X-Ray Diffraction Analysis of Eggshell of Columba livia (Pigeon)

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Abstract: The paper deals with X-ray diffraction analysis of powdered eggshell of pigeon (columba livia) the study reports inorganic constituents present in the egg shell. The crystallite size, degree of crystallinity of the same.

Keywords: Hydroxyapatite, eggshell, X-ray diffraction

I. INTRODUCTION

XRD is a technique used to characterize the crystallographic structure, crystallite size (grain size), and preferred orientation in polycrystalline or powdered solid samples. Powder diffraction is commonly used to identify unknown substances, by comparing diffraction data against a database maintained by the International Centre for Diffraction Data [1], therefore it is also helpful in the analysis of unknown biological samples. Many studies have been carried out to learn the x-ray diffraction analysis of eggshell of hen, quill and ostrich, Which helped in the synthesis of hydroxyapatite. The Hydroxyapatite (HAp) is one of the most versatile materials used for implantation purpose due to its similarity to natural bone material. HAp has approximate chemical formula Ca10(PO4)6(OH)2 or Ca5(PO4)3(OH) , and is the main inorganic constituent of bones in humans. HAp can be successfully synthesized by reaction of discarded hen eggshell with tri-calcium phosphate in presence of steam at 900 degree Centigrade and subsequent aging for 24 Hrs Synthetic HAp has been successfully used in hard tissue surgery. [2],[3]It is a particularly attractive material for bone and tooth implants since it closely resembles human tooth and bone mineral and has proven to be biologically compatible with these tissues [4-6]. Many studies have indicated that HAp ceramics show no toxicity, inflammatory response, pyrogenetic response. It has excellent fibrous tissue formation between implant and bone.[4]. It can be revealed by FT-IR and XRD analyses, the product is crystalline & DTA-TG shows good thermal stability. The particles are mostly spherical with nano-size.[7] A literature survey discloses that despite various investigation of X-ray diffraction analysis of eggshells of hen, partridge quail and ostrich. No particulars accessible on quantification of crystallinity of other avian birds such as pigeon, parrots and crows . in view of this, in the present examination, X-ray analysis of eggshell of columba livia (pigeon) has been constructed.

II. MATERIALS AND METHOD:

The pigeon eggshell sample of Columba livia (pigeon) was collected and cleaned with water thoroughly and dried in room temperature over night, the inner and outer membranes are removed mechanically moreover the eggshell was powdered using pestle and mortar.

III. DISCUSSION AND RESULT

The X-ray powder diffraction (XRD) analysis of the eggshell samples was done (Bruker D-8 Advanced, Germany) in reflection mode with Cu Kα (λ=1.5405 Å) radiation. The data were analyzed in the 2θ range from 10º to 80º with a scanning step of 2º per min. figure 1 represents the X-ray diffractograms of eggshell sample, where 2θ is taken on X-axis and intensities is taken on Y-axis
Results are presented as peak positions at 2θ and X-ray counts (intensity) in the form of a table. The relative intensity is recorded as the ratio of the peak intensity to that of the most intense peak. The d-spacing of each peak is obtained by solution of the Bragg
equation for the appropriate value of \( \lambda \). Comparing these d-spacings with known diffraction database provides an identification of the unknown sample. A systematic procedure is used by ordering the d-spacing in terms of their intensity beginning with the most intense peak. The observed ‘d’ matched with fundamentals of optics by sachinath mitra[8], at peak position 29.413, 39.415, 43.166, 47.417, 48.531 and 57.367 the observed ‘d’ which are 3.034, 2.284, 2.094, 1.913, 1.874 and 1.604 respectively matches and found that egg shell of Columba livia contains calcium carbonate as the major inorganic constituent. It is in the calcite form. The crystallite size is calculated [9] with the formula \( D_p = \frac{0.94 \lambda}{\beta^{1/2} \cos \theta} \). Therefore the crystal size is 23.91 nm. The lattice strain calculated is 0.006. In addition, degree of crystallinity is 99.73%. The calcium carbonate present in egg shell is a good nanomaterial.

REFERENCES


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