

THE REFERENCE VALUE FOR BLOOD POTASSIUM IN INHABITANTS OF BRAZIL BY EDXRF TECHNIQUE

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ABSTRACT

In the present study was intend to use the Energy Dispersive X-Ray Fluorescence technique (EDXRF) to perform potassium dosage in human beings using whole blood aiming its application, in the future, for studying in more details the common deficiencies in Brazilian population helping their diagnostic. To perform this investigation a total of 227 whole blood samples were analyzed. The influence of gender was also investigated. The results provide information which permit to perform a discussion about the advantages and limitations of using this alternative methodology for biochemistry examinations.

1. INTRODUCTION

The references values for inorganic elements in human specimens can facilitate the interpretation of data deriving from clinical practice because they reflect the findings in a select group of individuals [1]. In this investigation, the aim is to determine the concentration of the K for establishing the reference values (indicative interval related to the normal range) for use in clinical practices. The necessity to perform measurements in whole blood is related to the fact that the conventional clinical procedure is performed using serum or plasma, which demand time and is expensive because different apparatus must be used [2,3]. To perform these measurements a healthy group (male and female blood donators) age 18 - 60 years at 50 - 80 kg were select from bank blood. This element was selected to be analyzed in whole blood because it takes part in the human being metabolism and it is very important for preservation of the osmotic and acid–base equilibria of human fluids, so its variations are generally associated to pathological processes.

2. MATERIALS AND METHOD

2.1. Sample Preparation

In this study the samples came from Blood Banks from different parts of Brazil. The whole blood samples were obtained from a select healthy group constituted of male ($n = 156$) and female ($n = 71$) donors, age between 18 and 60 years at 50 and 85 kg, following the procedure conventionally establish for blood donation. This selection involved inhabitants with no history of toxicological exposure, non-smokers, low alcohol consumption, including non-drinkers. Volunteers were screened for Hepatitis B and C, AIDS, Syphilis and Chagas and positives for any one of these tests were excluded. For the blood collection, with the approval of the Ethical Committee (CAAE: 69992117.7.0000.0081), a small capillary pin (Clinitubes, Radiometer Copenhagen) was inserted in the subject's finger and $50 (\pm 0.5 \%) \mu\text{L}$ were dropped on to Whatman no. 41 filter paper (2.3 cm^2) using a calibrated micropipette. Samples were collected in duplicate.

2.2. Energy Dispersive X-Ray Fluorescence Technique (EDXRF)

The EDXRF analysis was performed using X-Ray Spectrometer (X-123 SDD model - Amptek®), with Au X-ray tube. The characteristic fluorescent X-rays emitted from the samples ($K\alpha$ line) was measured with a Si Drift detector ($25 \text{ mm}^2 \times 500 \mu\text{m}$) with Be window ($12.5 \mu\text{m}$). The excitation conditions were optimized in 30 kV and $5 \mu\text{A}$ and counting time of 300 s. The spectra analysis was performed using WinQxas software program [4].

3. RESULTS AND DISCUSSION

For analytical-quality control IAEA A-13 animal blood was used. The Z-score test indicated that the results were satisfactory ($|Z| < 2$) considering 95 % confidence interval. The relative standard deviations were lower than 4.7 % and relative error was expressed by 4.1 %. These results indicate the adequacy of the method for K determination in whole blood.

The K concentrations determined in whole blood samples is presented in Table 1. The results were expressed by: Mean Value (MV), Standard Deviation ($\pm 1\text{SD}$), Minimum (min) and Maximum (max) values and Reference Value (RV). The EDXRF results were checked by comparison with the Neutron Activation Analysis technique (NAA). This comparison is presented in Table 2.

According to the *t-test*, the indicative intervals for K in whole blood show non-significant differences when a comparison is performed by gender ($p > 0.05$). The results were also checked by comparison with the Neutron Activation Analysis technique (NAA) [5]. This comparison showed agreement with the 95% confidence level. Related to the use of this alternative methodology to perform clinical examinations, some advantages could be appointed: it does not require the serum-plasma separation, uses small amounts of whole blood and the sample can be storage without the need for refrigeration. In addition, this procedure offers a non-destructive analysis.

Table 1. Indicative interval for K in whole blood by EDXRF technique.

K, mg L ⁻¹	Total n = 227	Men n =156	Women n = 71
MV	1.23	1.27	1.04
±1SD	0.40	0.38	0.37
min	0.17	0.47	0.17
max	2.82	2.82	2.44
RV *	0.55 – 1.99	0.64 - 2.00	0.43 – 1.91

n: number of samples analyzed in duplicate

*confidence interval of 95% usually adopted for clinical practices

Table 2. Potassium concentration in whole blood by XRF and NAA techniques.

K, mg L ⁻¹	FRX, present study n = 227	AAN [5] n = 42
Mean	1.23	1.31
± 1DP	0.40	0.22
Minimum	0.17	0.93
Maximum	2.82	1.65
RV*	0.55 – 1.99	0.87 – 1.75

n: number of samples

*confidence interval of 95% usually adopted for clinical practices

4. CONCLUSIONS

These data from the present study give an indicative interval for the K concentration measured in whole blood. Related to the alternative procedure, considering the advantages appointed, it is possible to perform K analysis in whole blood in an agile, fast and economic way using EDXRF technique.

5. ACKNOWLEDGMENTS

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