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Multiple Electrolytes and Dextrose Injection Type 2

DEFINITION

Multiple Electrolytes and Dextrose Injection Type 2 is a sterile solution of Dextrose and suitable salts in Water for Injection to provide sodium, potassium, magnesium, calcium, and chloride ions. In addition, the salts provide ions of acetate, or acetate and citrate, or acetate and lactate, or gluconate and sulfate. It contains NLT 90.0% and NMT 110.0% of the labeled amounts of sodium (Na), potassium (K), magnesium (Mg), calcium (Ca), acetate ($C_2H_3O_2$), citrate ($C_6H_5O_7$), lactate ($C_3H_5O_3$), gluconate ($C_6H_{11}O_7$), and sulfate (SO_4); NLT 90.0% and NMT 120.0% of the labeled amount of chloride (Cl); and NLT 90.0% and NMT 105.0% of the labeled amount of dextrose ($C_6H_{12}O_6 \cdot H_2O$). It may contain Hydrochloric Acid or Sodium Hydroxide used to adjust the pH. It contains no antimicrobial agents.

IDENTIFICATION

• A.

Sample solution: Nominally 50 mg/mL of dextrose from a suitable volume of Injection

Analysis: Add a few drops of the *Sample solution* to 5 mL of hot alkaline cupric tartrate TS.

Acceptance criteria: A copious red precipitate of cuprous oxide is formed.

• B. [IDENTIFICATION TESTS—GENERAL \(191\)](#), [Magnesium](#) and [Chloride](#) : Meets the requirements

• C. **SODIUM:** The sample imparts an intense yellow color to a nonluminous flame.

• **D. POTASSIUM:** The sample imparts a violet color to a nonluminous flame. Because the presence of small quantities of sodium masks the color, screen out the yellow color produced by sodium by viewing through a blue filter that blocks the emission at 589 nm (sodium), but is transparent to emission at 404 nm (potassium). [NOTE—Traditionally, cobalt glass has been used, but other suitable filters are commercially available.]

• E. [IDENTIFICATION TESTS—GENERAL \(191\)](#), [Calcium](#): Meets the requirements of test A

• **F.** Where acetate is purported to be present, the retention time of the acetate peak of the *Sample solution* corresponds to that of the *Standard solution*, as obtained in the Assay for Acetate.

• **G.** Where citrate is purported to be present, the retention time of the citrate peak of the *Sample solution* corresponds to that of the *Standard solution*, as obtained in the Assay for Citrate.

• **H.** Where lactate is purported to be present, the retention time of the lactate peak of the *Sample solution* corresponds to that of the *Standard solution*, as obtained in the Assay for Lactate.

• **I.** Where gluconate is purported to be present, the retention time of the gluconate peak of the *Sample solution* corresponds to that of the *Standard solution*, as obtained in the Assay for Gluconate.

• J. [IDENTIFICATION TESTS—GENERAL \(191\)](#), [Sulfate](#): Where sulfate is purported to be present, it meets the requirements of test A.

ASSAY

• **ACETATE** (if present)

Mobile phase: 0.05 N sulfuric acid

Standard solution: 1.2 mg/mL of sodium acetate trihydrate (0.0088 mEq/mL of acetate) in water

Sample solution: Nominally 0.0088 mEq/mL of acetate from a volume of Injection in water

Chromatographic system

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

Mode: LC

Detector: UV 210 nm

Columns

Guard: 4.6-mm × 3-cm; packing L17

Analytical: 7.8-mm × 30-cm; packing L17

Column temperature: 60°

Flow rate: 0.8 mL/min

Injection volume: 20 µL

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 acetate ($C_2H_3O_2$) in the portion of Injection taken:

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

 r_U = peak response of acetate from the *Sample solution* r_S = peak response of acetate from the *Standard solution* C_S = concentration of acetate in the *Standard solution* (mEq/mL) C_U = nominal concentration of acetate in the *Sample solution* (mEq/mL)**Acceptance criteria:** 90.0%–110.0%**• CALCIUM**[NOTE—Concentrations of the *Standard solutions* and the *Sample solution* may be modified to fit the linear or working range of the atomic absorption spectrophotometer.]**Solution A:** 88.45 g/L of lanthanum chloride prepared as follows. Transfer a suitable quantity of lanthanum chloride to an appropriate volumetric flask. Add 50% of the final flask volume of water. Carefully add 25% of the final flask volume of hydrochloric acid. Mix, and allow to cool. Dilute with water to volume.**Solution B:** Mix 678 mL of hydrochloric acid with water to make 3000 mL.**Standard stock solution:** 1000 µg/mL of calcium prepared as follows. Transfer 499.5 mg of primary standard calcium carbonate to a 200-mL volumetric flask, and add 10 mL of water. Carefully add 5 mL of *Solution B*, and swirl to dissolve the calcium carbonate. Dilute with water to volume.**Standard solutions:** 10.0, 15.0, and 20.0 µg/mL of calcium prepared as follows. To three separate 100-mL volumetric flasks, each containing 5.0 mL of *Solution A*, add 1.0, 1.5, and 2.0 mL, respectively, of *Standard stock solution*. Dilute the contents of each flask with *Solution B* to volume.**Sample solution:** Transfer a volume of Injection, equivalent to 20 mg of calcium, to a 1000-mL volumetric flask containing 50.0 mL of *Solution A*. Dilute with *Solution B* to volume.**Blank:** 5.0 mL of *Solution A* diluted with *Solution B* to 100.0 mL**Instrumental conditions**(See [Atomic Absorption Spectroscopy \(852\)](#).)**Mode:** Atomic absorption spectrophotometry**Analytical wavelength:** Calcium emission line at 422.7 nm**Lamp:** Calcium hollow-cathode**Flame:** Air–acetylene**Analysis****Samples:** *Standard solutions, Sample solution, and Blank*Plot the absorbances of the *Standard solutions* versus the concentration, in µg/mL, of calcium, and draw the straight line best fitting the three plotted points. From the graph so obtained, determine the concentration (C), in µg/mL, of calcium in the *Sample solution*.

Calculate the percentage of the labeled amount of calcium (Ca) in the portion of Injection taken:

$$\text{Result} = (C/C_U) \times 100$$

 C = concentration of calcium in the *Sample solution* (µg/mL), interpolated from the graph obtained C_U = nominal concentration of calcium in the *Sample solution* (µg/mL)**Acceptance criteria:** 90.0%–110.0%**• CHLORIDE****Sample solution:** Transfer a volume of Injection, equivalent to 55 mg of chloride (1.55 mEq), to a suitable conical flask, and add water, if necessary, to bring the volume to 10 mL. Add 10 mL of glacial acetic acid, 75 mL of methanol, and 0.5 mL of eosin Y TS.**Titrimetric system**

Mode: Direct titration**Titrant:** 0.1 N silver nitrate VS**Endpoint detection:** Visual**Analysis****Sample:** *Sample solution*Titrate, with shaking, with *Titrant* to a pink endpoint.

Calculate the percentage of the labeled amount of chloride (Cl) in the portion of Injection taken:

$$\text{Result} = V \times N \times (F/W) \times 100$$

 V = Titrant volume consumed by the *Sample solution* (mL) N = actual normality of the *Titrant* (mEq/mL) F = equivalency factor, 35.45 mg/mEq W = nominal amount of chloride in the *Sample solution* (mg)**Acceptance criteria:** 90.0%–120.0%• **DEXTROSE****Sample solution:** Transfer a volume of Injection containing 2–5 g of dextrose to a 100-mL volumetric flask. Add 0.2 mL of 6 N ammonium hydroxide, and dilute with water to volume.**Analysis****Sample:** *Sample solution*Determine the angular rotation in a polarimeter tube (see [Optical Rotation \(781\)](#).)Calculate the percentage of the labeled amount of dextrose ($\text{C}_6\text{H}_{12}\text{O}_6 \cdot \text{H}_2\text{O}$) in the portion of Injection taken:

$$\text{Result} = [(100 \times a)/(l \times \alpha)] \times (1/C_U) \times (M_{r1}/M_{r2}) \times 100$$

 a = observed angular rotation of the *Sample solution* (°) l = length of the polarimeter tube (dm) α = midpoint of the specific rotation range for anhydrous dextrose, 52.9° C_U = nominal concentration of dextrose in the *Sample solution* (g/100 mL) M_{r1} = molecular weight of dextrose monohydrate, 198.17 M_{r2} = molecular weight of anhydrous dextrose, 180.16**Acceptance criteria:** 90.0%–105.0%• **CITRATE** (if present)**Mobile phase and Chromatographic system:** Proceed as directed in the [Assay for Citric Acid/Citrate and Phosphate \(345\)](#).**Standard solution:** 0.3 mEq/L of citrate ($\text{C}_6\text{H}_5\text{O}_7$) from [USP Citric Acid RS](#) in freshly prepared 1 mM sodium hydroxide**Sample solution:** Nominally 0.3 mEq/L of citrate in 1 mM sodium hydroxide from a volume of Injection diluted with freshly prepared sodium hydroxide**Analysis****Samples:** *Standard solution* and *Sample solution*Proceed as directed in [\(345\)](#).Calculate the percentage of the labeled amount of citrate ($\text{C}_6\text{H}_5\text{O}_7$) in the portion of Injection taken:

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

 r_U = peak response of citrate from the *Sample solution* r_S = peak response of citrate from the *Standard solution* C_S = concentration of citrate in the *Standard solution* (mEq/L) C_U = nominal concentration of citrate in the *Sample solution* (mEq/L)

Acceptance criteria: 90.0%–110.0%

• **GLUCONATE** (if present)

Mobile phase: Dissolve 7.0 g of calcium acetate in 1900 mL of water, and adjust with glacial acetic acid to a pH of 4.5 ± 0.1 . Dilute with water to 2000 mL, mix, pass through a filter of 0.5- μ m pore size or finer, and degas. Maintain the *Mobile phase* at $70 \pm 2^\circ$ at all times.

System suitability solution: 5 mg/mL each of [USP Sodium Lactate RS](#) and [USP Potassium Gluconate RS](#) in water

Standard solution: 4.6 mg/mL of [USP Potassium Gluconate RS](#) (0.02 mEq/mL of gluconate) in water

Sample solution: Nominally 0.023 mEq/mL of gluconate from a volume of Injection in water

Chromatographic system

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

Mode: LC

Detector: Refractive index

Column: 7.8-mm $\times$ 30-cm; packing L19 in the calcium form. Condition the column with *Mobile phase* for 60 min.

Column temperature: $70 \pm 2^\circ$

Flow rate: 1 mL/min

Injection volume: 50 μ L

System suitability

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

Suitability requirements

Resolution: NLT 4.0 between lactate and gluconate, *System suitability solution*

Relative standard deviation: NMT 2.0%, *Standard solution*

Analysis

Samples: *Standard solution* and *Sample solution*

Calculate the percentage of the labeled amount of gluconate ($C_6H_{11}O_7$) in the portion of Injection taken:

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

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

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

C_S = concentration of gluconate in the *Standard solution* (mEq/mL)

C_U = nominal concentration of gluconate in the *Sample solution* (mEq/mL)

Acceptance criteria: 90.0%–110.0%

• **LACTATE** (if present)

Mobile phase: Formic acid, dicyclohexylamine, and water (1:1:998)

System suitability solution: 3 mg/mL each of anhydrous sodium acetate and [USP Sodium Lactate RS](#) in water

Standard solution: 2 mg/mL of [USP Sodium Lactate RS](#) (0.018 mEq/mL of lactate) in water

Sample solution

For Injections containing >20 mEq/L of lactate: Nominally 0.02 mEq/mL of lactate from Injection in water

For Injections containing $\leq$ 20 mEq/L of lactate: Use the undiluted Injection.

Chromatographic system

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

Mode: LC

Detector: UV 210 nm

Column: 4.6-mm $\times$ 10-cm; packing L1

Flow rate: 1 mL/min

Injection volume: 20 μ L

System suitability

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

Suitability requirements

Resolution: NLT 2 between acetate and lactate, *System suitability solution*

Tailing factor: NMT 2.0, *Standard solution*

Relative standard deviation: NMT 2.0%, *Standard solution*

Analysis

Samples: *Standard solution* and *Sample solution*

Calculate the percentage of the labeled amount of lactate ($C_3H_5O_3$) in the portion of Injection taken:

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

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

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

C_S = concentration of lactate in the *Standard solution* (mEq/mL)

C_U = nominal concentration of lactate in the *Sample solution* (mEq/mL)

Acceptance criteria: 90.0%–110.0%

• MAGNESIUM

[NOTE—Concentrations of the *Standard solutions* and the *Sample solution* may be modified to fit the linear or working range of the atomic absorption spectrophotometer.]

Solution A: 88.45 g/L of lanthanum chloride prepared as follows. Transfer a suitable quantity of lanthanum chloride to an appropriate volumetric flask. Add 50% of the final flask volume of water. Carefully add 25% of the final flask volume of hydrochloric acid. Mix, and allow to cool. Dilute with water to volume.

Solution B: Mix 678 mL of hydrochloric acid with water to make 3000 mL.

Standard stock solution A: 1.00 mg/mL of magnesium (Mg) prepared as follows. Transfer 1.00 g of magnesium metal to a 1000-mL volumetric flask containing 10 mL of water. Slowly add 10 mL of hydrochloric acid, and swirl to dissolve the metal. Dilute with *Solution B* to volume.

Standard stock solution B: 100 µg/mL of magnesium (Mg) prepared as follows. Transfer 10.0 mL of *Standard stock solution A* to a 100-mL volumetric flask, and dilute with *Solution B* to volume.

Standard solutions: 10.0, 15.0, and 20.0 µg/mL of magnesium (Mg) prepared as follows. To three separate 100-mL volumetric flasks, each containing 5.0 mL of *Solution A*, add 10.0, 15.0, and 20.0 mL, respectively, of *Standard stock solution B*. Dilute the contents of each flask with *Solution B* to volume.

Sample solution: Transfer a volume of Injection, equivalent to 20 mg of magnesium (Mg) to a 1000-mL volumetric flask containing 50.0 mL of *Solution A*. Dilute with *Solution B* to volume.

Blank: 5.0 mL of *Solution A* diluted with *Solution B* to 100.0 mL

Instrumental conditions

(See [Atomic Absorption Spectroscopy \(852\)](#).)

Mode: Atomic absorption spectrophotometry

Analytical wavelength: Magnesium emission line at 285.2 nm

Lamp: Magnesium hollow-cathode

Flame: Air–acetylene

Analysis

Samples: *Standard solutions*, *Sample solution*, and *Blank*

Plot the absorbances of the *Standard solutions* versus the concentration, in µg/mL, of magnesium (Mg), and draw the straight line best fitting the three plotted points. From the graph so obtained, determine the concentration (C) in µg/mL, of magnesium (Mg) in the *Sample solution*.

Calculate the percentage of the labeled amount of magnesium (Mg) in each portion of Injection taken:

$$\text{Result} = (C/C_U) \times 100$$

C = concentration of magnesium (Mg) in the *Sample solution* (µg/mL), interpolated from the graph obtained

C_U = nominal concentration of magnesium (Mg) in the *Sample solution* (µg/mL)

Acceptance criteria: 90.0%–110.0%

• POTASSIUM AND SODIUM

Internal standard solution: 1.04 mg/mL of lithium nitrate prepared as follows. Transfer 1.04 g of lithium nitrate to a 1000-mL volumetric flask. Add a suitable nonionic surfactant, and then dilute with water to volume.

Potassium stock solution: 74.56 mg/mL of potassium chloride (1 mEq/mL of potassium) prepared as follows. Transfer 18.64 g of potassium chloride, previously dried at 105° for 2 h, to a 250-mL volumetric flask, and dilute with water to volume.

Sodium stock solution: 58.44 mg/mL of sodium chloride (1 mEq/mL of sodium) prepared as follows. Transfer 14.61 g of sodium chloride, previously dried at 105° for 2 h, to a 250-mL volumetric flask, and dilute with water to volume.

Standard stock solution: 0.0391J mg/mL of potassium (K) from *Potassium stock solution* and 0.02299J' mg/mL of sodium (Na) from *Sodium stock solution* prepared as follows. Transfer 0.1J mL of *Potassium stock solution* and 0.1J' mL of *Sodium stock solution* to a 100-mL volumetric flask, where J and J' are the labeled amounts, in mEq/L, of potassium and sodium, respectively, in the Injection. Dilute with water to volume.

Standard solution: Dilute 5.0 mL of *Standard stock solution* with *Internal standard solution* to 500.0 mL.

Sample solution: Dilute 5.0 mL of Injection with *Internal standard solution* to 500.0 mL.

Instrumental conditions

Mode: Flame photometer

Analytical wavelengths

Potassium: Maximum at 766 nm

Sodium: Maximum at 589 nm

Lithium: Maximum at 671 nm

Blank: *Internal standard solution*

Analysis

Samples: *Standard solution*, *Sample solution*, and *Blank*

Use the *Blank* to zero the instrument. Concomitantly determine the flame emission readings for the *Standard solution* and *Sample solution*.

Calculate the percentage of the labeled amount of potassium (K) in the portion of Injection taken:

$$\text{Result} = (R_U/R_S) \times (C_S/C_U) \times 100$$

R_U = emission reading ratio of potassium to lithium from the *Sample solution*

R_S = emission reading ratio of potassium to lithium from the *Standard solution*

C_S = concentration of potassium (K) in the *Standard solution* (mg/mL)

C_U = nominal concentration of potassium (K) in the *Sample solution* (mg/mL)

[NOTE—Each mg of potassium (K) is equivalent to 0.02558 mEq of potassium (K).]

Calculate the percentage of the labeled amount of sodium (Na) in the portion of Injection taken:

$$\text{Result} = (R_U/R_S) \times (C_S/C_U) \times 100$$

R_U = emission reading ratio of sodium to lithium from the *Sample solution*

R_S = emission reading ratio of sodium to lithium from the *Standard solution*

C_S = concentration of sodium (Na) in the *Standard solution* (mg/mL)

C_U = nominal concentration of sodium (Na) in the *Sample solution* (mg/mL)

[NOTE—Each mg of sodium (Na) is equivalent to 0.04350 mEq of sodium (Na).]

Acceptance criteria

Potassium: 90.0%–110.0%

Sodium: 90.0%–110.0%

• SULFATE (if present)

Sample solution: Equivalent to 120 mg (1.25 mEq) of sulfate, from a volume of Injection. Dilute, if necessary, to 200 mL, and add 1 mL of hydrochloric acid.

Analysis

Sample: *Sample solution*

Heat the *Sample solution* to boiling, and gradually add, in small portions and while constantly stirring, an excess of hot barium chloride TS (about 8 mL). Heat the mixture on a steam bath for 1 h, collect the precipitate of barium sulfate on a tared filtering crucible, wash until free from chloride, dry, ignite, and weigh.

Calculate the percentage of the labeled amount of sulfate (SO_4) in the portion of Injection taken:

$$\text{Result} = \{[W \times (M_{r1}/M_{r2}) \times (1/M_{r1})]/(L \times V)\} \times 100$$

W = weight of barium sulfate after ignition (mg)

M_{r1} = molecular weight of sulfate, 96.06

M_{r2} = molecular weight of barium sulfate, 233.43

L = label claim of sulfate in the Injection (mEq/mL)

V = volume of Injection in the *Sample solution* (mL)

Acceptance criteria: 90.0%–110.0%

SPECIFIC TESTS

- **BACTERIAL ENDOTOXINS TEST** (85): It contains NMT 0.5 USP Endotoxin Units/mL.
- **pH** (791): 4.0–6.5
- **OTHER REQUIREMENTS:** It meets the requirements in [Injections and Implanted Drug Products](#) (1).

ADDITIONAL REQUIREMENTS

- **PACKAGING AND STORAGE:** Preserve in single-dose glass or plastic containers. Glass containers are preferably of Type I or Type II glass.
- **LABELING:** The label states the content of each electrolyte in terms of milliequivalents (mEq) in a given volume. The label states the total osmolar concentration in mOsmol/L. When the contents are less than 100 mL, the label alternatively may state the total osmolar concentration in mOsmol/mL.
- **USP REFERENCE STANDARDS** (11).
[USP Citric Acid RS](#)
[USP Potassium Gluconate RS](#)
[USP Sodium Lactate RS](#)

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

Topic/Question	Contact	Expert Committee
MULTIPLE ELECTROLYTES AND DEXTROSE INJECTION TYPE 2	Documentary Standards Support	SM52020 Small Molecules 5

Chromatographic Database Information: [Chromatographic Database](#)

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