Supporting Information

Shape and structure controlling of calcium oxalate crystals by combinations of additives

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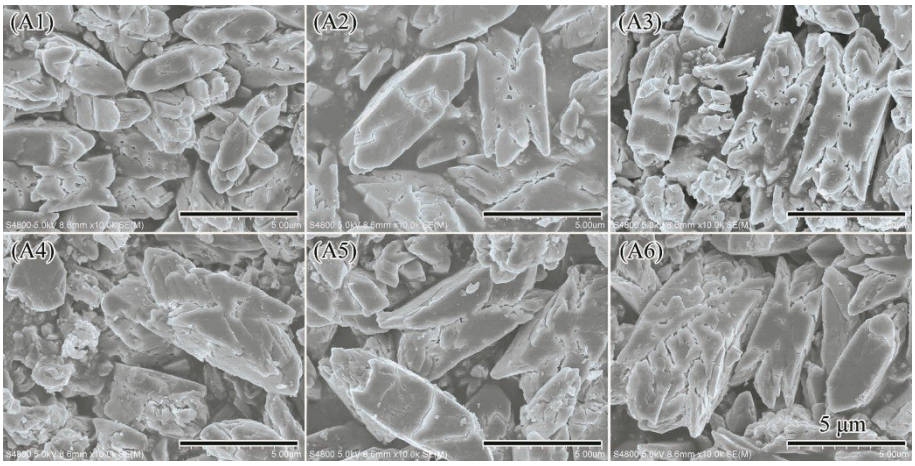

Figure S1. SEM image to show effects of D-aspartic acid on CaOx formation at pH 7. Panels (A1), (A2), (A3), (A4), (A5), (A6) show addition of D-aspartic acid at 0.1, 0.2, 0.4, 0.8, 1, 2 mmol/L.

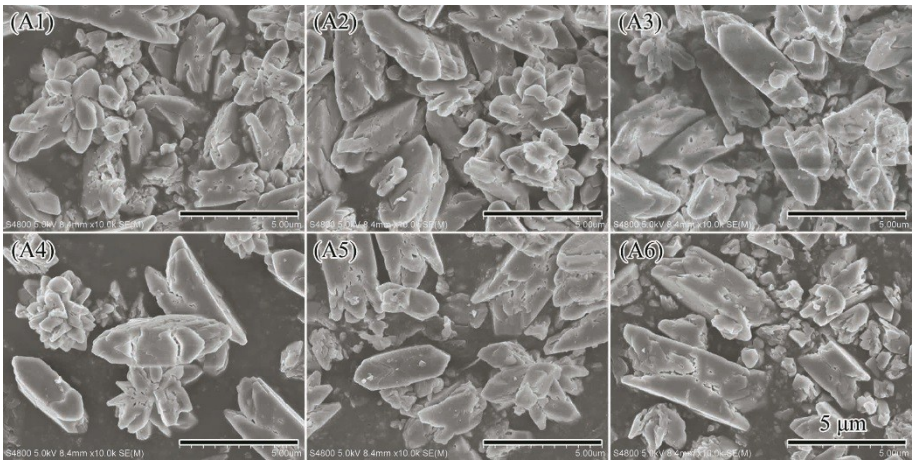

Figure S2. SEM image to show effects of L-aspartic acid on CaOx formation at pH 7. Panels (A1), (A2), (A3), (A4), (A5), (A6) show addition of L-aspartic acid at 0.1, 0.2, 0.4, 0.8, 1, 2 mmol/L.

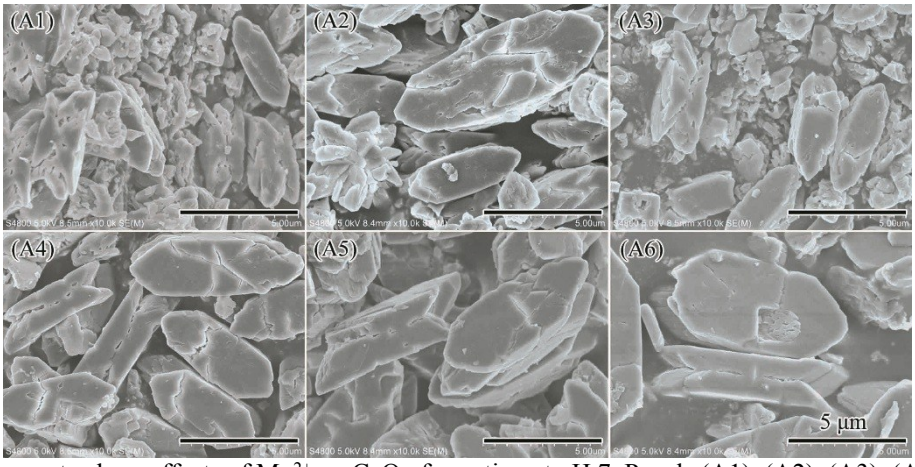

Figure S3. SEM image to show effects of Mg^{2+} on CaOx formation at pH 7. Panels (A1), (A2), (A3), (A4), (A5), (A6) show addition of Mg^{2+} at 0.1, 0.2, 0.4, 0.8, 1, 2 mmol/L.

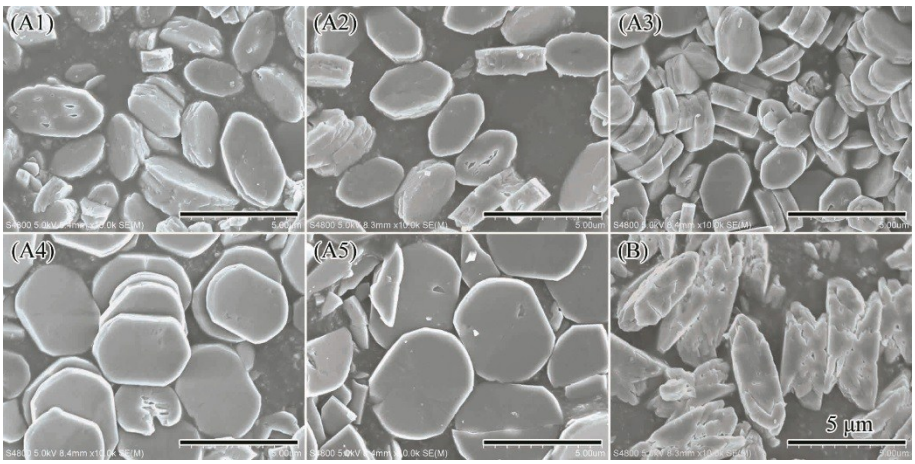

Figure S4. SEM image to show effects of $Na_3Citrate$ on CaOx formation at pH 7. Panels (A1), (A2), (A3), (A4), (A5) show addition of $Na_3Citrate$ at 0.1, 0.2, 0.4, 0.8, 1 mmol/L. Panel (B) shows CaOx formation of in the absence of additives.

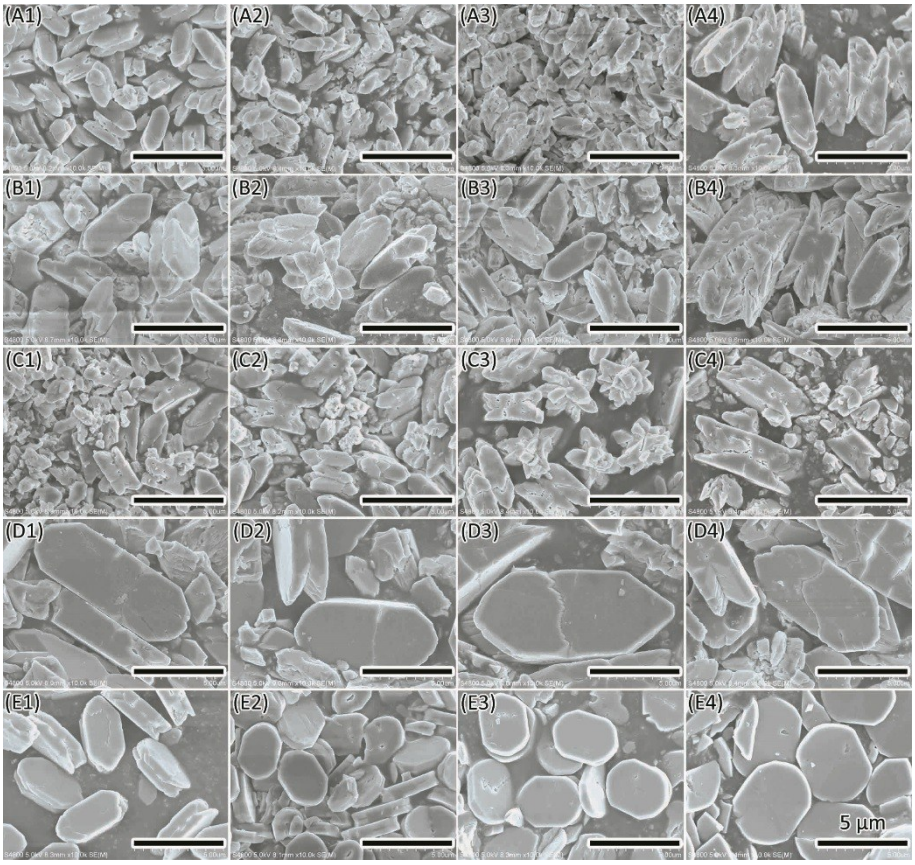

Figure S5. SEM images of COM formed at different pH. Panels (A1), (A2), (A3), (A4), CaOx. Panels (B1), (B2), (B3), (B4), CaOx with addition of D-aspartic acid (2 mmol/L). Panels (C1), (C2), (C3), (C4), CaOx with addition of L-aspartic acid (2 mmol/L). Panels (D1), (D2), (D3), (D4), CaOx with addition of Mg^{2+} (2 mmol/L). Panels (E1), (E2), (E3), (E4), CaOx with addition of Na_3Citrate (1 mmol/L). Numbers 1, 2, 3, 4 refer to pH 4, pH 5, pH 6, and pH 7, respectively.

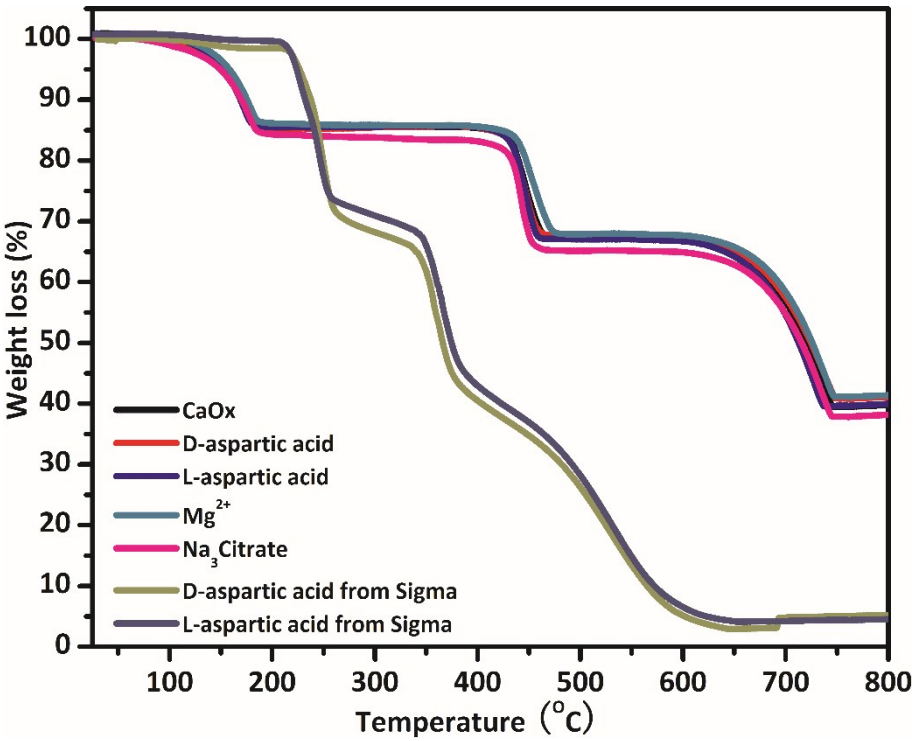

Figure S6. Thermogravimetric analysis of CaOx formed in the presence or absence of additives. Commercial chiral aspartic acid from Sigma Aldrich was also tested to show that no detectable amount of aspartic acid was included in COM crystals.

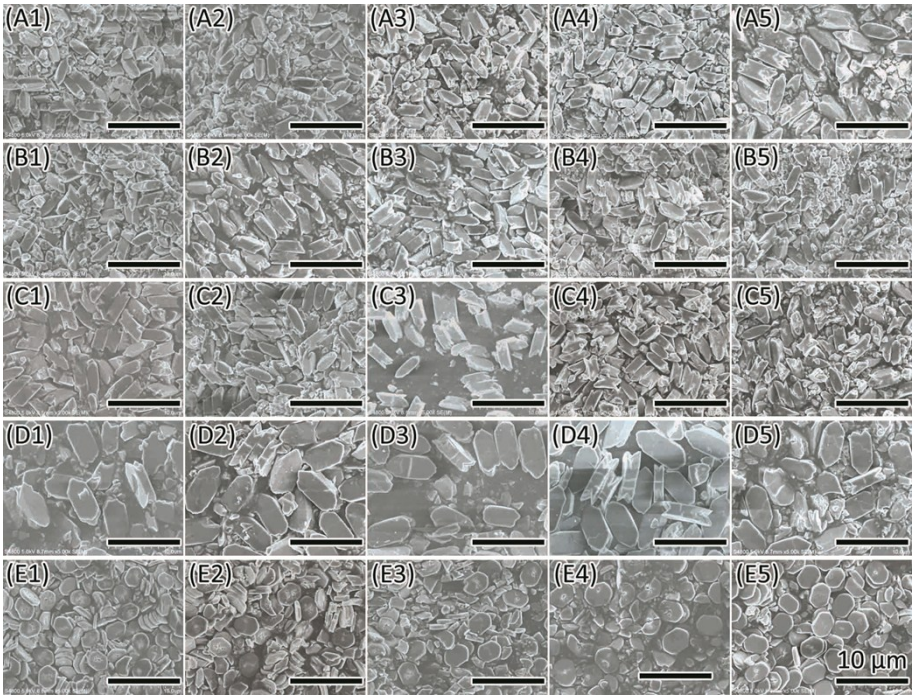

Figure S7. SEM images of COM formation in the presence or absence of additives. Panels (A1), (A2), (A3), (A4), CaOx. Panels (B1), (B2), (B3), (B4), CaOx with addition of D-aspartic acid (2 mmol/L). Panels (C1), (C2), (C3), (C4), CaOx with addition of L-aspartic acid (2 mmol/L). Panels (D1), (D2), (D3), (D4), CaOx with addition of Mg^{2+} (2 mmol/L). Panels (E1), (E2), (E3), (E4), CaOx with addition of Na_3Citrate (1 mmol/L). Numbers 1, 2, 3, 4, 5 refer to 0.25 hour, 0.5 hour, 1 hour, 2 hours, 4 hours, respectively.

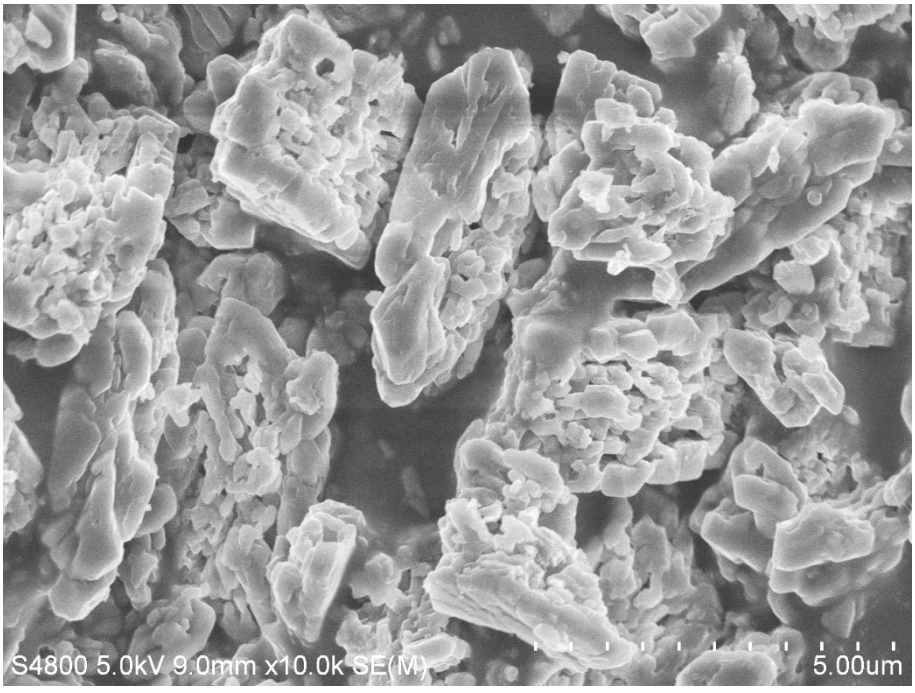

Figure S8. SEM image of CaOx formed in the presence of 2 mmol/L L-aspartic acid and crystallization time elongated to 10 days.

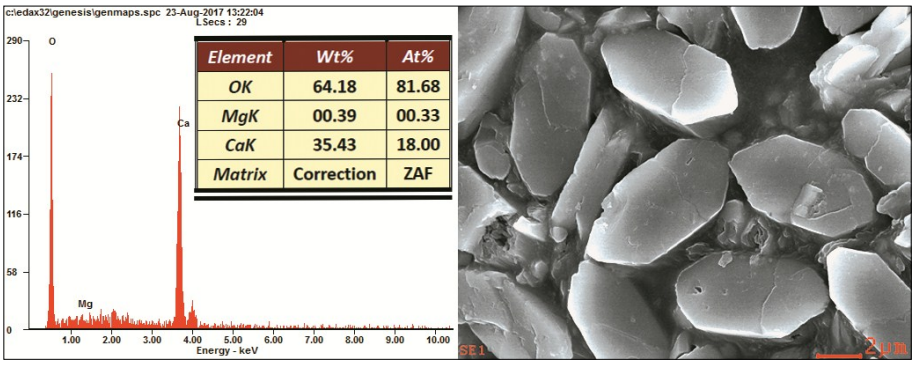

Figure S9. Energy dispersive spectra (left) and SEM image (right) of CaOx formed in the presence of 2 mmol/L Mg^{2+} in solution at pH 7.

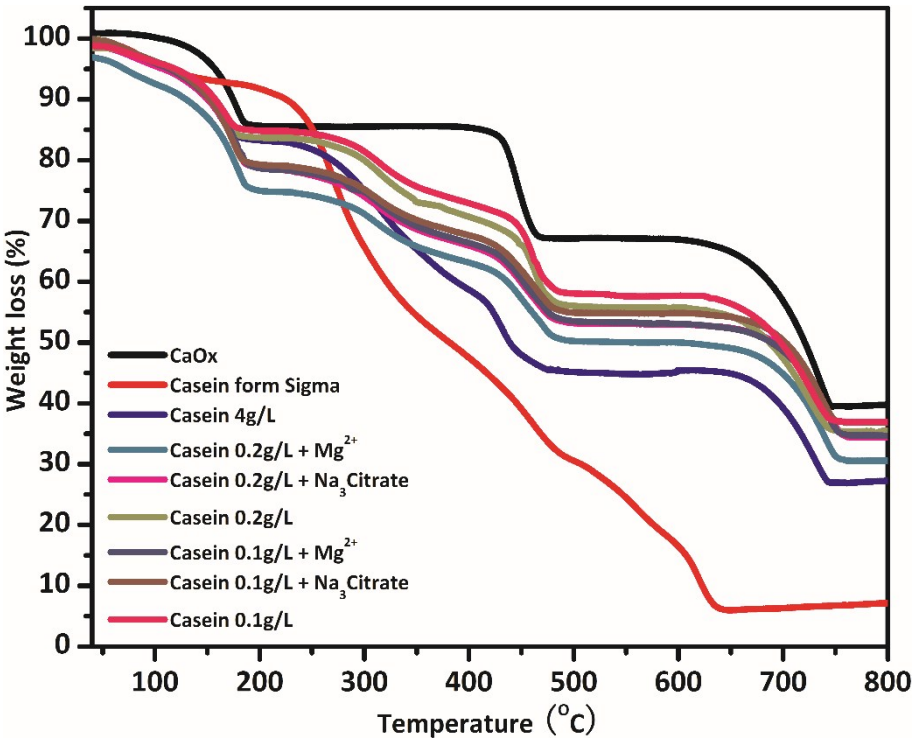

Figure S10. Thermogravimetric analysis of CaOx in the present of casein.

Table S1. Weight loss (%) of CaOx formed in the presence or absence of additives.

Sample	40-250 ºC	250-550 ºC	550-800 ºC	Total
CaOx only	14.5	18.4	27.3	60.2
D-aspartic acid from Sigma	20.5	66.1	8.2	94.8
L-aspartic acid from Sigma	22.5	62.7	10.3	95.5
CaOx formed in the presence of D-aspartic acid	14.7	17.5	26.7	58.9
CaOx formed in the presence of L-aspartic acid	14.5	18.4	27.1	60.0
CaOx formed in the presence of Mg^{2+}	14.1	18.0	26.5	58.6
CaOx formed in the presence of Na_3Citrate	16.0	18.9	26.9	61.8

Table S2. Weight loss (%) of CaOx in the presence of casein.

Sample	40-250 ºC	250-550 ºC	550-800 ºC	Total
CaOx only	14.5	18.4	27.3	60.2
Casein from Sigma	14.7	60.8	17.3	92.8
CaOx formed in the presence of 4 g/L Casein	18.2	36.9	17.6	72.7
CaOx formed in the presence of 2 g/L Casein	20.0	32.5	17.9	70.4
CaOx formed in the presence of 0.8 g/L Casein	17.3	33.3	17.2	67.8
CaOx formed in the presence of 0.2 g/L Casein	16.7	27.5	20.3	64.5
CaOx formed in the presence of 0.1 g/L Casein	15.6	26.7	20.7	63.0

Table S3. Binding energy (eV) of CaOx formed in the presence or absence of additives.

Sample	C 1s	Ca 2p	N 1s	O 1s	Mg 1s
CaOx only	284.8	347.3	400.2	532.1	1308.2
CaOx formed in the presence of Casein	284.8	347.2	399.7	531.5	1299.7
CaOx formed in the presence of Casein and Mg^{2+}	284.8	347.4	399.8	531.8	1301.9
CaOx formed in the presence of Casein and Na_3Citrate	284.8	347.5	399.8	531.8	1309.2