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COMPARATIVE QUALITY EVALUATION OF DIFFERENT BRANDS OF CIPROFLOXACIN TABLETS AVAILABLE IN PHARMACEUTICAL MARKET OF BANGLADESH

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Abstract

Ciprofloxacin is an antibiotic in a group of drugs called fluoroquinolones. It is a broad-spectrum antibiotic that acts against a number of bacterial infections. It is widely produced and marketed drug by many pharmaceutical companies in Bangladesh. The aim of the study is to compare the different physical parameters including hardness, friability, diameter, thickness, disintegration time, dissolution test and assay for quality evaluation and characterization of tablets of five different brands of Bangladeshi pharmaceutical company. All five brands of ciprofloxacin HCl tested meet the specification of the USP for content uniformity, weight variation, hardness, friability, thickness, diameter, disintegration and dissolution. The amount of active ciprofloxacin HCl varies from 482.15 mg to 507.85 mg among the products. The average hardness of the products varies 4.76 kg/cm to 9.46 kg/cm respectively. All the brands had shown disintegration time 7.0 to 12.2 minutes while they showed 88.15% to 96.51% release of active ingredient within 30 minutes in dissolution testing. This may confirm the absorption of the drug from gastrointestinal tract for optimum therapeutic effect.So from this study we can conclude that products of Ciprofloxacin available in Bangladeshi pharmaceutical market meet the quality parameter to satisfy therapeutic efficacy.

Keywords: *Ciprofloxacin tablets, hardness, disintegration time, dissolution rate, quality evaluation*

Introduction

Ciprofloxacin is an antibiotic in a group of drugs called fluoroquinolones [1]. In 1981 it was discovered by Bayer, Germany. The Food and Drug Administration (FDA) approved this drug in 1987 for uses in the United States as first oral broad-spectrum antibiotic [2]. For the wellbeing of the patients, quality of medicine is an absolute necessity. World Health Organization claimed that the manufacturers must undertake responsibility for the quality of the drugs that they produced [3]. The clinical effectiveness exerted by tablet formulation depends on at least two factors such as, the drug must be present in the labeled amount and its availability to the body [4]. The main objective of an oral tablet is to deliver the drug to the human body at certain and defined amount through the gastro-intestinal system for producing therapeutic effect [5]. The formulation of the drug product can have a significant effect on the quality parameters such as weight variation, hardness, friability, disintegration time, dissolution profile etc. This also includes the physiochemical properties of the active ingredients and excipients as well as the procedures used in the manufacturing process [6]. Moreover, quality control parameters also or physical properties of tablet are useful tools for maintaining consistency in batch-to-batch manufacturing and it should be performed for every drug product. All of these parameters are closely related to each other and have effect on drug absorption, bioavailability etc. [7]. The major objective of this work is to find out the current status of the quality of the marketed Ciprofloxacin preparations available in Bangladesh. This work will increase awareness among the health practitioners and drug control authority so that, pharmaceutical manufacturers are forced to produce quality medicine. This study will also provide a comprehensive knowledge about the weight variation, hardness, disintegration, dissolution, percentage of potency of Ciprofloxacin tablets available in the market and compares these values with the official specifications.

Materials and Methods

Five brands of Ciprofloxacin tablets, manufactured by five different manufacturers of Bangladesh with labelled contents of 500 mg were obtained from various retail pharmacies of Dhaka city in Bangladesh. All tablets were of same manufacturing year.

Instruments

Instruments used in this study were mortar, pestle, Electronic Balance (Ohaus CP213 China), Friability tester (Model: 902, Intech REV), Hardness Tester (Monsanto), Disintegration Test Apparatus (Aesico, CAT NO 20066B), Dissolution Test Apparatus USP (Minhua, RC-8) and UV Visible Spectrophotometer (T60U PG Instruments, England).

Collection of Samples

There are many brands of Ciprofloxacin tablets in Bangladesh. Samples were collected from retail medicine shop of different areas of Dhaka city and collected samples covered top, middle and lower companies ranked by Bangladesh Pharmaceutical Index, 3Q'2011. The samples were properly checked for their physical appearance, the name of the manufacturer, batch number, manufacturing data, expiration date, manufacturing license number, drug administration registration number, and the maximum retail price at the time of purchase. The samples were then properly coded for analysis (C01, C02, C03, C04, and C05).

Collection of Standard

The standard ciprofloxacin hydrochloride powder was obtained from the Desh Pharmaceuticals Ltd, Dhaka, Bangladesh. Unless otherwise specified, all other chemicals were of analytical grade.

Weight Variation Determination

20 tablets from each brand products were weighed individually in a weighing balance .The average weight of the tablet, as well as their percentage deviation, were calculated (Table 1). [8]

% of weight variation = [(Individual weight – average weight)/Average weight] ×100

Hardness Test

Hardness indicates the capability of a tablet to withstand mechanical shocks during handling in manufacturing, packaging, and shipping. [9] The hardness of five brands of Ciprofloxacin was determined and the observed results are shown in

the table-2.

Disintegration Test

To comply with the USP-NF standards, the tablets must disintegrate and all particles must pass through the 10-mesh screen within 30 min. If any residue remains, it must have a soft mass with no palpably firm core [10, 11].

Assay

Analysis of drug potency in tablets helps to determine the strength or content of drug in a dosage form. 100 mg of standard ciprofloxacin hydrochloride powder was weighed and dissolved in 10 ml of distilled water and diluted up to 100 ml to get 1000 µg/ml concentration of standard stock solution. From this stock solution 10 ml was taken to another 100 ml volumetric flask and diluted to get 100 µg/ml of drug concentration. Then, using this stock solution various other concentrations were prepared like 5, 10, 15, 20, 25 and 30 µg/ml. Absorbance values of these concentrations were measured at 276 nm by using UV spectrophotometer and standard graph was plotted by taking absorbance values on Y-axis and concentration values on X-axis. For this test tablets from each brand were crushed into fine powder and sufficient amount of powder was weighed so that the amount contains 100 mg of active ciprofloxacin and dissolved in 100 ml 0.1 M HCl and further dilution was made to obtain 100 µg/ml for each brand. Then 4 ml of each brand made up to 100 ml with 0.1 M HCl and the absorbance of each brand was taken at 276 nm against the blank [12]. The USP-NF specification is that the content of ciprofloxacin hydrochloride should not be less than 90% and not more than 110%, while BP specifies that the content should not be less than 95% and not more than 105% [11, 13].

In-vitro Dissolution Studies

For this test USP dissolution apparatus was used. To test for dissolution, one tablet was placed in each vessel (6 vessels) for each brand, containing 900 ml of 0.1 M hydrochloric acid (HCl) as a dissolution medium maintained at 37 ± 0.5 °C. The rotational speed of the apparatus was held constant at 50 rpm. When the temperature was set each tablet was placed in each basket for 30 min. After the desired time, 20 ml solution was collected and filtered. The filtrate was then analyzed by UV spectrophotometer at the wavelength of 276 nm, using 0.1 M HCl as blank. The percentage of drug release at each interval was calculated by using standard ciprofloxacin. As per USP-NF tablets meet with this test if not less than 75% dissolves in 45 min. According to BP tablet comply with this test if not less than 80% dissolves in 45 min [10, 11, 13].

Results and discussion

All the brand of Ciprofloxacin tablets used in this investigation was within their shelf life. All tablets obtained from local market were subjected to a number of tests in order to assess quality parameters like assay, weight variation, hardness, and disintegration time. All the tablets of different brand contained Ciprofloxacin within 100 ±5 % of the labeled claim. The USP [11] specifications for the assay are that the Ciprofloxacin content should be not less than 90 % and not more than 110 %. Therefore, the assay results ascertain the quality of Ciprofloxacin in all the products. Weight variation does serve as a pointer to good manufacturing practices (GMP) maintained by the manufacturers as well as the amount of active pharmaceutical ingredient (API) contained in the formulation. The weight variation for all the tablets used in this study showed compliance within the official specifications [8, 13], as none of the products deviated by up to 5 % from their average weight.

Weight Variation Test

The weight variation test is a satisfactory method of determining the drug content uniformity of tablets. When the weight variation is within the specifications the tablets are thought to contain a uniform active ingredient to give desired therapeutic response. But when the weight variation is out of the specification the tablets are thought to contain less or more active ingredient to give an ineffective therapeutic response or toxic effect respectively. It may vary due to result from, poor granulation flow properties, resulting in uneven die fill. The USP 12 specification of weight variation: ±7.5 for 130 to 324mg average weight of tablet & ± 5% for more than 324mg of an average weight of the tablet. Twenty tablets were selected from each of the brands and weighed individually

using electronic balance. Their average weights were calculated. For all tablet brands following mathematical equation was used for weight variation. [14] It was observed that all of the brands meet the USP specification. (Table 1)

Hardness Test

Hardness test of material is indicative of its strength. Most important physical feature for assessing tablet is hardness. [15] In this study, the hardness of different brands of Ciprofloxacin tablet was measured by hardness tester. The acceptable limit of hardness of a tablet is 4 to 7 kgf (kilogram of force). [16, 17] Besides, a force between 4 – 10 Kg is also considered to be satisfactory. [18][19] The hardness of five brands of Ciprofloxacin was determined and the observed results are shown in the table-2.The comparative Hardness of various brands of Ciprofloxacin tablets is graphically shown in Fig-1.

Disintegration time

Disintegration is the breakdown process of a tablet into smaller particles and is the first step towards dissolution. It could be directly related to dissolution and subsequent bioavailability of a drug. A drug in corroborated in a tablet is released rapidly as the tablet disintegrates a critical step for immediate release dosage forms because the rate of disintegration affects the dissolution and subsequently the therapeutic efficacy of the medicine. All the brands complied with compendia specifications for disintegration. The BP specification is that uncoated tablets should disintegrate within 15 min and film coated tablets should disintegrate within 30min while USP specifies that uncoated and film coated tablets should disintegrate within30min. The disintegrate of five brands of Ciprofloxacin was determined and the observed results are shown in the table-3.The comparative disintegrate of various brands of Ciprofloxacin tablets is graphically shown in Fig-2.

Assay

The assay results of all brands are between 95.28% and 99.40%. They meet the U.S.P specification for assay (Table 4).

Dissolution test

The dissolution rate of five brands of Ciprofloxacin tablets was determined. The observed results are shown in table-5. All the brands met the standard specification of the U.S.P standard. The comparative dissolution of various brands of Ciprofloxacin tablets is graphically shown in Figure-3.

Conclusion

Ciprofloxacin tablets have been analyzed to find their correct quality status. For this purpose, the marketed sample of five brands of Ciprofloxacin tablets was analyzed by using established methods and apparatus. The result of weight variation, hardness, disintegration time, dissolution and assay potency tests of all marketed products comply with pharmacopoeial limit. All of the brands have proved that they have the quality which meets the BP and the USP specification. The present study, although performed on a limited scale yet on the basis of professional judgment the data reported in this study can help the Drug Control Authority to get an idea about the quality status of the marketed Ciprofloxacin preparations in Bangladesh.

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Table 1: Weight Variation Test of Ciprofloxacin tablets

Sample code	Average weight per tablet (mg)	SD
C1	674.92	0.89
C2	670.58	0.85
C3	700.10	0.83
C4	610.10	0.81
C5	720.55	1.28

Table 2: Hardness of 5 brands of Ciprofloxacin tablets

Sample code	Hardness (kg/cm2)	SD
C1	7.20	0.27
C2	6.16	0.23
C3	6.66	0.23
C4	9.46	0.66
C5	4.76	0.21

Table 3: Disintegration time of various brands of Ciprofloxacin tablets

Sample code	Disintegration time(min)	SD
C1	10.0	1.30
C2	8.0	0.89
C3	12.20	1.30
C4	9.20	0.91
C5	7.0	0.95

Table 4: Potency of Ciprofloxacin tablets.

Sample code	Potency (%)	SD
C1	101.57	0.95
C2	98.87	0.60
C3	100.40	0.82
C4	99.23	0.55
C5	96.43	0.68

Table 5: Dissolution Rate of Various Brands of Ciprofloxacin tablets

Sample code	% of drug release	SD
C1	88.15	1.07
C2	89.31	0.61
C3	88.91	0.95
C4	90.80	0.92
C5	96.51	0.67

Figure 1: Hardness of various brands of Ciprofloxacin tablets

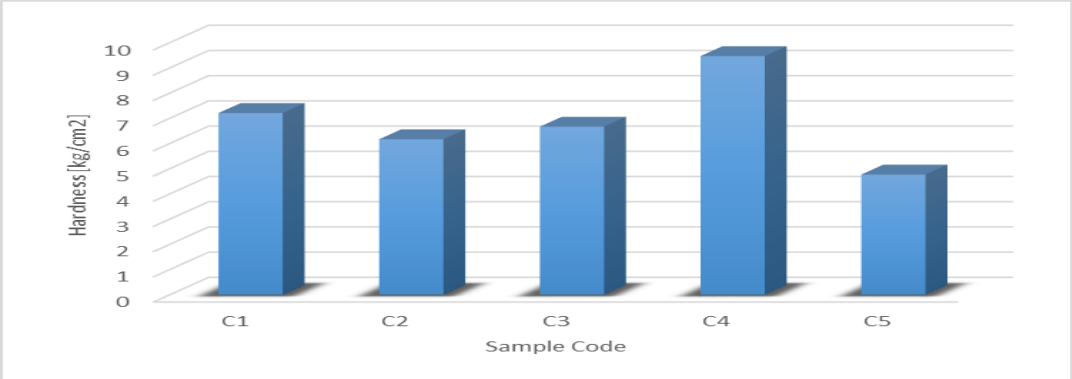

Figure 2: Disintegration time of various brands of Ciprofloxacin tablets