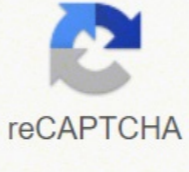




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## Determination of Calcium to Phosphate Ratio in Hydroxyapatite Extracted from Bovine Bone using LIBS

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### Abstract

Hydroxyapatite (HA) has been extensively studied as it constitutes the major part (approximately 70%) of the bone. The mechanical properties of HA itself, ceramics and bone cements prepared from HA vary greatly with slight variation in its Ca/P ratio. At present EDX, XRD, XRF and ICP are being used for determination of Ca/P ratio in HA. These techniques require special sample preparation and are often slow in terms of time taken for scanning. We report LIBS as a rapid alternative technique for calculation of Ca/P ratio. The sample has been obtained from bovine bone. Average Ca/P ratio in the sample was calculated as  $1.58 \pm 0.16$  and  $1.67 \pm 0.06$  by using LIBS and EDX respectively.

**Keywords:** LIBS, hydroxyapatite, Ca/P ratio, EDX, BHA

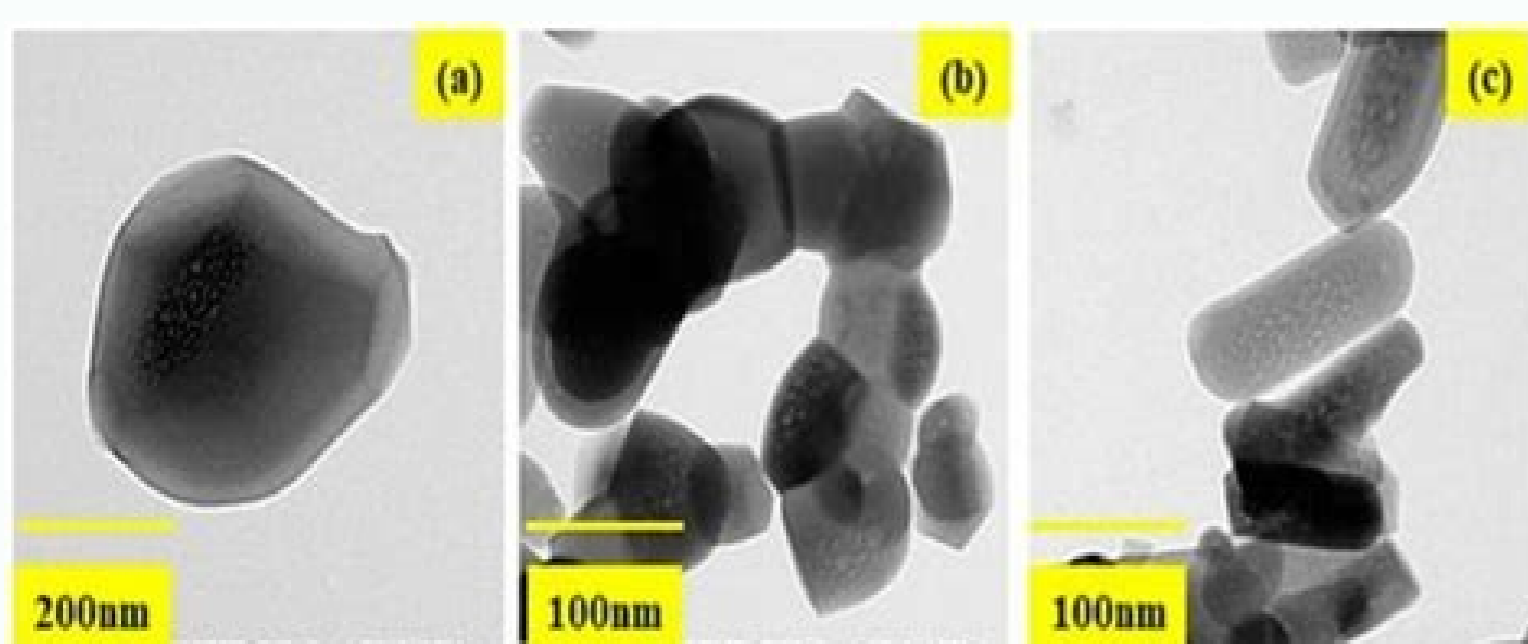
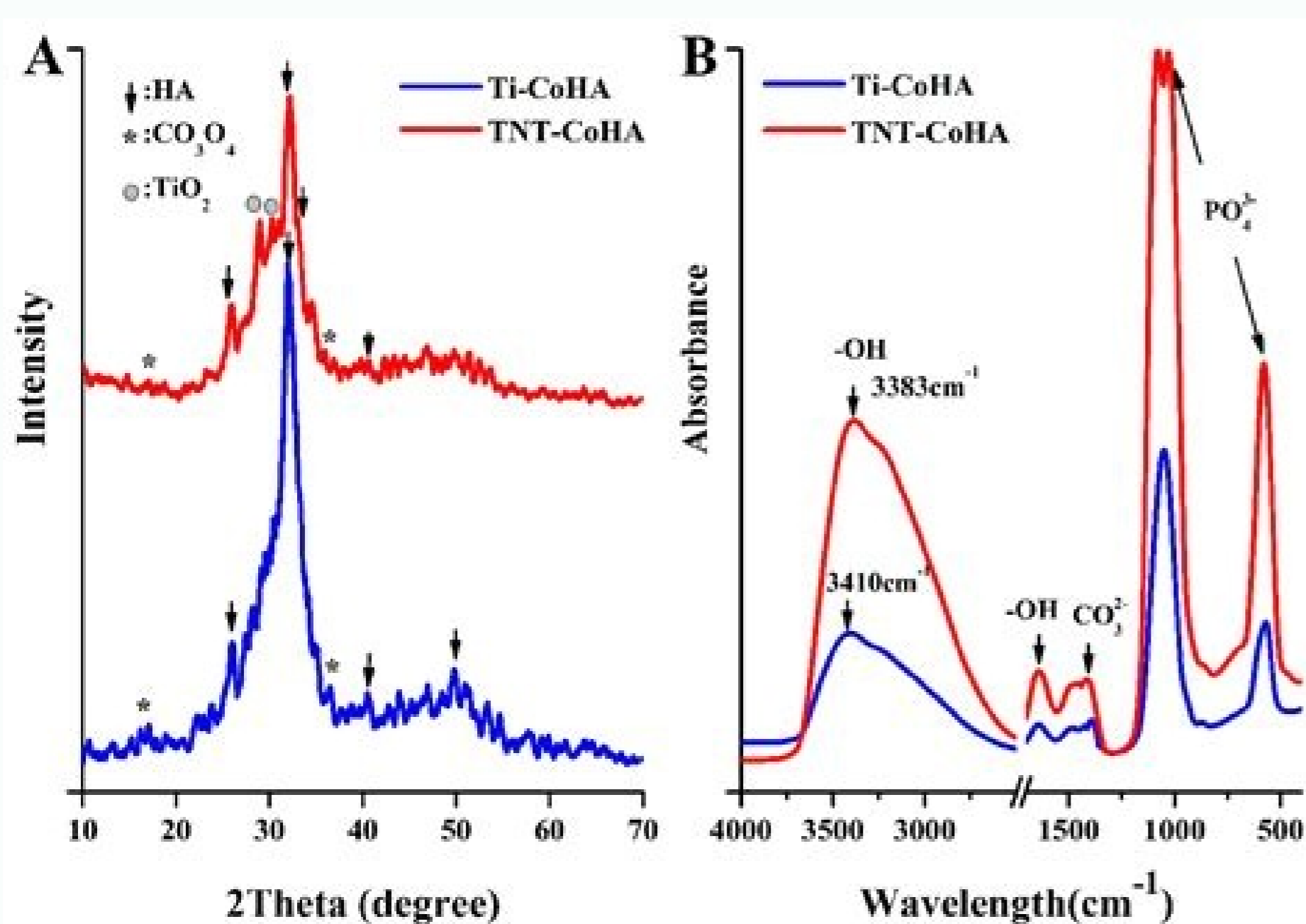
### 1. Introduction

Calcium phosphate based biomaterials have received great interest since the main constituent of inorganic mineral component in human bone is hydroxyapatite (HA) [1]. Calcium phosphates found in the system  $\text{CaO}-\text{P}_2\text{O}_5-\text{H}_2\text{O}$  constitute a large family of compounds that are of interest for biological applications [2]. These ceramics are usually described by their calcium/phosphorus atomic ratio (Ca/P). Among these ceramics, hydroxyapatite ( $\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$ , HA, Ca/P = 1.667) and  $\beta$ -tricalcium phosphate ( $\beta\text{-Ca}_3(\text{PO}_4)_2$ ,  $\beta$ -TCP, Ca/P = 1.5) have been extensively studied, and it is known that they exhibit different biological behaviors [3].

Calcium to phosphate ratio plays a very important role in the mechanical properties of the biomaterials. In a previous study [4] it is shown that a small variation in the Ca/P ratio of calcium deficient HA from 1.650 to 1.667 (i.e. relative deviation of Ca/P ratio <1%) resulted in substantial changes in the mechanical characteristics of densified BCP ceramics. Various techniques XRD [3], EDX [4], XRF [5], ICP [6] have been employed for elemental analysis and to find the Ca/P ratio of hydroxyapatite. All these techniques require special sample preparation and most of them require vacuum conditions and are time consuming. LIBS gives the advantage of minimal/no sample preparation along with being a rapid measurement technique.

In this study we have carried out LIBS of BHA (HA obtained from bovine bone) as an alternative technique to calculate the Ca/P ratio in a rapid way. Suitable peaks of Ca and P have been identified for the reliable determination of Ca/P ratio.

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