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FTIR Analysis of Egg Shell of Pigeon Columba livia

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Abstract: ***The paper presents FTIR analysis of powdered eggshell of pigeon Columba livia. Fresh samples of egg shells are cleaned, dried and powdered, excluding membranes, for the FTIR analysis. FTIR spectrum reveals three bands 1430 cm^{-1} (very strong), 875 cm^{-1} (strong) and 715 cm^{-1} (weak) suggesting that the major inorganic constituent of egg shell of Columba livia is calcium carbonate.***

Keywords: Egg shell; Pigeon; FTIR; Calcium Carbonate

I. INTRODUCTION

FTIR is a powerful analytical instrument for detecting functional groups and characterizing covalent bonding data. FTIR spectroscopy is a quantitative and qualitative study for the identification of organic and inorganic constituents of samples. Fourier Transform Infrared Spectroscopy (FTIR) pinpoints chemical bonds in a molecule by creating an infrared absorption spectrum. The spectrum makes an outline of the sample, a characteristic molecular fingerprint that can be utilized to screen and scan samples for many different components.Hui, et al [1] made Fourier transform infra-red spectroscopic study on hen's egg shell alone. Reaction of discarded hen egg shell with tri-calcium phosphate in presence of steam at 900 ^{0}C and subsequent aging for 24 hrs resulted in the formation of synthesized Hydroxyapatite. The FTIR investigation of these samples showed all the characteristic bands for Hydroxyapatite [2, 3]. Koutsopoulos, [4] first heated the egg shell by using furnace in order to remove organic composition of its content and decomposed calcium carbonate into calcium oxide at 1000 ^{0}C. Precipitation of calcium oxide and ammonium hydro phosphate solution at 5 ± 0.5 ^{0}C with concentration ratio of Ca/P 0.1/0.06 was done. FTIR spectrum did not show splitting of 604 cm^{-1} and 566 cm^{-1} bands, which indicates the sample is in amorphous phase. Carbonate is an inhibitor for calcium phosphate compound crystallization process [5]. Calcite growth inhibition by phosphorus-containing anions involves blockage of crystal growth sites on the calcite surface [6]. Inspite of these investigations, various researchers studied boiled egg shells. A search of literature reveals that there exists no information on FTIR analysis of eggshell in their natural state. In view of this, the aim of this paper is to reveal the Fourier transform infrared spectroscopic study of egg shell of *Columba livia* in its natural form.

II. MATERIALS AND METHODS

The egg shell samples of *Columba livia* (pigeon) were collected, cleaned with water thoroughly and dried in room temperature. The inner membrane was removed mechanically. The dry egg shell was powdered using pestle and mortar for the use of FTIR analysis. Infrared spectrum of the shell powder was recorded in FTIR spectrometer (Shimadzu FTIR – 8400S) in the range of 4000 cm^{-1} to 400 cm^{-1}. For the spectral recording, a small quantity of powder was mixed with potassium bromide (KBr) in the ratio of 1:4 and pressed in a stainless steel dye to produce thin KBr wafer, containing a relatively high concentration of the sample in IR transparent KBr matrix.

III. RESULTS AND DISCUSSION

For the IR analysis of a sample, IR spectrum is divided into *three* broad regions. Region I is from 4000 to 3000 cm^{-1}. It reveals the nature of hydrogen bonding. Region II is from 3000 to 1500 cm^{-1}. In this region bands pertaining to functional groups are present. Region III is from 1500 to 400 cm^{-1}, wherein information about most of the bio - minerals and their combinations, phases and substitutions is available.

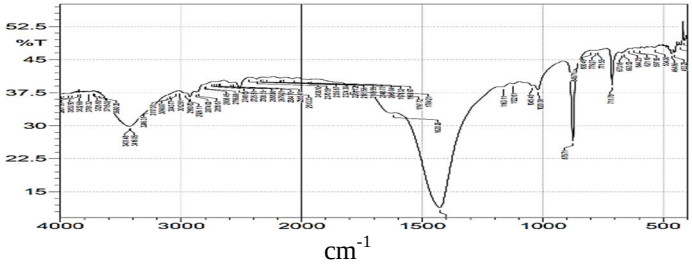


Fig. 1. FTIR spectrum of egg shell of pigeon Columbe livia

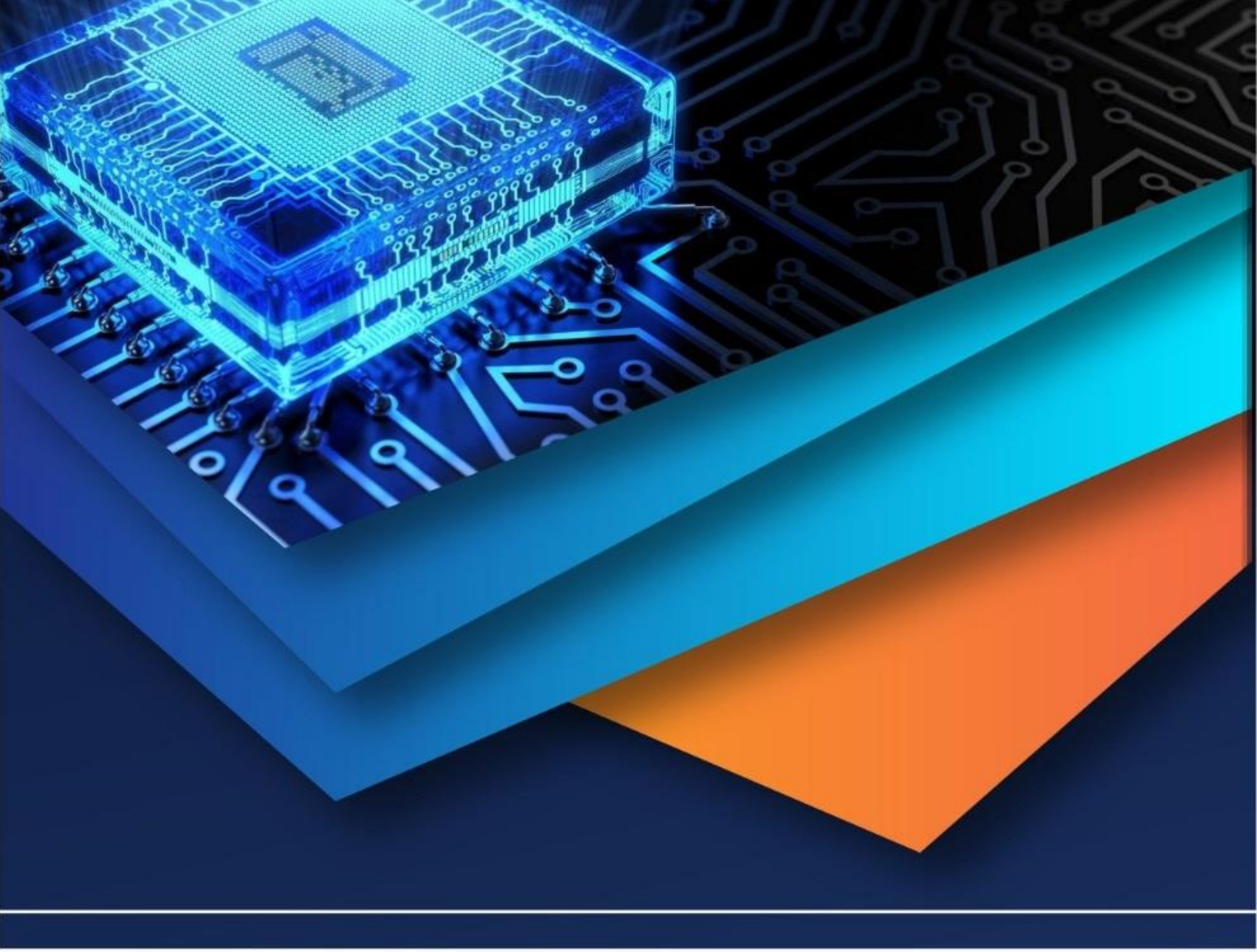
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Fig. 1. shows FTIR spectrum of egg shell of pigeon recorded in the range of 4000 cm^{-1} to 400 cm^{-1}. It reveals a series of bands with different intensities. The major bands at 1631 cm^{-1} (C - H stretch); 1543 cm^{-1}(N - H stretch and C-O- anti symmetric stretch); and 1238 cm^{-1} (C-H stretch with N-H bend) related to Amide I, Amide II and Amide III respectively in the spectral region 3000 cm^{-1} to 1500 cm^{-1} are attributed to the organic material, which are essentially proteins. These bands are not seen in the present FTIR spectrum. But the bands at 1430 cm^{-1} (very strong), 875 cm^{-1} (strong) and 715 cm^{-1} (weak) are observed, which are very much concerned with calcium carbonate. The paper concludes that the major inorganic constituent of egg shell of *Columba livia* is calcium carbonate.

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