A Quality Control Study of Different Brands of Atorvastatin Tablets

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ABSTRACT

To be considered a quality drug, a pharmaceutical tablet must meet specific standards. Key quality criteria for any drug in dosage form include safety, potency, efficacy, stability, patient acceptability, and regulatory compliance. These quality aspects must be established during the product development stage, where physical, chemical, and biological specifications are determined to ensure the product meets quality requirements. Our study aimed to determine and compare the percentage labeled claim, quality, and physicochemical characteristics of different brands of atorvastatin tablets using official and unofficial quality control tests. Atorvastatin, an HMG- CoA reductase inhibitor (statin), is essential for preventing hypercholesterolemia and related diseases. Although cholesterol is crucial in daily bodily functions, it can contribute to atherosclerosis development. We selected five brands of atorvastatin tablets (Atorva 40mg, Aztor 40mg, Lipicure 40mg, Lipikind 40mg, Lipvas 40mg) for analysis. Each sample underwent tests for hardness, friability, weight variation, disintegration, dissolution, and assay according to Indian Pharmacopoeia (IP) standards. All brands met the IP limits for hardness (4-8 kg/m^2) and also complied with the requirements for weight variation and friability. The disintegration time for all brands was within the 30-minute IP recommendation for film-coated tablets. Each brand exhibited over 85% drug release within 30 minutes, and the content ranged from 90% to 110% of the labeled claim. These findings indicate that all tested atorvastatin brands available in Kerala (Kanjirappally) meet IP quality requirements.

Keywords: Atorvastatin, Quality control, Pharmaceutical Tablets, Physicochemical Characteristics, Hypercholesterolemia, Indian Pharmacopoeia

INTRODUCTION

Quality control (QC) testing is essential to ensure drug safety, efficacy, and effectiveness. This process uses specific instruments to verify the quality of drugs according to established guidelines. Maintaining product quality through various QC tests ensures that a drug is safe for public use while also preserving its overall efficiency and quality. QC testing verifies that the drug adheres to the label's descriptions and data, checking for purities and impurities, active ingredients, and drug absorption by the body.

Regulatory bodies are continuously updating their requirements for pharmaceutical companies to ensure the quality of pharmaceuticals. In the pharmaceutical industry, the quality of drugs largely depends on rigorous testing conducted during and after manufacturing, adhering to the specifications of relevant pharmacopeias and the regulatory standards of specific countries. This process aims to ensure the highest standards of pharmaceuticals for human health. Quality control encompasses procedures implemented throughout manufacturing and post- production to verify compliance with requirements and ensure consistent product reproducibility.[1]

Types of QC Tests

Unofficial Tests

- General Appearance
- Thickness
- Hardness
- Friability

Official Tests

- Weight Variation
- Drug Content
- Disintegration Test
- Dissolution Test
- Assay

Drug profile

The drug under this study is Atorvastatin which is an anticholesteremic agent that is a synthetic HMG-CoA reductase inhibitor that effectively lowers plasma cholesterol levels by inhibiting endogenous cholesterol synthesis and reducing triglyceride levels. Atorvastatin may be particularly suitable for patients with heterozygous or homozygous familial hypercholesterolemia due to its marked LDL-cholesterol reductions. Additionally, its triglyceride-lowering properties suggest its potential use in treating combined hyperlipidemia or hypertriglyceridemia.
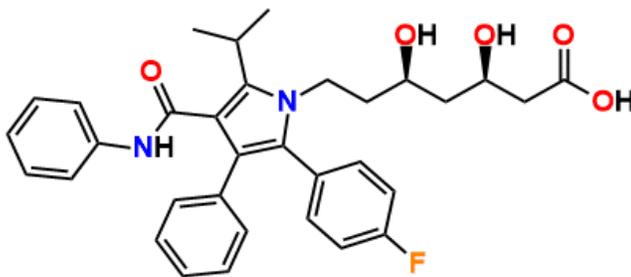
Figure 1: Chemical structure of Atorvastatin

- Category: Anticholesteremic agent

- Chemical formula: C33H35FN2O5

- IUPAC Name: (3*R*,5*R*)-7-[2-(4-fluorophenyl)-3-phenyl-4-(phenyl carbamoyl)-5-propan-2-ylpyrrol-1-yl]- 3,5-dihydroxy heptanoic acid

- Molecular Weight: 558.6 g/mol

- Characteristics: Crystalline solid

- Solubility: Soluble in organic solvents such as ethanol, DMSO, and dimethyl formamide (DMF) and slightly soluble in water. [2]

Aim & Objectives

The study aims to perform comparative analytical studies of different marketed brands of Atorvastatin tablets available in Kerala (Kanjirappally).

The following are the specific objectives of the present study:

- To perform various quality control tests of tablets as per Indian Pharmacopoeia such as weight variation, hardness, friability, disintegration, and dissolution tests.

- To ensure the safety and reliability of Atorvastatin tablets in terms of quality.

- To compare the physicochemical properties of these drugs.

- To determine the percentage purity through official standards according to IP.

MATERIALS AND METHOD

Materials required

- Different brands of Atorvastatin tablets (Atorva 40 mg, Aztor 40 mg, Lipicure 40 mg, Lipikind 40 mg, Lipvas 40 mg).

- Reagents for buffer preparation

- Monsanto hardness tester

- Roche friability

- Analytical balance

- Dissolution test apparatus

- Disintegration test apparatus
- UV visible spectrophotometer

Methods

1. **General Appearance Test:** The tablets were visually evaluated to assess their physical characteristics such as color, shape, presence of break lines, and any signs of damage or deformity.

2. **Weight Variation:** Twenty film-coated tablets were randomly selected and individually weighed to determine their weights, which were recorded. The percentage weight variation was calculated using the formula:

3. Weight Variation $= (WI - WA) / WA \times 100$

Where,

WI = Individual tablet's weight WA = Average tablet's weight

Table 1: Official standards of weight variation as per IP[3, 8]

Sl no	The average weight of the tablet	% Weight variation acceptable (+ or -)
1	84 or less mg	(+ or -) 10%
2	84-250 mg	(+ or -)7.5%
3	>250 mg	(+ or -)5%

Hardness Test:

The mechanical strength or hardness of the tablets was assessed using a Monsanto hardness tester, Six tablets from each brand were positioned in the center and perpendicular to the Monsanto hardness tester. The device gradually applied force until the tablets split, recording the force at the point of splitting. The recommended tablet hardness value is 4-8 kg/cm², with 9-15 kg/cm² considered acceptable for film- coated tablets.[4, 8]

Friability Test:

The friability of the tablets was evaluated using a friabilator, subjecting twenty randomly selected tablets from each batch to 100 revolutions at 25 rpm for 4 minutes. The tablets were re-weighed after revolutions to calculate the percentage friability using the equation:

Friability $(\%) = W1 - W2 / W1 \ X \ 100.$

Where W1 is the initial weight and W2 is the final weight.

Acceptance criteria: The Friability of tablets less than 1% is considered acceptable. [4, 8]

Disintegration Test:

Six tablets were placed in a basket-shaped tube and subjected to up-and-down movement in a water medium at 36-38 °C. Disintegration time was recorded when no residue of the tablet remained above the screen, adhering to the IP standard of 30 minutes for film-coated tablets.[5, 8]

Dissolution Test:

The dissolution rate of atorvastatin calcium from tablets was determined using a USP Type II dissolution test apparatus with phosphate buffer pH 6.8 at $37\pm1°C$ and a stirrer speed of 50 rpm. Samples were withdrawn at intervals (10, 20, 30, 40, 50, and 60 minutes), and their absorbance was measured at 246 nm using a UV-Vis spectrophotometer. Each withdrawn sample was replaced with fresh dissolution fluid. Acceptance criteria are that each unit is not less than D* + 5 percent [6,8]

Assay:

Solubility of the Drug

40 mg of Atorvastatin calcium was weighed, and its solubility was tested in water, methanol, and a phosphate buffer. The drug was found to be soluble in methanol.

Identification of λmax of Atorvastatin Standard

50 mg of Atorvastatin standard was weighed and dissolved in 50 ml of methanol to create a 1 mg/ml solution. From this, 10 ml was withdrawn and diluted to 100 ml. This solution was scanned in the UV range from 200-400 nm for analysis, and the spectrum was recorded.

Preparation of Standard Stock Solution

50 mg of pure Atorvastatin was accurately weighed and transferred to a 50 ml volumetric flask, dissolved in methanol, and the volume was made up to 50 ml, resulting in a concentration of 1 mg/ml. 10 ml of this solution was then diluted to 100 ml with methanol, yielding a concentration of 100 µg/ml.

Preparation of Sample Solution

20 tablets were obtained from the local market, and their average weight was determined. Powder equivalent to 50 mg of Atorvastatin was accurately weighed, dissolved in 50 ml of methanol, shaken for ten minutes, and filtered. 10 ml of this filtrate was diluted to 100 ml with methanol to achieve a concentration of 100 µg/ml. This solution was further diluted in a 10 ml volumetric flask with methanol to obtain a 10 µg/ml solution. The absorbance was measured at 246 nm against a reagent blank. [7]

IP Standards: According to Indian Pharmacopoeia (IP), Atorvastatin tablets should contain not less than 90.0% and not more than 110.0% of the labeled amount of Atorvastatin.[8]

RESULTS AND DISCUSSION

The quality control tests and analysis by UV Spectroscopy of different brands of Atorvastatin were performed and results were obtained as shown below.

General Appearance

Table 2: General Appearance test

General Appearance	Brands				
	Atorva	**Aztor**	**Lipikind**	**Lipicure**	**Lipvas**
Shape	Round	Round	Oval	Oval	Oval
Color	White	Red	Yellow	White	White
Taste	No taste	No taste	No taste	No taste	No taste
Odor	Odourless	Odourless	Odourless	Odourless	Odourless

Weight variation test

Table 3: Weight variation result

Brands (40mg)	Average weight	% Deviation	Limit (±5%) mg as per IP	Result
Atorva	0.371	1.7784	0.374 ± 0.539	PASS
Aztor	0.518	1.3414	0.520 ± 0.386	PASS
Lipikind	0.269	1.0406	0.271 ± 0.738	PASS
Lipicure	0.313	0.8625	0.315 ± 0.634	PASS
Lipvas	0.611	0.7681	0.615 ± 0.650	PASS

As per the Indian Pharmacopoeia (IP), no more than two individual tablet weights should deviate from the average weight by a specified percentage, and none should deviate by more than twice that percentage. The findings indicate that all tested brands met these criteria. Additionally, there were no significant differences observed in tablet weights among the authorized brands of each product selected for evaluation.

Hardness test

Table 4: Hardness test result

Brands	Hardness (kg/cm2)	Limit as per IP	Result
Atorva	7 kg/cm^2	4-10kg/cm^2	PASS
Aztor	6 kg/cm^2		PASS
Lipikind	8 kg/cm^2		PASS
Lipicure	5 kg/cm^2		PASS
Lipvas	9 kg/cm^2		PASS

Table 4 shows the hardness variation of different brands of Atorvastatin, and the results were analyzed as Brands Atorva, Aztor, Lipikind, Lipicure, Lipvas had hardness as 7 kg/cm^2, 6 kg/cm^2, 8 kg/cm^2, 5 kg/cm^2 and 9 kg/cm^2 respectively. Here, all the brands were within the range (4-10 kg/cm^2) and were found satisfactory, the batches were considered of good quality.

Friability test

Table 5: Friability test result

Weight in mg	Brands				
	Atorva	**Aztor**	**Lipikind**	**Lipicure**	**Lipvas**
Initial weight(w0)	7.531	10.566	5.432	6.371	12.359
Weight after revolution	7.530	10.563	5.430	6.369	12.356
% Friability	0.0132	0.0283	0.0368	0.0313	0.0242
Limit as per IP	< 1%				
Result	PASS	PASS	PASS	PASS	PASS

Table 5 shows the results of friability tests conducted on different brands of Atorvastatin, the percentage friability of Brands Atorva, Aztor, Lipikind, Lipicure, and Lipvas is 0.0132 % is 0.0283 %, 0.0368%, 0.0313 % and 0.0242% respectively. Here, five brands have a percent friability below 1% which indicates tablets will not face difficulty during storage or transportation.

Disintegration time

Table 6: Disintegration test result

Brands	Disintegration time(minutes)	Limit as per IP	Result
Atorva	9.2 minutes	Not more than 30 minutes	PASS
Aztor	6.5 minutes		PASS
Lipikind	7.4 minutes		PASS
Lipicure	12.3 minutes		PASS
Lipvas	5.9 minutes		PASS

Table 6 shows the results of disintegration tests of different brands of Atorvastatin, the disintegration times of Brands Atorva, Aztor, Lipikind, Lipicure, and Lipvas were 9.2minutes, 6.5minutes, 7.4 minutes, 12.3 minutes, and 5.9 minutes respectively. IP specifies that film-coated tablets should disintegrate within 30 minutes. All the brands pass the criteria.

Dissolution test

Table 7: Dissolution test result m

Time in minutes	Brand wise % release				
	Atorva	**Aztor**	**Lipikind**	**Lipicure**	**Lipvas**
10	80.44±2.07	81.51±1.45	93.82±0.823	89.67 ±1.32	84.07±1.48
20	85.18±1.39	85.16±1.88	96.04±0.804	91.38 ±1.301	91.14±1.04
30	92.26±1.09	92.67±1.21	98.95±0.60	94.38±0.756	96.53±0.55
40	96.36±1.23	97.84±0.91	99.96±0.416	96.95±0.429	98.47±0.42
50	99.15±0.53	99.7±0.596	101.81±0.35	100.60±0.413	100.36±0.29
60	102.97±0.17	100.22±0.296	101.91±0.17	101.82±0.35	101.43±0.23
Result	PASS	PASS	PASS	PASS	PASS

The dissolution profile of all the investigated brands was found within the limit. The evaluation showed that almost all 5 brands of drugs released not less than 85% in 30 minutes and showed 100%

release within 60 minutes indicating that the release pattern of drugs was the same although the brands were manufactured by different companies.

Assay

Table 8: Assay result

Brands	Labeled claim	Actual content	Percentage actual content	Limit as per IP	Result
Atorva	40mg	39.513	99.752	90-110%	Pass
Aztor	40mg	39.241	98.103		Pass
Lipikind	40mg	38.415	100.164		Pass
Lipicure	40mg	39.076	97.691		Pass
Lipvas	40mg	37.510	96.661		Pass

The table shows the assay results of different brands of atorvastatin. The evaluation showed that all the brands are within the range (90-110%) prescribed in the monograph proving their efficacy.

DISCUSSION

Quality control assessments of atorvastatin tablets stated that all five brands met the Pharmacopoeial standards. The evaluation includes various tests (Official and non-official) like General Appearance, Weight Variation, Hardness, Friability, Disintegration, Dissolution, and Assay. This study aimed to compare Atorva 40 mg, Aztor 40 mg, Lipikind 40 mg, Lipicure 40 mg, and Lipvas 40 mg to ensure their safety and quality consistency. According to IP guidelines, weight variation for tablets weighing 80 mg or less should not exceed 10%, a criterion all brands meet. Hardness testing, essential for assessing tablet strength, showed values between 5-9 kg/cm^2 across all brands, aligning with Pharmacopeial norms. Friability tests demonstrated minimal tablet loss during simulated transportation conditions, well below the permissible 1% limit. Disintegration tests confirmed that all brands dissolved within the mandated 30-minute timeframe, while dissolution tests indicated complete dissolution within 60 minutes, meeting regulatory requirements. Analysis of drug content across the five brands of atorvastatin tablets showed consistent results within the acceptable range of 90-110%, ensuring uniformity and adherence to official standards.

CONCLUSION

The quality control tests and analysis by UV Spectroscopy of different brands of Atorvastatin were performed, and the results were obtained as acceptable within the prescribed limit. The general appearance of the tablets was consistent across different brands, indicating uniformity and making them suitable for patient consumption. The weight variation test showed that all brands were within the acceptable range defined by the Indian Pharmacopoeia (IP). All results were within the

±5% limit, indicating good manufacturing quality. The hardness of the tablets was also within the acceptable range (4-10 kg/cm²) as per IP standards. The friability test results indicated that all brands had friability percentages well below the 1% limit set by the IP. This suggests that the tablets will not face issues during storage or transportation. The disintegration test results showed that all brands disintegrated within the 30-minute limit specified by the IP. These results confirm that all brands will dissolve adequately in the digestive tract. The dissolution test results revealed that all brands met the requirement of releasing not less than 85% of the drug within 30 minutes and approaching 100% within 60 minutes. These results indicate consistent drug release profiles among the brands. The assay results demonstrated that all brands were within the 90-110% range prescribed by the IP. Atorva had 99.752% of the labeled claim, Aztor 98.103%, Lipikind 100.164%, Lipicure 97.691%, and Lipvas 96.661%. The results confirmed that all brands complied with official specifications for these parameters according to pharmacopoeial limits. The percentage labeled claims were determined as follows: Atorva 40mg (99.752%), Aztor 40mg (98.103%), Lipikind 40mg (100.164%), Lipicure 40mg (97.691%), and Lipvas 40mg (96.661%) w/w. These findings identify Lipikind 40mg as having the highest labeled claim. Overall, the study concludes that all evaluated brands meet regulatory standards, ensuring their quality, efficacy, and safety as per pharmacopoeial requirements. Quality control testing of atorvastatin tablets is essential to assess their safety, effectiveness, and bioavailability, underscoring the importance of regular testing to uphold drug quality and patient health. In summary, the results of the quality control tests indicate that all brands of atorvastatin tablets tested confirm to the required standards for general appearance, weight variation, hardness, friability, disintegration time, dissolution, and assay. This consistency across various brands highlights the reliability and effectiveness of the manufacturing processes in producing high-quality atorvastatin tablets.

ACKNOWLEDGMENT

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