

# GEORGIAN MEDICAL NEWS

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ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

Медицинские новости Грузии  
საქართველოს სამედიცინო სიახლენი

## GEORGIAN MEDICAL NEWS

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**GMN: Georgian Medical News** is peer-reviewed, published monthly journal committed to promoting the science and art of medicine and the betterment of public health, published by the GMN Editorial Board since 1994. GMN carries original scientific articles on medicine, biology and pharmacy, which are of experimental, theoretical and practical character; publishes original research, reviews, commentaries, editorials, essays, medical news, and correspondence in English and Russian.

GMN is indexed in MEDLINE, SCOPUS, PubMed and VINITI Russian Academy of Sciences. The full text content is available through EBSCO databases.

**GMN: Медицинские новости Грузии** - ежемесячный рецензируемый научный журнал, издаётся Редакционной коллегией с 1994 года на русском и английском языках в целях поддержки медицинской науки и улучшения здравоохранения. В журнале публикуются оригинальные научные статьи в области медицины, биологии и фармации, статьи обзорного характера, научные сообщения, новости медицины и здравоохранения. Журнал индексируется в MEDLINE, отражён в базе данных SCOPUS, PubMed и ВИНТИ РАН. Полнотекстовые статьи журнала доступны через БД EBSCO.

**GMN: Georgian Medical News** – საქართველოს სამედიცინო სიახლენი – არის ყოველთვიური სამეცნიერო სამედიცინო რეცენზირებადი ჟურნალი, გამოიცემა 1994 წლიდან, წარმოადგენს სარედაქციო კოლეგიისა და აშშ-ის მეცნიერების, განათლების, ინდუსტრიის, ხელოვნებისა და ბუნებისმეტყველების საერთაშორისო აკადემიის ერთობლივ გამოცემას. GMN-ში რუსულ და ინგლისურ ენებზე ქვეყნდება ექსპერიმენტული, თეორიული და პრაქტიკული ხასიათის ორიგინალური სამეცნიერო სტატიები მედიცინის, ბიოლოგიისა და ფარმაციის სფეროში, მიმოხილვითი ხასიათის სტატიები.

ჟურნალი ინდექსირებულია MEDLINE-ის საერთაშორისო სისტემაში, ასახულია SCOPUS-ის, PubMed-ის და ВИНТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებში.

## WEBSITE

[www.geomednews.com](http://www.geomednews.com)

## К СВЕДЕНИЮ АВТОРОВ!

При направлении статьи в редакцию необходимо соблюдать следующие правила:

1. Статья должна быть представлена в двух экземплярах, на русском или английском языках, напечатанная через **полтора интервала на одной стороне стандартного листа с шириной левого поля в три сантиметра**. Используемый компьютерный шрифт для текста на русском и английском языках - **Times New Roman (Кириллица)**, для текста на грузинском языке следует использовать **AcadNusx**. Размер шрифта - **12**. К рукописи, напечатанной на компьютере, должен быть приложен CD со статьей.

2. Размер статьи должен быть не менее десяти и не более двадцати страниц машинописи, включая указатель литературы и резюме на английском, русском и грузинском языках.

3. В статье должны быть освещены актуальность данного материала, методы и результаты исследования и их обсуждение.

При представлении в печать научных экспериментальных работ авторы должны указывать вид и количество экспериментальных животных, применявшиеся методы обезболивания и усыпления (в ходе острых опытов).

4. К статье должны быть приложены краткое (на полстраницы) резюме на английском, русском и грузинском языках (включающее следующие разделы: цель исследования, материал и методы, результаты и заключение) и список ключевых слов (key words).

5. Таблицы необходимо представлять в печатной форме. Фотокопии не принимаются. **Все цифровые, итоговые и процентные данные в таблицах должны соответствовать таковым в тексте статьи.** Таблицы и графики должны быть озаглавлены.

6. Фотографии должны быть контрастными, фотокопии с рентгенограмм - в позитивном изображении. Рисунки, чертежи и диаграммы следует озаглавить, пронумеровать и вставить в соответствующее место текста **в tiff формате**.

В подписях к микрофотографиям следует указывать степень увеличения через окуляр или объектив и метод окраски или импрегнации срезов.

7. Фамилии отечественных авторов приводятся в оригинальной транскрипции.

8. При оформлении и направлении статей в журнал МНГ просим авторов соблюдать правила, изложенные в «Единых требованиях к рукописям, представляемым в биомедицинские журналы», принятых Международным комитетом редакторов медицинских журналов - <http://www.spinesurgery.ru/files/publish.pdf> и [http://www.nlm.nih.gov/bsd/uniform\\_requirements.html](http://www.nlm.nih.gov/bsd/uniform_requirements.html). В конце каждой оригинальной статьи приводится библиографический список. В список литературы включаются все материалы, на которые имеются ссылки в тексте. Список составляется в алфавитном порядке и нумеруется. Литературный источник приводится на языке оригинала. В списке литературы сначала приводятся работы, написанные знаками грузинского алфавита, затем кириллицей и латиницей. Ссылки на цитируемые работы в тексте статьи даются в квадратных скобках в виде номера, соответствующего номеру данной работы в списке литературы. Большинство цитированных источников должны быть за последние 5-7 лет.

9. Для получения права на публикацию статья должна иметь от руководителя работы или учреждения визу и сопроводительное отношение, написанные или напечатанные на бланке и заверенные подписью и печатью.

10. В конце статьи должны быть подписи всех авторов, полностью приведены их фамилии, имена и отчества, указаны служебный и домашний номера телефонов и адреса или иные координаты. Количество авторов (соавторов) не должно превышать пяти человек.

11. Редакция оставляет за собой право сокращать и исправлять статьи. Корректуре авторам не высылаются, вся работа и сверка проводится по авторскому оригиналу.

12. Недопустимо направление в редакцию работ, представленных к печати в иных издательствах или опубликованных в других изданиях.

**При нарушении указанных правил статьи не рассматриваются.**

## REQUIREMENTS

Please note, materials submitted to the Editorial Office Staff are supposed to meet the following requirements:

1. Articles must be provided with a double copy, in English or Russian languages and typed or computer-printed on a single side of standard typing paper, with the left margin of 3 centimeters width, and 1.5 spacing between the lines, typeface - **Times New Roman (Cyrillic)**, print size - 12 (referring to Georgian and Russian materials). With computer-printed texts please enclose a CD carrying the same file titled with Latin symbols.

2. Size of the article, including index and resume in English, Russian and Georgian languages must be at least 10 pages and not exceed the limit of 20 pages of typed or computer-printed text.

3. Submitted material must include a coverage of a topical subject, research methods, results, and review.

Authors of the scientific-research works must indicate the number of experimental biological species drawn in, list the employed methods of anesthetization and soporific means used during acute tests.

4. Articles must have a short (half page) abstract in English, Russian and Georgian (including the following sections: aim of study, material and methods, results and conclusions) and a list of key words.

5. Tables must be presented in an original typed or computer-printed form, instead of a photocopied version. **Numbers, totals, percentile data on the tables must coincide with those in the texts of the articles.** Tables and graphs must be headed.

6. Photographs are required to be contrasted and must be submitted with doubles. Please number each photograph with a pencil on its back, indicate author's name, title of the article (short version), and mark out its top and bottom parts. Drawings must be accurate, drafts and diagrams drawn in Indian ink (or black ink). Photocopies of the X-ray photographs must be presented in a positive image in **tiff format**.

Accurately numbered subtitles for each illustration must be listed on a separate sheet of paper. In the subtitles for the microphotographs please indicate the ocular and objective lens magnification power, method of coloring or impregnation of the microscopic sections (preparations).

7. Please indicate last names, first and middle initials of the native authors, present names and initials of the foreign authors in the transcription of the original language, enclose in parenthesis corresponding number under which the author is listed in the reference materials.

8. Please follow guidance offered to authors by The International Committee of Medical Journal Editors guidance in its Uniform Requirements for Manuscripts Submitted to Biomedical Journals publication available online at: [http://www.nlm.nih.gov/bsd/uniform\\_requirements.html](http://www.nlm.nih.gov/bsd/uniform_requirements.html)  
[http://www.icmje.org/urm\\_full.pdf](http://www.icmje.org/urm_full.pdf)

In GMN style for each work cited in the text, a bibliographic reference is given, and this is located at the end of the article under the title "References". All references cited in the text must be listed. The list of references should be arranged alphabetically and then numbered. References are numbered in the text [numbers in square brackets] and in the reference list and numbers are repeated throughout the text as needed. The bibliographic description is given in the language of publication (citations in Georgian script are followed by Cyrillic and Latin).

9. To obtain the rights of publication articles must be accompanied by a visa from the project instructor or the establishment, where the work has been performed, and a reference letter, both written or typed on a special signed form, certified by a stamp or a seal.

10. Articles must be signed by all of the authors at the end, and they must be provided with a list of full names, office and home phone numbers and addresses or other non-office locations where the authors could be reached. The number of the authors (co-authors) must not exceed the limit of 5 people.

11. Editorial Staff reserves the rights to cut down in size and correct the articles. Proof-sheets are not sent out to the authors. The entire editorial and collation work is performed according to the author's original text.

12. Sending in the works that have already been assigned to the press by other Editorial Staffs or have been printed by other publishers is not permissible.

**Articles that Fail to Meet the Aforementioned  
Requirements are not Assigned to be Reviewed.**

## ავტორთა საყურადღებო!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დავიცვათ შემდეგი წესები:

1. სტატია უნდა წარმოადგინოთ 2 ცალად, რუსულ ან ინგლისურ ენებზე, დაბეჭდილი სტანდარტული ფურცლის 1 გვერდზე, 3 სმ სიგანის მარცხენა ველისა და სტრიქონებს შორის 1,5 ინტერვალის დაცვით. გამოყენებული კომპიუტერული შრიფტი რუსულ და ინგლისურენოვან ტექსტებში - **Times New Roman (Кириллица)**, ხოლო ქართულენოვან ტექსტში საჭიროა გამოვიყენოთ **AcadNusx**. შრიფტის ზომა – 12. სტატიას თან უნდა ახლდეს CD სტატიით.

2. სტატიის მოცულობა არ უნდა შეადგენდეს 10 გვერდზე ნაკლებს და 20 გვერდზე მეტს ლიტერატურის სიის და რეზიუმეების (ინგლისურ, რუსულ და ქართულ ენებზე) ჩათვლით.

3. სტატიაში საჭიროა გაშუქდეს: საკითხის აქტუალობა; კვლევის მიზანი; საკვლევი მასალა და გამოყენებული მეთოდები; მიღებული შედეგები და მათი განსჯა. ექსპერიმენტული ხასიათის სტატიების წარმოდგენისას ავტორებმა უნდა მიუთითონ საექსპერიმენტო ცხოველების სახეობა და რაოდენობა; გაუტკივარებისა და დაძინების მეთოდები (მწვავე ცდების პირობებში).

4. სტატიას თან უნდა ახლდეს რეზიუმე ინგლისურ, რუსულ და ქართულ ენებზე არანაკლებ ნახევარი გვერდის მოცულობისა (სათაურის, ავტორების, დაწესებულების მითითებით და უნდა შეიცავდეს შემდეგ განყოფილებებს: მიზანი, მასალა და მეთოდები, შედეგები და დასკვნები; ტექსტუალური ნაწილი არ უნდა იყოს 15 სტრიქონზე ნაკლები) და საკვანძო სიტყვების ჩამონათვალი (key words).

5. ცხრილები საჭიროა წარმოადგინოთ ნაბეჭდი სახით. ყველა ციფრული, შემავსებელი და პროცენტული მონაცემები უნდა შეესაბამებოდეს ტექსტში მოყვანილს.

6. ფოტოსურათები უნდა იყოს კონტრასტული; სურათები, ნახაზები, დიაგრამები - დასათაურებული, დანომრილი და სათანადო ადგილას ჩასმული. რენტგენოგრაფიის ფოტოსურათები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალების შედეგების ან იმპრეგნაციის მეთოდი და აღნიშნოთ სურათის ზედა და ქვედა ნაწილები.

7. სამამულო ავტორების გვარები სტატიაში აღინიშნება ინიციალების თანდართვით, უცხოურისა – უცხოური ტრანსკრიპციით.

8. სტატიას თან უნდა ახლდეს ავტორის მიერ გამოყენებული სამამულო და უცხოური შრომების ბიბლიოგრაფიული სია (ბოლო 5-8 წლის სიღრმით). ანბანური წყობით წარმოდგენილ ბიბლიოგრაფიულ სიაში მიუთითეთ ჯერ სამამულო, შემდეგ უცხოელი ავტორები (გვარი, ინიციალები, სტატიის სათაური, ჟურნალის დასახელება, გამოცემის ადგილი, წელი, ჟურნალის №, პირველი და ბოლო გვერდები). მონოგრაფიის შემთხვევაში მიუთითეთ გამოცემის წელი, ადგილი და გვერდების საერთო რაოდენობა. ტექსტში კვადრატულ ფხიხლებში უნდა მიუთითოთ ავტორის შესაბამისი N ლიტერატურის სიის მიხედვით. მიზანშეწონილია, რომ ციტირებული წყაროების უმეტესი ნაწილი იყოს 5-6 წლის სიღრმის.

9. სტატიას თან უნდა ახლდეს: ა) დაწესებულების ან სამეცნიერო ხელმძღვანელის წარდგინება, დამოწმებული ხელმოწერითა და ბეჭდით; ბ) დარგის სპეციალისტის დამოწმებული რეცენზია, რომელშიც მითითებული იქნება საკითხის აქტუალობა, მასალის საკმაობა, მეთოდის სანდოობა, შედეგების სამეცნიერო-პრაქტიკული მნიშვნელობა.

10. სტატიის ბოლოს საჭიროა ყველა ავტორის ხელმოწერა, რომელთა რაოდენობა არ უნდა აღემატებოდეს 5-ს.

11. რედაქცია იტოვებს უფლებას შეასწოროს სტატია. ტექსტზე მუშაობა და შეჯერება ხდება საავტორო ორიგინალის მიხედვით.

12. დაუშვებელია რედაქციაში ისეთი სტატიის წარდგენა, რომელიც დასაბეჭდად წარდგენილი იყო სხვა რედაქციაში ან გამოქვეყნებული იყო სხვა გამოცემებში.

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## COMPARATIVE IN-VITRO QUALITY EVALUATION OF COMMERCIALY AVAILABLE DICLOFENAC SODIUM TABLETS

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### Abstract.

**Background:** Diclofenac Sodium is a widely used non-steroidal anti-inflammatory drug (NSAID) indicated for the management of various inflammatory and painful conditions. Multiple generic brands are available in the Saudi Arabian market, highlighting the importance of evaluating their pharmaceutical quality characteristics.

**Objective:** This study aimed to compare four commercially available brands of Diclofenac Sodium 50 mg enteric-coated tablets using standard in-vitro quality control tests.

**Methods:** Four brands of Diclofenac Sodium enteric-coated tablets were evaluated for weight variation, hardness, friability, disintegration, and dissolution characteristics using established pharmaceutical quality-control procedures. The obtained results were compared with relevant pharmacopeial specifications and commonly accepted quality criteria.

**Results:** All tested brands met the specified acceptance criteria for weight variation and friability. Hardness values varied among brands, with one product exhibiting higher crushing strength than the others. Disintegration testing demonstrated resistance in acidic medium followed by disintegration in phosphate buffer medium. Dissolution testing showed progressive drug release in phosphate buffer, with cumulative drug release exceeding 90% after 60 minutes for all brands.

**Conclusion:** The evaluated Diclofenac Sodium tablet brands demonstrated acceptable in-vitro quality characteristics across the tested parameters. While variations were observed among products, all brands exhibited satisfactory physical performance and drug-release behavior under the study conditions. Further investigations, including content uniformity testing, similarity factor analysis, and in-vivo bioequivalence studies, are recommended to provide a more comprehensive assessment of product equivalence and therapeutic interchangeability.

**Key words.** Diclofenac sodium, non-steroidal anti-inflammatory drugs, in-vitro quality evaluation, enteric-coated tablets, weight variation, friability, disintegration, dissolution, pharmaceutical quality, Saudi Arabia.

### Introduction.

Ensuring the quality, safety, and efficacy of pharmaceutical products is essential, particularly for widely used medications such as Diclofenac Sodium [1]. This non-steroidal anti-inflammatory drug (NSAID) is widely prescribed for its analgesic, antipyretic, and anti-inflammatory properties and is commonly used in the management of osteoarthritis, rheumatoid arthritis, and ankylosing spondylitis [2,3]. Pharmaceutical formulation strategies, including modified-release and pulsatile drug-delivery systems, have been developed to optimize therapeutic outcomes by controlling drug release patterns [4]. For example, press-coated aceclofenac tablets have demonstrated the potential

of timed-release formulations in improving treatment strategies for rheumatoid arthritis [4,5].

Generic medicines provide cost-effective alternatives to innovator products and play a vital role in improving access to healthcare. However, variations in manufacturing processes, excipient composition, and formulation characteristics may influence the pharmaceutical performance of generic products [6,7]. Previous investigations involving drugs such as Metformin [8,9], Ciprofloxacin [10], and Losartan Potassium [11] have reported differences in quality-control parameters, including dissolution behavior, friability, and dosage-unit consistency, highlighting the importance of routine quality assessment and post-marketing surveillance [12,13].

Diclofenac Sodium is marketed worldwide under numerous brand names and formulations. Variations in excipients, coating systems, manufacturing conditions, and tablet properties may influence characteristics such as hardness, disintegration, dissolution, and ultimately drug-release performance [1,14,15]. Previous studies evaluating diclofenac products marketed in Saudi Arabia generally reported compliance with established quality criteria while also identifying variability among products and batches, emphasizing the need for continued quality monitoring [16].

Given the widespread use of Diclofenac Sodium and the availability of multiple generic products in the Saudi Arabian market, periodic quality evaluation remains important. Therefore, the present study aimed to assess selected in-vitro quality characteristics of four commercially available brands of Diclofenac Sodium 50 mg enteric-coated tablets in Saudi Arabia. The evaluated parameters included weight variation, hardness, friability, disintegration, and dissolution. The findings contribute to the available evidence regarding the pharmaceutical quality characteristics of marketed Diclofenac Sodium products and may support ongoing quality-assurance and post-marketing surveillance efforts.

### Methodology.

#### Materials

This study evaluated four commercially available brands of Diclofenac Sodium 50 mg enteric-coated tablets:

- Diclomax (Brand A)
- Rumafen (Brand B)
- Votrex (Brand C)
- Apo-diclo (Brand D)

The products were obtained from a community pharmacy in Unaizah, Al-Qassim, Saudi Arabia. Product information, including manufacturer details, batch numbers, GTIN codes, and labeled manufacturing and expiration dates, was recorded for documentation and traceability purposes.

## Methods.

The selected brands were evaluated using standard pharmaceutical quality-control tests. The evaluated parameters included general appearance, hardness, friability, weight variation, disintegration, and dissolution characteristics. Where applicable, procedures and acceptance criteria were based on pharmacopeial recommendations and commonly accepted pharmaceutical quality-control practices.

### General Appearance and Organoleptic Evaluation.

Tablets were visually examined for characteristics relevant to product identification and quality assessment, including:

- Size
- Shape
- Color
- Odor
- Surface appearance
- Identification markings

Any embossing, engraving, or identifying marks present on the tablet surface were recorded.

### Hardness Test.

Tablet hardness was determined using a BIOBASE Tablet Hardness Tester (Model THT-1, China). Ten tablets from each brand were tested individually. Results were recorded in kilograms per square centimeter (kg/cm<sup>2</sup>).

Hardness testing was performed to evaluate the mechanical strength of the tablets and their ability to withstand handling, packaging, transportation, and storage. Although hardness ranges are commonly reported in pharmaceutical quality-control literature, acceptable values may vary according to formulation characteristics and coating systems, particularly for enteric-coated products.

### Friability Test

Friability testing was performed using a Roche Friability Tester (ERWEKA TAR220, Germany) operated at 25 rpm. Twenty tablets from each brand were subjected to 100 revolutions, dedusted, and reweighed.

Percentage friability was calculated as:

$$\% \text{ Friability} = [(A - B) / A] \times 100$$

Where:

- A = Initial tablet weight
- B = Final tablet weight

Weight-loss values below 1% were considered indicative of acceptable tablet mechanical integrity.

### Weight Variation Test.

Weight variation testing was conducted using a BOECO Electronic Balance (Model BAS32 Plus, Germany). Twenty tablets from each brand were individually weighed, and the mean tablet weight was calculated.

Average Weight = Sum of Individual Weights / Number of Tablets

Percentage deviation from the mean weight was calculated as:

$$\% \text{ Deviation} = [(\text{Individual Weight} - \text{Mean Weight}) / \text{Mean Weight}] \times 100$$

The test was performed to evaluate dosage-unit consistency through tablet weight uniformity. No content uniformity assay was performed as part of the present study; therefore, the

findings are limited to weight variation assessment.

### Disintegration Test.

Disintegration testing was performed using a USP disintegration apparatus (ERWEKA, Germany). The test was conducted using 0.1 N hydrochloric acid followed by phosphate buffer solution (pH 6.8) maintained at  $37 \pm 0.5^\circ\text{C}$ .

The time required for tablet disintegration under the study conditions was recorded. The test was performed to assess the behavior of the enteric-coated tablets in acidic and buffer media and to compare disintegration characteristics among the evaluated brands.

### In-Vitro Dissolution Test.

Dissolution testing was conducted using a PHARMA TEST PTWS 820D Dissolution Tester under the following conditions:

- Dissolution medium: 900 mL phosphate buffer (pH 6.8)
- Temperature:  $37 \pm 0.5^\circ\text{C}$
- Paddle speed: 50 rpm

Aliquots (5 mL) were collected at 15, 30, 45, and 60 minutes and analyzed spectrophotometrically at 275.8 nm using a Jenway Double Beam Spectrophotometer.

Drug concentration was estimated using a previously prepared Diclofenac Sodium calibration curve based on Beer–Lambert principles:

- $A = \epsilon Cl$
- where:
- A = absorbance
- $\epsilon$  = molar absorptivity
- C = concentration
- l = path length

The linear regression equation used for concentration estimation was:

- $y = mx + c$
- where:
- y = absorbance
- x = concentration
- m = slope
- c = intercept

The dissolution procedure was intended to compare the in-vitro drug-release characteristics of the evaluated brands under the selected experimental conditions.

### Statistical Analysis:

Descriptive statistics were used to summarize the measured quality-control parameters. Results are presented as mean values and standard deviations (or standard errors where applicable). The study was primarily designed as a comparative quality-control evaluation and did not include formal similarity factor (f1/f2) analysis or content uniformity testing.

## Results.

### General Appearance and Organoleptic Properties:

(Table 3.1.1) Summarizes the results of the general appearance test for the tablet dosage forms of the four different brands. In addition to (Figure 1) which shows images of tablets taken from each sample brand.

### Hardness Test:

Hardness is one of the most important physical features for

evaluating tablets. Excessively hard tablets may result in a decrease in the release of the drug. The hardness test was used to evaluate the capacity to withstand the shakes during processes of packaging, storage, and transportation. The Hardness tester is (BIOBASE Tablet Hardness Tester, Model No.: THT-1, S/N: 03688, China), it was used to measure the hardness of four different brands (Mean values  $\pm$  SEM, n=three). The sample size was ten tablets from each sample brand were used. According to USP, hardness should range from four to ten kg/cm<sup>2</sup> (One Kg equals to ten Newton). However, enteric-coated tablets show higher hardness values.

#### **Friability Test:**

Friability is defined as the percentage of weight loss by tablets due to mechanical action during the test. It is used to evaluate what happens to a tablet due to its handling. Friability was determined by Roche Friability tester (ERWEKA Friability Tester TAR220, Model No.: 300612.096e, Germany). Tablets were weighed before and after putting them in the Roche Friabilator, adjusted at a total of 100 rotations (i.e. 25 rpm for four min), and friability is expressed as the percentage friability loss. The test was performed in triplicate. And the sample size was 20 tablets, from each sample brand.

Limit according to USP, A compressed tablet that loses less than 0.1 to 0.5 % of the tablet weight is considered acceptable.

#### **Weight Variation Test (U.S.P):**

This test was performed by using an electronic balance (BOECO Electronic Balance, Model No.: BAS32 plus. Readability: 0.0001g. S/N: 140361. Dulse, Germany), A sample batch of 20 tablets from each brand was used. The tablets were selected randomly and weighed individually and the average weight was calculated using (equation 3.2) and (equation 3.3). The individual weights were compared with the upper and lower limits, according to USP (Table 3.4.1).

The Upper and Lower Limits were calculated for the four brand tablets using the following formulas (Equation 3.1) and (Equation 3.2):

$Upper\ Limit = average\ weight + (average\ weight \times \%7.5)$   
(Equation 3.1)

$Lower\ Limit = average\ weight - (average\ weight \times \%7.5)$   
(Equation 3.2).

#### **In-vitro Disintegration Test (U.S.P):**

Tablet disintegration was determined by using the USP disintegration test apparatus (ERWEKA, Model No.: 132012, Odba, Germany). It was used to evaluate the quality, bioavailability, and effectiveness of tablets. The test was performed in triplicate. The sample size was 18 tablets from each sample of the four brands used. 0.1 N HCL Phosphate buffer solution of pH 6.8 at 37 °C was the medium used for this test and the apparatus was stirred at 28-32 cycles/minutes. The time taken to break each tablet into small particles and pass them out through the ten-mesh screen was recorded. The disintegration time was taken to be the time no particle remained on the basket of the system. Disintegration time limit of enteric-coated tablets according to USP is from one to two hours (60-120 min).

#### **In-vitro Dissolution Test:**

The dissolution medium was used for zero adjustment and blank reading of the spectrophotometer was set with Phosphate

buffer. The amount of Diclofenac Sodium dissolved in the medium was determined by comparing the readings obtained with that of a standard Diclofenac Sodium solution, prepared just before use and standard calibration curve for Diclofenac Sodium was prepared as shown in (Table 3.6.1) and (Figure 4.1). Using the Beer Lambert law (Equation 4.1). Where A, is the absorbance,  $\epsilon m$  is molar extinction coefficient, C is the concentration, and l is the optical path length in cm. In addition to its linear equation (Equation 4.2) where y is the absorbance, x is the concentration (in  $\mu g/ml$ ) and c is the y intercept of the graph, According to USP.

$A = \epsilon m Cl$  (Equation 4.1)

$y = mx + c$  (Equation 4.2)

The dissolution rate of the four enteric-coated sample tablets from each brand of Diclofenac Sodium were obtained in 900 ml of Phosphate buffer of pH 6.8 at various intervals viz. 15, 30, 45 and 60 min, analyzed at 275.8 nm using the UV Spectrophotometer (Table 4.6.2 a, b, c, and d).

The amount dissolved at the time intervals were determined using the Beer's plot and the dissolution profiles were obtained for all of the four brands. The UV absorbance data and plot of percent of Diclofenac Sodium dissolved as a function of time for all the four brands were represented in Table 4.6.2 a & b, c and d and Figure 4.1. The percentages dissolved in 60 min, were obtained for all sample brands using standard methods. The result of the drug content assay is as follows: Diclomax (Brand A) 94.08%, Rumafen (Brand B) 94.52%, Votrex (Brand C) 96.69% and 98.85% for Apo diclo (Brand D). Figure 4.2 shows the cumulative percentage drug release for all of the four sample brands of Diclofenac Sodium.

#### **Discussion.**

The present study compared the in-vitro quality characteristics of four commercially available brands of Diclofenac Sodium 50 mg enteric-coated tablets marketed in Saudi Arabia. The evaluated parameters included weight variation, hardness, friability, disintegration, and dissolution characteristics. Overall, the tested products demonstrated relatively consistent performance across the evaluated quality-control parameters, although differences were observed among brands.

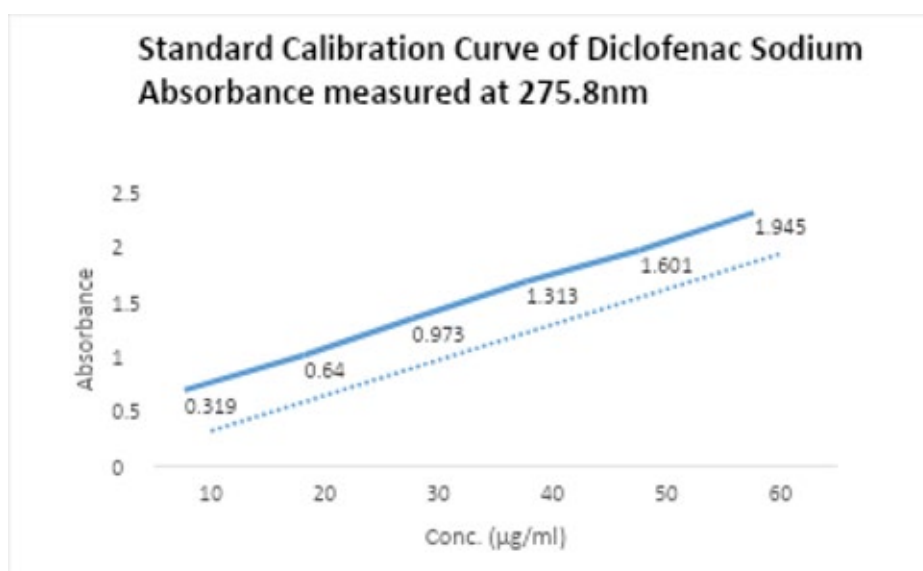
Weight variation results showed limited variability among tablets within each brand, indicating acceptable consistency in tablet mass. However, it should be noted that the present investigation evaluated weight variation only and did not include content uniformity testing. Therefore, the findings should be interpreted as indicators of tablet weight consistency rather than direct confirmation of dosage-unit uniformity.

Friability values were low for all evaluated brands, suggesting adequate mechanical resistance during handling, packaging, transportation, and storage. These findings are consistent with previous investigations of generic pharmaceutical products that reported acceptable physical integrity despite differences in formulation characteristics [8-10].

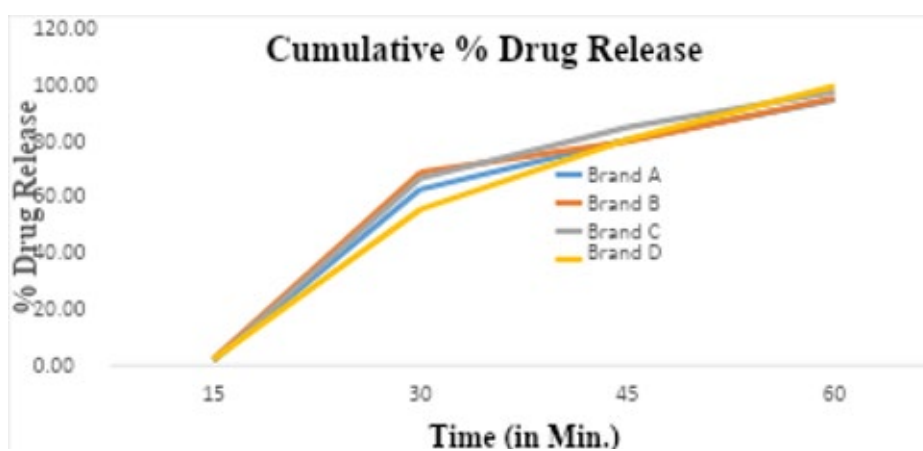
Differences were observed in hardness values among the evaluated products. Apo-diclo (Brand D) demonstrated higher hardness values compared with the other brands. Increased tablet hardness may be influenced by formulation composition, compression force, coating characteristics, and manufacturing



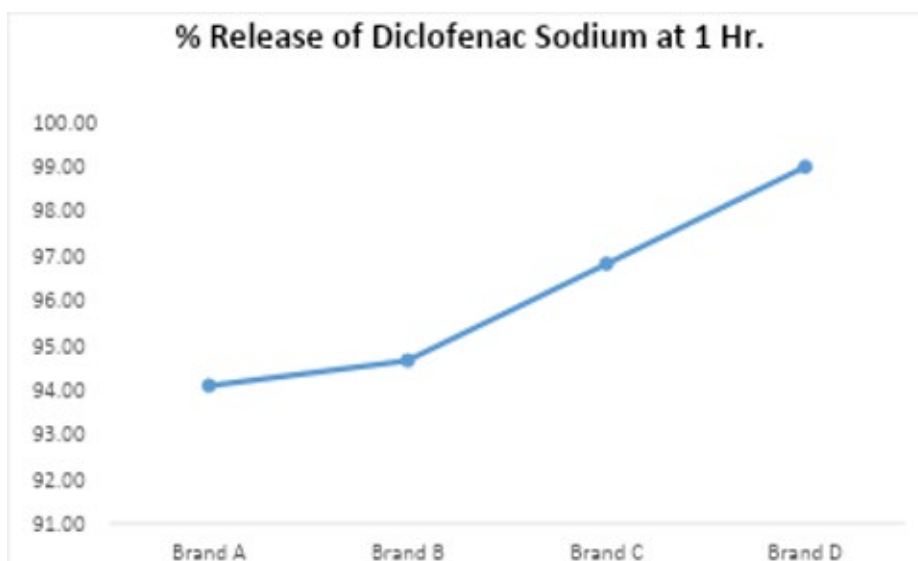
*Figure 3.1. General Appearance of the four sample brands of Diclofenac Sodium tablets.*



*Figure 3.2. Standard Calibration Curve of Diclofenac Sodium.*



*Figure 3.3. Cumulative percentage the drug's release.*



**Figure 3.4.** Percentage Release of Diclofenac Sodium at 1 hour.

**Table 3.1.1.** Results of the General Appearance Test and the Organoleptic proprieties of each brand.

| S.NO | Characteristics | Brand A                                 | Brand B                               | Brand C                                                    | Brand D                       |
|------|-----------------|-----------------------------------------|---------------------------------------|------------------------------------------------------------|-------------------------------|
| 1    | Color           | Orange in color                         | White in color                        | Orange in color                                            | Orange in color               |
| 2    | Size            | Circular                                |                                       |                                                            |                               |
| 3    | Shape           | Top view is convex and rounded          |                                       |                                                            |                               |
| 4    | Odor            | No noticeable odor                      |                                       |                                                            |                               |
| 5    | Taste           | Bitter, unpleasant taste with no flavor |                                       |                                                            |                               |
| 6    | Surface texture | smooth, engraved 'JI' letters and '12'  | Smooth, engraved 'RP' letters and '2' | Smooth, glossy, engraved surface with letters 'H' and '50' | Smooth, engraved surface '50' |

**Note:** Brand A is Diclomax, Brand B is Rumafen, Brand C is Votrex and Brand D is Apo-diclo.

**Table 3.2.1.** Results for Hardness Test for the four brands (in kg/cm<sup>2</sup>), sample size is ten tablets for each brand.

| Tablet No.     | Brand A         | Brand B         | Brand C         | Brand D          |
|----------------|-----------------|-----------------|-----------------|------------------|
| 1              | 10.28           | 3.42            | 7.80            | 15.22            |
| 2              | 10.02           | 6.40            | 7.37            | 14.94            |
| 3              | 11.01           | 4.37            | 8.70            | 15.86            |
| 4              | 10.08           | 3.76            | 7.17            | 16.70            |
| 5              | 12.06           | 3.75            | 6.78            | 11.47            |
| 6              | 6.86            | 3.43            | 7.14            | 14.81            |
| 7              | 7.85            | 5.02            | 7.59            | 15.26            |
| 8              | 5.29            | 7.30            | 5.98            | 14.36            |
| 9              | 9.11            | 4.84            | 7.20            | 13.78            |
| 10             | 9.25            | 4.58            | 6.96            | 15.75            |
| Mean $\pm$ SEM | 9.181 $\pm$ 2.0 | 4.687 $\pm$ 1.3 | 7.269 $\pm$ 0.7 | 14.815 $\pm$ 1.4 |

**Note:** Brand A is Diclomax, Brand B is Rumafen, Brand C is Votrex, and Brand D is Apo-diclo.

**Table 3.3.1.** Results for the Friability test for the four selected brands.

| Brand                  | Diclomax (Brand A) | Rumafen (Brand B) | Votrex (Brand C) | Apo-Diclo (Brand D) |
|------------------------|--------------------|-------------------|------------------|---------------------|
| Initial Weight (in mg) | 4078.8             | 5743.3            | 4134.2           | 4333.7              |
| Final Weight (in mg)   | 4078.6             | 5743.1            | 4134.1           | 4333.2              |
| %Loss                  | 0.49%              | 0.34%             | 0.24%            | 0.012%              |

**Table 3.4.1.** Weight limit according to USP (United States Pharmacopoeia, 2010).

| Limits according to tablets weight | USP tablets weight |
|------------------------------------|--------------------|
| $\pm 10\%$                         | 130 mg or less     |
| $\pm 7.5\%$                        | 130 mg to 324 mg   |
| $\pm 5\%$                          | More than 324 mg   |

**Table 3.4.2.** Result of the upper and lower limits (in mg).

| Brand Name | Upper Limit | Lower Limit |
|------------|-------------|-------------|
| Brand A    | 218.9       | 188.4       |
| Brand B    | 309.755     | 266.534     |
| Brand C    | 223.26      | 192.109     |
| Brand D    | 232.856     | 200.364     |

**Table 3.4.3.** Results of Weight Variation Test for Diclomax (Brand A) tablets.

| Tablet No. | Weight In mg | % Weight Variation | Status | Tablet No. | Weight In mg | % Weight Variation | Status |
|------------|--------------|--------------------|--------|------------|--------------|--------------------|--------|
| 1          | 205          | 0.66               | Pass   | 11         | 207.1        | 1.69               | Pass   |
| 2          | 202          | -0.81              | Pass   | 12         | 200.8        | -1.4               | Pass   |
| 3          | 200.1        | -1.75              | Pass   | 13         | 201.5        | -1.06              | Pass   |
| 4          | 202          | -0.81              | Pass   | 14         | 203.3        | -0.17              | Pass   |
| 5          | 200.6        | -1.5               | Pass   | 15         | 204.3        | 0.32               | Pass   |
| 6          | 204.5        | 0.41               | Pass   | 16         | 207.1        | 1.69               | Pass   |
| 7          | 205.6        | 0.96               | Pass   | 17         | 199          | -2.29              | Pass   |
| 8          | 204.8        | 0.56               | Pass   | 18         | 213          | 4.59               | Pass   |
| 9          | 205.4        | 0.86               | Pass   | 19         | 198.5        | -2.53              | Pass   |
| 10         | 208          | 2.13               | Pass   | 20         | 200.5        | -1.55              | Pass   |
| Mean ± SEM | 203.7±3.6 mg |                    |        |            |              |                    |        |

**Table 3.4.4.** Results for Weight Variation Test for Rumafen (Brand B) tablets.

| Tablet No. | Weight In mg | % Weight variation | Status | Tablet No. | Weight In mg | % Weight variation | Status |
|------------|--------------|--------------------|--------|------------|--------------|--------------------|--------|
| 1          | 295.8        | 2.66               | Pass   | 11         | 294.3        | 2.14               | Pass   |
| 2          | 295.9        | 2.69               | Pass   | 12         | 280.3        | -2.72              | Pass   |
| 3          | 286          | -0.74              | Pass   | 13         | 280.3        | -2.72              | Pass   |
| 4          | 276.5        | -4.04              | Pass   | 14         | 293.8        | 1.96               | Pass   |
| 5          | 287.4        | -0.26              | Pass   | 15         | 286.7        | -0.5               | Pass   |
| 6          | 286.9        | -0.43              | Pass   | 16         | 290          | 0.64               | Pass   |
| 7          | 291.4        | 1.13               | Pass   | 17         | 283.8        | -1.51              | Pass   |
| 8          | 288.5        | 0.12               | Pass   | 18         | 290.4        | 0.78               | Pass   |
| 9          | 286          | -0.74              | Pass   | 19         | 293.1        | 1.72               | Pass   |
| 10         | 288.9        | 0.26               | Pass   | 20         | 286.9        | -0.43              | Pass   |
| Mean ± SEM | 288.1±5.3 mg |                    |        |            |              |                    |        |

**Table 4.4.5.** Results for Weight Variation Test for Votrex (Brand C) tablets.

| Tablet No. | Weight In mg | % Weight variation | Status | Tablet No. | Weight In mg | % Weight variation | Status |
|------------|--------------|--------------------|--------|------------|--------------|--------------------|--------|
| 1          | 206.1        | -0.76              | Pass   | 11         | 206.5        | -0.57              | Pass   |
| 2          | 209.5        | 0.87               | Pass   | 12         | 202.7        | -2.4               | Pass   |
| 3          | 208.6        | 0.44               | Pass   | 13         | 203.2        | -2.16              | Pass   |
| 4          | 209          | 0.63               | Pass   | 14         | 214          | 3.04               | Pass   |
| 5          | 205.8        | -0.91              | Pass   | 15         | 207.6        | -0.04              | Pass   |
| 6          | 204.1        | -1.73              | Pass   | 16         | 207.4        | -0.14              | Pass   |
| 7          | 213.3        | 2.7                | Pass   | 17         | 203.5        | -2.02              | Pass   |
| 8          | 211.1        | 1.64               | Pass   | 18         | 207.5        | -0.09              | Pass   |
| 9          | 209.2        | 0.73               | Pass   | 19         | 211.2        | 1.69               | Pass   |
| 10         | 204.3        | -1.63              | Pass   | 20         | 209.1        | 0.68               | Pass   |
| Mean ± SEM | 207.7±3.2 mg |                    |        |            |              |                    |        |

**Table 3.4.6.** Results for Weight Variation Test for Apo-diclo (Brand D) tablets.

| Tablet No.     | Weight In mg       | % Weight variation | Status | Tablet No. | Weight In mg | % Weight variation | Status |
|----------------|--------------------|--------------------|--------|------------|--------------|--------------------|--------|
| 1              | 216.6              | 0.01               | Pass   | 11         | 218.4        | 0.84               | Pass   |
| 2              | 216.5              | -0.04              | Pass   | 12         | 220.9        | 1.99               | Pass   |
| 3              | 217.9              | 0.61               | Pass   | 13         | 218.3        | 0.79               | Pass   |
| 4              | 211                | -2.58              | Pass   | 14         | 216          | -0.27              | Pass   |
| 5              | 219                | 1.12               | Pass   | 15         | 213          | -1.66              | Pass   |
| 6              | 217.7              | 0.51               | Pass   | 16         | 212.3        | -1.98              | Pass   |
| 7              | 219.6              | 1.39               | Pass   | 17         | 218.5        | 0.88               | Pass   |
| 8              | 213.2              | -1.56              | Pass   | 18         | 216.6        | -0.01              | Pass   |
| 9              | 215.8              | -0.36              | Pass   | 19         | 217.4        | 0.38               | Pass   |
| 10             | 218.3              | 0.79               | Pass   | 20         | 214.7        | -0.87              | Pass   |
| Mean $\pm$ SEM | 216.6 $\pm$ 2.6 mg |                    |        |            |              |                    |        |

**Table 3.5.1.** Results of the Disintegration Test.

| Brand             | Disintegration Time (0.1 N HCL) | Disintegration Time (In Phosphate Buffer) |
|-------------------|---------------------------------|-------------------------------------------|
| Brand A Diclomax  | 90 min and 30 sec.              | 15 min                                    |
| Brand B Rumafen   | 94 min and 28 sec.              | 18 min                                    |
| Brand C Votrex    | 99 min and 02 sec.              | 17 min                                    |
| Brand D Apo-diclo | 110 min and 5 sec.              | 20 min                                    |

**Table 3.6.1.** Serial Dilution of Diclofenac Sodium in Phosphate buffer solution (pH 6.8).

| Conc. ( $\mu$ g/ml) | Absorbance at 275.8nm |
|---------------------|-----------------------|
| 10                  | 0.319                 |
| 20                  | 0.64                  |
| 30                  | 0.973                 |
| 40                  | 1.313                 |
| 50                  | 1.601                 |
| 60                  | 1.945                 |

**Table 3.6.2a.** Dissolution profile of Diclomax (Brand A) at various time intervals.

| Time Interval (Min.) | Abs.  | Conc. ( $\mu$ g/ml) | Conc. ( $\mu$ g/ml) in 900ml with dil. factor 10 | Conc. (mg) in 900ml | % Release |
|----------------------|-------|---------------------|--------------------------------------------------|---------------------|-----------|
| 15                   | 0.032 | 0.109433            | 984.8952                                         | 0.98                | 1.97      |
| 30                   | 1.119 | 3.460234            | 31142.11                                         | 31.14               | 62.28     |
| 45                   | 1.432 | 4.425092            | 39825.83                                         | 39.83               | 79.65     |
| 60                   | 1.692 | 5.226572            | 47039.15                                         | 47.04               | 94.08     |

**Table 3.6.2b.** Dissolution profile of Rumafen (Brand B) at various time intervals

| Time Interval (Min.) | Abs.  | Conc. ( $\mu$ g/ml) | Conc. ( $\mu$ g/ml) in 900ml with dil. factor 10 | Conc. (mg) in 900ml | % Release |
|----------------------|-------|---------------------|--------------------------------------------------|---------------------|-----------|
| 15                   | 0.039 | 0.131011            | 1179.1                                           | 1.18                | 2.36      |
| 30                   | 1.228 | 3.796239            | 34166.15                                         | 34.17               | 68.33     |
| 45                   | 1.424 | 4.400432            | 39603.88                                         | 39.60               | 79.21     |
| 60                   | 1.700 | 5.251233            | 47261.1                                          | 47.26               | 94.52     |

**Table 3.6.2c.** Dissolution profile of Votrex (Brand C) at various time intervals.

| Time Interval (Min.) | Abs.  | Conc. ( $\mu$ g/ml) | Conc. ( $\mu$ g/ml) in 900ml with dil. factor 10 | Conc. (mg) in 900ml | % Release |
|----------------------|-------|---------------------|--------------------------------------------------|---------------------|-----------|
| 15                   | 0.028 | 0.097102            | 873.9211                                         | 0.87                | 1.75      |
| 30                   | 1.189 | 3.676017            | 33084.16                                         | 33.08               | 66.17     |
| 45                   | 1.515 | 4.680949            | 42128.55                                         | 42.13               | 84.26     |
| 60                   | 1.739 | 5.371455            | 48343.09                                         | 48.34               | 96.69     |

**Table 3.6.2d.** Dissolution profile of Apo-diclo (Brand D) at various time intervals.

| Time Interval (Min.) | Abs.  | Conc. ( $\mu$ g/ml) | Conc. ( $\mu$ g/ml) in 900ml with dil. factor 10 | Conc. (mg) in 900ml | % Release |
|----------------------|-------|---------------------|--------------------------------------------------|---------------------|-----------|
| 15                   | 0.036 | 0.121763            | 1095.869                                         | 1.10                | 2.19      |
| 30                   | 0.991 | 3.06566             | 27590.94                                         | 27.59               | 55.18     |
| 45                   | 1.436 | 4.437423            | 39936.81                                         | 39.94               | 79.87     |
| 60                   | 1.778 | 5.491677            | 49425.09                                         | 49.43               | 98.85     |

**Table 3.6.3.** *Percentage Release of Diclofenac Sodium at 1 hour.*

| Sample Name | Abs. at 1hr. | Conc. (µg/ml) | Conc. (µg/ml) in 900ml with dil. factor 10 | Conc. (mg) in 900ml | % Release |
|-------------|--------------|---------------|--------------------------------------------|---------------------|-----------|
| Brand A     | 1.692        | 5.226572      | 47039.15                                   | 47.04               | 94.08     |
| Brand B     | 1.70         | 5.257716      | 47319.44                                   | 47.32               | 94.64     |
| Brand C     | 1.739        | 5.378086      | 48402.78                                   | 48.40               | 96.81     |
| Brand D     | 1.778        | 5.498457      | 49486.11                                   | 49.49               | 98.97     |

conditions. Although excessive hardness has the potential to delay tablet disintegration and drug release, the dissolution results obtained under the present study conditions did not suggest impaired release performance for this product. Similar observations have been reported in studies demonstrating that enteric-coated formulations may exhibit greater mechanical strength while maintaining acceptable release characteristics [4,5].

Disintegration testing demonstrated differences in the behavior of the evaluated products in acidic and buffer media. These findings may reflect variations in coating composition, coating thickness, manufacturing processes, and excipient selection among brands. Because enteric-coated formulations are specifically designed to protect the active ingredient from gastric conditions and delay drug release until exposure to intestinal pH, the observed differences highlight the importance of coating performance in determining product behavior.

Dissolution testing demonstrated progressive drug release for all evaluated products under the selected experimental conditions, with cumulative release values exceeding 90% after 60 minutes in phosphate buffer medium. Differences in dissolution profiles among brands were relatively small; however, formal similarity assessment using model-independent similarity factors ( $f_1/f_2$ ) was not performed. Consequently, the present findings should not be interpreted as definitive evidence of dissolution equivalence or product interchangeability.

The findings generally support previous reports demonstrating acceptable in-vitro quality characteristics among marketed Diclofenac Sodium products [1,14,15]. Nevertheless, differences in formulation composition, excipients, manufacturing processes, and coating technologies may influence pharmaceutical performance and should continue to be monitored through post-marketing quality assessment programs.

In Saudi Arabia, ongoing regulatory oversight and post-marketing surveillance play an important role in maintaining pharmaceutical quality [16-18]. Continued monitoring of marketed generic products remains important to identify potential variability among brands and batches and to support quality assurance efforts within the pharmaceutical supply chain.

### Limitations.

This study has several limitations. First, only four brands of Diclofenac Sodium tablets were evaluated, which may not represent all products available in the Saudi Arabian market. Second, the study relied exclusively on in-vitro quality-control tests and did not include in-vivo bioavailability or bioequivalence assessments. Consequently, no conclusions can be drawn regarding therapeutic equivalence or clinical interchangeability.

Third, content uniformity testing was not performed. Therefore, the study evaluated tablet weight consistency rather than direct dosage-unit uniformity. Fourth, similarity factor analysis ( $f_1/f_2$ ) was not conducted; consequently, dissolution profile equivalence among brands could not be formally assessed. Fifth, statistical comparisons among brands were not performed, limiting the ability to determine whether observed differences were statistically significant.

In addition, the influence of storage conditions, environmental factors, excipient composition, and manufacturing variables was not investigated. Finally, only a single batch of each product was evaluated, and batch-to-batch variability was not assessed.

### Recommendations.

Future studies should include a larger number of brands and multiple production batches to provide a more comprehensive evaluation of product consistency. Additional investigations should incorporate content uniformity testing, formal dissolution similarity analysis using  $f_1/f_2$  factors, and appropriate statistical comparisons among products. Evaluating the influence of formulation characteristics, excipient composition, and storage conditions may further improve understanding of product performance.

Where feasible, future research should also include in-vivo bioavailability or bioequivalence studies to provide a more comprehensive assessment of therapeutic performance. Continued post-marketing surveillance remains important for maintaining pharmaceutical quality and supporting regulatory decision-making.

### Conclusion.

The four evaluated brands of Diclofenac Sodium 50 mg enteric-coated tablets demonstrated generally acceptable in-vitro quality characteristics with respect to the parameters assessed in this study, including weight variation, hardness, friability, disintegration, and dissolution behavior. Although differences were observed among products, all brands exhibited satisfactory physical performance under the study conditions.

The findings provide useful information regarding the pharmaceutical quality characteristics of the evaluated products. However, because content uniformity testing, dissolution similarity analysis, and in-vivo bioequivalence studies were not performed, the results should not be interpreted as evidence of therapeutic equivalence or clinical interchangeability. Further investigations are warranted to provide a more comprehensive assessment of product performance and equivalence.

### REFERENCES

1. Abbas J, Ahmer A, Yousuf M, et al. Comparative physicochemical evaluation of selective brands of Diclofenac Potassium tablets available in Pakistan. *J Pharm Res Int.* 2020;32:90-97.

2. Hammami MM, Hussein RF, AlSwayeh R, et al. Eight enteric-coated 50 mg Diclofenac Sodium tablet formulations marketed in Saudi Arabia: in-vitro quality evaluation. *BMC Res Notes*. 2020;13:340.
3. Ameer OZ. In vitro pharmaco-equivalence analysis of Diclofenac Potassium oral film-coated tablets relative to marketed generics. *J Pharm Pharmacogn Res*. 2023;11:585-594.
4. Rashid R, Zaman M, Ahmad M, et al. Press-coated Aceclofenac tablets for pulsatile drug delivery: Formulation and in-vitro evaluations. *Pharmaceutics*. 2022;15:326.
5. Elsayed MM, Aboelez MO, Elsayed BEM, et al. Tolmetin Sodium fast dissolving tablets for rheumatoid arthritis treatment: Preparation and optimization using Box-Behnken design and response surface methodology. *Pharmaceutics*. 2022;14:880.
6. Razali FN, Anuar MS, Rajendram SS. Quality assessment on generic antipyretic tablets and their stability withstanding unfavorable environments. *Asian J Med Health Sci*. 2022;5:37-40.
7. Abdullah S, Saleem Z, Godman B. Coping with increasing medicine costs through greater adoption of generic prescribing and dispensing in Pakistan as an exemplar country. *Expert Rev Pharmacoecon Outcomes Res*. 2024;24:167-170.
8. Bhatta NK, Thapa A, Sah DK, et al. Assessment of quality control parameters of multi-sourced Metformin HCl sustained release tablets marketed in Nepal. *J Karnali Educ Health Res*. 2022;1:1-7.
9. Ebiere D, Samuel JB, Ikoi AI. Comparative in-vitro bioequivalence analysis of Metformin hydrochloride tablet formulations available in Yenagoa Metropolis, Bayelsa State, Nigeria. *J Chem Res Adv*. 2023;4:21-26.
10. Olawepo PO, Olayemi OJ, Alfa J. Quality assessment of some brands of Ciprofloxacin and Levofloxacin tablets circulating in Karu Local Government Area of Nasarawa State, Nigeria. *Niger J Pharm*. 2023;57:570-573.
11. Khan K, Khan GM, Muzammal M, et al. Preparation of Losartan Potassium controlled release matrices and in-vitro investigation using rate controlling agents. *Molecules*. 2022;27:864.
12. Onyeike KM, Madubuike KG. Comparison of the analgesic and ulcerogenic activities of five brands of Diclofenac sold in the Nigerian market. *J Sustain Vet Allied Sci*. 2024;6:34-38.
13. Hammami MM, AlSwayeh RF, Hussein R. Pharmaceutical quality of seven brands of Diclofenac tablets on the Saudi market. *BMC Res Notes*. 2020;13:548.
14. Alwadi MM, Chuasuwan B, Joshi RP, et al. Enhanced dissolution and bioavailability profiling of generic NSAIDs. *Saudi Pharm J*. 2022;30:90-97.
15. Gianturco SL, Pavlech LL, Storm KD, et al. Diclofenac sodium: Summary Report. Prepared for the US Food and Drug Administration. University of Maryland School of Pharmacy; 2021.
16. Alhur A, Alhur A, Al Malh S, et al. Recent Trends and Innovations in Pharmacy Practice: An Evidence-Based Narrative Review. *Journal of Pioneering Medical Sciences*. 2026;15:14.
17. Bakr RA, Kotta S, Aldawsari HM, et al. Improvement of solubility, dissolution, and bioavailability of Phenytoin intercalated in Mg-Al layered double hydroxide. *Front Pharmacol*. 2024;15:1440361.
18. Patel M, Shelke S, Surti N, et al. Design, preparation, and in-vitro evaluation of gastroretentive floating matrix tablet of mitiglinide. *Front Pharmacol*. 2023;14:1140351.
19. Alhur AA, Alsaeed W, Albalawi B, et al. Pharmacy Students' Attitudes Towards AI in Pharmaceutical Practices. *Journal of Pioneering Medical Sciences*. 2025;14:132-7.
20. Abdallah MH, Shawky S, Shahien MM, et al. Development and evaluation of nano-vesicular emulsion-based gel as a promising approach for dermal Atorvastatin delivery against inflammation. *Int J Nanomed*. 2024;19:11415-11432.
21. Elamrawy F, Helal NA, Abou-Taleb BA, et al. Pharmaceutical Polygon Fingerprinting Matrix System: A potential tool for pharmaceutical quality control. *Med Princ Pract*. 2024;33:372-384.
22. Alhur AA, Albatshan M, Alanazi HM, et al. Pharmacists in the digital era: Opportunities and challenges in telepharmacy implementation. *Modern Phytomorphology*. 2025;19.