STUDY ON THE IMPACT OF CIPROFLOXACIN HCL TABLET QUALITY CONTROL TESTS

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ABSTRACT

A fluroquinolone antibiotic of the second generation is ciprofloxacin. In this study, 500 mg Ciprofloxacin Hydrochloride pills from three different manufacturers were chosen at random and evaluated using USP standards. Melting point, weight, thickness, friability, potency, stability, disintegration, dissolution tests, and chemical content determination were evaluated as quality parameters. The results of each brand from all three brands were pleasant in tests of melting point, weight fluctuation, length and breadth, and thickness. The goods have a friability of 0%, 0.232%, and 0.380%. Three brands' average hardness is higher than what is considered acceptable. All of samples had a strong dissolving profile and achieved 80% dissolution in 30 minutes (83.521%, 81.713%, and 83.811%). Assay of Ciprofloxacin tablets revealed that all sample contained labeled potency within the range (108.98%, 107.92%, and 106.86%). The potency of three brand is reduced after stability test. *In-vivo* bioavailability studies showed that three different brand of Ciprofloxacin HCl tablet meet the standards for physiochemical properties which indicates a drug with better quality.

KEYWORDS: Friability, Dissolution, Absorbance, Standard Curve.

INTRODUCTION

Ciprofloxacin is frequently used to treat gonorrhoea, skin and soft tissue infections, bone and joint infections, lower respiratory tract infections, bacterial diarrhoea, and surgical prophylaxis. One of the medicines that the FDA has licensed for use in individuals who have been exposed to anthrax by inhalation is ciprofloxacin. It works by preventing DNA gyrase from being able to unwind the DNA helix, which is necessary for DNA replication [Ali et al., 2010]. This prevents DNA gyrase from being able to stop bacterial DNA replication. It can be administered intravenously, orally, or as ocular drops. Typical adverse reactions include rash, diarrhoea, vomiting, and nausea [Heidelbaugh and Holmstrom, 2013].

MATERIALS AND METHODS

Collection of Sample

Three different brands (20 tablets of each brand) of Ciprofloxacin Hydrochloride 500 mg tablets was chosen, to evaluate whether their claim can meet the specification. These 3 brands were coded as A, B and C. The samples were properly checked for their physical appearance, name of manufacturer, batch number, and manufacturing date, expiry date, manufacturing license number and maximum retail price at the time of purchase. The samples were stored in proper storage condition during evaluation test.

Table 1: List of Three Pharmaceutical Companies Tablet Used.

No.	Code Initial	Drug
1	A	Ciprofloxacin HCl 500mg
2	B	Ciprofloxacin HCl 500mg
3	C	Ciprofloxacin HCl 500mg

Table 2: Materials Used in the Experiment.

Items	Names of Ingredients
Drug	Ciprofloxacin HCl 500mg
Chemicals and Solvents	0.1 N HCl, Lactose, Na Starch Glycolate, Mg Stearate, CrossPovidone,Talc, Mannintol
Tablets	Ciprofloxacin HCl 500mg

Tablet Formulation

Tablets of Ciprofloxacin were prepared by using direct compression technique. The composition of granules is summarized in Table 2.3. Calculated amount of the drug was mixed with excipients thoroughly for 15 minutes for each tablet separately. The mixture was compressed lightly using a KBR Press with a compression force of 4 ton to obtain hardness in the range of 180-220 N.

Table 3: Formulation of CiprfloxacinHCl 500 mg.

Ingredients	Quantity	Justification
CiprfloxacinHCl	500 mg	API
Na Starch Glycolate	40 mg	Super Disintegrant
Crosspovidone	24 mg	Binder
Lactose	108 mg	Filler
Mg Stearate	8.1 mg	Lubricant
Talc	40 mg	Lubricant
Mannitol	75 mg	Sweetening Agent

Disolution of Formulated Tablet

Dissolution test of the tablet were performed using USP dissolution apparatus II (paddle) in 1000 ml 0.1N HCl media as dissolution media, at 50 rpm and 37±0.5ºC temperature. About 900 ml of the media was filled into 1000 ml beaker of dissolution apparatus. The formulated Ciprofloxacin HCl tablet was placed into a beaker. 37^0C i.e. body temperature and 50 rpm i.e. rotation per minute was adjusted and then motor was started.

Preparation of Standard Curve by Using Different Absorbance

10 mg of Ciprofloxacin was weighted and dissolved with 100 ml distilled water with a 100 ml volumetric flask. Then 12 ml of this solution was taken in another volumetric flask and made up to 100 ml with 0.1N HCl. It was considered as stock.

Then 1 ml, 2 ml, 3ml, 4ml, 5 ml, 6 ml, 7 ml, 8 ml, 9 ml and 10 ml of stock solution were taken in 10 test tubes respectively and volume was adjusted up to 10 ml with distilled water. Thus, solution with a concentration ranging from 1.2 µg /ml to 12µg/ml was obtained and the absorbance of the solutions was measured by UV spectrophotometer at 277 nm.

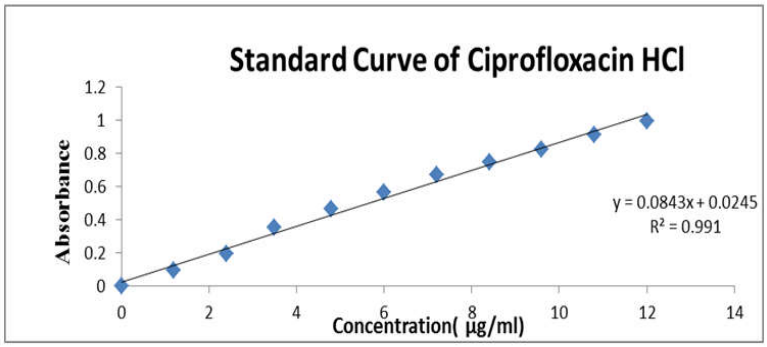

Figure 1 : Standard Calibration Curve of Ciprofloxacin HCl.

UV Spectrophotometric Method

The potency of the Ciprofloxacin tablet should comply with the specification because very highly potent drug may give toxic effect and very less potent drugs may give sub-therapeutic effect**.** Potency test is known as quantitative tests and are designed to determine how much of the drug in the sample**.**

RESULT AND DISCUSSION

For comparative study, the following quality attributes were analyzed: weight variation test, friability, hardness, thickness, diameter, potency, disintegration time, formulation tablet and *in vitro* dissolution profile of 3 different brands of Ciprofloxacin HCl 500 mg tablets.

Result of Weight Variation

The following table represents the comparative study of weight variation of Ciprofloxacin HCl 500mg (tablet) of three different marketed brands in which 20 tablets of each brand weretaken.

Table 4: Average Weight (mg) of 20 Tablets of Each Brand of 500mg Ciprofloxacin Hydrochloride and their % Deviation.

Brand	Average weight (mg)	Maximum weight (mg)	Minimum weight (mg)	(+)% Deviation	(-)% Deviation
A	789.55	795	783	0.69659932	-0.8295864
B	687.5	699	670	1.67272727	-2.5454545
C	748.45	761	739	1.6767987	-1.2626093

Discussion

According to USP specification, tablets weighted 324 mg or more can have the maximum ± 5% deviation. From the above data, no single tablet of all of the three brands cross the % deviation.

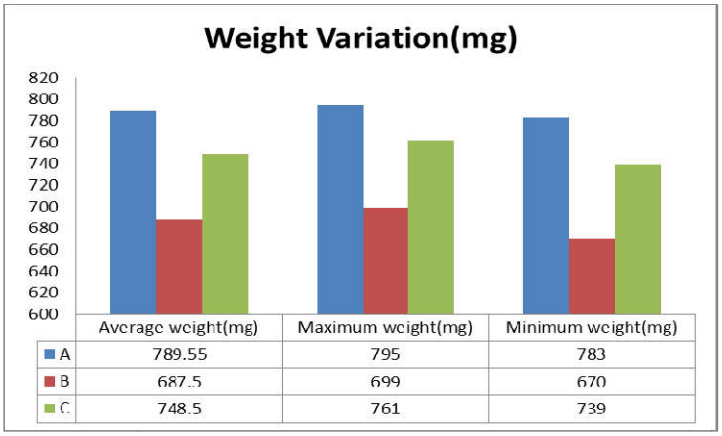

Figure 2: Graphical Representation of Weight Variation of Different Brands.

Now the positive percentage deviations are shown below by the graphical presentation.

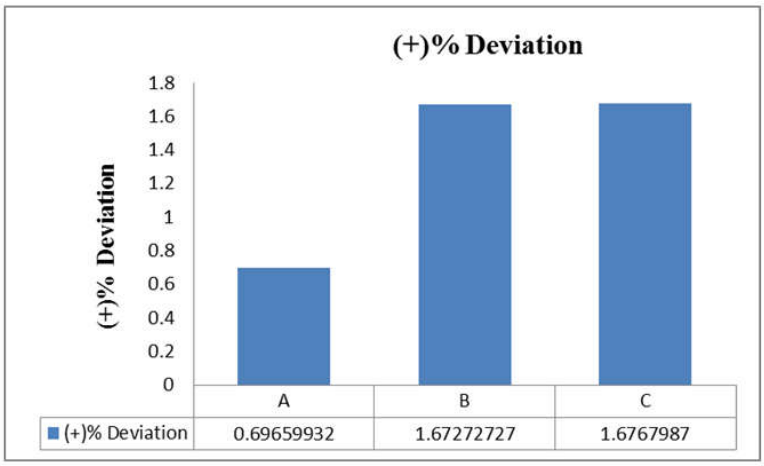

Figure 3: Graphical Representation of (+) % Deviation of Three Brands ofCiprofloxacin.

Now the positive percentage deviations are shown below by the graphical presentation:

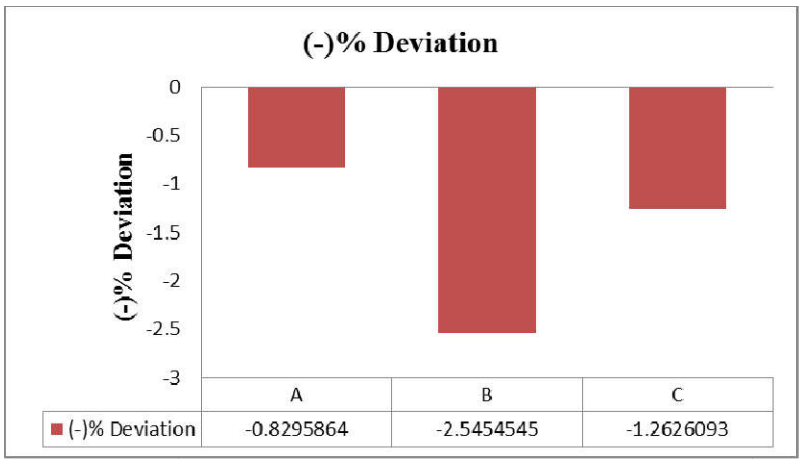

Figure 4: Graphical Representation of (-) % Deviation of Three Brands of Ciprofloxacin.

Result of Length and Width

Table 5: Average Length (mm) and Width (mm) of 20 Tablets of Each Brand of 500 mgCiprofloxacin Hydrochloride Tablets.

Brand name	Average Length(mm)	Average Width(mm)
A	18.186	8.303
B	12.6885	_
C	16.151	7.317

The average of three brands are shown by following graph.

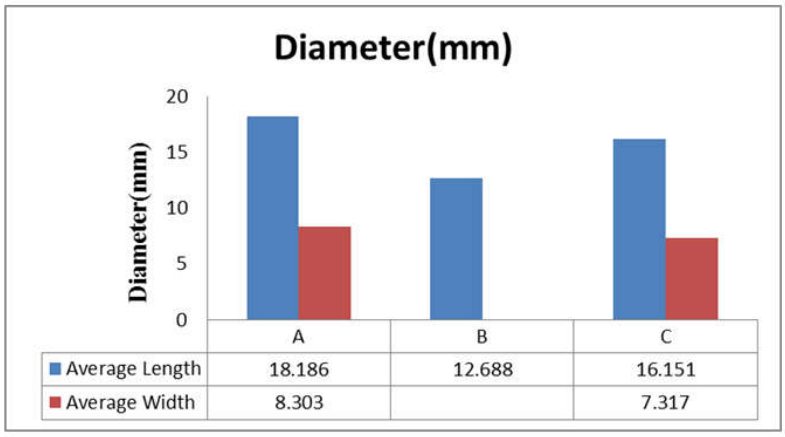

Figure 5: Graphical Representation of Diameter of Three Brands of Ciprofloxacin HCl.

Discussion

Form the above data we can say that all the tablets of different brands are almost the same in length and width except brand B.So there will be a similar rate of disintegration of those brands except brand B.

Result of Thickness

The average thickness of three brands is shown by following graph.

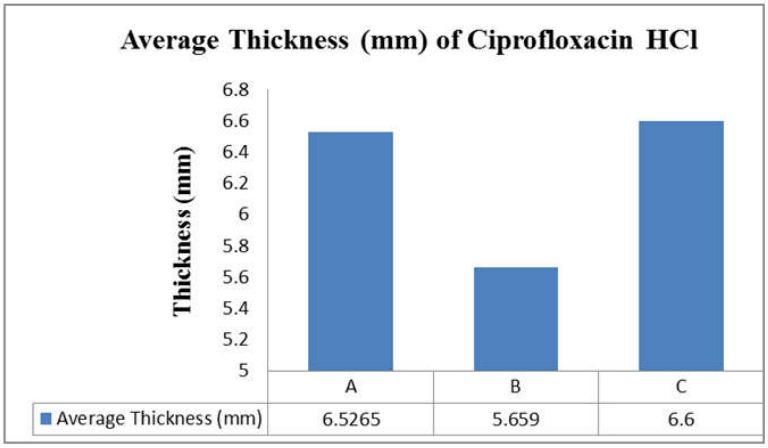

Figure 6: Graphical Representation of Average Thickness of the Tablets of Three Brands.

Discussion

Form the above data, all the tablets of different brands are almost the same in thickness so there will be a similar rate of disintegration.

Melting Point

The following table (Table 6) represents the comparative study of melting point of Ciprofloxacin HCl in which API was taken.

Table 6: Melting Point of Ciprofloxacin HCl

Name of the Drug	Melting Point
Ciprofloxacin HCl	312°C

Discussion: From the above table, the data of melting point showed that Ciprofloxacin HCl meet the specification.

Hardness

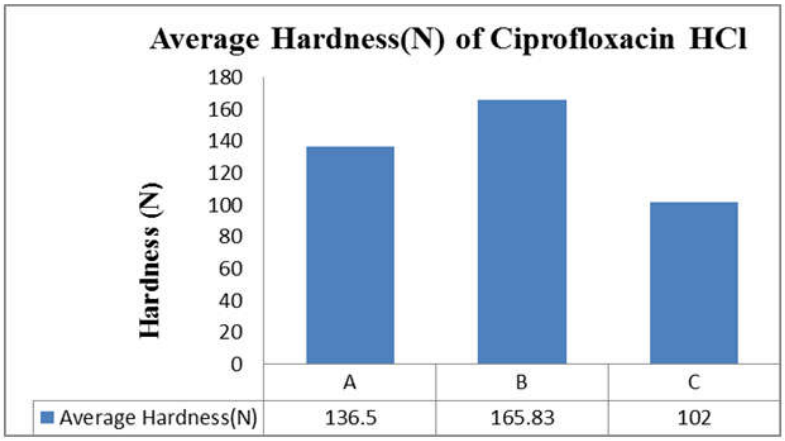

Figure 7: Graphical Representation of Comparative Analysis of Hardness ofCiprofloxacin HCl Tablets of Three Different Brands.

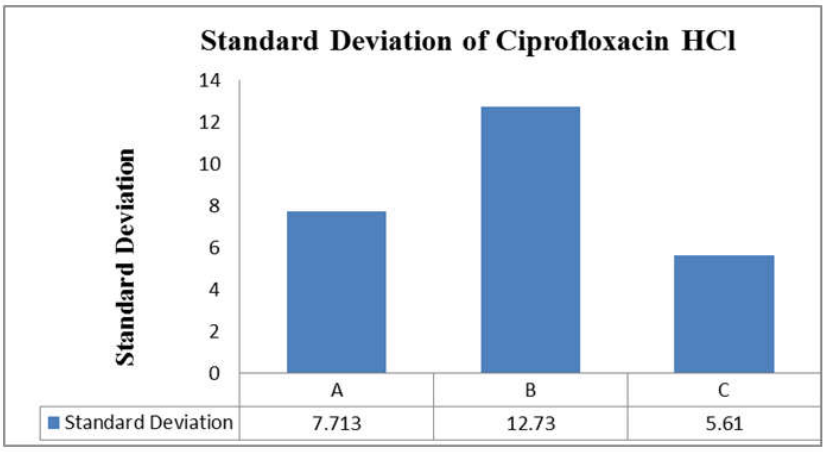

Figure 8: Graphical Representation of Comparative Analysis of Standard Deviation of Ciprofloxacin HCl Tablets of Three Different Brands.

Friability

The following table represents the comparative study of friability of Ciprofloxacin HCl tabletof three different marketed brands in which 7 tablets of each brand were used.

Specification

According to USP, % of Friability of Ciprofloxacin Hydrochloride 500 mg tablet should beNMT 1%.

Discussion

According to USP specification, the friability of tablets should not be greater than 1. Depending on this specification, we can say from the above data, that all the tablets of all the brands meet the specification. Now the percent friability is shown by the following graphical representation.

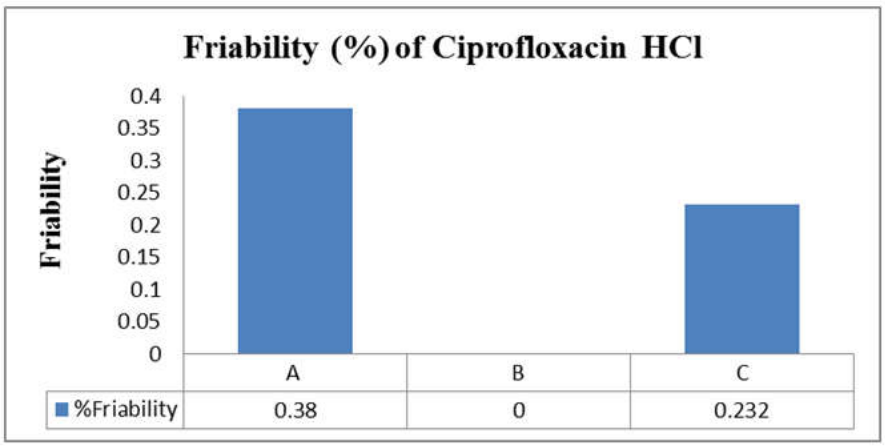

Figure 9: Graphical Representation of the % Friability of Three Different brands ofCiprofloxacin HCl.

Disintegration Time

The disintegration time of different Ciprofloxacin HCl brands was measured and the result ofall the brands was less than 15 minutes.

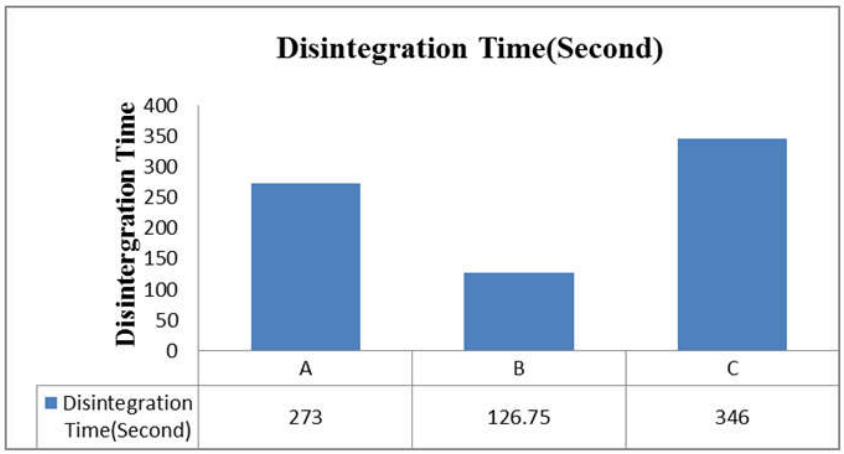

Figure 10: Graphical Representation of Disintegration Time of Three Different Brandsof Ciprofloxacin HCl.

Potency Test

The potency of each brand of Ciprofloxacin was determined from the standard curve.According to the USP, the potency should be within the range of 90-110%.

The table 7 represents the comparative study of Potency (%) of 4 Ciprofloxacin HCl tabletsof each brand.

Table 7: Potency of 3 Tablets of Each Brand of 500mg Ciprofloxacin Hydrochloride.

Brand	Abs.	µg/ml	Total Vol. (ml)	D.F	Avg. Tablet Wt. (mg)	Sample Taken (mg)	Drug in Tablet	Strength (mg)	Potency (%)
A	0.848	9.809	100	11.11	786	15.72	544.9	500	108.98%
B	0.794	9.83	100	11.11	748	14.96	539.6	500	107.92%
C	0.805	9.61	100	11.11	681	13.62	534.3	500	106.86%

Discussion: From the above data reveals that all brands meet the USP specification.

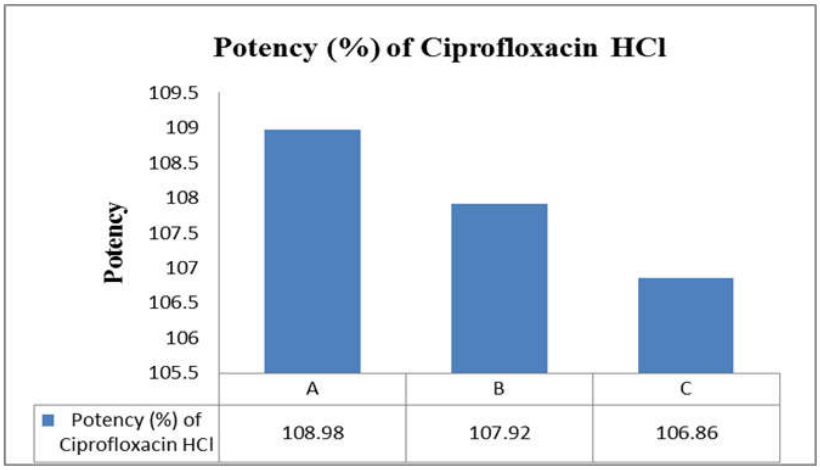

Figure 11: The Potency of Three Different Brands of Ciprofloxacin Tablets.

Stability Test

For stability test the potency of each brand of Ciprofloxacin was determined from the standard curve. According to the USP, the stability should be within the range of 90-110%. The table 3.10 represents the comparative study of stability of 3 Ciprofloxacin HCl tablets of each brand.

Discussion: From the above table, After 15 days our observation for Brand A potency was 108.98% it reduced to 93.50%, Brand B potency was 107.92% it reduced to 103.2%, Brand C potency was 106.86% it reduced to 101.76%.So all brands meet the USP Specification.

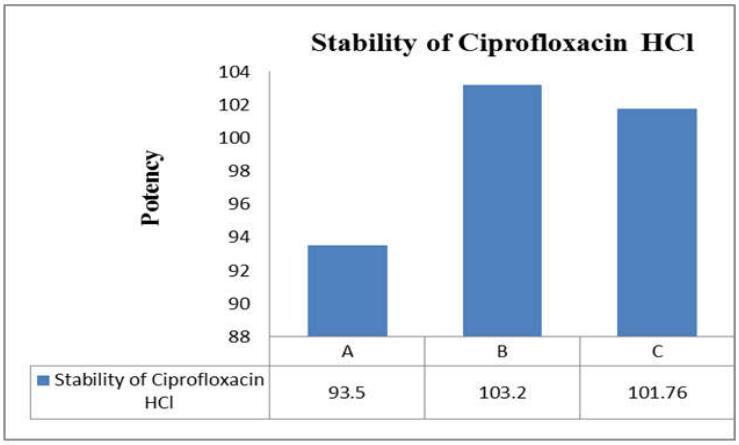

Figure 12: Stability of 3 Tablets of Each Brand of 500mg Ciprofloxacin Hydrochloride.

: Dissolution or % Release of Drug

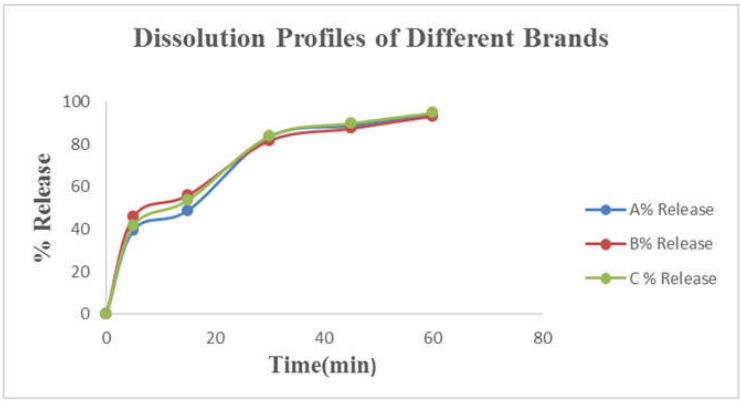

Figure 13: % Release of Drug of Each Brand of 500mg Ciprofloxacin HydrochlorideTablets at 0, 5, 15, 30, 45 and 60 Minutes.

According to USP, the rate of drug release of Ciprofloxacin Hydrochloride tablets not less than 80% after 30 minutes. Within 30 minutes, all the brands showed greater than 80% release. The following graph figure no 3.12 represents the relation between the rate of drug release of different brands at 0, 5, 15, 30, 45 and 60 minute.

Graphical presentation of dissolution profile of Brand A is given below.

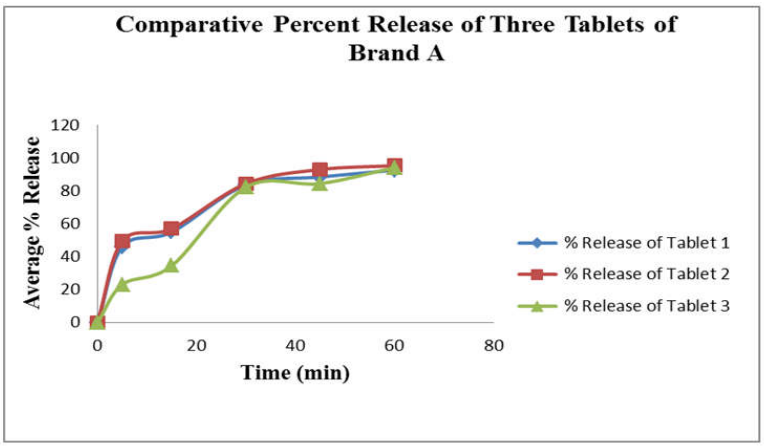

Figure 14: Comparative Percent Release of Three Tablets of Brand A.

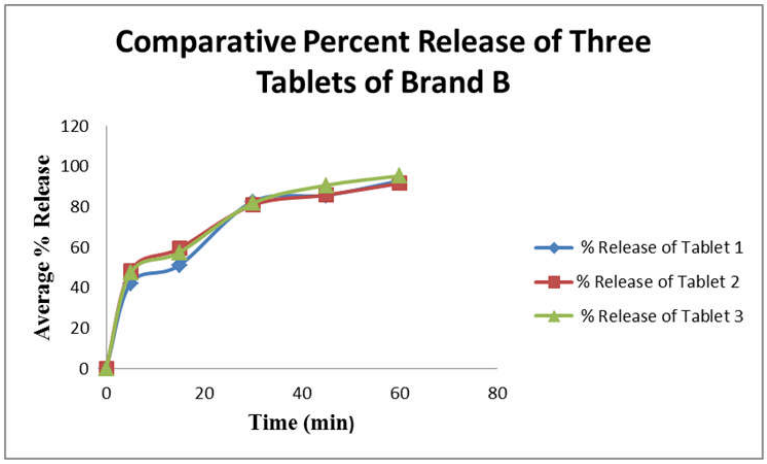

Figure 15: Comparative Percent Release of Three Tablets of Brand B.

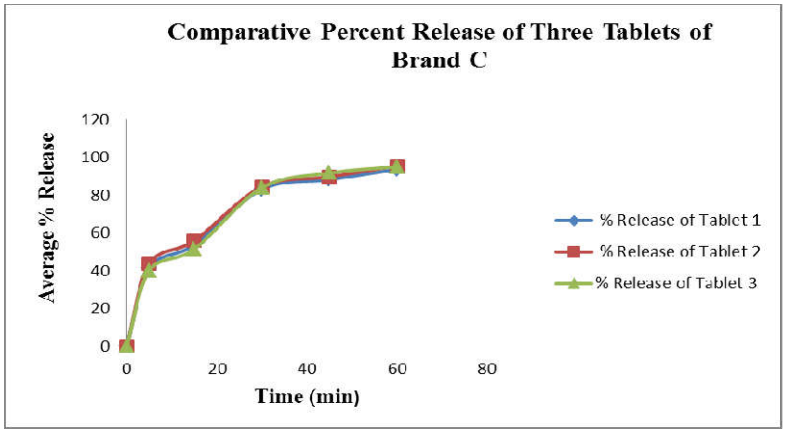

Figure 16: Comparative Percent Release of Three Tablets of Brand C.

Formulation and Disolution of Ciprofloxacin HCl Tablet

Dissolution profile of formulated Ciprofloxacin HCl (300 mg) tablet in 0.1N HCl media was performed and the observed result is shown in the following tables. The USP specification is not less than 80 % of the labeled amount of Ciprofloxacin HCl is dissolved in 30 minutes.

After measuring the absorbance of the formulated tablet, at 0, 5, 15, 30, 45 and 60 minutes via UV spectrometer, the values were put into the equation on and calculated the % release of drug which is represented in the following tables 8.

Table 8 : % Release of Drug of formulated CiprofloxacinHCl Tablets.

Time	Absorbance	mcg/ml	Dilution Factor	mg/10 ml	mg/900 ml	Cumulative Amount Disslove	%Release
0	0	0	0	0	0	0	0
5	0.402	4.4780	50	2.2390	201.512	201.512	40.302
15	0.502	5.6642	50	2.8321	254.893	257.132	51.426
30	0.781	8.9739	50	4.4869	403.825	408.896	81.779
45	0.825	9.4958	50	4.7479	427.313	436.871	87.374
60	0.863	9.9466	50	4.9733	447.597	461.903	92.380

Graphical presentation of dissolution profile of Formulated Tablet is given below.

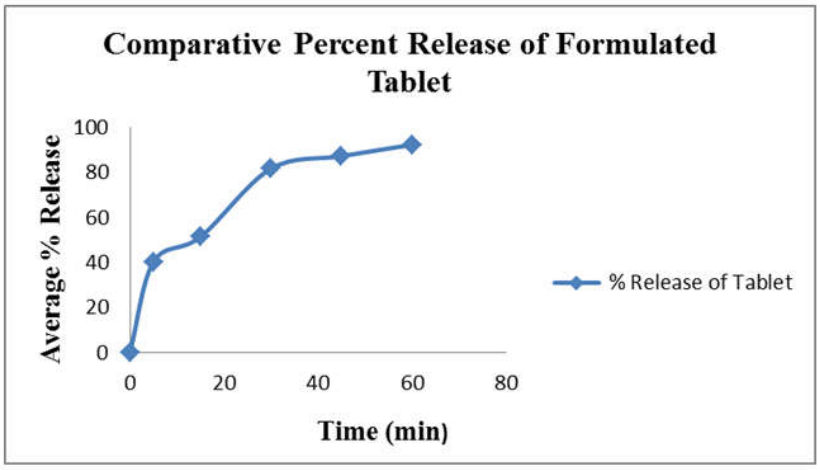

Figure 17: Comparative Percent Release of Formulated Tablet.

Discussion

The assessments involved the evaluation of uniformity of melting point, weight, thickness, friability, potency, stability, disintegration, dissolution tests and chemical content determination. All the brands used were within their shelf life as at the time of study. The weight uniformity for the three brands of Ciprofloxacin tablets comply with the USP specification. In this study, no significant variations were found. This indicate that samples from different brands of Ciprofloxacin have manufacturing excellency. The friability was also tested for these tablets for all brands. Disintegration of a tablet must be occurring prior to absorption of drug molecules. So 3 lowest DT indicates the rapid onset of action of that tablet. In this study, it was found that brand A (273) have lowest DT followed by brand B (126.75) and brand C (345). Hardness of the tablet of brand A (136.5), B (165.83), C (102), which did not meet the specification. Potency indicates the percent of active ingredient present in the tablet. In this study, highest amount of potency showed by brand A (108.98 %) followed by brand B (107.92 %) and brand C (106.86 %). The highest amount stability of showed by brand B (103.2 %) followed by brand B (101.76 %) and brand A (93.50 %). The entire brand attained 80% dissolution rate within 30 minutes. The % release rate of brand A (94.122 %) , brand B (93.236 %) and brand C (94.71 %) within 60 minutes. Therefore all the 3 brands have similar patterns of bioavailability. The results obtained from this study revealed that all the brands have passed the USP general specification standard for dissolution rate test for immediate release tablets.

CONCLUSION

In conclusion, the results indicated that all marketed 3 brands of ciprofloxacin HCl tablets seem to have good overall quality with high dissolution rate and hence very good bioavailability. It is a general psychology that the quality generic medicines may poor as compared to leading brands available in the market. But, this investigation will help to change the view of people towards generic medicines. The problem of fake and substandard medicines remains the big challenge that regulatory authorities may face and thus arises the need for adequate quality assurance and quality control of drugs.

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