Zinc Investigation in Osteoporosis Diseases by X-ray Micro fluorescence

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Zinc (Zn) is an essential element that can be found in bones. It seems to have effects on growth, bone turnover and mineralization making its relationship with bones still opening. Zn is one of the most abundant nutritionally essential trace elements in human body and it is known to be necessary for normal bone metabolism. The participation of trace minerals in normal development and maintenance of the skeleton is related to their catalytic functions in organic bone matrix synthesis. This mineral regulates secretion of calcitonin from thyroid gland and influences bone turnover. Its deficiency causes reduction in osteoblastic activity, collagen and chondroitin sulfate synthesis and alkaline phosphotase activity. It is known that deficiency of ovarian hormone in menopause stimulates bone loss. Ovariectomy also causes osteoporosis due to the lack of estrogen. Many in vitro and in vivo studies of ovariectomized animals have been reported that Zn has an anabolic effect on bone metabolism by inhibiting bone resorption, stimulating bone formation and mineralization. Its mineral has a structural role, bound to fluoride in the hydroxyapatite.

The x-ray microfluorescence (μXRF) is an analytical technique based on the elemental local excitation and microscopic analysis of the region of interest. Through this technique it is possible to determine the elemental concentration and the distribution of the elements on a sample surface. The advent of synchrotron radiation (SR) has added a new dimension to the use of x-rays in imaging. Its brilliance and brightness allows high efficiency for trace.

The goal of this study is, by XRF analysis, to characterize bone samples, with and without pathology, in the trabecular region. For that purpose, an XRF beam line was used at the Brazilian Synchrotron Light National Laboratory. The images were done in an area equal to 3.2 mm^2, including a cortical and a trabecular section, with 10 seconds per point. All of the samples were placed in a mylar film and their measurements was taken into account in the calculation of concentrations.

The results show that quantitative μXRF-SR analysis applying the fundamental parameter method is a powerful and alternative technique to characterize the micro architecture of bone structures. With the use of this technique it is possible to observe the osteoporotic modifications on the bone structures with respect to the morphology and the chemical elements. It was demonstrated that the Zn distributions in tabecular and cortical zones on a micron length scale is very helpful in understanding the function of this chemical element in such structures.