

Aim: Limit Test for Iron

References:

1. Indian Pharmacopoeia (IP) 2022, Appendix 2.3.3, Limit Tests for Iron.
2. British Pharmacopoeia (BP) 2023, Appendix VIII, Limit Test for Iron.
3. United States Pharmacopoeia (USP) 43-NF 38, General Chapter <241> Iron.

Objective:

To determine the presence and permissible quantity of iron in a pharmaceutical substance, ensuring it meets the acceptable limit as specified by pharmacopeial standards.

Materials and Reagents

1. Reagents:

- Citric acid (10% w/v solution)
- Thioglycolic acid
- Ammonia solution (strong ammonia, 25% w/v)
- Hydrochloric acid (HCl, 10% v/v)
- Standard iron solution (20 ppm Fe)
- Purified water

2. Apparatus:

- Nessler cylinders (50 mL)
- Glass rods
- Pipettes (1 mL, 2 mL)
- Measuring cylinders
- Beakers (100 mL)
- Analytical balance

Principle:

The limit test for iron is based on the reaction of ferrous (Fe^{2+}) ions with thioglycolic acid in the presence of citric acid to form a purple-colored complex. The intensity of this color is proportional to the amount of iron present and is compared visually against a standard iron solution.

Procedure:

1. Preparation of the Standard Iron Solution:

- **Standard Iron Solution (20 ppm Fe):** Prepare by dissolving 0.1726 g of ferrous ammonium sulfate $[(\text{NH}_4)_2\text{Fe}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}]$ in 10 mL of 10% HCl. Dilute with purified water to 1000 mL to obtain a 10 ppm Fe solution. From this, further dilute 10 mL to 100 mL with purified water to make a 1 ppm Fe solution.

2. Preparation of the Test Solution:

- Weigh and dissolve the specified quantity of the test sample (usually 1.0 g) in 40 mL of water.

- Add 2 mL of 10% hydrochloric acid and 20 mL of citric acid solution (10% w/v).

- Add 0.1 mL of thioglycolic acid and mix well.

- Add strong ammonia solution dropwise until the solution is just alkaline to litmus paper (check by dipping a glass rod in the solution and touching it to litmus paper).

- Dilute the solution with purified water to 50 mL in a Nessler cylinder.

3. Preparation of the Standard Solution:

- Transfer 2 mL of the standard iron solution (20 ppm Fe) to a Nessler cylinder.

- Add 40 mL of water, 2 mL of 10% hydrochloric acid, 20 mL of citric acid solution, and 0.1 mL of thioglycolic acid.

- Add strong ammonia solution dropwise until just alkaline to litmus.

- Dilute with purified water to 50 mL in a Nessler cylinder.

4. Preparation of the Blank Solution:

- Prepare a blank solution using the same quantities of reagents (40 mL water, 2 mL HCl, 20 mL citric acid solution, 0.1 mL thioglycolic acid) without adding the test substance or iron standard. Adjust with ammonia to just alkaline and dilute to 50 mL.

5. Comparison:

- Allow all solutions to stand for 5 minutes.
- Compare the color intensity of the test solution with the standard solution against a white background.

Observation:

- The color intensity of the test solution should not exceed that of the standard solution, indicating that the iron content is within the permissible limit.

Result: The sample passes the limit test if the color of the test solution is not more intense than that of the standard iron solution, confirming that the iron content is within the acceptable limit.