concentration in Blood of Brazilian Athletes Using NAA

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Abstract. In this study the potassium levels in blood were determined in male athletes, age 18 to 26 years, before, du ring an d after t he tread mill ex ercise p rotocol usin g Neutron Activation Analyses (NAA). These data are important to check the potassium imbalance in blood during the period of competition preparation.

Keywords: ^{24}K, blood, neutron activation, gamma spectrometry, athletes.
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INTRODUCTION

The body's K contained in blood is critical for maintaining normal functioning of the muscles, heart, and nerves. Low blood potas sium levels (hypokalemia) and high blood potassium levels (hyperkalem ia) can lead to arrhythm ia (abnorm al heart rhythms). According to nutrition sour ces, hum an body needs per day at least one gram of potassium to m aintain the body' s balance.The interest in its evaluation in blood ha s increase in the sports medicine due the disorders caused, mainly, its deficiency or even low instan taneous con centration dim inishing the athlete perform ance causing disorientation, nervous irritability, muscular fatigue a nd, in m ore severe situation, cardiac arrhythmias. The LABEX (UNICAMP, Sa o Paulo, Brazil) in the last years has investigated m etabolic corre lations that occur with th e athletes during physical activities by serum anal yses (Ion Specific Electrode) [1]. To perfor m this analys es, serum samples (each 3 mL of blood, at least) must be collected before, during and after the physical exercise. However, this is very stressing and can interferer in the results.

In this s tudy potassium levels were investig ated in athletes subm itted to physical exercise (treadm ill) in the LABEX us ing Neutron Activation Analyses (NAA) technique. This procedure was applied due some advantages: it uses small quantities of blood (15 μL); agile execution (it is not nece ssary waiting for blood coagulation procedure neither perform ing the serum -plasma separation) and it is not destructive (the blood sample can be storage for future reexamination, for long period, without the need of refrigeration) [2].

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COLLECTION AND PREPARATION OF THE SAMPLES

Ten male athletes from LABEX, age 18 to 26 years, participated of this study. They were submitted to constant load exercise at treadmill: The aim was performing 10km in optimized time. The blood collection was performed at LABEX before, during and after the exercise. During the exercise, blood samples were collected every 2km. A small capillary was inserted in the athlete's fingertip and about 50µL of blood were collected. Immediately after the collection, exactly 15µL were transferred to Whatman filter paper (in duplicate) and dried for few minutes using an infrared lamp. The same procedure was used for standard preparation. For the control group the blood samples were collected from healthy male donators selected blood banks, with ages ranging from 18 to 26 years and weighing 50 to 85 kg.

EXPERIMENTAL PROCEDURE

The samples and standard (IAEA-A-13 Body Fluids certified reference material) were sealed into individual polyethylene bag and irradiated for 60s in a pneumatic station in the nuclear reactor (IEA-R1, 3.5MW, pool type) at IPEN, in a thermal neutron flux of $8.13 \cdot 10^{12}$ n/cm^2.s^1. After the irradiation, the blood sample and standard were γ-counted for 10 minutes using an HPGe detector (FWHM = 1.87keV for 1.33MeV of ^{60}Co) and the area of the 1525keV peak, corresponding to γ transition related to the ^{42}K, was evaluated. The potassium concentration was calculated using the software *ATIVAÇÃO* [3].

RESULTS AND DISCUSSION

Table 1 shows the results for potassium concentration in blood to the control group and for the athletes (before the exercise). According to this table the potassium levels for all the athletes (at rest) are in agreement with the normal range. The potassium concentrations for the control group are shown in Figure 1; the range, considering ±1SD (1.28 – 1.84 gL^{-1}), ±2SD (1.00 - 2.12 gL^{-1}) and ±3SD (0.72 – 2.40 gL^{-1}) were also included for comparison. In figure 2 is presented the behavior of potassium concentration in blood before and after the exercise program (immediately in the end of the physical exercise) for all the athletes.

TABLE 1. The potassium concentration in blood samples.

K, gL^{-1}	Mean	±1SD	Median	Mode	Minimum value	Maximum value
Control group, *n*=30	1.56	0.28	1.54	1.53	1.21	2.54
Athletes (at rest), *n=10*	1.47	0.54	1.35	1.61	1.00	2.71

n: number of samples

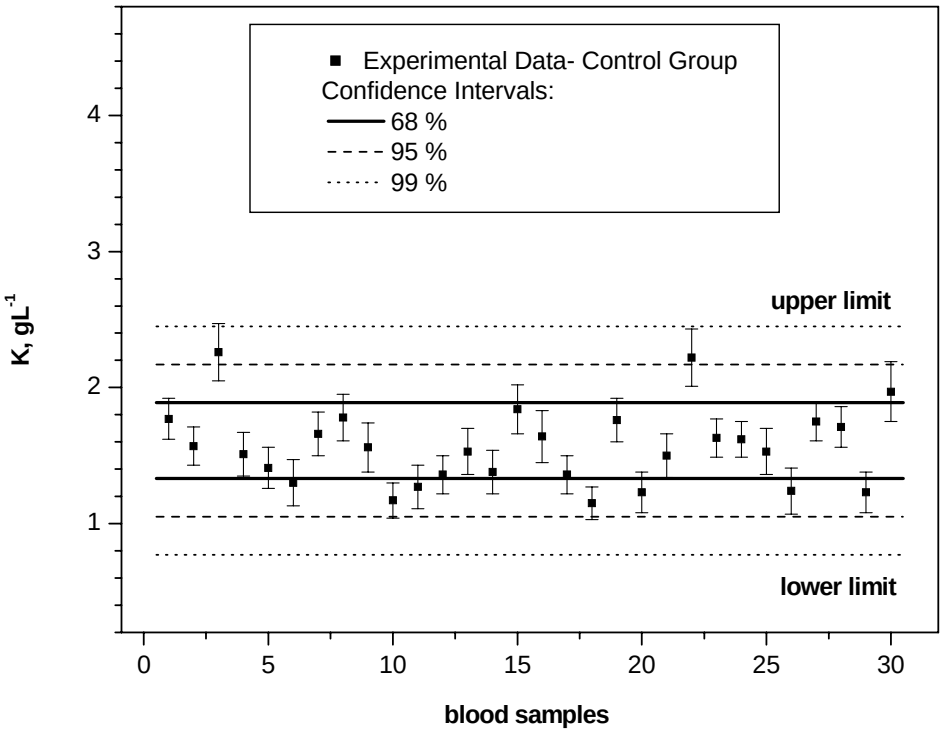

FIGURE 1. The K data for control group

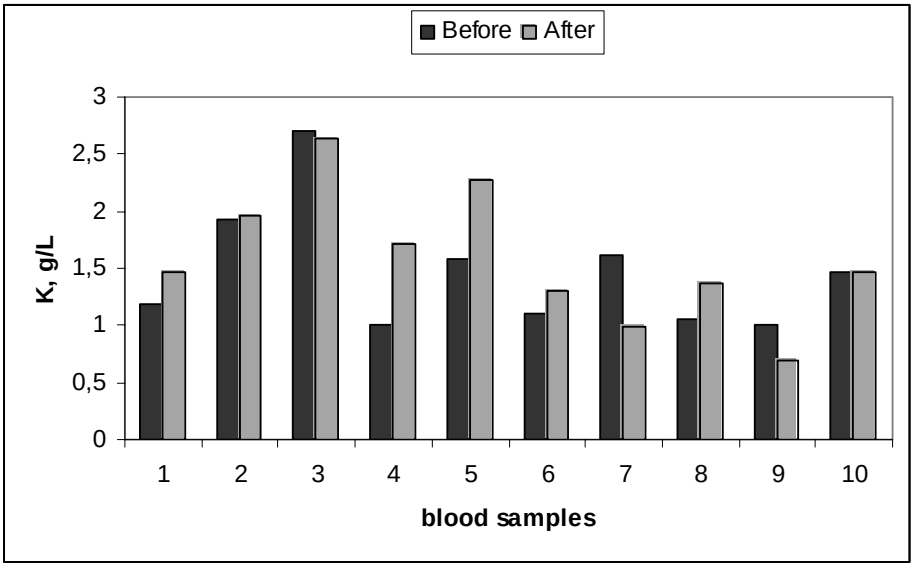

FIGURE 2. The K data before and after the exercise

According to figure 2 all th e athletes finished the ph ysical exercise without symptoms of severe fatigue (K levels in whole blood <1.00 gL^{-1}).

During the exercise was observed that 70% of the cases were kept the norm al range (1.00 – 2.12 gL^{-1}) following the behavior presented figure 3 (athlete 1); 20% of the cases were upper to the norm al range (during and after the exercise) suggesting a light tendency of Hyperkalem ia (>2.12 gL^{-1}) and only one case of H ypokalemia (K level in blood <1.00g/L) was observed, but not severe.

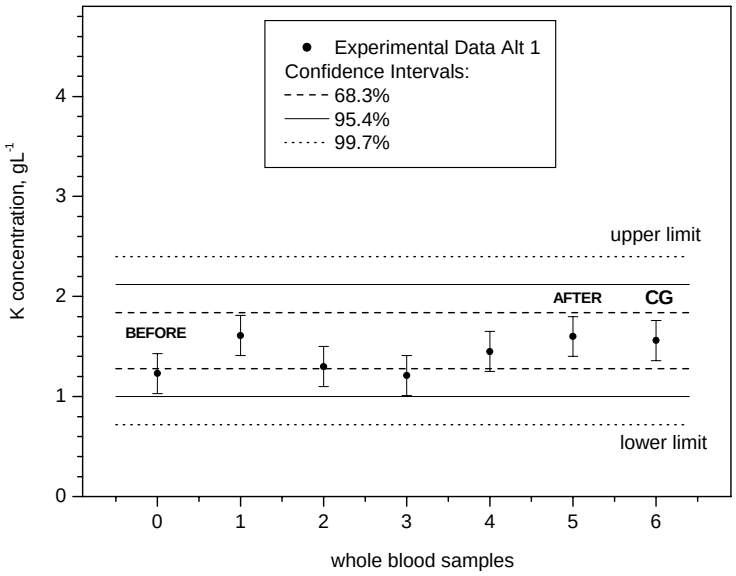

FIGURE 3. The K data during the exercise; the mean value for the control group (CG) was also include for comparison.

CONCLUSION

The use of the NAA technique has allowed a quantitative estim ation of K in blood samples of a thletes during the physical exerci se in agile way using sm all quantities of blood (15µL) something not recommended by us ing the conventional clinical analysis, due the necessity to perform several blood collection (at least f our of 3m l each) in small period (minutes).

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