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DIFFERENCES IN TRACE ELEMENT CONCENTRATIONS IN WHOLE BLOOD OF SJL/J MICE USING NAA

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ABSTRACT

The Br, Cl, K, and Na concentrations were determined in whole blood samples of SJL/J isogenic mouse using NAA and they were compared to other strains with well-established values. Also the similarities with human being reference values have been available. A discussion about these correlation in whole blood estimation allowed the choice of a better mouse strain as reference and for experimental model.

1. INTRODUCTION

One of the most used animals in biological field for experimentation is the mouse. Thus, the knowledge of its whole blood elemental composition may reveal physiologic differences among distinct mouse strains which are very important in several applications in health area, such as clinical investigations, medicine testing, vaccines, antibiotics, anesthetics, antidepressants and also for organs transplantation as well as for medical diagnostic studies before tested in human beings.

The SJL/J mouse strain is susceptible to induced autoimmune diseases such as experimental autoimmune encephalitis (EAE), inflammatory muscle disease and also presents a progressive muscular dystrophy [1, 2, 3]. Calcium homeostasis, nitric oxide modulation of vascular tone, sodium and chloride channel protein functions, and mechanisms of membrane permeability control are critical aspects of muscle function [4, 5, 6]. This dysferlin deficiencient mouse has been widely used as a model for different human diseases, and for experimental research, so the determination of metal elements in whole blood may help to evaluate and compare the advantages of different treatment schedules.

Considering the lack of data related to metals and ions concentrations in whole blood in this mouse strain as well as the relevancy of these pieces of information for clinical practices in veterinary medicine, mainly for clinical practices, in this study the Br, Cl, K, and Na concentrations were determined in whole blood samples of SJL/J isogenic mouse using Neutron Activation Analysis technique, specifically the semi-parametric methodology [7]. This nuclear procedure consists of the irradiation of the sample with neutrons, together with the activation detectors (small metallic Au foils) used for measurement of the flux distribution, followed by the measurement of the γ-ray activities induced in the sample, where the elements in the sample can be identified and quantified by using their nuclear properties.

This study is part of a project entitled: "Determination of reference values for concentrations of trace elements in whole blood using nuclear methodology", nowadays in development at Instituto de Pesquisas Energéticas e Nucleares (IPEN - CNEN/SP) in collaboration with several Research Centers as well as with Blood Banks and Hematological Laboratories and from different regions of Brazil. The data from the SLJ/J strain will contribute for applications in veterinary medicine related to biochemistry of whole blood.

2. EXPERIMENTAL PROCEDURE

To perform this investigation the whole blood samples of two-month-old adult females (n = 7) and males (n = 4) that was originally obtained from the Jackson Laboratory (Maine, USA) and further inbred at IPEN – CNEN/SP (São Paulo, Brazil). About 0.5 ml of whole blood was collect of each specimen and aliquots of 100μl was then transferred to the filter paper and dried for few minutes using an infrared lamp.

Each sample was sealed into an individual polyethylene bag and irradiated together with the Au foils in the IEA R1 nuclear reactor, for few minutes (2- 5 minutes) permitting the simultaneous activation of Br, Cl, K and Na in these samples. A γ-spectrometer system composed by an HPGe detector connected to an ADCAM multichannel analyzer and to a PC computer were then used to measure the induced gamma-ray activities. The concentrations were calculated using an in-house software [8].

3. RESULTS AND DISCUSSION

The element concentrations are presented in Table 1. Considering that all the analysis were performed in duplicate, the results are the mean value and the associated errors are represented by one standard deviation (68%).

These results were compared to other strains with well-established values, namely the NZB, B10.RIII, BALB/c, A/J, $H_{III,}$ L_{III}, AIR_{MAX} and AIR_{MIN} [9] and the behavior of these data can be compared in Fig. 1, 2, 3 and 4 for Br, Cl, K, and Na, respectively.

The data for SJL/J mouse strain are similar to human reference values when one standard deviation is considered, except to K values.

For Br and Cl concentrations, the SJL/J strain when compared to the other mouse strains showed lower mean values, on the other hand, the K and Na concentrations presented the highest values.

Table 1. The concentration of Br, Cl, K and Na in whole blood samples of SJL.

Element	Mean ± SD A M F	Minimum value	Maximum value	Reference value
Br, g/l	0.0024 ± 0.0015			
(n = 10)	0.0014 ± 0.0003	0.0010	0.050	0.009 - 0.039
	0.0031 ± 0.0016			[0.0024 - 0.0096]*
Cl, g/l	2.37 ± 0.20			
(n = 11)	2.50 ± 0.24	2.01	2.86	2.17 - 2.57
	2.30 ± 0.15			[2.34 - 3.00]*
K, g/l	2.24 ± 0.26			
(n = 11)	2.38 ± 0.35	1.92	2.88	1.98 - 2.50
	2.16 ± 0.17			[1.09 - 1.53]*
Na, g/l	1.85 ± 0.16			
(n = 11)	1.88 ± 0.10	1.71	2.27	1.13 - 1.95
	1.84 ± 0.08			[1.24 - 1.60]*

* Human Reference Value [10]
n: number of samples
A: all the samples
M: only males
F: only females

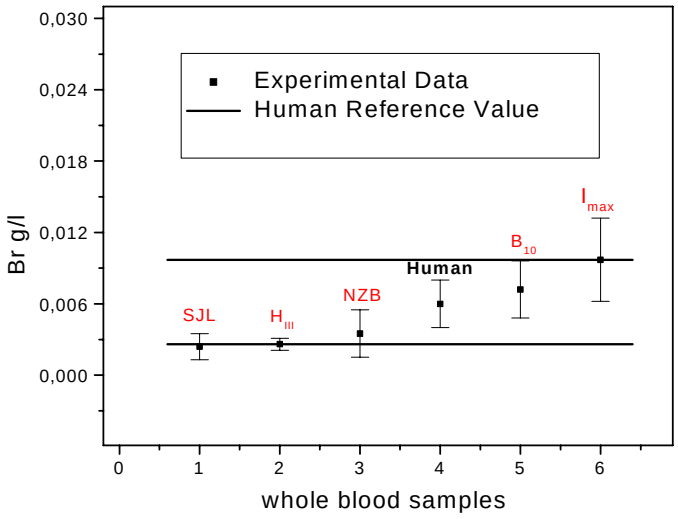

Figure 1. Concentration of Br in whole blood samples of SJL/J mouse compared to other strains with well-established values [9] as well as with human being whole blood estimation [10]. The intervals from human reference were also included considering one standard deviation.

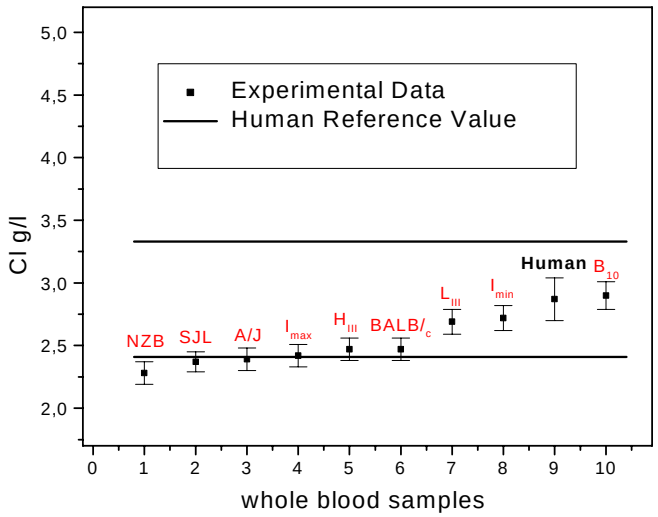

Figure 2. Concentration of Cl in whole blood samples of SJL/J mouse compared to other strains with well-established values [9] as well as with human being whole blood estimation [10]. The intervals from human reference were also included considering one standard deviation.

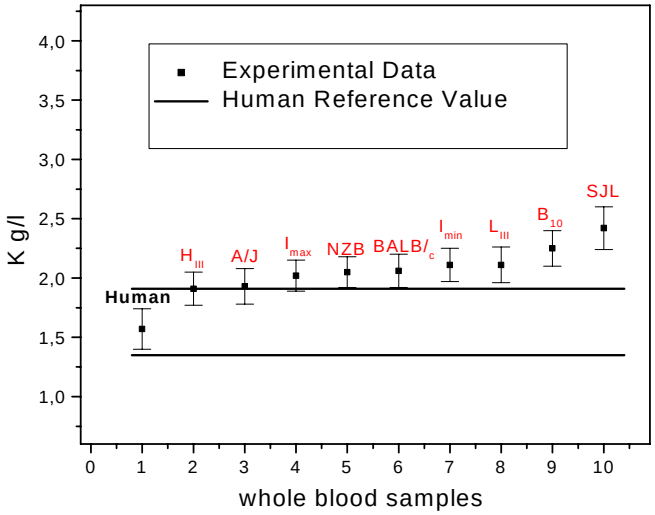

Figure 3. Concentration of K in whole blood samples of SJL/J mouse compared to other strains with well-established values [9] as well as with human being whole blood estimation [10]. The intervals from human reference were also included considering one standard deviation.

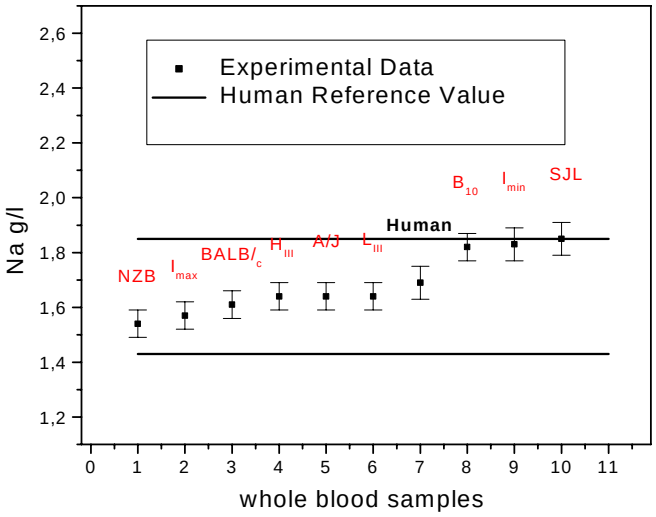

Figure 4. Concentration of Na in whole blood samples of SJL/J mouse compared to other strains with well-established values [9] as well as with human being whole blood estimation [10]. The intervals from human reference were also included considering one standard deviation.

There are some cases of hyperkalemia in myotonic dystrophy [11] but few data are related to mice. The physiological and pathological caracterization of these animal models are very important for comparative studies.

4. CONCLUSION

The results of neutron activation indicated that the occurrences of elements analyzed were similarly distributed for the SJL/J mice and the other eight strains. Moreover, the correlation with human whole blood estimation allows the choice of a better mouse strain as reference and for experimental model.

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