



Performance of LBIOVT for ^{210}Pb determinations by LSC over eight years of participation in the National Intercomparison Program of Brazil.

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1. Introduction

In vitro bioassay is an indirect analytical method that identifies and quantifies radionuclides deposited internally in the human body through the analysis of urine and feces [1]. In that regard, the LBIOVT (In vitro Bioassay Laboratory) plays an important role in the DIDOS (Division of Dosimetry), of IRD (Institute of Radioprotection and Dosimetry) in Brazil, from the point of view of occupational radiological protection and to individuals from the public.

^{210}Pb is a naturally occurring radionuclide, widely distributed on the earth's surface and can be incorporated by humans through food chain or directly by ingestion or inhalation in situations of occupational or accidental exposures. Because of its metabolic and dosimetric characteristics, ^{210}Pb becomes an important isotope from the radiation protection point of view [2].

A new approach for the determination of ^{210}Pb by liquid scintillation counting (LSC) was developed by the LBIOVT in 2013 [3]. This method has been evaluated during the various intercomparisons in which the laboratory participates.

This work shows the performance of LBIOVT in the determination of ^{210}Pb in water by LSC over eight years of participation in the National Intercomparison Program (PNI) of Brazil.

2. Methodology

One of the evaluation criteria for quality assurance and control and performance evaluation of radiobioassay service laboratories appointed by the ABNT NBR ISO/IEC 17025:2017 and ISO 282018:2010 is the participation in intercomparisons programs [4, 5].

In this work, the results obtained by participating in the PNI were evaluated by calculating the standard score (z-score) as shown in equation (1):

$$z - \text{score} = \frac{x - \mu}{\sigma / \sqrt{n}} \quad (1)$$

Where x is the mean value obtained by the analytical method, μ is the reference value, σ is the uncertainty of μ and n is the number of repetition of the analytical method, which is set to be 3 by default. Z-scores are expressed in terms of standard deviations from their means and the closer the value gets to zero, the better the performance achieved by the participating laboratory. If $|z\text{-score}| \geq 3$, the system is considered out of control.

In this work we compared the z-score values obtained during the eight years of participation in the PNI, from 2013 to 2020.

3. Results and Discussion

The z-score values obtained from the determination of ^{210}Pb by LSC were plotted in figure 1.

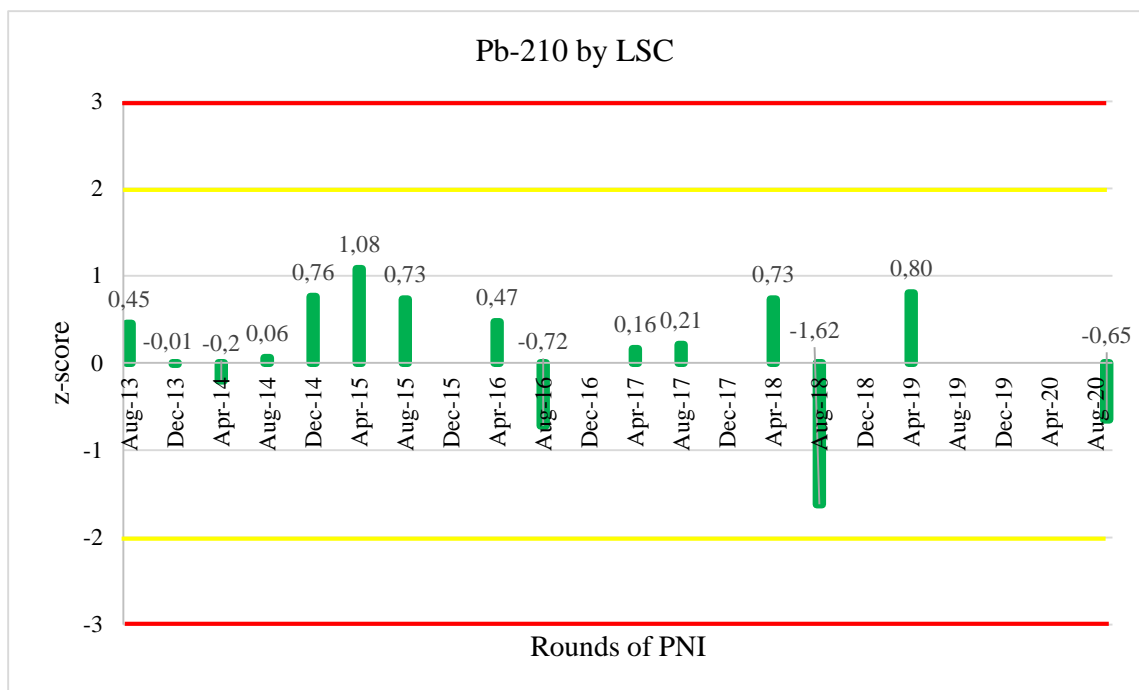


Figure 1: z-score values from different rounds of PNI for ^{210}Pb determinations in water by liquid scintillation counter during eight years of LBIOVT participation.

The results obtained were kept between 1 standard deviation from reference value, showing good reproducibility and being reliable for the determination of ^{210}Pb by liquid scintillation counter. The lower value obtained for z-score was -0.01 during the round of december of 2013 and the highest value obtained was -1.62 during the round of august of 2018. The mean value of z-score found was 0.15 . There were no values above 2 standard deviation, showing a good performance achieved by the participating laboratory. The presence of values below and above zero also indicates that there is no trend in the results.

4. Conclusions

The determination of ^{210}Pb in water by liquid scintillation counting of LBIOVT showed good reproducibility of the results during the eight years of participation in the National Intercomparison Program (PNI) of Brazil. Therefore, this method can be considered reliable for the proposed determination.

References

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