



# **SYNTHESIS AND CHARACTERIZATION OF CALCIUM CARBONATE NANOPARTICLES FOR FUTURE APPLICATIONS IN POULTRY AND DAIRY INDUSTRY**

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**A thesis submitted in the partial fulfillment of the requirements for the degree of  
Master of Science in Food Chemistry and Quality Assurance.**

**Department of Applied Chemistry and Chemical Technology**

**Faculty of Food Science and Technology**

**Chattogram Veterinary and Animal Sciences University**

**Chattogram-4225, Bangladesh.**

**August 2023**

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**Sadia Tuz Zohra**

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**This is to certify that we have examined the above Master's thesis and have  
found that is complete and satisfactory in all respects and that all revisions  
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**DEDICATED TO MY  
BELOVED FAMILY &  
RESPECTED TEACHERS**

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## Abbreviation

<b>%</b>	: Percentage
<b>&amp;</b>	: And
<b>ANOVA</b>	: Analysis of variance
<b>AOAC</b>	: Association of Official Analytical Chemists
<b>NP</b>	: Nano Particles
<b>NCC</b>	: Nano Calcium Carbonate
<b>°C</b>	: Degree Celsius
<b>UV</b>	: Ultra Violet
<b>XRD</b>	: X-ray Diffraction
<b>FTIR</b>	: Fourier Transform Infrared Spectroscopy
<b>TEM</b>	: Transmission Electron Microscopy
<b>MRI</b>	: Magnetic Resonance Imaging
<i>et al</i>	: <i>Et alii/ et aliae/ et alia</i>
<b>etc</b>	: Et cetera
<b>g</b>	: Gram
<b>CNT</b>	: Carbon Nanotubes
<b>mm</b>	: Millimeter
<b>mg</b>	: Milligram
<b>cm</b>	: Centimeter
<b>nm</b>	: Nanometer
<b>rpm</b>	: Revolutions per minute
<b>PPM</b>	: Parts per million
<b>m</b>	: Meter
<b>DNA</b>	: Deoxyribonucleic acid
<b>µg</b>	: Microgram
<b>SS</b>	: Soluble Starch
<b>CA</b>	: Calcium Acetate
<b>CC</b>	: Calcium Carbonate
<b>SPSS</b>	: Statistical Package for Social Science

## Abstract

Synthesis of calcium carbonate nanoparticles (CCNPs) have attracted great attention due to their biocompatibility, surface functionalization, ease of production, and enormous potential for use in both industrial and biomedical applications. A novel, quick coprecipitation technique was used in this study to create CCNPs from calcium acetate and ammonium carbonate under the control of soluble starch at 20°C, 50°C and 80°C. The synthesized nanoparticles were characterized using UV-Visible, FT-IR, TEM and XRD techniques. The formation of CCNPs were primarily confirmed by the UV-Visible spectra in the wavelength of 205nm, 216nm and 209nm respectively. The asymmetric stretching (v3), symmetric stretching (v1), out-of-plane (v2) and in-plane bending (v4) vibrations, together with the functional group with Ca-O, O-H, C-H and C-C, which are indicating the existence of carbonate, were validated by Fourier transform infrared (FT-IR) spectroscopy. The average particle size of the synthesized CCNPs was found to be  $44 \pm 10$  nm,  $29 \pm 4$  nm,  $105 \pm 65$  nm, respectively at 20°C, 50°C and 80°C using transmission electron microscopy (TEM). X-ray powder diffraction (XRD) was performed to monitor the crystal phases along with average particle size of the CCNPs found to be 40.65 nm, 26.58nm and 32nm as estimated by Scherrer formula that indicates the particles are in crystalline structure, respectively at 20 °C, 50°C and 80°C which were consistent with the average particle sizes estimated from the TEM. The average particle size at 50°C was found to be the lowest in contrast to the other two samples, validating the XRD study's and TEM's findings. The characterization of the outcome demonstrates that, the synthesized CCNPs are in the form of calcite nanoparticles with increased nano properties which indicates that, they have potential for use in future applications.

**Keywords:** Calcium carbonate, Co-precipitation, Calcite, Nanoparticles, Particle size

