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A Novel, Facile Method for the Synthesis of pH-Modulating Inorganic Carbonate Nonparticles

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A Novel, Facile Method for the Synthesis of pH-Modulating Inorganic Carbonate Nanoparticles

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Many biological systems need to strictly maintain the acid/base homeostatic balance (pH) of their cellular environment. In humans, several pathological conditions, including cancer and diabetic ketoacidosis, are characterized by dysregulation or failure of pH maintenance mechanisms. Treatment of such conditions has focused on modulating pH to appropriate physiological ranges. Prior studies show that nanoparticles of inorganic carbonates, particularly of calcium carbonate, are effective in achieving this. Thus, inorganic carbonate nanoparticles are pursued as a possible therapy for many pH-based disorders, but have faced significant difficulties associated with reliably synthesizing stable inorganic carbonates at sub-micron size scales. To address this problem, a novel, dessicator-based method of synthesizing a wide variety of inorganic carbonate nanoparticles using metal chlorides and ammonium bicarbonate was studied. Six nanoparticle preparations synthesized with this method were subsequently analyzed for particle size, morphology, pH-modulating properties, and optical characteristics. Results show that this method is capable of producing uniform, spherically shaped particles in the 50-150 nm range. In addition, while all the carbonates demonstrated an alkalization effect relative to their respective chlorides, the extent to which pH was increased depended on the specific cation associated with the carbonate. Also, all the nanoparticle solutions exhibited a distinct fluorescence emission peak at approximately 500 nm. These findings suggest that such particles can have a wide range of potential therapeutic applications in biomedical environments. The pH-modulating effects and optical properties, along with the inherent advantages of the nanoparticle platform, will be extremely useful in the management of a variety of diseases.