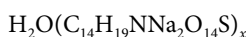
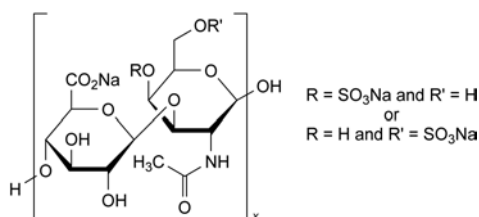


- B. 1-(2-chlorobenzoyl)-3-[(4-trifluoromethoxy)phenyl]urea (triflumuron).

01/2009:2064

CHONDROITIN SULFATE SODIUM

Chondroitini natrii sulfas



DEFINITION

Natural copolymer based mainly on the 2 disaccharides: [4]-(β -D-glucopyranosyluronic acid)-(1 \rightarrow 3)-[2-(acetyl-amino)-2-deoxy- β -D-galactopyranosyl 4-sulfate]-(1 \rightarrow) and [4]-(β -D-glucopyranosyluronic acid)-(1 \rightarrow 3)-[2-(acetyl-amino)-2-deoxy- β -D-galactopyranosyl 6-sulfate]-(1 \rightarrow), sodium salt. On complete hydrolysis it liberates D-galactosamine, D-glucuronic acid, acetic acid and sulfuric acid. It is obtained from cartilage of both terrestrial and marine origins. Depending on the animal species of origin, it shows different proportions of 4-sulfate and 6-sulfate groups.

Content: 95 per cent to 105 per cent (dried substance).

PRODUCTION

The animals from which chondroitin sulfate sodium is derived must fulfil the requirements for the health of animals suitable for human consumption.

CHARACTERS

Appearance: white or almost white, hygroscopic powder.

Solubility: freely soluble in water, practically insoluble in acetone and in ethanol (96 per cent).

IDENTIFICATION

- A. Infrared absorption spectrophotometry (2.2.24).

Preparation: discs of *potassium bromide R*.

Comparison: for chondroitin sulfate sodium of terrestrial origin use *chondroitin sulfate sodium CRS* and for chondroitin sulfate sodium of marine origin use *chondroitin sulfate sodium (marine) CRS*.

- B. Solution S1 (see Tests) gives reaction (b) of sodium (2.3.1).

- C. Examine the electropherograms obtained in the test for related substances.

Results: the principal band in the electropherogram obtained with the test solution is similar in position to the principal band in the electropherogram obtained with reference solution (a).

TESTS

Solution S1. Dissolve 2.500 g in 50.0 mL of *carbon dioxide-free water R*.

Solution S2. Dilute 1.0 mL of solution S1 to 10.0 mL with *water R*.

pH (2.2.3): 5.5 to 7.5 for solution S1.

Specific optical rotation (2.2.7): -20 to -30 (terrestrial origin) or -12 to -19 (marine origin) (dried substance), determined on solution S1.

Intrinsic viscosity: 0.01 m³/kg to 0.15 m³/kg.

Test solution (a). Weigh 5.000 g (m_{op}) of the substance to be examined and add about 80 mL of an 11.7 g/L solution of *sodium chloride R* at room temperature. Dissolve by shaking at room temperature for 30 min. Dilute to 100.0 mL with an 11.7 g/L solution of *sodium chloride R*. Filter through a membrane filter (nominal pore size 0.45 μm) and discard the first 10 mL. The concentration of test solution (a) is only indicative and must be adjusted after an initial measurement of the viscosity of test solution (a).

Test solution (b). To 15.0 mL of test solution (a) add 5.0 mL of an 11.7 g/L solution of *sodium chloride R*.

Test solution (c). To 10.0 mL of test solution (a) add 10.0 mL of an 11.7 g/L solution of *sodium chloride R*.

Test solution (d). To 5.0 mL of test solution (a) add 15.0 mL of an 11.7 g/L solution of *sodium chloride R*.

Determine the flow-time (2.2.9) for an 11.7 g/L solution of *sodium chloride R* (t_0) and the flow times for the 4 test solutions (t_1 , t_2 , t_3 and t_4), at 25.00 ± 0.03 °C. Use an appropriate suspended level viscometer (specifications: viscometer constant = about 0.005 mm²/s², kinematic viscosity range = 1-5 mm²/s, internal diameter of tube $R = 0.53$ mm, volume of bulb $C = 5.6$ mL, internal diameter of tube $N = 2.8$ -3.2 mm) with a funnel-shaped lower capillary end. Use the same viscometer for all measurements; measure all outflow times in triplicate. The test is not valid unless the results do not differ by more than 0.35 per cent from the mean and if the flow time t_1 is not less than $1.6 \times t_0$ and not more than $1.8 \times t_0$. If this is not the case, adjust the concentration of test solution (a) and repeat the procedure.

Calculation of the relative viscosities

Since the densities of the chondroitin sulfate solutions and of the solvent are almost equal, the relative viscosities η_{ri} (being η_{r1} , η_{r2} , η_{r3} and η_{r4}) can be calculated from the ratio of the flow times for the respective solutions t_i (being t_1 , t_2 , t_3 and t_4) to the flow time of the solvent t_0 , but taking into account the kinetic energy correction factor for the capillary ($B = 30\,800$ s³), as shown below:

$$\frac{t_i - \frac{B}{t_i^2}}{t_0 - \frac{B}{t_0^2}}$$

Calculation of the concentrations

Calculate the concentration c_1 (expressed in kg/m³) of chondroitin sulfate sodium in test solution (a) using the following expression:

$$m_{\text{op}} \times \frac{x}{100} \times \frac{100 - h}{100} \times 10$$

x = percentage content of chondroitin sulfate sodium as determined in the assay;

h = loss on drying as a percentage.

Calculate the concentration c_2 (expressed in kg/m³) of chondroitin sulfate sodium in test solution (b) using the following expression:

$$c_1 \times 0.75$$

Calculate the concentration c_3 (expressed in kg/m³) of chondroitin sulfate sodium in test solution (c) using the following expression:

$$c_1 \times 0.50$$

Calculate the concentration c_4 (expressed in kg/m^3) of chondroitin sulfate sodium in test solution (d) using the following expression:

$$c_1 \times 0.25$$

Calculation of the intrinsic viscosity

The specific viscosity η_{si} of the test solution (being η_{s1} , η_{s2} , η_{s3} and η_{s4}) is calculated from the relative viscosities η_{ri} (being η_{r1} , η_{r2} , η_{r3} and η_{r4}) according to the following expression:

$$\eta_{ri} - 1$$

The intrinsic viscosity $[\eta]$, defined as

$$[\eta] = \lim_{c \rightarrow 0} \left(\frac{\eta_s}{c} \right)$$

is calculated by linear least-squares regression analysis using the following equation:

$$\frac{\eta_{si}}{c_i} = c_i \times k_H + [\eta]$$

c_i = concentration of the substance to be examined expressed in kg/m^3 ;

k_H = Huggins' constant.

Related substances. Electrophoresis (2.2.31).

Buffer solution A (0.1 M barium acetate pH 5.0). Dissolve 25.54 g of *barium acetate R* in 900 mL of *water R*. Adjust to pH 5.0 with *glacial acetic acid R* and dilute to 1000.0 mL with *water R*.

Buffer solution B (1 M barium acetate pH 5.0). Dissolve 255.43 g of *barium acetate R* in 900 mL of *water R*. Adjust to pH 5.0 with *glacial acetic acid R* and dilute to 1000.0 mL with *water R*.

Staining solution. Dissolve 1.0 g of *toluidine blue R* and 2.0 g of *sodium chloride R* in 1000 mL of 0.01 M *hydrochloric acid*. Filter.

Test solution. Prepare a 30 mg/mL solution of the substance to be examined in *water R*.

Reference solution (a). Prepare a 30 mg/mL solution of *chondroitin sulfate sodium CRS* in *water R*.

Reference solution (b). Dilute 2.0 mL of reference solution (a) to 100.0 mL with *water R*.

Reference solution (c). Mix equal volumes of reference solution (b) and *water R*.

Procedure. Allow the electrophoresis support to cool the plate to 10 °C. Pre-equilibrate the agarose gel for 1 min in buffer solution A. Remove excess liquid by careful decanting. Dry the gel for approximately 5 min. Place 400 mL of buffer solution B into each of the containers of the electrophoresis equipment. Transfer 1 μL of each solution to the slots of the agarose gel. Pipette a few millilitres of a 50 per cent V/V solution of *glycerol R* onto the cooled plate of the electrophoresis equipment and place the gel in the middle of the ceramic plate. Place a wick, saturated with buffer solution B, at the positive and negative sides of the agarose gel. Ensure that there is good contact between the electrophoresis buffer and the agarose gel. Perform the electrophoresis under the following conditions: 75 mA/gel, resulting in a voltage of 100-150 V (maximum 300-400 V) for a gel of about 12 cm \times 10 cm. Carry out the electrophoresis for 12 min. Place the gel in a mixture consisting of 10 volumes of *anhydrous ethanol R* and 90 volumes of buffer solution A for 2 min. Carry out the electrophoresis for 20 min. Place the gel in a mixture consisting of 30 volumes of *anhydrous ethanol R* and 70 volumes of buffer solution A for 2 min. Carry out the electrophoresis for 20 min. Stain the gel in the staining solution for 10 min. Destain the gel for 15 min under running

tap water followed by 10-15 min with *water R* until the band in the electropherogram obtained with reference solution (c) is visible. Allow the gel to dry.

System suitability:

- the electropherogram obtained with reference solution (c) shows a visible band;
- the band in the electropherogram obtained with reference solution (b) is clearly visible and similar in position to the band in the electropherogram obtained with reference solution (a).

Results: any secondary band in the electropherogram obtained with the test solution is not more intense than the band in the electropherogram obtained with reference solution (b) (2 per cent).

Protein (2.5.33, *Method 2*): maximum 3.0 per cent (dried substance).

Test solution. Dilute 1.0 mL of solution S1 to 50.0 mL with 0.1 M *sodium hydroxide*.

Reference solutions. Dissolve about 0.100 g of *bovine albumin R*, accurately weighed, in 0.1 M *sodium hydroxide* and dilute to 50.0 mL with the same solvent. Carry out all additional dilutions using 0.1 M *sodium hydroxide*.

Chlorides (2.4.4): maximum 0.5 per cent.

Dilute 1 mL of solution S2 to 15 mL with *water R*. Do not add diluted nitric acid. Prepare the standard using 5 mL of *chloride standard solution (5 ppm Cl) R* and 10 mL of *water R*.

Heavy metals (2.4.8): maximum 20 ppm.

1.0 g complies with test C. Prepare the reference solution using 2 mL of *lead standard solution (10 ppm Pb) R*.

Loss on drying (2.2.32): maximum 12.0 per cent, determined on 1.000 g by drying in an oven at 105 °C for 4 h.

Microbial contamination

TAMC: acceptance criterion 10^3 CFU/g (2.6.12).

TYMC: acceptance criterion 10^2 CFU/g (2.6.12).

Absence of *Staphylococcus aureus* (2.6.13).

Absence of *Pseudomonas aeruginosa* (2.6.13).

Absence of *Escherichia coli* (2.6.13).

Absence of *Salmonella* (2.6.13).

Absence of bile-tolerant gram-negative bacteria (2.6.13).

ASSAY

Test solution (a). Weigh 0.100 g (m_1) of the substance to be examined, dissolve in *water R* and dilute to 100.0 mL with the same solvent.

Test solution (b). Dilute 5.0 mL of test solution (a) to 50.0 mL with *water R*.

Reference solution (a). Weigh 0.100 g (m_0) of *chondroitin sulfate sodium CRS*, previously dried as described in the test for loss on drying, dissolve in *water R* and dilute to 100.0 mL with the same solvent.

Reference solution (b). Dilute 5.0 mL of reference solution (a) to 50.0 mL with *water R*.

Titration solution (a). Weigh 4.000 g of *cetylpyridinium chloride monohydrate R* and dilute to 1000 mL with *water R*.

Titration solution (b). Weigh 1.000 g of *cetylpyridinium chloride monohydrate R* and dilute to 1000 mL with *water R*.

Perform either visual or photometric titration as follows:

Visual titration. Titrate 40.0 mL of reference solution (a) and 40.0 mL of test solution (a) with titration solution (a). The solution becomes turbid. At the end point, the liquid appears clear, with an almost-white precipitate in suspension. The precipitate is more apparent if 0.1 mL of a 1 per cent solution of *methylene blue R* is added before starting the titration. The precipitated particles are more apparent against the blue background.

Photometric titration. Titrate 50.0 mL of reference solution (b) and 50.0 mL of test solution (b) with titrant solution (b). To determine the end point, use a suitable autotitrator equipped with a phototrode at a suitable wavelength (none is critical) in the visible range.

Calculate the percentage content of chondroitin sulfate sodium using the following expression:

$$\frac{v_1 \times m_0}{v_0 \times m_1} \times \frac{100}{100 - h} \times Z$$

- v_0 = volume of appropriate titrant solution when titrating the appropriate reference solution, in millilitres;
 v_1 = volume of appropriate titrant solution when titrating the appropriate test solution, in millilitres;
 h = loss on drying of the substance to be examined, as a percentage;
 Z = percentage content of $\text{H}_2\text{O}(\text{C}_{14}\text{H}_{19}\text{NNa}_2\text{O}_{14}\text{S})_x$ in *chondroitin sulfate sodium CRS*.

STORAGE

In an airtight container, protected from light.

LABELLING

The label states the origin of the substance (marine or terrestrial).

01/2011:0476

CHYMOTRYPSIN

Chymotrypsinum

[9004-07-3]

DEFINITION

Chymotrypsin is a proteolytic enzyme obtained by the activation of chymotrypsinogen extracted from the pancreas of beef (*Bos taurus* L.). It has an activity of not less than 5.0 microkatal per milligram. In solution it has maximal enzymic activity at about pH 8; the activity is reversibly inhibited at pH 3, the pH at which it is most stable.

PRODUCTION

The animals from which chymotrypsin is derived must fulfil the requirements for the health of animals suitable for human consumption. Furthermore, the tissues used shall not include any specified risk material as defined by any relevant international or, where appropriate, national legislation.

The method of manufacture is validated to demonstrate that the product, if tested, would comply with the following test.

Histamine (2.6.10): not more than 1 µg (calculated as histamine base) per 5 microkatal of chymotrypsin activity. Before carrying out the test, heat the solution of the substance to be examined on a water-bath for 30 min.

CHARACTERS

Appearance: white or almost white, crystalline or amorphous powder, hygroscopic if amorphous.

Solubility: sparingly soluble in water.

IDENTIFICATION

- A. Dilute 1 mL of solution S (see Tests) to 10 mL with *water R*. In a depression in a white spot-plate, mix 0.05 mL of this solution with 0.2 mL of the substrate solution. A purple colour develops.

Substrate solution. To 24.0 mg of *acetyltyrosine ethyl ester R* add 0.2 mL of *ethanol (96 per cent) R* and swirl to dissolve. Add 2.0 mL of 0.067 M *phosphate buffer solution pH 7.0 R* and 1 mL of *methyl red mixed solution R* and dilute to 10.0 mL with *water R*.

- B. Dilute 0.5 mL of solution S to 5 mL with *water R*. Add 0.10 mL of a 20 g/L solution of *tosylphenylalanylchloromethane R* in *ethanol (96 per cent) R*. Adjust to pH 7.0 and shake for 2 h. In a depression in a white spot-plate, mix 0.05 mL of this solution with 0.2 mL of the substrate solution (see Identification test A). No colour develops within 3 min of mixing.

TESTS

Solution S. Dissolve 0.10 g in *carbon dioxide-free water R* and dilute to 10.0 mL with the same solvent.

Appearance of solution. Solution S is not more opalescent than reference suspension II (2.2.1).

pH (2.2.3): 3.0 to 5.0 for solution S.

Specific absorbance (2.2.25): 18.5 to 22.5, determined at the absorption maximum at 281 nm; maximum 8, determined at the absorption minimum at 250 nm.

Dissolve 30.0 mg in 0.001 M *hydrochloric acid* and dilute to 100.0 mL with the same acid.

Trypsin.

Substrate solution. To 98.5 mg of *tosylarginine methyl ester hydrochloride R*, suitable for assaying trypsin, add 5 mL of *tris(hydroxymethyl)aminomethane buffer solution pH 8.1 R* and swirl to dissolve. Add 2.5 mL of *methyl red mixed solution R* and dilute to 25.0 mL with *water R*.

Test solution. Transfer to a depression in a white spot-plate 0.01 mL of *tris(hydroxymethyl)aminomethane buffer solution pH 8.1 R* and 0.1 mL of solution S. Add 0.2 mL of the substrate solution.

Reference solution. At the same time and in the same manner as for the test solution, prepare a solution using the substance to be examined to which not more than 1 per cent *m/m* of *trypsin BRP* has been added.

Start a timer. No colour appears in the test solution within 3-5 min after the addition of the substrate solution. A purple colour is produced in the control solution.

Loss on drying (2.2.32): not more than 5.0 per cent, determined on 0.100 g by drying at 60 °C at a pressure not exceeding 0.7 kPa for 2 h.

ASSAY

The activity of chymotrypsin is determined by comparing the rate at which it hydrolyses *acetyltyrosine ethyl ester R* with the rate at which *chymotrypsin BRP* hydrolyses the same substrate under the same conditions.

Apparatus. Use a reaction vessel of about 30 mL capacity provided with:

- a device that will maintain a temperature of 25.0 ± 0.1 °C;
- a stirring device, for example a magnetic stirrer;
- a lid with holes for the insertion of electrodes, the tip of a burette, a tube for the admission of nitrogen and the introduction of reagents.

An automatic or manual titration apparatus may be used. For the latter, the burette is graduated in 0.005 mL and the pH meter is provided with a wide scale and glass-calomel or glass-silver-silver chloride electrodes.

Test solution. Dissolve 25.0 mg of the substance to be examined in 0.001 M *hydrochloric acid* and dilute to 250.0 mL with the same acid.

Reference solution. Dissolve 25.0 mg of *chymotrypsin BRP* in 0.001 M *hydrochloric acid* and dilute to 250.0 mL with the same acid.