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Non-active Surgical Implants - Determination Method for Oligomeric Siloxanes in Mammary Implants

无源外科植入物 硅凝胶填充乳房植入物中寡聚硅氧烷类物质测定方法

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1 Scope

This Standard specifies the gas chromatograph-mass spectrometer (GC/MS) qualitative and quantitative test methods for oligomeric siloxanes in the silicone elastomer shell and silicone gel filler of mammary implants.

In addition to the method selected in this Standard, other equivalent methods may also be adopted, but appropriate methodological verification is required.

2 Normative References

The following documents are indispensable to the application of this document. In terms of references with a specified date, only versions with a specified date are applicable to this document. In terms of references without a specified date, the latest version (including all the modifications) is applicable to this document.

Pharmacopoeia of the People's Republic of China (Volume II)

3 Terms and Definitions

The following terms and definitions are applicable to this document.

3.1 Mammary Implant

Mammary implant refers to an implant with a shell for increasing the breast size or replacing the breast. The shell can be filled with a filler by a manufacturer or a surgeon.

3.2 Shell

Shell refers to the outer envelope of an implant.

3.3 Filler

Filler refers to the content of an implant.

3.4 Silicone Elastomer

Silicone elastomer refers to a material with rubber characteristics obtained by cross-linking silicone elastomer compound, i.e., through vulcanization or secondary

spectrometer (GC/MS) for the qualitative and quantitative determination of the extracts. The extracts are mainly oligomeric siloxanes, such as: octamethylcyclotetrasiloxane (D4), decamethylcyclopentasiloxane (D5) and dodecamethylcyclohexasiloxane (D6), etc.

5.2 Test Procedures

5.2.1 Preparation of test solutions

5.2.1.1 Preparation of silicone elastomer test solution

Weigh-take an appropriate amount of the silicone elastomer shell material; cut it into small pieces of about 1 cm^2. In accordance with the proportion of 1 g of sample added with 5 mL of acetone, add acetone; seal it. At room temperature, at the frequency of 40 kHz, conduct ultrasonic for 30 min. For the liquid part, use 0.45 μm organic filter membrane to filter it, then, obtain the test solution.

In the same way, prepare the blank control solution.

5.2.1.2 Preparation of silicone gel test solution

Weigh-take an appropriate amount of the silicone gel material. In accordance with the proportion of 1 g of sample added with 5 mL of acetone, add acetone; seal it. At room temperature, at the frequency of 40 kHz, conduct ultrasonic for 30 min. For the liquid part, use 0.45 μm organic filter membrane to filter it, then, obtain the test solution.

In the same way, prepare the blank control solution.

5.2.2 Preparation of standard solution

Respectively take 0.05 g of D4 and D5 oligomeric siloxanes, accurately weigh them. Use acetone to reach a constant volume of 50 mL. Successively use acetone to dilute the solution and prepare a mixed standard solution of D4 and D5 oligomeric siloxanes with at least 5 concentration gradients and with a concentration of 1 μg/mL ~ 50 μg/mL.

5.2.3 GC/MS determination

5.2.3.1 GC/MS qualitative determination

5.2.3.1.1 GC/MS qualitative conditions are as follows:

a) Chromatographic column: 5% phenyl - 95% polydimethylsiloxane as the special capillary column of stationary liquid for mass spectrometry (30 m × 0.25 mm × 0.25 μm);

b) Column temperature: 60 °C (maintain for 3 min); at 10 °C/min, raise it to 300 °C (maintain for 10 min);

c) Inlet temperature: 280 °C;

d) Carrier gas: helium, flow rate: 1.0 mL/min;

e) Injection volume: 1 μL;

f) Electron impact ionization source (EI source), energy 70 eV;

g) Ion source temperature: 230 °C;

h) Solvent delay time: 4 min;

i) Scan (SCAN) mode, scan range: 35 u ~ 500 u.

5.2.3.1.2 Respectively take the blank solution, standard solution and sample solution to test by the gas chromatograph-mass spectrometer.

5.2.3.2 GC/MS quantitative determination

5.2.3.2.1 GC/MS quantitative conditions are as follows:

a) Chromatographic column: 5% phenyl - 95% polydimethylsiloxane as the special capillary column of stationary liquid for mass spectrometry (30 m × 0.25 mm × 0.25 μm);

b) Column temperature: 60 °C (maintain for 3 min); at 10 °C/min, raise it to 300 °C (maintain for 10 min);

c) Inlet temperature: 280 °C;

d) Carrier gas: helium, flow rate: 1.0 mL/min;

e) Injection volume: 1 μL;

f) Electron impact ionization source (EI source), energy 70 eV;

g) Ion source temperature: 230 °C;

h) Solvent delay time: 4 min;

i) Selected ion mode (SIM), quantitative ion: select the ion with high abundance and large mass-to-charge ratio in the mass spectrum of oligomeric siloxanes, for example, 281, 265, 249 for D4; 355, 267, 73 for D5.

5.2.3.2.2 Respectively take the blank solution, standard solution and sample solution to test by the gas chromatograph-mass spectrometer. Take a standard solution of intermediate concentration for 5 consecutive injections; calculate the relative standard deviation RSD of the peak area of oligomeric siloxanes.

Appendix B

(Informative)

Rough Qualitative and Semi-quantitative Methods in the Absence of Reference Substance of Oligomeric Siloxanes

B.1 Rough Qualitative Analysis

Respectively perform a library search on the mass spectrums of the various oligomeric siloxanes, and if the search similarity is ≥ 90%, then, it can be judged that the substance exists.

B.2 Semi-quantitative Analysis

Since the various oligomeric siloxanes are a series of homologues and have similar response sensitivity in the mass spectrometric detector, the peak area of oligomeric siloxanes in the absence of the reference substance can be compared with that of the homologous reference substance (for example, D4 or D5) for the semi-quantitative analysis.

It can be expressed in Formula (B.1):

$$X = C_R \times A / A_R \qquad \cdots\cdots (B.1)$$

Where,

X---the residual amount of oligomeric siloxanes in the absence of the reference substance, expressed in (μg/g);

C_R---the residual amount of oligomeric siloxanes with the reference substance, expressed in (μg/g);

A---the peak area of oligomeric siloxanes in the absence of the reference substance;

A_R---the peak area of oligomeric siloxanes with the reference substance.

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