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PHARMACEUTICAL ASSESSMENT OF FIVE DIFFERENT GENERIC BRANDS OF PREDNISOLONE TABLETS IN LIBYAN MARKET

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ABSTRACT

Generic medicines are those where patent protection has expired, and which may be produced by manufacturers other than the innovator company. Use of generic medicines has been increasing in recent years, primarily as a cost saving measure in healthcare provision. Generic medicines are typically **20 – 90 %** cheaper than originator equivalents. Physicians often continue to prescribe brand-name drugs to their patients even when less expensive pharmacologically equivalent generic drugs are available. Unfortunately Physicians in general and Libyan Physicians in particular tend to prescribe brand-name drugs, even without evidence of their therapeutic superiority, because neither they nor their insured patients bear these drugs' increased cost with respect to generic substitutes. This study is to compare the quality of five different prednisolone tablets of the same strength from different companies under different trade names; Julphar, October pharma, Akums, Actavis, Pfizer compared them with pure prednisolone reference (**BPCRS**) using pharmacopeial and nonofficial methods. General quality tests of these tablets like weight variation, hardness, friability, disintegration time, dissolution and assay were determined according to pharmacopeial methods. Assay of generic products revealed that all samples contained between (**90.0-110.0**% w/w) of labelled chemical content and dissolution test not less than **70%**. All products complied with the official specification; limits for friability, hardness tests, uniformity of weight and thickness

uniformity, except Gupisone® from Julphar do not comply with the limits for the friability test, hardness and uniformity of weight.

KEYWORDS: Quality Control, Pharmaceutical Analysis, Generic medicines, Prednisolone.

1. INTRODUCTION

Prednisolone is a well-known corticosteroid that is used to treat a wide variety of acute and chronic disorders, including arthritis, asthma, allergic diseases, hepatitis, congenital adrenal hyperplasia, systemic lupus erythematosus and certain haematological, infectious, cardiac, dermal, neurological, metabolic, gastrointestinal (GI) diseases as well as malignant diseases and many inflammatory states.[1-3]

Prednisolone is a synthetic steroid that is chemically defined as 11b,17a, 21-trihydroxypregna- 1,4-diene-3, 20-dione. The molecular formula is $C_{21}H_{28}O_5$. It has 21 carbon atoms with a total of **4** rings: three 6-carbon rings designated **A**, **B**, and **C**, and five-carbon ring, **D** as shown in Fig. **1**. It is anhydrous or contains one or half molecules of water of hydration. M.wt is 360.45. Prednisolone is a synthetic glucocorticoid, a derivative of cortisol. It is the active metabolite of the drug prednisone and is normally used in patients with hepatic failure, as these individuals are unable to metabolize prednisone into prednisolone.

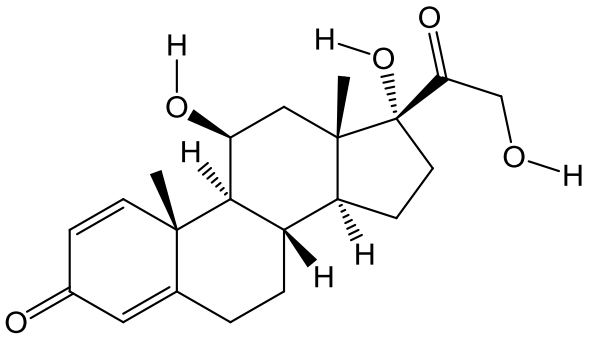


Figure. 1. Chemical structures of Prednisolone

Quality of the drug according to the modern definition requires that the product contain the quantity of each active ingredient claimed on its label within the applicable limits of its specifications, contain the same quantity of active ingredient from one dosage unit to the next, be free from extraneous substances, maintain its potency, therapeutic availability and appearance until used, and upon administration release active ingredient for full biological availability.[4]

Quality control is the part of Good Manufacture Practice (GMP) that is concerned with sampling, specifications, testing, documentation and release procedures which ensure that the necessary and relevant tests are actually carried out and that the materials are not released for use, not products released for sale or supply, until their quality has been judged to be satisfactory.[5]

The safety and efficacy of a pharmaceutical dosage form can be guaranteed when its quality is reliable. The efficacy of pharmaceutical dosage forms generally depends on their formulation properties, and manufacturing methods, hence it is likely that the quality of dosage form may vary.[6]

The increase in the number of generic drug products from different multiple sources has placed people and prescribers in a position of selecting one from among several seemingly equivalent products.[7] Many of these products are inexpensive and affordable, but with uncertainly about their quality.[8] Regular control of drug products has long been an integral part of the pre-and post-marketing quality control to safeguard the public.

Many developing countries do not have an effective means of monitoring the quality of generic drug products in the market. This results in a widespread distribution of substandard and/or counterfeit drug products. It was in view of this fact that WHO issued guidelines for global standard and requirements for registration, assessment, marketing, authorization and quality control of generic pharmaceutical products.[7]

If available, affordable, of good quality and properly used, drugs can offer a simple, cost-effective answer to many health problems. Despite the obvious medical and economic importance of drugs there are still widespread problems with lack of access, poor quality, and irrational use.[9] A generic drug is identical - or bioequivalent to a brand name drug in dosage form, safety, strength, route of administration, quality, performance characteristics and intended use. Although generic drugs are chemically identical to their branded counterparts, they are typically sold at substantial discounts from the branded price. Generic medicines are those where patent protection has expired, and which may be produced by manufacturers other than the innovator company. Use of generic medicines has been increasing in recent years, primarily as a cost saving measure in healthcare provision. Generic medicines are typically **20 – 90 %** cheaper than originator equivalents.

Generic drug products must satisfy the standards of quality, efficacy and safety as those applicable to the innovator products.[7] Preliminary physicochemical assessment of the products is very important and in vitro dissolution testing can be a valuable prediction of the in vivo bioavailability and bioequivalence of oral solid dosage forms.[7]

The main purpose of this study is to evaluate some quality control parameters, by comparing the quality, safety, and efficacy of five brands of prednisolone tablets available in the Libyan market which are under different trade names from different companies as (Julphar, Akums, October pharma, Actavis, Pfizer) with pure B.P. prednisolone reference (**BPCRS**), All tests were carried out by methods specified in the Pharmacopeias (BP, USP, Ph. Eur.) The non-official tests as uniformity of mass, friability, thickness, diameters, disintegration time, hardness and official tests as uniformity of dosage units (assay) and dissolution tests were performed. Whereas every sample was approved in BP tests, the results in the dissolution profile test showed that all of the generic drugs were pharmaceutically equivalent.

The physicochemical parameters and assay of the five brands of prednisolone tablets were assessed through the evaluation of uniformity of tablet weight, friability, hardness, disintegration, dissolution profile and uniformity of tablet content (assay) of active ingredients according to established methods. Weight variation of the tablets proved statistically that all of the tablets were in accordance to the required limits that is **±7.5 %** deviations. Dissolution test was carried out; none had less than **70%** within **30** minutes. Pharmaceutical assay was carried out none had less than the required specification (**90.0 % - 110.0 %**). The disintegration time was found within 2 minutes. All brands complied with the official specification for uniformity of weight, friability, and disintegration except the Gupisone® from Julphar. The assay of prednisolone tablets by LC using UV detection at 254 nm revealed that all samples contained between **90.0%- 110.0** (w/w) of labelled chemical content.

2. MATERIAL AND METHODS

2.1 Reagents and solutions

All chemicals used were of analytical grade and used without further purification. Methanol for LC grade, acetone were from carloerba company. Butylparben (Butyl 4-hydroxy benzoate), Prednisolone standard were from Fluka analytical company. Potassium bromide for infra-red Spectroscopy was from BDH company. Soyabean casein digest medium, plate count agar, sabouraud dextrose agar, mackonky broth, Makonky agar, Xylose- lysine

deoxycholate agar were from hi media laboratory. All Information about Generic products as mentioned in Table **1**.

Table 1. Information of Generic products

Product Name	Company	Origin	Dose (mg)	Exp. Date
Prednisolone	Actavis	UK	**5**	02/2016
Deltacortil®	Pfizer	Turkey	**5**	06/2014
Gupisone®	Julphar	UAE	**5**	03/2017
Prednisolone	Akums	India	**5**	06/2015
Prednisolone	October Pharma	Egypt	**5**	01/2017

All solutions were prepared by using ultrapure MilliQ-water (Millipore, Milford, MA, USA) and were filtered with a 0.2 µm membrane filter syringe (Dassel, Germany).
All samples were weighed using Sartorius CP64A analytical balance (Sartorius incl).

2.2 Equipments

2.2.1 Liquid chromatographic system and conditions

The assay of prednisolone carried on by using the method currently prescribed in the B.P 5th edition and was performed on Prominence UFLC (Model SPD-20A Shimadzu Corporation, Kyoto, Japan). system consisting of a LC a quaternary pump (Model SPD-20AD Shimadzu Corporation, Kyoto, Japan), an auto injector Model SIL-20ACHT Shimadzu Corporation, Kyoto, Japan), a UFLC UV-VIS detector (Model SPD-20AV Shimadzu Corporation, Kyoto, Japan) The column temperature was maintained by using oven (Model CTO-20AC Shimadzu Corporation, Kyoto, Japan). Data acquisition was supported by (LC Solution software version 1.25, Shimadzu Corporation, Kyoto, Japan). The mobile phase used for the analysis of prednisolone was delivered using an LC pump at a flow rate of 1.0 ml.min^{-1}. The samples were injected using an autosampler. The amount of sample injected was 20 µL.

The column temperature was maintained at 35°C by keeping it in the oven. The stationary phase used for the separation of prednisolone was ODS-C18 Ascentis Express C18 (150 x 4.6 mm ID, 2.7 µm) with a column guard (50 x 4.6 mm ID, 2.7 µm) (SUPLECO Analytical, Bellefonte, USA). The UV detector was used at 254 nm. the instrumental set up is shown in the Figure.**2**.

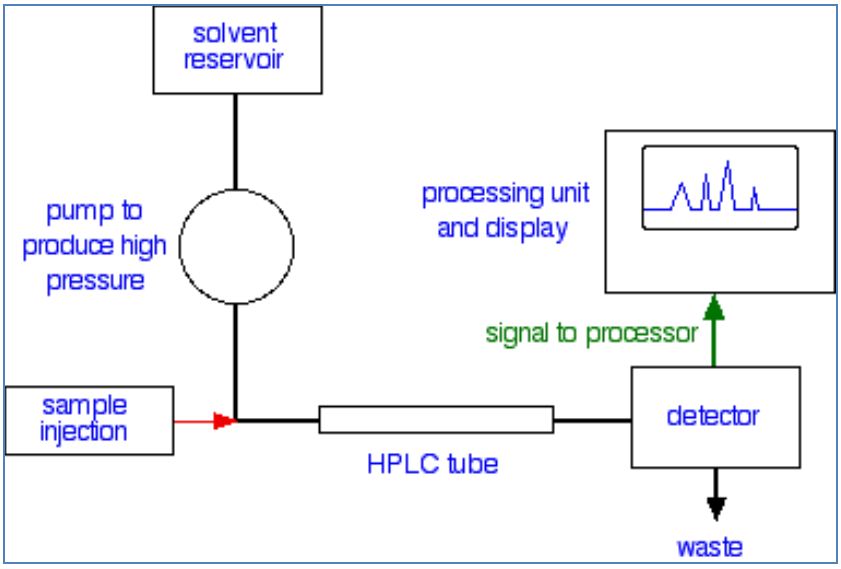


Figure.2. Flow scheme for HPLC.

2.2.2 Instruments for non-official (Physical) test

The non-official tests were done by various instruments as frariabilty tester (ERWEKA® TAR220) for frariabilty test, tablet combination tester (ERWEKA® TBH425 WTD) for hardness, diameter, thickness, weight tests, disintegration apparatus (ERWEKA® Model ZT320) for disintegration test, dissolution test unit (ERWEKA DT600) for dissolution test, Fourier Transform Infra-Red Spectroscopy (IR Prestige 21) for identification by IR, Data acquisition was supported by (IR Solution software version 1.4, Shimadzu Corporation, Kyoto, Japan). Incubator memmert; (Model 30-750), Oven memmert Model 3033 for microbiological tests.

2.3 Methods

2.3.1 Internal Stranded preparation

An internal standard solution of butylparaben was prepared by dissolving **75 mg** of butylparaben in 100 mL of volumetric flask dissolved in water, a 10 mL of solution in 100 mL of volumetric flask diluted by mobile phase (**42** mL of Water: **58** mL of Methanol) to produce a **75 µg.mL^{-1}** final concentration of working Internal Stranded solution.

2.3.2 Standard preparation

A Reference solutions of prednisolone was prepared by dissolving **50 mg** of prednisolone reference (**BPCRS**) in 100 mL of volumetric flask dissolved in water, a 10 mL of the solution, 10 mL of internal standard solution were added to 100 mL of volumetric flask and

diluted in mobile phase (**42** mL of Water : **58** mL of Methanol) to produce a **50 µg.mL^{-1}** final concentration of working Stranded solution.

2.3.3 Sample preparation

A **20** tablets were weighed to measure the average weight and grinded it well. a **50** mg equivalent prednisolone in 100 mL of volumetric flask dissolved in 58 mL of methanol shake and sonicated for 20 min each and make it up with MilliQ water, a 10 mL of the solution, 10 mL of internal standard solution were added to 100 mL of volumetric flask and diluted by mobile phase (**42** mL of Water : **58** mL of Methanol) to produce a **50 µg.mL^{-1}** final concentration of working sample solution.

2.3.4 Assay of content of active ingredient

Different products were tested during the assay by LC method according to British Pharmacopeia 5th ed.[11], chromatographic condition as shown in Table **2** and finally, **50 µg.mL^{-1}** of prednisolone, due do not availability of dexamethasone as internal standard in house, the butyl paraben was chosen as internal standard at a concentration of **75 µg.mL^{-1}** according to Japanese Pharmacopeia (JP).[12] **Figure.3**. shows typical chromatogram of prednisolone (**BPCRS**) and butyl paraben as internal Standard.

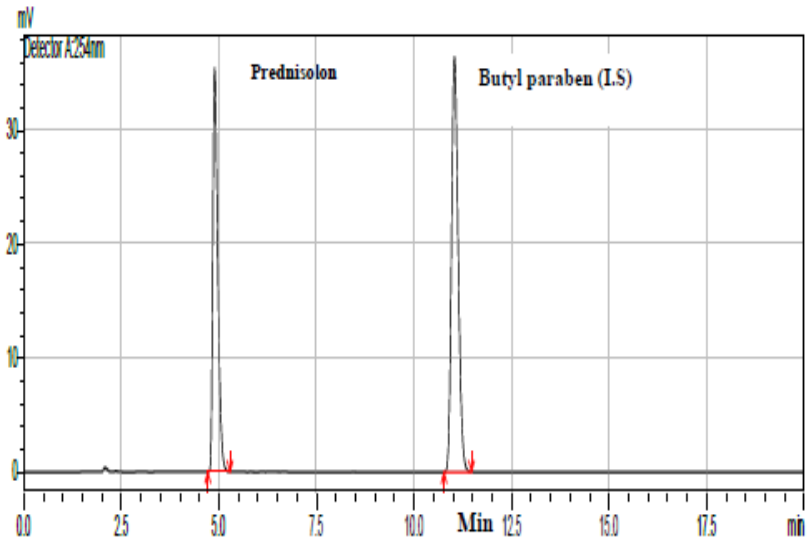


Figure. 3. Typical LC chromatogram of prednisolone (BPCRS) and butyl paraben as (I.S).

Table 2. Chromatographic conditions, assay of content by B.P method.[11]

Mobile phase	**H_2O : Methanol (42 : 58 v/v)**
Elution	Isocratic: 100 **%**
Column Temp	35 °C
Flow rate	1 mL. min^{-1}
Detection (UV)	254 nm
Injection vol.	20 µL

In this test amount of drug in the dosage form is determined. A number of units from a products are selected at random and assay procedures are carried out then the results obtained must be within the prescribed percentage limits.[11-13] It is to assure the presence of the required amount of active ingredient **Figure.4** shows typical chromatograms overlay of five prednisolone generic products and butyl paraben as internal Standard. More variation could lead to ineffectiveness therapeutic drug level or overdosing which lead to toxicity.[14]

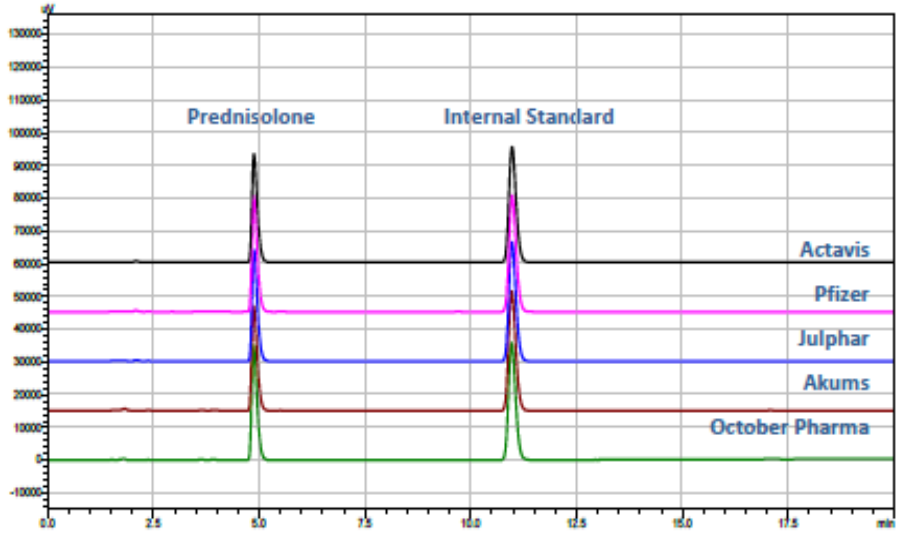


Figure. 4. Typical LC chromatograms overlay of five prednisolone generic drugs and Butyl paraben as (I.S).

2.3.5 Dissolution test

Dissolution test is the measurement of the proportion of drug dissolving in a stated time under standardized conditions *in vitro*.[15] To ensure availability of drug for absorption. Since the dissolution of drug is considered to be an essential step in the absorption process, the availability of drug for absorption from a dosage form largely depends on the drug dissolving in gastrointestinal fluids.[16] Also to predict *in vivo* bioavailability, The prediction of in vivo bioavailability of most oral drugs depends mostly on the in vitro dissolution studies. Ideally, dissolution tests should provide data to distinguish good and bad products formulations,

batches especially when operating conditions are optimal.[8] chromatographic condition for determination the drug dissolved after certain time as shown in (Table **3**).

Table 3: Chromatographic conditions, determination of drug dissolved by B.P method.[11]

Mobile phase	**H_2O : Methanol (42 : 58 v/v)**
Elution	Isocratic: 100%
Column Temp	35 °C
Flow rate	1 mL. min^{-1}
Detection (UV)	254 nm
Injection vol.	50 µL

2.3.6 Uniformity of weight determination

The tablet weight routinely measured to ensure that a tablet contains the proper amount of drug.[17] It is the test used to measure the uniformity of total mass of tablet "active ingredient and excipient in the batch. High variability of dose may cause toxicity or insufficient therapeutic drug level.[14] Also to ensure that the tablets in each lot are within the appropriate size range.[7]

2.3.7 Diameter and thickness measurements

The physical dimensions of the tablet along with the density of the materials in the tablet formulation and their proportions, determine the weight of the tablet. The diameter and thickness express the size of tablet.[17]

2.3.8 Friability test

Friability of uncoated tablet is the phenomenon where by tablet surfaces are damaged and/or show evidence of lamination or breakage when subjected to mechanical shock or attrition and is expressed as the loss of mass and it is calculated as a percentage of the initial mass.[11] This test is performed to evaluate ability of the tablets to withstand abrasion in packaging, handling and transporting.[13] Tablet which does not resist abrasion tend to powder, chip and fragment when handle.

2.3.9 Hardness test

Tablet hardness is usually expressed as the force required to break-down the tablet[18], it is the test to measure the solidity of tablet to stand post operation procedure such as packing , storaging or handling. Although there is no official test for tablet hardness (it is non-

compendia test), this property must be controlled during production to ensure that the product is firm enough to withstand handling during packaging and transporting without breaking, chipping or crumbling. Hardness may affect tablet friability and disintegration time. It usually affect drug dissolution and release, and it may affect bioavailability.[19]

2.3.10 Disintegration test

The disintegration test is provided to determine whether tablets or capsules disintegrate within the prescribed time when placed in a liquid medium at the experimental conditions.[19] Complete disintegration is the state in which any residue of the unit, except fragments of insoluble coating or capsules shell remaining on the screen of the test apparatus or adhering to the lower surface of the disk, if used, is a soft mass having no palpably firm core.[19]

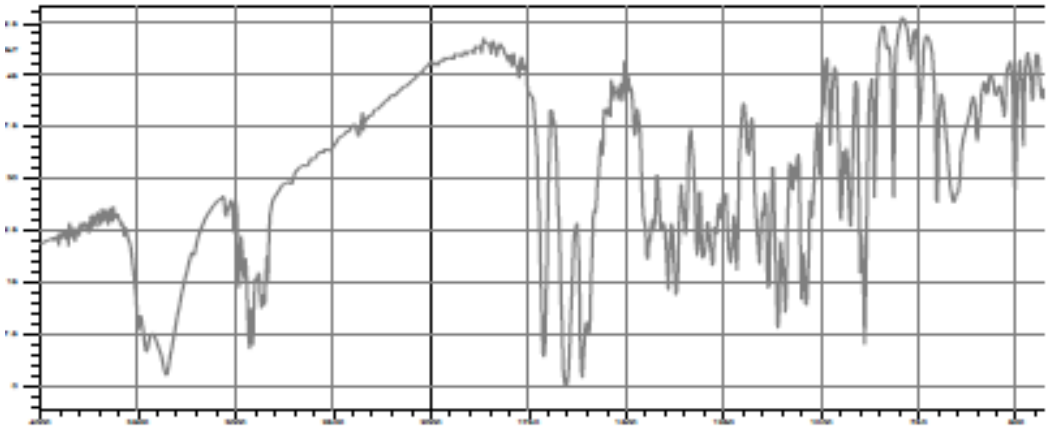
The disintegration provides drug particles with an increase surface area within the gastrointestinal tract and is the first important step toward solution, so this test is important to ensure the disintegration and discharge the drugs to the body fluids for dissolution.[15] It is used as a guide to formulator in the preparation of an optimum formula, and as an in process control test to ensure lot to lot uniformity.[17] It is the test used to measure the time of tablet disintegration.

2.3.11 Identification of Compounds

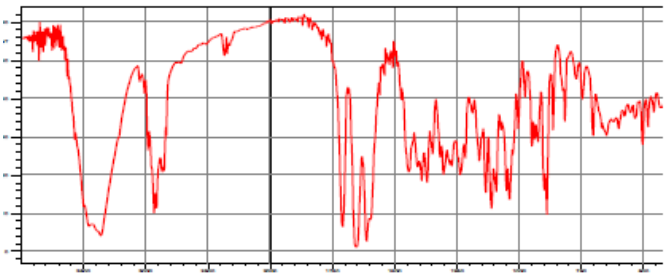
Infrared (**IR**) test is pharmacopeial test used for identification of compounds by detecting of the functional groups in it. IR analysis based upon a comparison of sample IR spectrum with that of reference standard as will be shown in Fig.5. which were acquired by (IR Solution software version 1.4, Shimadzu Corporation, Kyoto, Japan).

By preparing the substance (prednisolone products) and the prednisolone reference substance (**BPCRS**) by the same procedure and record the spectra between 4000-650 cm^{-1} (2.5-15.4 μm) under the same operational conditions.[11]

The transmission minima (absorption maxima) in the spectrum obtained with the prednisolone products correspond in position and relative size to those in the spectrum obtained with the prednisolone reference substance (**BPCRS**).



(A)



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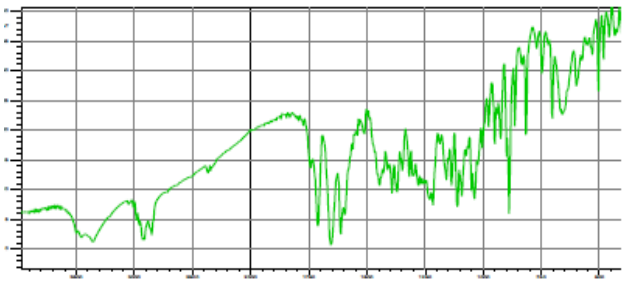

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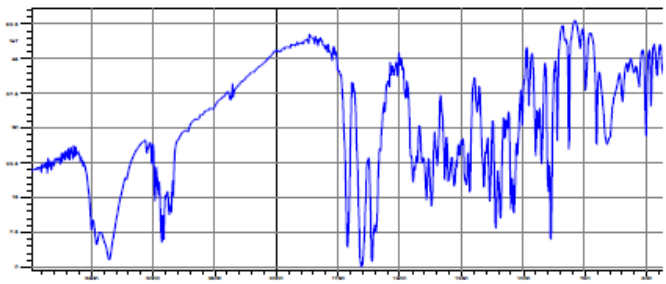

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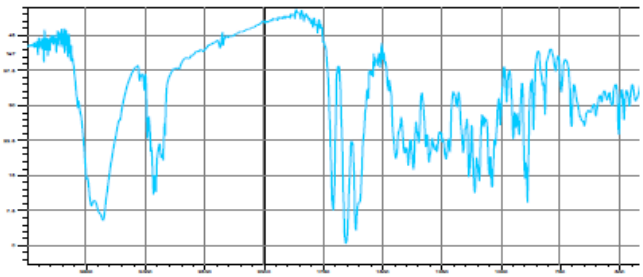

(E)

Figure. 5. Typical IR spectra;(A)- Prednisolone (BPCRS), (B)- Gupisone® by Julphar, (C)- Prednisolone by Akums, (D)- Prednisolone by Actavis, (E)- Prednisolone by October Pharma.

3. RESULTS AND DISCUSSION

3.1 Results

The quality control tests results for the different formulations are summarized in tables **4**, **5** and **6**. All official tests were carried out according to British Pharmacopeia BP 5th (**2010**), Ph. Eur. 6th ed. *(**2007**) and USP 33-NF 28 (**2010**).*[11, 20, 22] For the assay of average weight, since the values found were higher than **80** mg, ranging from **80** to **118** mg, each unit could vary by

±7.5 % around the average, with a tolerance of two tablets outside this limit, and none could deviate more than **10 %** from the nominal value. Just one tablet of sample Gupisone® had an individual weight more than **7.5%** higher than average and thus all drugs were approved.

Table 4. Determination of drug content (assay) and dissolution test.

Product Name	% Content	Dissolution %
Actavis	103.3	105.4 **±0.8**
Pfizer	98.2	102.1 **±2.8**
Julphar	101.6	98.3 **±7.9**
Akums	97.6	73.1 **±3.0**
October Pharma	92.8	99.3 **±2.4**

Table **4** presents the results for dosage unit content, uniformity and the dissolution profiles. All of the five analyzed samples had contents compatible with that required by BP[5th], mean content ranging from **90** to **110%** and uniformity of dosage units between **85** and **115%**. Dissolution profiles for all the drugs showed more than **70 %** of the active ingredient dissolved within **30** minutes.

The friability test resulted in a small loss of mass, well below the limit recommended by B.P (less than **1%**), for all the tablets analyzed (Table **5**).

Table 5. Uniformity of weight

Product Name	Min weight (mg)	Max weight (mg)	Ave. weight (mg)	RSD (%)
Actavis	99.9	103.7	101.8	1.0
Pfizer	111.9	114.1	112.9	0.5
Julphar	106.2	116.9	113.5	3.0
Akums	111.5	117.9	115.8	1.4
October Pharma	77.2	85.4	80.8	2.9

All drugs were approved with regard to friability and hardness, since this parameter was found to be above **40 N** for all samples, except Gupisone® **31 N** for hardness, **1.1 %** for friability and **3.5%** of RSD % for thickness. The disintegration time of all samples also proved satisfactory, as all tablets had completely disintegrated in less than **30** minutes, which was about 2 minutes . The results of these tests are presented in Table **6**.

Table 6: Non official (Physical) tests.

Product Name	Weight (mg)	Diameter (mm)	Thickness (mm)	Hardness (N)	Friability (%)	Disintegration (Sec)
Actavis	101.8 ± 1.0	6.4 ±0.2	2.4 ± 0.4	57.4 ± 8.6	0.14	99
Pfizer	112.9 ± 0.5	7.0 ±0.4	2.6 ± 0.4	40.2 ± 10.2	0.06	29
Julphar	113.5 ± **3.0**	7.1 ±0.3	2.3 ± **3.5**	**31.0 ± 14.9**	**1.1**	45
Akums	115.8 ± 1.4	7.1 ±0.3	2.9 ± 0.9	40.4 ± 8.4	0.14	75
October Pharma	80.8 ± 2.8	6.0 ± 0.2	2.5 ± 2.0	61.2 ± 17.5	0.11	80

3.1.1 Official (Pharmacopeial) Results

The results for Official tests are presented in Table **4**.

3.1.1.1 Content of Active Ingredient:

The dose content uniformity was tested by the method of weight variation. Twenty tablets were weighed, accurately and individually, in each sample. From the content test result, the active content in each unit was calculated, presuming homogeneous distribution of this component in the formulation. Results were expressed as percentage of declared quantity and its relative standard deviation (**RSD** %).

3.1.1.2 Dissolution

The dissolution profiles of the five generic drug (released drug) being tested against the prednisolone reference (**BPCRS**). Since all the drugs showed more than **95 %** of the active ingredient dissolved within **30** minutes. Except the Akums has the lowest value, which was **73.1%.**

The evaluation of dissolution test indicated that there was no significant variation found between all generic brands of prednisolone tablets except Akums product (Table **4**).

3.1.1.3 Non official (Pharmacopeial) Results

The results for non-official tests are presented in Table **5** and **6**.

3.1.1.4 Weight uniformity

Twenty tablets from each sample were individually weighed on an analytical balance the results is shown in table **5**.

3.1.1.5 Friability

All generic drugs were approved with regard to friability, since this parameter was found to be less than **1%** for all samples except Gupisone® from Julphar, which was **1.1%** as shown in table **6**.

3.1.1.6 Hardness

All drugs were approved with regard to hardness since this parameter was found to be above **40 N** for all samples except Gupisone® from Julphar, which was **31 N** as shown in table **6**.

3.1.1.7 Disintegration

The immersion liquid for this test was water at **37 ± 1ºC**. Six tablets of each sample were assessed, the disintegration time of all samples also proved satisfactory, as all tablets had completely disintegrated within **2** minutes as shown in table **6**.

3.1.1.8 Infrared (IR)

By extract a quantity of the powdered tablets with acetone, filter and evaporate the filtrate to dryness (**residue**). The IR spectrum of residue was compared with the prednisolone reference substance's (**BPCRS**) IR spectrum as shown in **Figure. 5**.

The matching of the product's IR data against prednisolone reference substance's (**BPCRS**) IR data were obtained more than **93.0 %.** Therefore all products are comply regards to the IR matching.

4. DISCUSSION

The results presented in Tables **4**, **5** and **6** indicate that all the analyzed drugs attain standards of quality recommended by official compendia [British pharmacopeia (**BP**), United states Pharmacopeia (**USP**) and European Pharmacopoeia (**Ph**. **Eur**.).[11,20,22]

Since it is common for drug tablets to vary in weight, mechanical resistance and disintegration characteristics (besides the design, thickness, diameter and size specific to each drug), these properties must be controlled during manufacturing, to ensure the expected appearance and therapeutic efficacy of the product.[23]

The assay of uniformity of mass is used to check homogeneity among the units of the sampled batch. Tablets of different weights may differ in quality parameters, including the content of active ingredient.[24, 25] Among all the tablets analyzed in this study, only one unit

of drug Gupisone® by Julphar fell outside the limits of **±7.5** % defined for tablets of more than **80** mg and less than **250** mg.

Tablets are also subject to mechanical shocks during production, packing, storage, transportation, distribution and handling. For this reason, they should possess a certain level of mechanical resistance.

High friability (i.e., low capacity to withstand friction) means that the drug is more likely to suffer mechanical erosion, which may cause loss of the active ingredient and thus compromise its efficacy. Hardness is related to friability, but also to disintegration and dissolution speed.

A very hard tablet may exhibit an increased dissolution time.[24, 26, 27] As shown in Table **4**, all drugs were approved in respect of their friability and hardness and thickness except for Gupisone® by Julphar, which has the frariabilty more than **1 %,** less than **40 N** and highest RSD % (**3.5 %** for thickness) and (**3.0 %** for uniformity of weight).

The physical assay on disintegration is related to the capacity of solid pharmaceutical forms to release their active ingredients, because before their solubalization the tablets must disintegrate into small particles, increasing the contact surface with the dissolution medium and favoring absorption and bioavailability of the drug.[27, 28]

All drugs were approved with regard to their disintegration time (Table 6).

The results of dosage assays presented in Table **4** showed that the average content of prednisolone among the analyzed drugs ranged from **90.0 %** to **110 %**. Product from October Pharma. showed the lowest content, since its average content was **92.8 %,** this deviation still maintained the drug content within the interval of **90–110 %** (British Pharmacopeia).[11]

The results for uniformity of dose showed that, even with a limit higher than that allowed by British pharmacopeia.[11] **(85 – 115%)**, the results were close to the average content. Therefore, all drugs were approved in the assays related to prednisolone content.

The dissolution study may be performed by collecting only one aliquot from the bath after **30** minutes, in which case **70 %** of the prednisolone must be dissolved in the dissolution medium after this interval.

This reinforces the importance of assessing whole dissolution profiles in order to determine pharmaceutical equivalence, as well as in routine quality control. Despite the great advances in the last decade, these results confirm the need for tighter legislation and inspection regarding the quality of similar and generic drugs already on the market, which when implemented will further enhance the quality of drugs available to the Libyan population, besides increasing the availability of generic drugs in Libya.

5. CONCLUSION

This work has been carried out to conduct a comparison of various products of prednisolone tablet drug **5 mg** from various companies and countries by using non official and official methods in official compendia (British pharmacopeia, United states Pharmacopeia and European Pharmacopoeia).[11,20,22] When looking to the analytical techniques that are used in the evaluation of five generic products of prednisolone in our project it has been found that all generic products are comply with the specifications for content (**90.0 - 110.0%)** and dissolution test not less than **70 %**.

All generic products comply with the limits for the friability, hardness tests, uniformity of weight and thickness uniformity except the Gupisone® from Julphar do not comply with the limits for the friability test which is more than **1 %**, hardness was less than **40 N**, highest **RSDs** % (**3.5 %** for thickness) and (**3.0 %** for uniformity of weight).

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