

Calcium oxalate precipitation: Implications for kidney stone formation

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Calcium oxalates are widely occurring natural minerals found in plants, animals, fungi, and various microorganisms. In humans, these phases are the primary constituents of kidney stones (urolithiasis), forming through precipitation in the urinary tract. This study investigates calcium oxalate precipitation under controlled experimental conditions, focusing on key parameters such as pH, temperature, initial calcium and oxalate concentrations of the precipitating fluid, stirring, and reaction time. To closely mimic physiological conditions, experiments were conducted at room (25°C) and physiological (37°C) temperatures within a pH range of 6.0 – 8.0. A wide spectrum of calcium (0.5 – 10 mM) and oxalic acid (0.2 – 5 mM) concentrations was utilized to model hypercalciuria and hyperoxaluria, two major risk factors for stone formation. Since urinary precipitation is highly complex due to the intricate composition of urine, the study first utilized a simplified solution composition containing only calcium chloride and oxalic acid to establish baseline precipitation behaviors. Following this, a more complex system incorporating artificial urine and bio-elements were tested to better simulate *in vivo* conditions. This stepwise approach allows for a clearer understanding of calcium oxalate crystallization mechanisms and the factors influencing stone formation. The findings contribute to a better understanding of kidney stone formation and may aid in developing preventative or therapeutic strategies for urolithiasis.