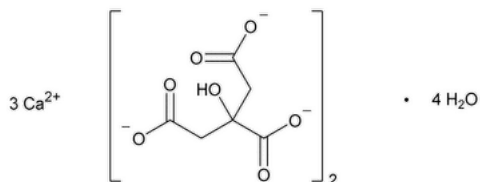


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Calcium Citrate



$C_{12}H_{10}Ca_3O_{14} \cdot 4H_2O$ 570.49

1,2,3-Propanetricarboxylic acid, 2-hydroxy-, calcium salt (2:3), tetrahydrate;

Calcium citrate (3:2), tetrahydrate CAS RN[®]: 5785-44-4; UNII: MLM29U2X85.

DEFINITION

Calcium Citrate contains NLT 98.0% and NMT 102.0% of calcium citrate $[Ca_3(C_6H_5O_7)_2]$, calculated on the dried basis.

IDENTIFICATION

• A.

Sample: 0.5 g

Analysis: Dissolve the *Sample* in a mixture of 10 mL of [water](#) and 2.5 mL of [2 N nitric acid](#). Add 1 mL of [mercuric sulfate TS](#), heat to boiling, and add 1 mL of [potassium permanganate TS](#).

Acceptance criteria: A white precipitate is formed.

• **B.** The retention time of the calcium peak of the *Sample solution* corresponds to that of the *Standard solution*, as obtained in the Assay.

ASSAY

• PROCEDURE

Use [water](#) with a resistivity of NLT 18 megohm-cm to prepare the solutions.

Mobile phase: 34 mM [methanesulfonic acid](#) in [water](#). [NOTE—It is recommended to use a suitable cation trapping technique to ensure that the *Mobile phase* is sufficiently free of cationic impurities.]

System suitability stock solution: 4 mg/mL of [USP Calcium Citrate RS](#) and 0.5 mg/mL of [USP Magnesium Carbonate RS](#) prepared as follows.

Transfer an appropriate amount of [USP Calcium Citrate RS](#) and [USP Magnesium Carbonate RS](#) to a suitable volumetric flask. Add [6 N hydrochloric acid](#) to about 10% of the final volume and dissolve. Dilute with [water](#) to volume.

System suitability solution: 0.08 mg/mL of [USP Calcium Citrate RS](#) and 0.01 mg/mL of [USP Magnesium Carbonate RS](#) in [water](#) from *System suitability stock solution*

Standard stock solution: 4 mg/mL of [USP Calcium Citrate RS](#) prepared as follows. Transfer an appropriate portion of [USP Calcium Citrate RS](#) to a suitable volumetric flask. Add [6 N hydrochloric acid](#) to about 10% of the final volume and dissolve. Dilute with [water](#) to volume.

Standard solution: 0.08 mg/mL of [USP Calcium Citrate RS](#) in [water](#) from *Standard stock solution*

Sample stock solution: 4 mg/mL of Calcium Citrate prepared as directed for the *Standard stock solution*

Sample solution: 0.08 mg/mL of Calcium Citrate in [water](#) from the *Sample stock solution*

Chromatographic system

(See [Chromatography \(621\)](#), [System Suitability](#).)

Mode: LC

Detector: Conductivity with suppression

Columns

Guard: 5.0-mm × 5-cm; 5.5-μm packing [L84](#)

Analytical: 5.0-mm × 25-cm; 5.5-μm packing [L84](#)

Column temperature: 50°

Flow rate: 1.5 mL/min

Injection volume: 10 μL

Run time: NLT 2 times the retention time of calcium

System suitability

Samples: *System suitability solution* and *Standard solution*

[NOTE—The relative retention times for the magnesium and calcium ions are 0.76 and 1.0, respectively.]

Suitability requirements

Resolution: NLT 2.0 between magnesium and calcium, *System suitability solution*

Tailing factor: NMT 2.0, *Standard solution*

Relative standard deviation: NMT 0.73%, *Standard solution*

Analysis

Samples: *Standard solution* and *Sample solution*

Calculate the percentage of calcium citrate $[\text{Ca}_3(\text{C}_6\text{H}_5\text{O}_7)_2]$ in the portion of Calcium Citrate taken:

$$\text{Result} = (r_U/r_S) \times (C_S/C_U) \times 100$$

r_U = peak response of calcium from the *Sample solution*

r_S = peak response of calcium from the *Standard solution*

C_S = concentration of [USP Calcium Citrate RS](#) in the *Standard solution* (mg/mL)

C_U = concentration of Calcium Citrate in the *Sample solution* (mg/mL)

Acceptance criteria: 98.0%–102.0% on the dried basis

IMPURITIES

Change to read:

- **▲** [ARSENIC \(211\), Procedures, Procedure 1](#) ▲ (CN 1-JUN-2023)

Sample: 1 g

Analysis: Dissolve the *Sample* in 5 mL of [3 N hydrochloric acid](#), and dilute with [water](#) to 35 mL.

Acceptance criteria: NMT 3 ppm

Change to read:

- **▲** [LEAD \(251\), Procedures, Procedure 1](#) ▲ (CN 1-JUN-2023)

Standard solution: 5 mL of *Diluted standard lead solution* [5 µg of lead (Pb)]

Sample solution: Dissolve 0.5 g of Calcium Citrate in 20 mL of [3 N hydrochloric acid](#). Evaporate this solution to 10 mL on a steam bath, dilute with [water](#) to 20 mL, and cool.

Acceptance criteria: NMT 10 ppm

- **LIMIT OF FLUORIDE**

Use water with a resistivity of NLT 18 megohm-cm to prepare the solutions. Prepare and store all solutions in plastic containers.

Solution A: 50 mM [potassium hydroxide](#) in [water](#)

Solution B: [Water](#)

Mobile phase: See [Table 1](#).

Table 1

Time (min)	Solution A (%)	Solution B (%)
0	10	90
10	10	90
15	100	0
25	100	0
30	10	90
45	10	90

[NOTE—Alternatively, *Mobile phase* can be generated electrolytically using an automatic eluant generator. It is recommended to use suitable anion trapping techniques to ensure the *Mobile phase* is free of all anionic impurities.]

Diluent: 0.03 N [hydrochloric acid](#) and 0.03 N [potassium hydroxide](#) in [water](#)

System suitability solution: 0.13 µg/mL of [USP Sodium Fluoride RS](#) and 0.08 µg/mL of [USP Sodium Acetate RS](#) in [water](#)

Standard stock solution: 0.2 mg/mL of [USP Sodium Fluoride RS](#) prepared as follows. Transfer an appropriate amount of [USP Sodium Fluoride RS](#) to a suitable volumetric flask. Add [water](#) to about 20% of the final volume, followed by [6 N hydrochloric acid](#) to 0.5% of the final volume. Add 6 N [potassium hydroxide](#) to 0.5% of the final volume. Dilute with [water](#) to volume.

Standard solution: 0.13 µg/mL of [USP Sodium Fluoride RS](#) in *Diluent* from *Standard stock solution*

Sample solution: 2 mg/mL of Calcium Citrate prepared as directed in *Standard stock solution*

Chromatographic system

(See [Chromatography \(621\), System Suitability](#).)

Mode: LC

Detector: Conductivity with suppression

Columns

Guard: 4.0-mm × 5-cm; 13-μm packing [L120](#). [NOTE—Alternatively, a 4.0-mm × 0.5-cm column that contains 4.6-μm packing [L91](#) may be used.]

Analytical: 4.0-mm × 25-cm; 7.5-μm packing [L113](#). [NOTE—Alternatively, a 4.0-mm × 25-cm column that contains 4.6-μm packing [L91](#) may be used.]

Column temperature: 30°

Flow rate: 1 mL/min

Injection volume: 10 μL

System suitability

Samples: *System suitability solution* and *Standard solution*

[NOTE—The relative retention times for the fluoride and acetate peaks are 1.0 and 1.2, respectively.]

Suitability requirements

Resolution: NLT 1.5 between the fluoride and acetate peaks, *System suitability solution*

Tailing factor: NMT 2.0, *Standard solution*

Relative standard deviation: NMT 5.0%, *Standard solution*

Signal-to-noise ratio: NLT 20, *Standard solution*

Analysis

Samples: *Standard solution* and *Sample solution*

Calculate the percentage of fluoride in the portion of Calcium Citrate taken:

$$\text{Result} = (r_U/r_S) \times (C_S/C_U) \times (A_r/M_r) \times 100$$

r_U = peak response of fluoride from the *Sample solution*

r_S = peak response of fluoride from the *Standard solution*

C_S = concentration of [USP Sodium Fluoride RS](#) in the *Standard solution* (μg/mL)

C_U = concentration of Calcium Citrate in the *Sample solution* (μg/mL)

A_r = atomic weight of fluoride, 19.00

M_r = molecular weight of sodium fluoride, 41.99

Acceptance criteria: NMT 0.003%

• LIMIT OF ACID-INSOLUBLE SUBSTANCES

Sample solution: Dissolve 5 g of Calcium Citrate by heating with 16.7% (v/v) [hydrochloric acid](#) for 30 min.

Analysis: Filter, wash, and dry at 105° for 2 h the residue so obtained.

Acceptance criteria: NMT 10 mg (0.2%)

SPECIFIC TESTS

• [LOSS ON DRYING \(731\)](#)

Analysis: Dry at 150° for 4 h.

Acceptance criteria: 10.0%–13.3%

ADDITIONAL REQUIREMENTS

• **PACKAGING AND STORAGE:** Preserve in well-closed containers.

• [USP REFERENCE STANDARDS \(11\)](#)

[USP Calcium Citrate RS](#)

[USP Magnesium Carbonate RS](#)

[USP Sodium Acetate RS](#)

[USP Sodium Fluoride RS](#)

Auxiliary Information - Please [check for your question in the FAQs](#) before contacting USP.

Topic/Question	Contact	Expert Committee
CALCIUM CITRATE	Documentary Standards Support	SM52020 Small Molecules 5

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