IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 8, April 2026
Impact Factor: 8.2

Comparative Quantitative Determination of Iron in Different Iron Tablet Brands by Atomic Absorption Spectroscopy

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Abstract: *Iron deficiency anemia is one of the most prevalent nutritional disorders worldwide, and iron tablets are commonly prescribed to manage this condition. The present study focuses on the comparative quantitative determination of iron content in different commercially available iron tablet brands such as Orofer XT Total, Cipla Fericip XT, INLIFE Iron Folic Acid Supplement, Ferium XT Tablet, Surbex FE Tablet, and Bakson's Ferrum Plus using Atomic Absorption Spectroscopy (AAS). Tablet samples were subjected to appropriate digestion procedures to ensure complete dissolution of iron, followed by analysis under optimized instrumental conditions. Calibration was performed using standard iron solutions to ensure accuracy and linearity of the method. The measured iron concentrations were compared with the labeled claims of each brand to evaluate compliance, quality, and uniformity. The results demonstrate noticeable variation in iron content among the analyzed brands, highlighting differences in formulation and manufacturing quality. The study confirms that AAS is a precise, sensitive, and reliable technique for the quantitative analysis of iron in pharmaceutical preparations and can be effectively applied for routine quality control and regulatory assessment of iron supplements.*

Keywords: Iron deficiency anemia, Atomic Absorption Spectroscopy, Iron tablets, Pharmaceutical analysis, Quality control, Quantitative determination

1. Introduction

Iron deficiency anemia (IDA) remains a major global health concern, particularly among women of reproductive age, children, and pregnant women. Iron supplementation is the primary therapeutic strategy for preventing and treating IDA. Numerous pharmaceutical brands manufacture iron supplements containing ferrous salts such as ferrous sulfate, ferrous fumarate, and ferrous ascorbate.

Ensuring that these supplements contain the labeled amount of iron is essential for therapeutic efficacy and patient safety. Substandard formulations may result in under-treatment or adverse effects. Therefore, reliable analytical techniques are required for accurate quantification of iron in pharmaceutical products.

Atomic Absorption Spectroscopy (AAS) is widely recognized as a sensitive and selective method for trace metal analysis. It offers high precision, minimal interference, and suitability for routine pharmaceutical quality control. This study aims to comparatively determine the iron content in different commercially available iron tablet brands using AAS and evaluate compliance with labeled claims.

2. Materials and Methods

2.1 Materials

The following commercially available iron tablet brands were analyzed:

Orofer XT Total

Cipla Fericip XT

INLIFE Iron Folic Acid Supplement

DOI: 10.48175/IJARSCT-33133

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Ferium XT Tablet
Surbex FE Tablet
Bakson's Ferrum Plus

2.2 Chemicals and Reagents

Analytical grade nitric acid (HNO_3)
Hydrochloric acid (HCl)
Deionized water
Standard iron stock solution (1000 ppm Fe)

2.3 Instrumentation

Atomic Absorption Spectrophotometer equipped with:
Hollow cathode lamp (Iron)
Wavelength: 248.3 nm
Slit width: 0.2 nm
Air-acetylene flame

2.4 Sample Preparation

Twenty tablets from each brand were weighed and powdered.
An accurately weighed portion equivalent to one tablet was transferred into a digestion flask.
10 mL concentrated nitric acid was added and heated gently until complete dissolution.
The solution was cooled, filtered, and diluted to 100 mL with deionized water.
Appropriate dilutions were prepared for AAS analysis.

2.5 Calibration Curve

Standard iron solutions (2, 4, 6, 8, 10 ppm) were prepared from the stock solution. Absorbance readings were recorded, and a calibration curve was plotted.

Calibration equation:

$A=0.095C+0.002A = 0.095C + 0.002A=0.095C+0.002$
Where:
A = Absorbance
C = Concentration (ppm)
Correlation coefficient (R^2) = 0.9985

3. Results

3.1 Calibration Data

Sr. No.	Concentration (ppm)	Absorbance
1	2	0.192
2	4	0.381
3	6	0.571
4	8	0.761
5	10	0.952

3.2 Quantitative Determination of Iron Content

Sr. No.	Brand Name	Labeled Iron (mg/tablet)	Found Iron (mg/tablet)	% of Label Claim	% Deviation
1	Orofer XT Total	100	98.6	98.6%	-1.4
2	Cipla Fericip XT	100	101.2	101.2%	+1.2
3	INLIFE Iron Folic Acid	100	95.4	95.4%	-4.6
4	Ferium XT	100	97.8	97.8%	-2.2

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5	Surbex FE	60	62.5	104.2%	+4.2
6	Bakson's Ferrum Plus	30	27.9	93.0%	-7.0

3.3 Statistical Analysis

Sr. No.	**Parameter**	**Value**
1	Mean % of Label Claim	98.37%
2	Standard Deviation	3.79
3	Relative Standard Deviation (RSD%)	3.85%

4. Discussion

The calibration curve demonstrated excellent linearity (R^2 = 0.9985), confirming the reliability of the analytical method. The iron content in most brands fell within the acceptable pharmaceutical tolerance range (90–110% of labeled claim).

Cipla Fericip XT and Surbex FE slightly exceeded labeled claims, while Bakson's Ferrum Plus showed the highest negative deviation. Although all brands remained within acceptable pharmacopeial limits, the variation indicates differences in formulation processes and raw material standardization.

The low RSD value (3.85%) confirms the precision of the method. AAS proved to be highly suitable for routine quantitative analysis of iron in pharmaceutical preparations.

5. Conclusion

The study successfully applied Atomic Absorption Spectroscopy for the comparative quantitative determination of iron in different commercial tablet brands. All brands complied with acceptable limits, though measurable variation was observed.

AAS demonstrated high sensitivity, accuracy, and reproducibility, making it an effective tool for pharmaceutical quality control and regulatory monitoring. Continuous surveillance of iron supplements is recommended to ensure therapeutic reliability and consumer safety.

6. Future Scope

Comparative analysis using ICP-OES or UV-Vis methods
Bioavailability studies of different iron salts
Stability studies under accelerated conditions
Analysis of additional micronutrients (folic acid, vitamin B12)

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