

Supporting Information

Opposite Effects for Cations in Enhancing and Suppressing Nucleation of Pathology Crystallization of Gout

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Experimental

Materials. Uric acid (>99%), Calcium chloride (>99%), Potassium chloride (>99%), Sodium chloride (>99%), Ammonium chloride (>99%), Sodium hydroxide (>99%) were obtained from Sigma Aldrich and used without purification. Aqueous solutions were prepared using deionized water (18.2 M Ω) purified with a Nanjing Yipuyida purification system.

Table S1 Influence of various cations in different added concentration on solubilities of MSUM at 25 °C (pH = 7.4) in the presence of 5mM MSUM and 140mM NaCl, with a typical standard deviation of 0.2 mg/100g of H₂O.

Concentration of added cation (mM)	MgCl ₂ (mg/dl)	NH ₄ Cl(mg/dl)	KCl(mg/dl)	CaCl ₂ (mg/dl)
0	4.2	4.2	4.2	4.2
0.4	4.2	4.2	4.2	4.1
5	3.7	3.8	4.8	
15	2.8	3.2	6.3	
25	2	2.5	7.6	

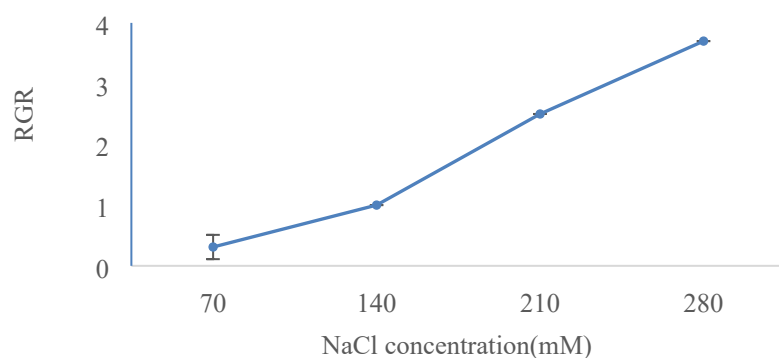


Figure S1. Influence of different concentrations of Na⁺ on the relative growth rate of MSUM along the major growth directions (c-axis) of MSUM crystals at 25 °C in the presence of 5mM MSUM. The growth rate of a control sample (a solution in the presence of 140 mM NaCl and 5 mM MSUM at pH 7.4) is 3.1 μ m/s under the above experimental conditions. The growth rate data are an average of at least three measurements. Error bars equal 2 standard deviations.

Table S2. Results of induction time experiments in presence of various cations in different added concentration, 5mM MSUM and 140mM NaCl, including 95% confidence intervals from linear regression.

Sample	NH ₄ Cl		KCl		MgCl ₂		CaCl ₂	
	S	τ(s)	S	τ(s)	S	τ(s)	S	τ(s)
C ^α =0.4	22.6	141	22.6	101	22.6	132	23.2	127
C ^α =5	25	148	19.8	135	25.7	215		
C ^α =15	29.7	271	15.1	206	33.9	360		
C ^α =25	38	307	12.5	223	47.5	456		

C^α: The sample is C mM additive cationic solution containing 5mM MSUM and 140mM NaCl. τ is the induction time.

Table S3 The ionic radius r,^[1] Gibbs free energy of hydration and hydrated diameter α^[2] for cations

Items	Mg ²⁺	Ca ²⁺	Na ⁺	K ⁺	NH ₄ ⁺
r (pm)	72	100	102	138	168
α (pm)	800	600	450	300	250
Δ _{hyd} G/kJ mol ⁻¹	-1830	-1505	-365	-295	-285

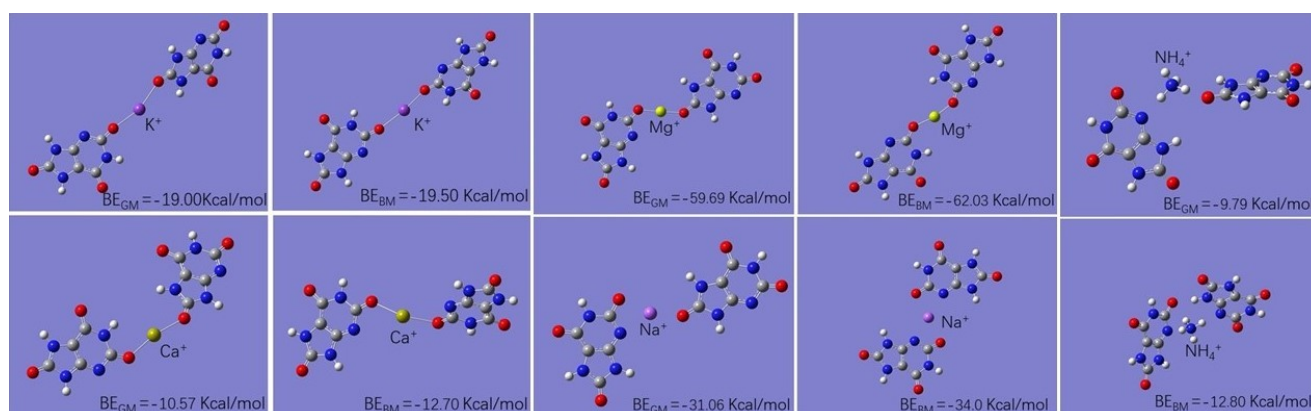


Figure S2. Optimized conformations and their Binding Energies (kcal mol⁻¹) of chain cation bridges, urate(o2)⁻···cation⁺···urate(o8)⁻ and urate(o2)⁻···cation⁺···urate(o2)⁻

References

- [1] Marcus, Y. Thermodynamics of solvation of ions. Part 5.-Gibbs free energy of hydration at 298.15 K. *J. Chem. Soc. Faraday Trans.*, 1991, 87, 2995-2999.
- [2] Harris, D. C. Quantitative chemical analysis, w. H. Freeman and Company, New York, 9 edn, 2016, pp.165-166.