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X- ray experimental set-up for *in-vivo* nail test

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Introduction

In recent years, alternative techniques to investigate specifics ions and metals, of clinical relevance, in the human body have made significant progress. These biochemical tests on body fluids like, for example, in serum, plasma and urine are very useful for various clinical diagnoses and for routine analysis (check-up). In the last years, X-ray Fluorescence (XRF) techniques have been applied to this clinical finality at IPEN/CNEN-SP, in collaboration with research centers from Brazil. The success in this alternative procedure for clinical analyses motivated us to verify the use a portable X-ray Fluorescence Spectrometry for *in-vivo* nail test as a diagnostic of some specific dysfunctions, such as, the evaluation of bone dysfunctions by measurement of Ca (bone decalcification) as well providing data on body hydration (Cl and K). In addition, provide useful data for sports medicine, mainly by the evaluation of S, responsible in the organism for collagen production and maintenance of muscle tissues.

In this investigation, a portable and compact equipment for X-ray Fluorescence, using targets of Ag and Au and low voltages (tens of KV) and current (few μA), were evaluated for *in-vivo* nail test. Experimental conditions for current, voltage and exposition time, for both targets, and dose evaluation were investigated.

Experimental

The XRF analysis was performed using a compact X-ray spectrometer model X-123 SDD with Au/Ag X-ray targets. The characteristic X-ray fluorescent intensity of K_α lines were measured with a Si Drift detector **(**25 mm^2 x 500 μm) with Be window (12.5 μm). For the spectrometer calibration, certified standard solutions containing varying concentrations of Ca, Cl, K and S were prepared. All the spectral analysis was performed using WinQxas software (IAEA, version 1.3). The experimental conditions for voltage, current, as well as the appropriate choice of collimators and filters were investigated to reduce radiation exposure, to enable *in- vivo* analysis on nails.

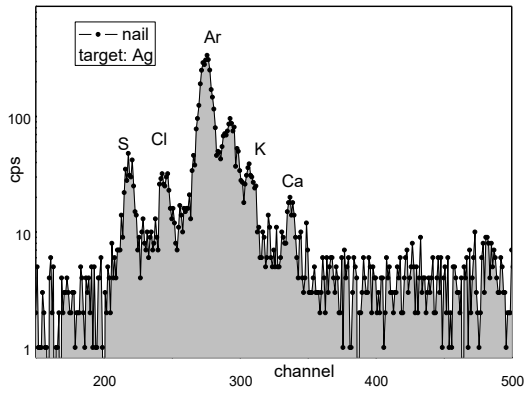
Results

In table 1 are present the optimized experimental conditions for *in-vivo* nail tests using compact XRF experimental set-up. This evaluation was performed using the emission line K_a (2.1 keV for S; 2.6 keV for Cl; 3.3 keV for K and 3.6 keV for Ca). To illustrate, in figure 1 is presented a XRF spectra for nail using the optimized experimental condition for Ag target (15 kV, 50 μA, 10 s). In this figure, the Argon peaks (Ar) are due to its presence in air. The execution is faster (10s -15s), allows simultaneous analyzes of Ca, Cl, K and S and the dose exposition is below the established limits.

Table 1. Experimental conditions for XRF experimental set-up analysis

Experimental conditions	Targets	
	Ag	Au
Voltage, kV	15	30
Current, μA	50	40
without vacuum	atmosphere	atmosphere
Detector /type	Silicon Drift	Silicon Drift
	with Be widow	with Be widow
Collimator, mm	5	2
Time count, s	10	15

Figure 1. Nail spectrum using X-ray experimental set-up with Ag target



Conclusion

There are several motivations and positive expectations for this clinical application, but the great advantage is the feasibility of using this facility in underserved regions, without a clinical laboratory. In addition, this X-ray experimental facility can be adapted for use in a Basic River Health Unit.