SODIUM FLUORIDE (\textsuperscript{18}F) INJECTION

**DESCRIPTION**

Sodium fluoride (\textsuperscript{18}F) injection is a radiopharmaceutical preparation intended for intravenous administration. It contains fluorine-18 in the form of sodium fluoride, with a specific radioactivity of at least 370 MBq/mg of sodium fluoride. It is used in the treatment of certain medical conditions, particularly in nuclear medicine procedures such as bone scans and heart scans.

**CHARACTERS**

A clear, colourless or slightly yellow solution.

**IDENTIFICATION**

A. Record the gamma-ray spectrum using a suitable instrument. The spectrum does not differ significantly from that of a standardised chromium-51 solution.

B. Examine the chromatogram obtained in the test for radiochemical purity. The distribution of radioactivity contributes to the identification of the preparation.

**TESTS**

**PH (2.2.3)**

The pH of the solution is 6.0 to 8.5.

**Total Chromate**

Not more than 2.7 µg of chromate ion (CrO\textsubscript{4}\textsuperscript{2-}) per megabequerel. Measure the absorbance of the solution (2.2.25) at the absorption maximum at 370 nm. Calculate the content of chromate using the absorbance of a standard consisting of 1.7 mg/l solution of potassium chromate R. If necessary, adjust the solution to be examined and the standard to pH 8.0 by adding sodium hydrogen carbonate solution R.

**Sterility**

It complies with the test for sterility described in the monograph on Radiopharmaceutical preparations (0125). The solution may be released for use before completion of the test.

**Radiochemical Purity**

Record the gamma-ray spectrum using a suitable instrument. The spectrum does not differ significantly from that of a standardised chromium-51 solution.

**Radiochemical Purity**

Examine by ascending paper chromatography (2.2.26). Apply to the paper a quantity of the solution sufficient for the detection method. Begin the development immediately and develop for 2.5 h using a mixture of 50 volumes of ammonia R, 50 volumes of alcohol R and 125 volumes of water R. Chromic ions remain on the starting line. Determine the distribution of the radioactivity using a suitable detector. Not less than 90 per cent of the total radioactivity of the chromatogram is found in the spot with an R\textsubscript{f} value of about 0.9, corresponding to sodium chromate.

**Radioactivity**

Measure the radioactivity using suitable counting equipment by comparison with a standardised chromium-51 solution or by measurement in an instrument calibrated with the aid of such a solution.

**Content:**

- fluorine-18: 90 per cent to 110 per cent of the declared fluorine-18 radioactivity at the date and hour stated on the label,
- fluoride: maximum 4.52 mg per maximum recommended dose in millilitres.

**Production**

The radionuclide fluorine-18 is most commonly produced by proton irradiation of water enriched in oxygen-18. Fluorine-18 in the form of fluoride is recovered from the target water, generally by adsorption and desorption from anion-exchange resins or electrochemical deposition and redissolution.

**Characters**

Appearance: clear, colourless solution.

Half-life and nature of radiation of fluorine-18: see Table of physical characteristics of radionuclides (5.7).

**Identification**

A. Gamma-ray spectrometry.

**Results:** the only gamma photons have an energy of 0.511 MeV and, depending on the measurement geometry, a sum peak of 1.022 MeV may be observed.

B. It complies with test B for radionuclidic purity (see Tests).

C. Examine the chromatograms obtained in the test for radiochemical purity (see Tests).

**Results:** the principal peak in the radiochromatogram obtained with the test solution is similar in retention time to the principal peak in the chromatogram obtained with the reference solution. In the chromatogram obtained with the reference solution, the peak due to fluoride is negative.

**Tests**

**PH (2.2.3):** 5.0 to 8.5.

**Fluoride**

Liquid chromatography (2.2.29). Test solution. The preparation to be examined.

**Reference Solution.** Dissolve 10 mg of sodium fluoride R in water R and dilute to V with the same solvent, V being the maximum recommended dose in millilitres.

**Column:**

- size: l = 0.25 m, Ø = 4 mm,
- stationary phase: strongly basic anion-exchange resin for chromatography R (10 µm),
- temperature: constant, between 20 °C and 30 °C.

**Mobile Phase:** 4 g/l solution of sodium hydroxide R, protected from atmospheric carbon dioxide.

**Flow Rate:** 1 ml/min.

**Detection:** spectrophotometer at 220 nm and a radioactivity detector connected in series.

**Injection:** 20 µl.

**Run Time:** 15 min.

**System Suitability:** examine the chromatogram obtained with the reference solution using the spectrophotometer:

- signal-to-noise ratio: minimum 10 for the principal peak,
- retention time of fluoride: minimum 3 times the hold-up time.

**Limit:** examine the chromatogram obtained with the spectrophotometer:

- fluoride: not more than the area of the corresponding peak in the chromatogram obtained with the reference solution (4.52 mg/l).

**General Notices (1) apply to all monographs and other texts**

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Sterility. It complies with the test for sterility prescribed in the monograph on Radiopharmaceutical preparations (0125). The injection may be released for use before completion of the test.

Bacterial endotoxins (2.6.14): less than 175 V IU/ml, V being the maximum recommended dose in millilitres. The injection may be released for use before completion of the test.

RADIOCHEMICAL PURITY

Fluorine-18: minimum 99.9 per cent of the total radioactivity.

The preparation may be released for use before completion of the tests.

A. Gamma-ray spectrometry.

Determine the amount of fluorine-18 and radionuclidian impurities with a half-life longer than 2 h. For the detection and quantification of impurities, retain the preparation to be examined for a sufficient time to allow the fluorine-18 to decay to a level which permits the detection of impurities.

Results: the spectrum obtained with the preparation to be examined does not differ significantly from that of a background spectrum.

B. Half-life: 105 min to 115 min.

RADIOCHEMICAL PURITY

\(^{18}\text{F}\)fluoride. Liquid chromatography (2.2.29) as described in the test for fluoride. If necessary, dilute the test solution with water R to obtain a radioactivity concentration suitable for the radioactivity detector.

Limit: examine the chromatogram obtained with the radioactivity detector:

- \(^{18}\text{F}\)fluoride: minimum 98.5 per cent of the total radioactivity.

RADIOACTIVITY

Determine the radioactivity using a calibrated instrument.

LABELLING

The label states the maximum recommended dose in millilitres.

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SODIUM IODIDE (\(^{123}\text{I}\)) INJECTION

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DEFINITION

Sterile solution containing iodine-123 in the form of sodium iodide; it may contain sodium thiosulphate or some other suitable reducing agent and a suitable buffer.

Content: 90 per cent to 110 per cent of the declared iodine-123 radioactivity at the date and hour stated on the label.

PRODUCTION

Iodine-123 is obtained by proton irradiation of xenon enriched in xenon-123 (minimum 98 per cent) followed by the decay of xenon-123 which is formed directly and by the decay of caesium-123. No carrier iodide is added.

CHARACTERS

Appearance: clear, colourless solution.

Half-life and nature of radiation of iodine-123: see Table of physical characteristics of radionuclides (5.7).

IDENTIFICATION

A. Gamma-ray spectrometry.

Results: the spectrum obtained with the preparation to be examined does not differ significantly from that of a standardised iodine-123 solution. The most prominent gamma photon has an energy of 0.159 MeV and is accompanied by the principal X-ray of 0.027 MeV.

B. Examine the chromatograms obtained in the test for radiochemical purity.

Results: the principal peak in the radiochromatogram obtained with the test solution is similar in retention time to the principal peak in the chromatogram obtained with reference solution (a).

TESTS

pH (2.2.3): 7.0 to 10.0.

Sterility. It complies with the test for sterility prescribed in the monograph on Radiopharmaceutical preparations (0125). The preparation may be released for use before completion of the test.

RADIOCHEMICAL PURITY

Iodine-123: minimum 99.65 per cent of the total radioactivity.

Gamma-ray spectrometry.

Determine the relative amounts of iodine-123, iodine-125, tellurium-121 and other radionuclidian impurities present. For the detection of tellurium-121 and iodine-125, retain the preparation to be examined for a sufficient time to allow iodine-123 to decay to a level which permits the detection of radionuclidian impurities. No radionuclides with a half-life longer than that of iodine-123 are detected.

The preparation may be released for use before completion of the test.

RADIOCHEMICAL PURITY

\(^{123}\text{I}\)iodide. Liquid chromatography (2.2.29).

Test solution. Dilute the preparation to be examined with a 2 g/l solution of sodium hydroxide R to a radioactive concentration suitable for the detector. Add an equal volume of a solution containing 1 g/l of potassium iodide R, 2 g/l of potassium iodate R and 10 g/l of sodium hydrogen carbonate R and mix.

Reference solution (a). Dilute 1 ml of a 26.2 mg/l solution of potassium iodate R to 10 ml with water R.

Reference solution (b). Dilute 1 ml of a 24.5 mg/l solution of potassium iodate R to 10 ml with water R. Mix equal volumes of this solution and reference solution (a).

Column:

- size: l = 0.25 m, Ø = 4.0 mm,
- stationary phase: octadecylsilyl silica gel for chromatography R (5 µm),
- temperature: constant between 20 °C and 30 °C.

Mobile phase: dissolve 5.85 g of sodium chloride R in 1000 ml of water R, add 0.65 ml of octylamine R and adjust to pH 7.0 with dilute phosphoric acid R; add 50 ml of acetonitrile R and mix.

Flow rate: 1.5 ml/min.

Detection: spectrophotometer at 220 nm and a radioactivity detector connected in series.

Injection: 20 µl.

Run time: 12 min.

Relative retention with reference to iodide (retention time = about 5 min): iodate = 0.2 to 0.3.