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Calcium Acetate Capsules

To view the Notice from the Expert Committee that posted in conjunction with this accelerated revision, please click www.uspnf.com/rb-calcium-acetate-caps-20230825.

DEFINITION
Calcium Acetate Capsules contain NLT 90.0% and NMT 110.0% of the labeled amount of calcium acetate ($C_4H_6CaO_4$).

IDENTIFICATION
- **A.** The retention time of the calcium peak of the *Sample solution* corresponds to that of the *Standard solution*, as obtained in the *Assay*.
- **B.** **Identification Tests—General** ⟨191⟩, *Chemical Identification Tests, Acetate*

Sample solution: 67 mg/mL of calcium acetate from Capsule contents

Acceptance criteria: Meet the requirements for test *B*

ASSAY
- **Procedure**

Solution A: 0.75 mM dipicolinic acid and 1.7 mM nitric acid in water. [Note—Warm water may be required to dissolve dipicolinic acid.]

Mobile phase: Acetone and *Solution A* (10:90). Pass through a suitable filter of 0.2-µm pore size.

Standard solution: 0.08 mg/mL of USP Calcium Acetate RS in water

Sample stock solution: Nominally 6.7 mg/mL of calcium acetate prepared as follows. Transfer an appropriate portion of the contents of NLT 20 Capsules to a suitable volumetric flask. Add water to about 40% of the final volume of the flask and sonicate for 20 min with intermittent shaking. Dilute with water to volume. Pass through a suitable filter of 0.45-µm pore size.

Sample solution: Nominally 0.08 mg/mL of calcium acetate in water from the *Sample stock solution*

Chromatographic system
(See *Chromatography* ⟨621⟩, *System Suitability*.)

Mode: Ion chromatography

Detector: Conductivity

Column: 4.0-mm × 15-cm; 5-µm packing L76

Column temperature: 35°

Flow rate: 0.9 mL/min

Injection volume: 10 µL

Run time: NLT 1.5 times the retention time of the calcium peak

System suitability

Sample: *Standard solution*

Suitability requirements

Column efficiency: NLT 1000 theoretical plates

Relative standard deviation: NMT 2.0%

Analysis

Samples: *Standard solution* and *Sample solution*

Calculate the percentage of the labeled amount of calcium acetate ($C_4H_6CaO_4$) in the portion of Capsules 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 Acetate RS in the *Standard solution* (mg/mL)

C_U = nominal concentration of calcium acetate in the *Sample solution* (mg/mL)

Acceptance criteria: 90.0%–110.0%

PERFORMANCE TESTS

Change to read:

- **Dissolution** ⟨711⟩

Test 1

Medium: Water; 900 mL

Apparatus 2: 50 rpm, with sinkers

Time: 10 min

Solution A, Mobile phase, Standard solution, Chromatographic system, and **System suitability:** Proceed as directed in the *Assay*.

Sample solution: Pass a portion of the solution under test through a suitable filter of 0.45-µm pore size. Dilute with *Medium* to a concentration similar to the *Standard solution*, if necessary.

Analysis

Samples: *Standard solution* and *Sample solution*

Calculate the percentage of the labeled amount of calcium acetate ($C_4H_6CaO_4$) dissolved:

$$\text{Result} = (r_U/r_S) \times C_S \times V \times D \times (1/L) \times 100$$

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 Acetate RS in the *Standard solution* (mg/mL)

V = volume of *Medium*, 900 mL

D = dilution factor of the *Sample solution*, if needed

L = label claim (mg/Capsule)

Tolerances: NLT 80% (Q) of the labeled amount of calcium acetate ($C_4H_6CaO_4$) is dissolved.

Test 2: If the product complies with this test, the labeling indicates that it meets USP *Dissolution Test 2*.

Medium: 0.1 N hydrochloric acid; 900 mL

Apparatus 1: 100 rpm

Time: 15 min

Blank: 0.2% (v/v) nitric acid

Standard solution A: 4.0 µg/mL of calcium[1] in the *Blank*

Standard solution B: 5.0 µg/mL of calcium[1] in the *Blank*

Standard solution C: 6.0 µg/mL of calcium[1] in the *Blank*

Standard solution D: 7.0 µg/mL of calcium[1] in the *Blank*

Standard solution E: 8.0 µg/mL of calcium[1] in the *Blank*

Sample solution: Pass a portion of the solution under test through a suitable filter of 1.0-µm pore size. Dilute with *Blank* to a concentration similar to *Standard solution C*, if necessary.

Instrumental conditions

(See *Atomic Absorption Spectroscopy* ⟨852⟩.)

Mode: Atomic absorption spectrometry

Analytical wavelength: 422.8 nm

Lamp: Calcium hollow-cathode

Flame: Air–acetylene oxidizing flame

System suitability

Samples: *Blank*, *Standard solution A*, *Standard solution B*, *Standard solution C*, *Standard solution D*, and *Standard solution E*

Suitability requirements

Correlation coefficient: NLT 0.995, from the linear regression in the *Analysis*

Drift: Within ±2%, *Standard solution D*. (See *Atomic Absorption Spectroscopy* ⟨852⟩, *Procedure, Analysis*.)

Analysis

Samples: *Blank*, *Standard solution A*, *Standard solution B*, *Standard solution C*, *Standard solution D*, *Standard solution E*, and *Sample solution*

Use the *Blank* to set the instrument to zero. Concomitantly determine the responses for *Standard solution A*, *Standard solution B*, *Standard solution C*, *Standard solution D*, and *Standard solution E*. Construct a linear calibration curve by plotting the absorbance values of *Standard solution A*, *Standard solution B*, *Standard solution C*, *Standard solution D*, and *Standard solution E* versus their corresponding concentrations, in µg/mL. From the linear calibration curve, determine the concentration (C), in µg/mL, for calcium in the *Sample solution*.

Calculate the percentage of the labeled amount of calcium acetate ($C_4H_6CaO_4$) dissolved:

$$\text{Result} = C \times V \times F \times D \times (M_{r1}/M_{r2}) \times (1/L) \times 100$$

C = concentration of calcium in the *Sample solution* (µg/mL)

V = volume of *Medium*, 900 mL

F = conversion factor, 0.001 mg/µg

D = dilution factor of the *Sample solution*, if needed

M_{r1} = molecular weight of calcium acetate, 158.17

M_{r2} = molecular weight of calcium, 40.08

L = label claim (mg/Capsule)

Tolerances: NLT 85% (Q) of the labeled amount of calcium acetate ($C_4H_6CaO_4$) is dissolved.

Test 3: If the product complies with this test, the labeling indicates that it meets USP *Dissolution Test 3*.

Tier 1

Medium 1: Water; 900 mL

Apparatus 2: 100 rpm, with sinkers

Time: 15 min

Tier 2

Medium 2: Simulated gastric fluid TS; 900 mL

Apparatus 2: 100 rpm, with sinkers

Time: 15 min

Determine the amount of calcium acetate dissolved using *Analytical procedure 1* or *Analytical procedure 2* for *Tier 1* and *Analytical procedure 3* for *Tier 2*.

Sample stock solution: Pass a portion of the solution under test through a suitable filter of 0.45-µm pore size.

Dissolution procedure: Perform the test using the conditions in *Tier 1*. In the presence of cross-linking, repeat the test with a new set of Capsules using the conditions in *Tier 2*.

Analytical procedure 1

Blank: 0.02 N nitric acid

Standard solution A: 2.4 µg/mL of USP Calcium Acetate RS in the *Blank*

Standard solution B: 3.2 µg/mL of USP Calcium Acetate RS in the *Blank*

Standard solution C: 4.0 µg/mL of USP Calcium Acetate RS in the *Blank*

Standard solution D: 4.8 µg/mL of USP Calcium Acetate RS in the *Blank*

Standard solution E: 5.6 µg/mL of USP Calcium Acetate RS in the *Blank*

Sample solution: Nominally 3.7 µg/mL of calcium acetate from *Sample stock solution*. Dilute with *Blank* if necessary.

Instrumental conditions

(See *Atomic Absorption Spectroscopy* ⟨852⟩.)

Mode: Atomic absorption spectrometry

Analytical wavelength: 422.8 nm

Lamp: Calcium hollow-cathode

Flame: Nitrous oxide–acetylene

Replicates: 4

System suitability

Samples: *Blank*, *Standard solution A*, *Standard solution B*, *Standard solution C*, *Standard solution D*, *Standard solution E*, and *Sample solution*

Suitability requirements

Relative standard deviation: NMT 3.0% in 4 replicate measurements, *Standard solution A*, *Standard solution B*, *Standard solution C*, *Standard solution D*, *Standard solution E*, and *Sample solution*

Correlation coefficient: NLT 0.995, from the linear regression in the *Analysis*

Drift: Within ±5%, the absorbance value of *Standard solution E*. (See *Atomic Absorption Spectroscopy* ⟨852⟩, *Procedure*, *Analysis*.)

Analysis

Samples: *Blank*, *Standard solution A*, *Standard solution B*, *Standard solution C*, *Standard solution D*, *Standard solution E*, and *Sample solution*

Use the *Blank* to set the instrument to zero. Concomitantly determine the responses for *Standard solution A*, *Standard solution B*, *Standard solution C*, *Standard solution D*, and *Standard solution E*. Construct a quadratic calibration curve by plotting the absorbance values of *Standard solution A*, *Standard solution B*, *Standard solution C*, *Standard solution D*, and *Standard solution E* versus their corresponding concentrations, in µg/mL. From the quadratic calibration curve, determine the concentration (C), in µg/mL, for calcium acetate in the *Sample solution*.

Calculate the percentage of the labeled amount of calcium acetate ($C_4H_6CaO_4$) dissolved:

$$\text{Result} = C \times V \times F \times D \times (1/L) \times 100$$

C = concentration of calcium acetate in the *Sample solution* (µg/mL)

V = volume of *Medium 1*, 900 mL

F = conversion factor, 0.001 mg/µg

D = dilution factor of the *Sample solution*, if needed

L = label claim (mg/Capsule)

Analytical procedure 2

Titrimetric system

(See *Titrimetry ⟨541⟩*.)

Mode: Complexometric titration

Titrant: 0.005 M edetic acid (EDTA)

Endpoint detection: Photometric at 610 nm

Analysis: To an aliquot of the *Sample stock solution* equivalent to about 7.4 mg of calcium acetate, add 60 mL of 0.1 N sodium hydroxide and 0.2 g of hydroxy naphthol blue indicator. Titrate with *Titrant*, determining the endpoint photometrically using a suitable autotitrator.

Calculate the percentage of the labeled amount of calcium acetate ($C_4H_6CaO_4$) dissolved:

$$\text{Result} = V_S \times M \times F \times (V_M/V_A) \times (1/L) \times 100$$

V_S = volume of *Titrant* consumed by the aliquot of *Sample stock solution* (mL)

M = actual molarity of the *Titrant* (mmol/mL)

F = equivalency factor of calcium acetate, 158.17 mg/mmol

V_M = volume of *Medium 1*, 900 mL

V_A = volume of the aliquot taken (mL)

L = label claim (mg/Capsule)

Analytical procedure 3

Blank: *Medium 2*

Titrimetric system

(See *Titrimetry ⟨541⟩*.)

Mode: Complexometric titration

Titrant: 0.005 M edetic acid (EDTA)

Endpoint detection: Visual

Analysis: To an aliquot of the *Sample stock solution* equivalent to about 7.4 mg of calcium acetate, add 50 mL of water, 10 mL of 0.1 N sodium hydroxide, and 0.2 g of hydroxynaphthol blue indicator. Titrate with *Titrant* to a blue endpoint while stirring using a magnetic stirring bar. Perform a *Blank* determination in the same manner.

Calculate the percentage of the labeled amount of calcium acetate ($C_4H_6CaO_4$) dissolved:

$$\text{Result} = (V_S - V_B) \times M \times F \times (V_M/V_A) \times (1/L) \times 100$$

V_S = volume of *Titrant* consumed by the aliquot of *Sample stock solution* (mL)

V_B = volume of *Titrant* consumed by the *Blank* (mL)

M = actual molarity of the *Titrant* (mmol/mL)

F = equivalency factor of calcium acetate, 158.17 mg/mmol

V_M = volume of *Medium 2*, 900 mL

V_A = volume of the aliquot taken (mL)

L = label claim (mg/Capsule)

Tolerances: NLT 85% (Q) of the labeled amount of calcium acetate ($C_4H_6CaO_4$) is dissolved.

Test 4: If the product complies with this test, the labeling indicates that it meets USP *Dissolution Test 4*.

Medium: Water; 900 mL, deaerated

Apparatus 2: 50 rpm, with appropriate sinkers, if necessary

Time: 20 min

Solution A: 0.7% (v/v) phosphoric acid in water

Mobile phase: Methanol and *Solution A* (5:95)

Standard solution: 0.74 mg/mL of USP Calcium Acetate RS in *Medium*

Sample solution: Pass a portion of the solution under test through a suitable filter of 0.45-µm pore size.

Chromatographic system

(See *Chromatography ⟨621⟩, System Suitability*.)

Mode: LC

Detector: UV 202 nm

Column: 4.6-mm × 25-cm; 5-µm packing L1

Flow rate: 1 mL/min

Injection volume: 10 µL

Run time: NLT 2 times the retention time of the acetate peak

System suitability

Sample: *Standard solution*

Suitability requirements

Tailing factor: NMT 2.0

Relative standard deviation: NMT 2.0%

Analysis

Samples: *Standard solution* and *Sample solution*

Calculate the percentage of the labeled amount of calcium acetate ($C_4H_6CaO_4$) dissolved:

$$\text{Result} = (r_U/r_S) \times C_S \times V \times (1/L) \times 100$$

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

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

C_S = concentration of USP Calcium Acetate RS in the *Standard solution* (mg/mL)

V = volume of *Medium*, 900 mL

L = label claim (mg/Capsule)

Tolerances: NLT 85% (Q) of the labeled amount of calcium acetate ($C_4H_6CaO_4$) is dissolved.

▲**Test 5:** If the product complies with this test, the labeling indicates that it meets USP *Dissolution Test 5*.

Medium: 0.1 N hydrochloric acid; 500 mL

Apparatus 2: 50 rpm, with suitable sinkers if necessary

Time: 30 min

Solution A: 0.7 mL/L of phosphoric acid in water

Mobile phase: Methanol and *Solution A* (5:95)

Standard solution: 0.74 mg/mL of USP Calcium Acetate RS in *Medium*

Sample solution: Dilute a portion of the solution under test with *Medium* to a concentration similar to that of the *Standard solution*. Pass through a suitable filter of 0.45-µm pore size, discarding the first 3 mL of the filtrate.

Chromatographic system

(See *Chromatography ⟨621⟩, System Suitability*.)

Mode: LC

Detector: UV 202 nm

Column: 4.6-mm × 25-cm; 5-µm packing L1

Flow rate: 1 mL/min

Injection volume: 10 µL

Run time: NLT 2 times the retention time of acetate

System suitability

Sample: *Standard solution*

Suitability requirements

Tailing factor: NMT 2.0

Relative standard deviation: NMT 2.0%

Analysis

Samples: *Standard solution* and *Sample solution*

Calculate the percentage of the labeled amount of calcium acetate ($C_4H_6CaO_4$) dissolved:

$$\text{Result} = (r_U/r_S) \times C_S \times V \times D \times (1/L) \times 100$$

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

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

C_S = concentration of USP Calcium Acetate RS in the *Standard solution* (mg/mL)

V = volume of *Medium*, 500 mL

D = dilution factor of the *Sample solution*

L = label claim (mg/Capsule)

Tolerances: NLT 80% (*Q*) of the labeled amount of calcium acetate ($C_4H_6CaO_4$) is dissolved.▲ (RB 1-Sep-2023)

• **Uniformity of Dosage Units ⟨905⟩:** Meet the requirements

ADDITIONAL REQUIREMENTS

• **Packaging and Storage:** Preserve in well-closed containers and store at controlled room temperature.

• **Labeling:** When more than one *Dissolution* test is given, the labeling states the *Dissolution* test used only if *Test 1* is not used.

• **USP Reference Standards ⟨11⟩**
USP Calcium Acetate RS

[1] From commercially available, National Institute of Standards and Technology (NIST)-traceable standard solution for calcium.

Auxiliary Information - Please check for your question in the FAQs before contacting USP.

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

Chromatographic Database Information: Chromatographic Database

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