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

Juveria Iram[1], Kaleem Jaleeli[2], Adeel Ahmad[3]
[1, 2, 3,] *Biophysics Research Laboratory, Department of Physics, Nizam College (Autonomous), Osmania University, Hyderabad – 500 001, India*

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 crystalinity 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, quil 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 crytallinity 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

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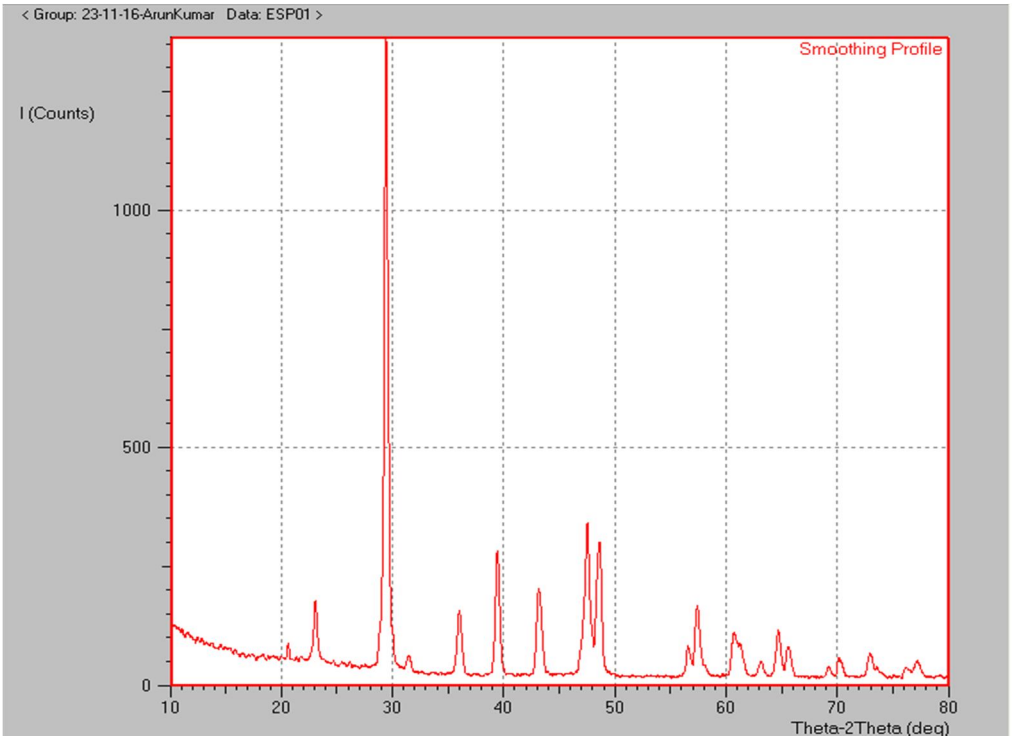

No	2θ (degree)	d (A°) observed	I	I/Io	FWHM	Integrated I	d (A°) reported	Order
1	23.055	3.854	87	10	0.3286	1818	-	-
2	28.760	3.101	40	4	0.2000	912	-	-
3	29.413	3.034	915	100	0.3591	17834	3.0300	10
4	29.980	2.978	57	6	0.2534	1506	-	-
5	35.991	2.493	94	10	0.4411	2349	-	-
6	39.415	2.284	183	20	0.4091	4274	2.280	7
7	43.166	2.094	126	14	0.5175	3485	2.090	
8	47.120	1.927	76	8	0.3120	1469	-	-
9	47.471	1.913	224	24	0.4220	4030	1.910	9
10	47.920	1.896	55	6	0.2720	929	-	-
11	48.531	1.874	187	20	0.5132	4920	1.873	8
12	56.570	1.625	47	5	0.3000	850	-	-
13	57.367	1.604	102	11	0.4492	2734	1.600	6
14	60.700	1.524	63	7	0.5400	1622	-	-
15	61.280	1.511	43	5	0.3866	1058	-	-
16	64.663	1.440	70	8	0.4067	1572	-	-
17	65.600	1.421	48	5	0.4400	1093	-	-
18	70.115	1.341	37	4	0.2500	684	-	-
19	72.920	1.296	34	4	0.4683	988	-	-

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

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equation for the appropriate value of λ. 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, 48.531and 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 $D_p=0.94\ \lambda/\beta_{1/2}\cos\theta$. Therefore the crytal size is 23.91nm.The lattice strain calculated is 0.006. in addition, degree of crytalinity is 99.73%. The calcium carbonate present in egg shell is a good nanomaterial.

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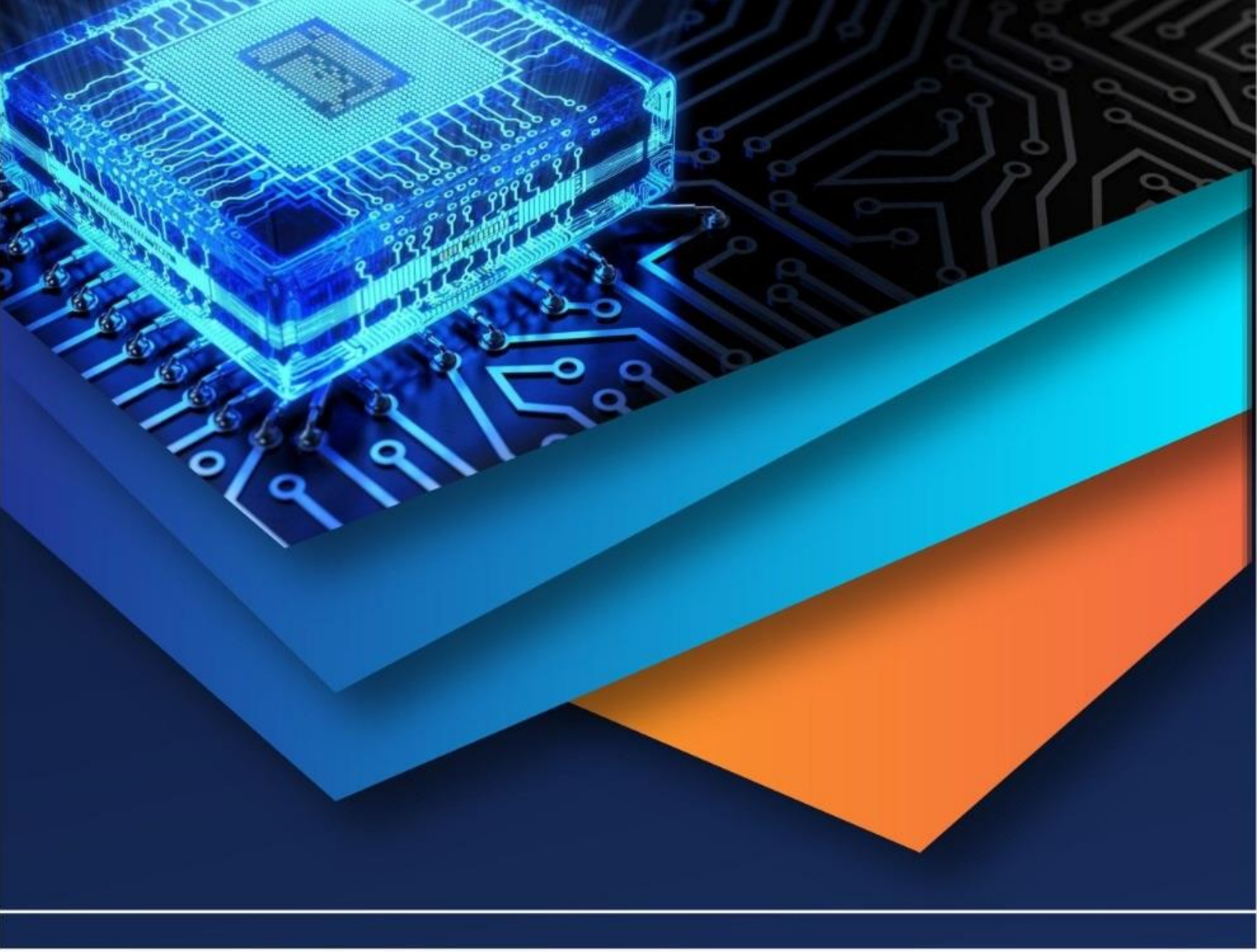

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