LEBDA MEDICAL JOURNAL, VOL. 11, NO. 2 (30 October 2026), PP. 39–48.

Lebda Medical Journal; [LMJ]; {Online ISSN:2520-095X}

Lebda Medical Journal Homepage: https://lebmedj.elmergib.edu.ly/index.php/LMJ/en

Received:19.10.2026; Revised:27.10.2026; Accepted:28.10.2026; Published:30.10.2026.

In-Vitro Quality Assessment of Different Brands of Vitamin C Tablets Available in the Libyan Market

Faraj A. Shmam[a,*], Abadi G. Abadi[a], Mahmoud A. Aldebaibi[a], Omar M. Ahmemeed[a], Aseel H. Al-ammary[b], Samia H. Al-Areq[b], Alia A. Sasi[b]

[a] Department of Pharmaceutics and Industrial pharmacy, Faculty of Pharmacy, Elmergib University, Al-Khums, Libya.

Faculty of Pharmacy, Elmergib University, Al-Khums, Libya

*Corresponding author Email: fashmam@elmergib.edu.ly

A B S T R A C T

Background: Vitamin C, or ascorbic acid, is a vital water-soluble vitamin and a potent antioxidant essential for human health. Vitamin C tablets are widely available as over-the-counter (OTC) products and are often used without medical supervision; therefore, strict adherence to pharmacopeial standards is essential to ensure their safety, efficacy, and quality consistency across different brands.

Objectives: The aim of this study was to evaluate the quality of four brands of 500 mg vitamin C tablets commonly sold over-the-counter in the Libyan market. The four brands were labeled as Brand 1, Brand 2, Brand 3, and Brand 4, and evaluated to assess whether they meet the required quality standards.

Methods: The pharmaceutical quality of different vitamin C Brands was assessed using several in-vitro tests according to the United States Pharmacopeia (USP); the assessment included chemical and physical properties such as friability, hardness, uniformity of content, weight variation, dissolution rate, and disintegration time.

Results: All tested brands passed the disintegration and hardness tests and complied with USP standards. However, Brand 2 and Brand 4 failed to meet the requirements for friability test. In addition, the Brand 4 failed to meet the USP specification for weight variation, content uniformity, and the dissolution test. The observed failures in Brand 2 and Brand 4 indicate that not all vitamin C Brands fulfilled the USP requirements, suggesting potential differences in pharmaceutical quality and interchangeability, whereas Both Brand 1 and Brand 3 successfully complied with all quality control tests. However, Brand 3 demonstrated superior performance, achieving a faster drug release rate and a shorter disintegration time compared to the other brands.

Conclusion: The findings indicate that not all vitamin C brands available in the Libyan market meet the required pharmacopeial standards. Continuous quality control testing, strict regulatory supervision, and proper storage conditions are essential to ensure that pharmaceutical products distributed in the market provide safe, effective, and reliable therapeutic outcomes.

Keywords: *Vitamin C tablets; Ascorbic acid; In-vitro dissolution assessment; Libya market; Post-market tablet evaluation.*

1. Introduction

L –ascorbic acid, commonly known as vitamin C is a well -known micronutrient essential for maintaining normal physiological function. Vitamin C exists primarily in two forms: Ascorbic Acid (AA) and dehydroascorbic acid (DHA). It is a potent antioxidant and serves as cofactor for numerous enzymatic reactions. Vitamin C plays an important role in several biological processes, including proper immune system function, carnitine and catecholamine metabolism, iron absorption from food, and collagen synthesis [1-4]. Vitamin C tablets are widely available as over-the counter (OTC) products and are frequently consumed without medical supervision. The high demand and broad

LEBDA MEDICAL JOURNAL, VOL. 11, NO. 2 (30 October 2026), PP. 39–48.

Lebda Medical Journal; [LMJ]; {Online ISSN:2520-095X}

Lebda Medical Journal Homepage: https://lebmedj.elmergib.edu.ly/index.php/LMJ/en

Received:19.10.2026; Revised:27.10.2026; Accepted:28.10.2026; Published:30.10.2026.

market availability of vitamin C necessitate strict adherence to pharmacopeial standards to ensure safety, efficacy, and uniformity across different brands. High dose formulation, such as 500mg and 1000mg tablets, present additional formulation and stability challenges, as ascorbic acid is inherently unstable and prone to oxidative degradation when exposed to light, heat, oxygen, alkaline pH, and moisture [5-6]. Such degradation reduces potency and may compromise therapeutic effectiveness. Therefore, appropriate formulation strategies, protective packaging, and controlled storage conditions are essential to maintain product stability throughout shelf life [7].

Routine quality evaluation is critical due to susceptibility to degradation. Pharmacopeial monographs in the United States pharmacopeia, British Pharmacopeia and European Pharmacopeia specify limits for assay, dissolution, and uniformity to ensure consistent delivery of the labeled amount of active ingredient [8]. Despite established regulatory standards, variability in product quality among manufactures has been reported. Differences in excipients, formulation design, manufacturing processes, and storage conditions can significantly influence tablet performance [7]. Content uniformity ensures accurate dosing in each tablet, while dissolution testing evaluates the rate and extent of drug release, which directly affects bioavailability. Tablets that meet assay requirements but fail dissolution testing may not achieve the intended therapeutic effect [6]. Mechanical properties, including hardness and friability influence tablet integrity during packaging, transportation, and handling. However, excessive hardness may delay disintegration, whereas insufficient hardness can result in brittleness and breakage. Excipients and manufacturing parameters further affect stability and performance, particularly if they promote moisture uptake that accelerate ascorbic acid degradation [7].

Despite the limited number of studies related to the quality assessment of vitamin C tablets in Libya, there were a several studies had been reported internationally. One of these studies conducted by Iwuozor emphasized the importance of performing comprehensive physical and chemical tests to ensure that products comply with pharmacopeial standards. The study evaluated five brands of vitamin C tablets for their percentage content of ascorbic acid (active pharmaceutical ingredient, API), friability, disintegration time, and hardness. The results showed that all samples complied with the pharmacopeial requirements for hardness and disintegration time. However, Samples 1, 3, 4, and 5 failed the assay test for percentage content of ascorbic acid, while Sample 2 failed the friability test. A key limitation of that study was the absence of a detailed correlation between dissolution profiles and API content, which would have provided stronger evidence regarding the relationship between drug content and in vitro performance [9]. The current study addresses this limitation by establishing a comprehensive analytical correlation between dissolution profiles and API content.

Similarly, a study conducted by Lahai et al. [6], evaluated nine vitamin C products and found that all products complied with the requirements for uniformity of dosage units, friability, and identification tests. However, variations were observed in disintegration and assay results, with some products failing to meet the British Pharmacopoeia (BP) specifications for vitamin C content. The assay results obtained using titration and colorimetric methods. Out of the nine products tested, seven complied with the BP assay specifications, one contained less vitamin C than the permitted limit, and one exceeded the specified upper limit.

Furthermore, the challenge of substandard vitamin C formulation is well documented in African markets. Babalola, et alconducted a study assessed five brands of ascorbic acid tablets [10]. The brands were analyzed for their uniformity of weight, hardness, friability and disintegration time using official methods, quantitative analysis was conducted using dissolution test and high-performance liquid chromatography (HPLC). All five brands passed the friability test, disintegration test and dissolution test and content uniformity.

In Libya, the pharmaceutical market is heavily reliant on imported brands from various global sources. Despite the high consumption of vitamin C supplements, there is a profound lack of published studies specifically evaluating the in vitro quality of vitamin C tablets available

Corresponding author: Email: fashmam@elmergib.edu.ly

LEBDA MEDICAL JOURNAL, VOL. 11, NO. 2 (30 October 2026), PP. 39–48.

Lebda Medical Journal; [LMJ]; {Online ISSN:2520-095X}

Lebda Medical Journal Homepage: https://lebmedj.elmergib.edu.ly/index.php/LMJ/en

Received:19.10.2026; Revised:27.10.2026; Accepted:28.10.2026; Published:30.10.2026.

in the Libyan market. Most existing local literature focuses on clinical nutritional status rather than the pharmaceutical equivalence of the products [11-13]. This study represents an effort to address this gap by assessing the quality of different brands available to Libyan consumers. The present study was conducted due to widespread availability of numerous brands of vitamin C tablets in the pharmaceutical local market. As a commonly consumed OTC product, vitamin C tablets must consistently comply with pharmacopeial quality standards to ensure therapeutic effectiveness and patient safety. Conducting such a study contributes to regulatory monitoring, supports Good Manufacturing Practice (GMP) enforcement, and promotes the availability of safe, effective, and high-quality pharmaceutical products. Therefore, this study aims to evaluate and compare the quality and in-vitro performance of selected brands of 500mg ascorbic acid tablets available in the Libyan market in accordance with United State Pharmacopeia (USP) standards.

2. Materials and Methods

2.1 Materials

Four brands of vitamin C 500mg tablets available in the Libyan market were purchased from community pharmacy and coded alphabetically as shown in Table 1. The products were checked for tablet appearance, aesthetics, packaging quality, batch number, manufacturing and expiry dates before purchasing. In addition, standard vitamin C (Mindex Limited. UK) used as reference.

Table 1. Different Brands of Vitamin C tablets

Code	Origin	Batch No	Manufacturing Date	Expiry Date
Brand 1	USA	42535	11/2024	11/2027
Brand 2	Tunisia	VC 01	12/2024	12/2026
Brand 3	Tunisia	24116	10/2024	10/2027
Brand 4	Ukraine	056	09/2024	09/2027

2.2 Methodology

This study applied official pharmacopeial guidelines, specifically the United States Pharmacopeia (USP), to establish the appropriate in vitro quality control protocols and analytical procedures. Several physicochemical assessments of vitamin C tablets were evaluated including, weight variation, friability, hardness, drug content, disintegration time and dissolution profile.

2.2.1 Hardness test

The hardness test was conducted using Erweka hardness tester (TBH 125, Erweka, Germany). Ten tablets from each brand were randomly selected, and each tablet was placed between the jaws of the tester. The force at which the tablets cracked or broken recorded in Newtons (N).

2.2.2 Weight variation:

Twenty tablets were randomly selected from each brand of the vitamin C tablets. The tablets were weighed individually using an electronic analytical balance and the main individual weight recorded. The average weight of each brand was calculated and standard deviations were

Corresponding author: Email: fashmam@elmergib.edu.ly

LEBDA MEDICAL JOURNAL, VOL. 11, NO. 2 (30 October 2026), PP. 39–48.

Lebda Medical Journal; [LMJ]; {Online ISSN:2520-095X}

Lebda Medical Journal Homepage: https://lebmedj.elmergib.edu.ly/index.php/LMJ/en

Received:19.10.2026; Revised:27.10.2026; Accepted:28.10.2026; Published:30.10.2026.

determined. The product passed the test, if not more than two tablets out of 20 falling outside the official percentage limit ±5% to ±10% of the average weight, and none exceedingly twice the allowed limit.

2.2.3 Friability test:

Ten tablets were randomly selected from each brand for this investigation. The tablets were cleaned of adhering powder and weighed prior to testing. In accordance with the manufacturer's instructions, the tablets were placed into the friabilator drum (Pharma Test Apparatebau AG, Germany) and the apparatus was operated for 100 revolutions. After completion the test, the tablets were removed, cleaned of adhering powder and reweighed.

According to USP standards, a weight loss of less than or equal to 1% is considered acceptable for tablet friability.

The friability result was calculated using the following formula:

$$\textbf{Friability (\%)} = [(W1 - W2) / W1] \times 100$$

where W1 represents the initial weight of the tablets and W2 represents the final weight after the test.

2.2.4 Dissolution test:

The dissolution test was performed using dissolution testing apparatus II (DT600, Erweka GmbH, Germany). The apparatus was equilibrated and maintained at a temperature of 37 ±0.5 °C. Six tablets were placed individually into the vessels; each fitted with a paddle. The dissolution medium consisted of 900 mL of distilled water (pH 6.0). The paddle rotation speed was set at 50 rpm.

At predetermined time intervals (10, 20, 30, 40, 50, and 60 minutes), samples of 5 ml were withdrawn and replaced with 5ml dissolution medium. The samples then filtered and diluted 50 times using dissolution medium. The absorbance of the diluted solution was measured at 267 nm using a UV–Visible spectrophotometer (SPECORD 210 PLUS, Analytik Jena, Germany). The concentration of vitamin C in the dissolution medium was subsequently calculated using previously established calibration curve. According to the USP, the tablet complies with the test if each unit contains not less than 75%(Q) of the labeled amount of the drug dissolved within 45 minutes.

2.2.5 Disintegration test:

The disintegration apparatus (Pharma Test PTZS, Germany) was used and equilibrated to maintain at a temperature of 37 ±2.0°C. One tablet from a specific brand was placed in each of the six tubes of the basket assembly, and a disc was positioned appropriately. The apparatus was operated using distilled water as the immersion medium. The time required for each tablet to disintegrate was recorded. The test was stopped after 30 minutes if complete disintegration had not occurred.

According to USP standards, the tablets comply with the test if all six tablets disintegrate completely within 30 minutes. If one or two tablets fail to disintegrate, the test should be repeated using 12 additional tablets. The requirement is considered fulfilled if not fewer than 16 of the total 18 tablets tested disintegrate completely within 30 minutes.

2.2.6 Uniformity of Content test:

The evaluation of a tablet's therapeutic potential requires careful monitoring of drug content uniformity to ensure consistency among individual tablets as well as between different production batches. In this study, ten tablets of each brand were selected and crushed individually into fine powder. Each tablet's powder was dissolved in distilled water, filtered and diluted. The absorbance was measured using UV-Visible spectrophotometer (Specord 210 PLUS, Analytik Jena, Germany) at 267 nm. Drug content was calculated for each tablet and

Corresponding author: Email: fashmam@elmergib.edu.ly

LEBDA MEDICAL JOURNAL, VOL. 11, NO. 2 (30 October 2026), PP. 39–48.

Lebda Medical Journal; [LMJ]; {Online ISSN:2520-095X}

Lebda Medical Journal Homepage: https://lebmedj.elmergib.edu.ly/index.php/LMJ/en

Received:19.10.2026; Revised:27.10.2026; Accepted:28.10.2026; Published:30.10.2026.

compared against USP standards to determine uniformity. According to USP, using a suitable analytical method to determine the individual contents of APIs of 10 tablets taken at random. The tablet complies with the test, if each individual content is between 85% and 115% of the labelled claim content.

2.2.7 Statistical Data Analysis

The obtained results assessment of pharmaceutical equivalence is a critical step in ensuring that four multinational Vitamin C brands perform similarly or different. This statistical method was used to determine whether there were statistically significant differences among the brands with respect to their physicochemical characteristics. To achieve this, two complementary approaches were used: The statistical methods used (ANOVA) and Model-Independent Methods (F1 and F2).

1. Statistically Significant (ANOVA)

One-Way ANOVA (Excel 2016, Microsoft, US). This test determines if there is a significant difference among all the tested brands as a group. A p-value < 0.05 indicate that the brands are significantly different.

2. Similarity and Difference Factors (F1 & F2)

These are the primary regulatory tools recommended by the FDA to compare dissolution curves:

a. The difference Factor (F1): It calculates the percent difference between two curves. For the products to be considered similar, the value must be ≤ 15.

b. The similarity Factor (F2): It measures how close the dissolution profiles are to each other. A value between 50 and 100 ensures that the two brands are similar and interchangeable.

3. Results and discussion

3.1 Weight Variation:

The experimental findings indicated that the average weights of all four vitamin C brands (Brand 1, Brand 2, Brand 3, Brand 4) were greater than 324 mg. According to USP standards, for tablets within this weight range, the permissible deviation from the average weight is ±5%, with no more than two tablets exceed this limit and none exceeding ±10%. The percentage deviations of individual tablet weights from the average weight for each brand are presented in Table 2.

Table 2. Weight variation results

Code	Average weight	Max Deviation
Brand 1	795.53mg	±1.554938%
Brand 2	644.405mg	±3.0873441%
Brand 3	621.86mg	±5.795516%
Brand 4	495.055mg	±7.424427%

For Brands 1 and 2, all tablets complied with the USP weight variation limits none of the tablets deviated by more than ±5% from the average weight. Therefore, all tablets complied with the USP weight variation limits. Brand 3 complied with the USP weight variation standards. Although one tablet deviated by more than ±5%, it remained within the maximum allowable limit of ±10%. Therefore, Brand 3 is considered acceptable and meets the official requirements. Brand 4 did not comply with the USP weight variation specifications, as three individual

Corresponding author: Email: fashmam@elmergib.edu.ly

LEBDA MEDICAL JOURNAL, VOL. 11, NO. 2 (30 October 2026), PP. 39–48.

Lebda Medical Journal; [LMJ]; {Online ISSN:2520-095X}

Lebda Medical Journal Homepage: https://lebmedj.elmergib.edu.ly/index.php/LMJ/en

Received:19.10.2026; Revised:27.10.2026; Accepted:28.10.2026; Published:30.10.2026.

tablets deviated beyond the ±5% limit. Since the pharmacopeial standard permits no more than two tablets to exceed this range, Brand 4 failed the uniformity of weight test.

3.2 Friability:

All tested Brands complied with the USP specifications for friability, except Brand 2 and Brand 4. Brand 2 showed a friability value slightly above the acceptable limit (1.028%), indicating a minor tendency toward mechanical breakage. In contrast, Brand 4 exhibited a remarkably high friability percentage of 7.049%, which severely violates the USP standard (not more than 1%) as shown in Table 3. This substantial deviation indicates that Brand 4 lacks adequate mechanical strength and tablet cohesion, making it highly susceptible to capping, lamination, or crumbling during packaging and transport. The increased friability in both brands, particularly the severe failure in Brand 4, could be attributed to insufficient binder concentration, moisture content, inadequate compression force during manufacturing, or improper storage. Unlike Brand 2, where the deviation is minimal, the significant failure of Brand 4 critically affects the overall product quality.

Table 3. Friability test results

Code	Initial weight	Final weight	% friability
Brand 1	795.59mg	794.21mg	0.1735
Brand 2	645.87mg	639.23mg	1.0280
Brand 3	620.88mg	619.20mg	0.2706
Brand 4	498.76mg	463.60mg	7.049

3.3 Hardness test:

The crushing strength (hardness) of the selected four vitamin C Brands was determined, and the average values along with their standard deviation (SD) are summarized in Table 4. The hardness test results indicate noticeable variations among the four tested Brands. Brands 1 exhibited the highest mechanical strength with an average hardness of 104.3 N, indicating a highly compacted tablet, though it also showed the highest variance (SD= 16.38). In contrast, Brands 2 and 4 recorded the lowest average hardness values at 37N and 39.3N, respectively. Brand 3 demonstrated an intermediate and robust hardness of 70.2N with good consistency (SD=6.18).

Although pharmacopeia (USP) does not specify a strict universal limit for tablet hardness since it largely depends on the formulation intended use (e.g., chewable vs swallowable tablets) a general industrial acceptance criterion for conventional tablets is typically above 40N to ensure structural integrity during handling, packaging, and transportation. Based on these results, Brands 1 and 3 possess strong mechanical integrity, while Brands 4 and 2 are on the softer side (falling slightly below 40N) but may still be acceptable depending on their specific formulation.

Table 4. The hardness results

Code	Average value (N)	Standard Deviation
Brand 1	104.3	16.3847
Brand 2	37	5.8357
Brand 3	70.2	6.1788
Brand 4	39.3	3.4075

Corresponding author: Email: fashmam@elmergib.edu.ly

LEBDA MEDICAL JOURNAL, VOL. 11, NO. 2 (30 October 2026), PP. 39–48.

Lebda Medical Journal; [LMJ]; {Online ISSN:2520-095X}

Lebda Medical Journal Homepage: https://lebmedj.elmergib.edu.ly/index.php/LMJ/en

Received:19.10.2026; Revised:27.10.2026; Accepted:28.10.2026; Published:30.10.2026.

3.4 Disintegration time:

The disintegration time is a crucial physical property of tablets, representing the first step toward drug dissolution and subsequent absorption. The disintegration time for six tablets from each of four brands was determined and the results are shown in Table 5. All tested brands successfully complied with the 30-minute disintegration limit. These results indicate that while all brands meet the disintegration standards; the four tested brands showed notable variability, as Brand 3 demonstrating the most efficient performance through the fastest disintegration (1.26min) and highest consistency (SD=0.36), which directly correlates with the "Burst release" observed in its dissolution profile (Figure 1). While Brand 4 and Brand 2 recorded moderate disintegration averages of 6.02 and 13.50 minutes respectively, and Brand 1 showed the longest time at 20.36 minutes.

Table 5. Disintegration time results

Tab. No	Brand 1	Brand 2	Brand 3	Brand 4
1	18:02	11:00	1:03	2:12
2	18:10	11:01	1:05	3:30
3	20:00	11:02	1:08	5:59
4	21:00	14:00	1:09	6:20
5	21:00	16:00	1:10	8:00
6	24:00	18:00	2:00	10:12
average	20.36	13.50	1.26	6.02
SD	2.21	3.01	0.36	2.91

3.5 Dissolution test:

Dissolution rate is an important quality control parameter that is directly related to the absorption and bioavailability of vitamin C. The present study found that after 45 minutes, the release rate of different brands showed a wide variation, ranging from 38% to 98% (Figure 1). Brand 3 showed the highest percentage of drug release reaching approximately 98% at the 45minutes, indicating excellent dissolution. Brand 2 and Brand 1 followed with a satisfactory release rate of about 85%. Brand 4 had the lowest release at only 38%, which fails to meet the standard dissolution requirements for immediate-release tablets.

This substantial variation among the brands can be attributed to several pharmaceutical factors, including the type and concentration of excipients such as binder, disintegrant, and lubricant, as well as differences in the manufacturing process, particularly the compression force applied during tablet production, or storage conditions.

3.5.1 Statistical Analysis and Pharmaceutical Equivalence:

One-Way ANOVA: The simultaneous comparison of the four Vitamin C brands yielded a p-value of 0.008. Since this result is statistically significant ($p < 0.05$), it indicates substantial variations in the dissolution behavior among the tested brands. However further pairwise comparison revealed an exception between Brand 1 and Brand 2; no significant difference was observed between them ($P= 0.363$), suggesting pharmaceutical equivalence between these two specific Brands.

Corresponding author: Email: fashmam@elmergib.edu.ly

LEBDA MEDICAL JOURNAL, VOL. 11, NO. 2 (30 October 2026), PP. 39–48.

Lebda Medical Journal; [LMJ]; {Online ISSN:2520-095X}

Lebda Medical Journal Homepage: https://lebmedj.elmergib.edu.ly/index.php/LMJ/en

Received:19.10.2026; Revised:27.10.2026; Accepted:28.10.2026; Published:30.10.2026.

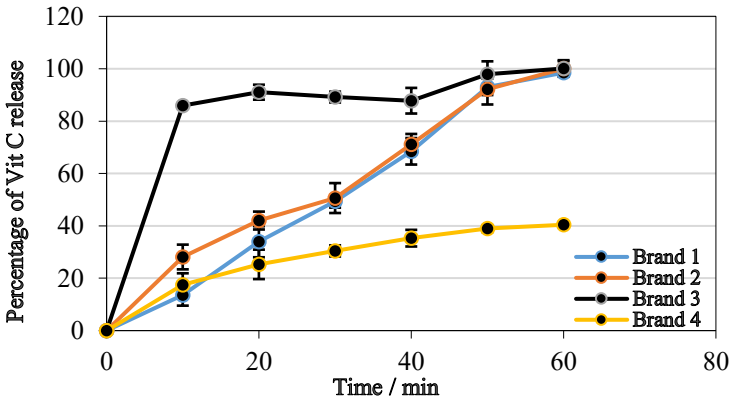


Figure 1. The dissolution profile of different vitamin C Brands

Evaluation of Similarity (f1 and f2):

Table 6 summarizes the mathematical comparison between the brands in their dissolution performance. The comparison between Brand 1 and Brand 2 was the only one met the FDA requirements for similarity (f2 =57.70). This suggest that these two formulations are likely manufactured using similar excipients and compression forces, leading to an equivalent dissolution rate that ensures identical therapeutic performance.

Table 6. Statistical Analysis of the Dissolution Performance of Different Brands

Comparison Brands	f1(Limit ≤ 15)	f2 (Limit ≥ 50)	Result
Brand 1 vs. Brand 2	7.62	57.70	Similar
Brand 1 vs. Brand 4	47.35	22.07	Not Similar
Brand 2 vs. Brand 4	51.08	21.24	Not Similar
Brand 2 vs. Brand 3	43.70	22.51	Not Similar
Brand 3 vs. Brand 4	65.96	10.76	Not Similar
Brand 1 vs. Brand 3	54.64	18.94	Not Similar

In contrast, the pairwise comparison between the other brands specifically Brand 1vs. Brand 4, Brand 2 vs. Brand 3, and Brand 2 vs. Brand 4 showed severe deviations in their dissolution profiles. These brands failed to meet the pharmaceutical equivalence criteria, as indicated by the low f2 values. For instance, the comparison between Brand 3 and Brand 4 resulted in an f2 of only 10.76, which is far below the required limit of 50. Furthermore, the high f1 values (65.96) confirm a large relative difference in the amount of drug released at each interval. This indicates that the rate and extent of Vitamin C release vary significantly between these manufacturers.

3.6 Uniformity of Content:

The determination of the active pharmaceutical ingredient (API) concentration is a fundamental quality control parameter to ensure patient safety and therapeutic efficacy. The acceptable pharmacopeial limit for vitamin C ranging from 85% to 115% of the labeled claim. Assuming a standard label claim of 500 mg, the results displayed in Figure 2 reveal that Brand 1 exhibited the most accurate formulation with a

Corresponding author: Email: fashmam@elmergib.edu.ly

LEBDA MEDICAL JOURNAL, VOL. 11, NO. 2 (30 October 2026), PP. 39–48.

Lebda Medical Journal; [LMJ]; {Online ISSN:2520-095X}

Lebda Medical Journal Homepage: https://lebmedj.elmergib.edu.ly/index.php/LMJ/en

Received:19.10.2026; Revised:27.10.2026; Accepted:28.10.2026; Published:30.10.2026.

concentration of 487mg (97.4%), while Brands 2 and 3 showed higher concentration of 569mg (113.8) and 563mg (112.6%) respectively. Although these values are near the upper limit, they remain within the acceptable range. In contrast, Brand 4 failed the test significantly, recording a critically low concentration of only 292 mg (58.4%), which is severely below the minimum required limit. This significant deficiency in API concentration directly explains the poor dissolution profile previously observed for Brand 4 (Figure 1), confirming that the formulation lacks the necessary drug content to achieve therapeutic efficacy. This significant deficiency in API concentration can be attributed to major formulation or manufacturing problems, including possible blending failure or segregation of the active pharmaceutical ingredient, or it can be ascribed to improper storage or packaging which may expose API to external environment, as Vitamin C is known to be highly affected by a variety of environmental factors, including pH, temperature, oxygen, light and moisture that lead to reduced stability for vitamin C.

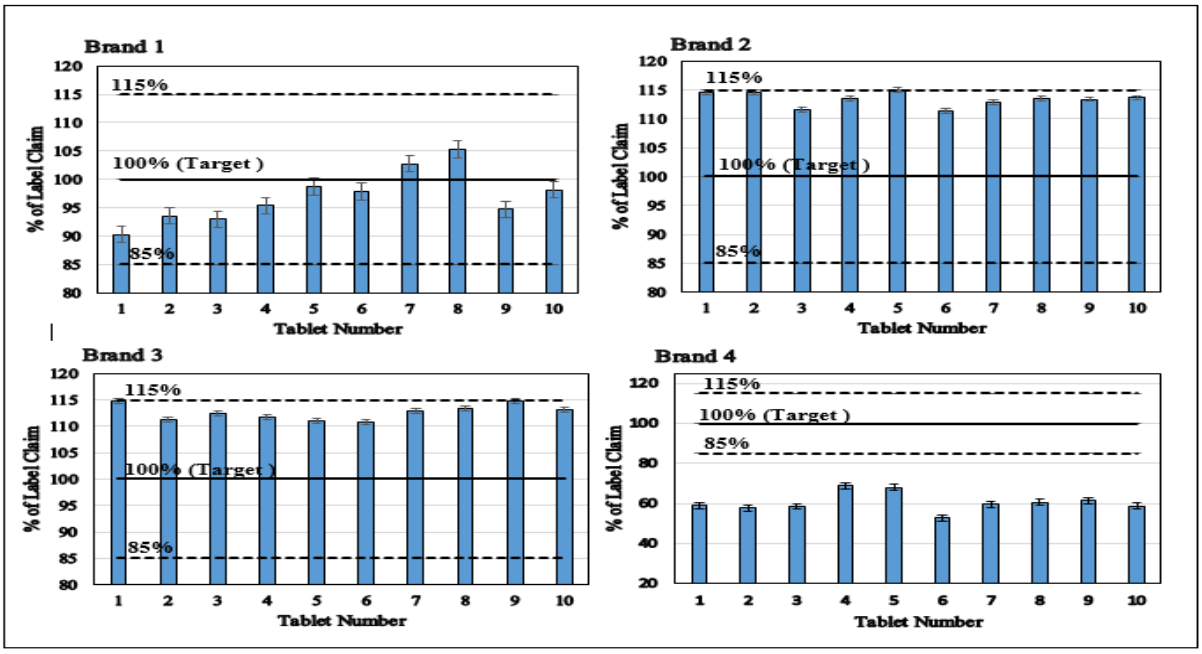


Figure 2. The content uniformity of different vitamin C Brands

4. Conclusion

The therapeutic efficacy of vitamin C depends on its pharmaceutical quality. Therefore, strict quality control is essential to ensure the safety, stability, and uniformity of vitamin C tablets across different brands. This study evaluated the in-vitro pharmaceutical quality of four 500 mg vitamin C brands available in the Libyan market against official pharmacopeial standards. The findings revealed significant variations in the physicochemical characteristics and in-vitro performance among the tested products. While most of the evaluated brands demonstrated high pharmaceutical quality and complied with the required standards for hardness and disintegration, critical deviations were observed.

Both Brand 2 and Brand 4 failed the friability test. While Brand 2 showed a minor deviation, Brand 4 exhibited a severe failure in friability, indicating a critical lack of mechanical strength and tablet cohesion during handling and transportation. In addition, Brand 4 showed

Corresponding author: Email: fashmam@elmergib.edu.ly

Lebda Medical Journal; [LMJ]; {Online ISSN:2520-095X}

Lebda Medical Journal Homepage: https://lebmedj.elmergib.edu.ly/index.php/LMJ/en

Received:19.10.2026; Revised:27.10.2026; Accepted:28.10.2026; Published:30.10.2026.

comprehensive quality deficiencies, failing the weight variation, content uniformity, and dissolution tests. These accumulated failures may drastically affect the consistency of the delivered dose and the release of the active pharmaceutical ingredient, potentially reducing or compromising the therapeutic effectiveness of the product.

Both Brand 1 and Brand 3 successfully complied with all quality control tests. However, Brand 3 demonstrated superior performance, achieving a faster drug release rate in the dissolution test and a shorter disintegration time compared to the other brands. In conclusion, the findings indicate that not all vitamin C brands available in the Libyan market meet the required pharmacopeial standards. Continuous quality control testing, strict regulatory supervision, and proper storage conditions are essential to ensure that pharmaceutical products distributed in the market provide safe, effective, and reliable therapeutic outcomes.

CONFLICT OF INTEREST

The authors declare no conflict of interest

AUTHORS' CONTRIBUTIONS

F. S: Methodology Conceptualization, Investigation, writing original draft, Writing review & editing. A.A: Resources, Writing review & editing. M. A: Methodology & editing Investigation. O. A: Writing review & editing. A.S.A: Methodology, writing original draft. S. A: Methodology, writing original draft. A.S: Methodology, writing original draft.

5. References

1. Padayatty SJ, Levine M. Vitamin C: the known and the unknown and Goldilocks. Oral Dis. 2016;22(6):463–493. doi:10.1111/odi.12446.
2. See XZ, Yeo WS, Saptoro A. A comprehensive review and recent advances of vitamin C: Overview, functions, sources, applications, market survey and processes. Chemical Engineering Research and Design. 2024 Jun 1; 206:108-29. https://doi.org/10.1016/j.cherd.2024.04.048.
3. Abdullah M, Jamil RT, Attia FN. Vitamin C (ascorbic acid) [Updated 2023 May 1]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan–. Available from: https://www.ncbi.nlm.nih.gov/books/NBK499877/
4. Cerullo G, et al. The long history of vitamin C: from prevention of the common cold to potential aid in the treatment of COVID-19. Front Immunol. 2020;11:574029. doi: 10.3389/fimmu.2020.574029
5. Yin X, et al. Chemical stability of ascorbic acid integrated into commercial products: a review on bioactivity and delivery technology. Antioxidants (Basel). 2022;11(1):153. doi: 10.3390/antiox11010153
6. Lahai M, et al. Evaluation of the quality of different brands of ascorbic acid in Freetown, Sierra Leone. Int J Pharm Pharm Sci. 2021;13(9).
7. Taylor KMG, Aulton ME, editors. Aulton's pharmaceutics: the design and manufacture of medicines. 4th ed. Edinburgh: Churchill Livingstone/Elsevier; 2013.
8. Pathy K. Process for preparation of vitamin C and method for determination of vitamin C in tablets. SF J Chem Res. 2018;2(1). Available from: https://www.myexperiment.org/files/1979/versions/1.
9. Iwuozor KO. Quality assessment of selected vitamin C tablets sold at Bridge Head Market, Onitsha. Chem Biomol Eng. 2018;3(3):47–50. doi: 10.11648/j.cbe.20180303.15
10. Babalola DG, et al. Quality assessment of five brands of ascorbic acid tablets marketed in Ogun state, Nigeria. J Pharm Bioresour. 2025;22(1):13–22. doi: 10.4314/jpb.v22i1.2
11. Eljamay SM, Alghazali MAA, Eldalal HHA. Incident of vitamin D deficiency in Derna City, Libya. J Endo Metabol Res. 2022;3(1):1–15. doi: 10.37191/Mapsci-2582-7960-3(1)-020
12. Sulayman LA, et al. Comparison of vitamin C in various fresh and commercial fruit juices commonly consumed in the northwestern region of Libya. Nova Journal of Medical and Biological Sciences. 2018;7(1):1–4. doi: 10.20286/nova-jmbs-070102
13. Bofars MS. High temperature decreases the vitamin C bioavailability in five fruits juice collected from Tripoli, Libya. Biological and Biomedical Journal. 2025;2(2):67–72. doi: 10.21608/bbj.2024.263771.1044

Corresponding author: Email: fashmam@elmergib.edu.ly