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Original Article

Comparative Evaluation of Different Types of Diclofenac Sodium Tablets

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Abstract

Tablet is unit solid dosage form containing drug substance with diluents and prepared by either compression or molding method. A recent development in technology has presented variable dosage alternatives for patients. The experimental design has conducted comparative evaluation of different types of marketed Diclofenac Sodium Tablets in which Sustained release (100mg),enteric coating(50mg), dispersible tablet(50mg) was taken. Dissolution pattern of marketed Diclofenac sodium sustained release, enteric coated and dispersible tablets and interpret the results obtained. Also thickness, weight variation and disintegration time, hardness (kg/cm$^{2)}$, friability, assay, size & shape, absorption. %drug release the data was used to do the evaluation studies. All the three tablets compared with official standard were found within the range. Dissolution studies showed that Diclofenac sodium was slowly released in sustained release tablet compared to that of enteric coated tablet and drug release from dispersible tablet was very fast.

Keywords: Dissolution, hardness, dispersible, sustained release friability.

1. Introduction

Tablet is unit solid dosage form containing drug substance with or without suitable diluents and prepared by either compression method. Tablet is unit solid dosage form containing drug substance with diluents and prepared by either compression or molding method. The oral route is most common way of administering drugs, and among the oral dosage forms tablets of various different types are the most common. Although a variety of tablets exist, with few exceptions (primarily sugar lozenges) tablets are formed by the compression of a powder held within a confined space. A tablet consists of one or more drugs (active ingredients) as well as a series of other substances used in the formulation of a complete preparation. Tablets are intended for oral administration. Some are swallowed as whole, some after being chewed, some are dissolved or dispersed in water before being administered and some are retained in the mouth, where the active ingredient is liberated. Thus, a variety of tablets exist and the type of excipients and also the way in which they are incorporated in the tablet vary between the different types.

Tablets are used mainly for systemic drug delivery but also for local drug action. For systemic use the drug must be released from tablet, i.e. normally dissolved in the fluids of the mouth, stomach or intestine, and thereafter be absorbed into the systemic circulation, by which it reaches its site of action. Alternatively, tablets can be formulated for local delivery of the drugs in mouth.

1.1. Advantages

1. They are unit dosage form having greatest dose precision and least content variability.
2. Their cost is lowest of all dosage form.
3. They are easiest and cheapest to package and transport.
4. They have best chemical, mechanical, and microbial stability.
5. They are essentially tamperproof dosage form.
6. It requires minimum space.

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7. They are lightest and most compact of all dosage form.
8. Suited to large-scale production.
9. Tablets can be used for sustained release medicament when coated.

1.2. Disadvantages

1. Some drugs resist compression into dense compact, due to their amorphous nature.
2. Drugs with poor wetting and slow dissolution may be difficult to formulate and manufacture as tablet.
3. Bitter-tasting drugs, with objectionable odour or drug, which are sensitive to Atmospheric moisture, the tablet may require coating, in such cases capsule may best way of dosage form.

1.3. Types of tablets

A) Tablets ingested orally
1. Compressed tablet
2. Multiple Compressed tablets
3. Multilayered tablet
4. Sustained release tablet
5. Enteric coated tablet
6. Sustained release tablet
7. Film coated tablet
8. Chewable tablet

B) Tablets used in oral cavity
1. Buccal tablet
2. Sublingual tablet
3. Lozenge tablets and torches
4. Dental cones

C) Tables administered by other routes
1. Implantation tablet
2. Vaginal tablet

D) Tablets used to prepare solution
1 Effervescent tablet
2 Dispensing tablet
3 Hypodermic tablet
4 Tablet triturates

1.4. Ideal Properties

1. It should be elegant with free of defects such as cracks.
2. It should be free from discoloration and contamination.
3. It should have strength to withstand of various mechanical shocks during its production, packaging, transport and dispensing.
4. It should have chemical and physical stability.
5. It should be able to release medicaments in the body in a predictable and reproducible manner.
6. It should have a suitable chemical stability over the time so as not allow alteration of medicinal agent.
7. It should be free from microbial load.
8. It should not absorb moisture and not contain unbound water in it.
9. It should be physiologically inert not contaminated.

2. Tablet Coating

Definition

Tablet coating is application of a coating material to the exterior of a tablet with the intention of conferring benefits and properties to the dosage forms over the uncoated variety.

2.1. Types of coating

1. Film coating
2. Sugar coating
3. Enteric coating

2.2. Reasons for coating tablets

1. To protect the drug from its surrounding environment (air, moisture, & light) to improve stability.
2. To mask the taste, odor, & colour of drug.
3. To improve physical & chemical protection for drug.
4. To control or modify the release of drug from tablet. (Enteric, repeat action, sustained released product).
5. To protect the drug from gastric environment.
6. To avoid the chemical incompatibilities (two drugs).
7. To provide sequential release.
8. To improve pharmaceutical elegance.
9. To avoid cross contamination during manufacturing.
10. To give mechanical strength to the tablet.
11. To improve product identity.

2.3. Properties of tablet for coating

1. The tablet must possess proper physical characteristics.
2. It must tolerate the intense attrition of tablets striking other tablet or walls of coating equipments, the tablet must resistant to abrasion & chipping.
3. Surface of tablet should not be brittle, soften in the presence of heat, or rough in the early phase of coating.
4. Tablet must have smooth surface.
5. The ideal tablet shape for coating is sphere, which allows to tablet to roll freely in the coating pan with minimal tablet-tablet contact.
6. The coating composition must wet the tablet surface (Hydrophobic surface surfactant).

3. Enteric coating

Small intestine: The delayed –action tablet dosage form is intended to release a drug after some time delay, or after the tablet has passed through one part of the GI tract into another. The enteric-coated tablet is the most common example of a delayed-actions tablet product. Not all delayed –action tablets are enteric or are intended to produce the enteric effect. Simply, technique is used to protect the tablet core from disintegrating in the acid environment of the stomach for one or more of the following reasons,

1. To protect acid-labile drug from the gastric fluid. e.g. (enzymes, erythromycin)
2. To prevent gastric distress or nausea due to irritation from a drug. (Aspirin)
3. To deliver drugs intended for local action in the intestine (intestinal Antiseptics)
4. To deliver drugs that is optimally absorbed in the small intestine to their primary absorption site in their most concentrated form
5. To provide a delayed release component for repeat action tablets.

The action of enteric coating results from a difference in the respective gastric and Intestinal environment in regard to pH and enzymatic properties[3, 5].

3.1. Ideal properties of film forming agents

1. It should be non-toxic
2. It should be inert and compatible with core.
3. It should form thin film.
4. Film formed should have sufficient tensile strength and not permeable to gastric fluid.

The specifications for an enteric coated tablet are that all of the six tablets placed in separate tubes of the USP disintegration apparatus (using disc) remain intact after 30 min of exposure in stimulated gastric fluid at 37ºC ±2ºC and then disintegration within the specified for that products monograph plus 30 min. If one or two tablets fails to disintegrate completely in the intestinal fluids, the test is repeated on 12 additional tablets, not less than 16 of the total 18 tablets tested must disintegrate completely. The coatings that are used today to produce enteric effect are primarily mixed acid functionality and acid ester functionality synthetic or modified natural polymers. Cellulose acetate phthalate has longest history of use as an enteric coating. More recently, polyvinyl acetate phthalate and hydroxypropyl methylcellulose phthalate have come into use. All three polymers have the common feature of containing the dicarboxylic acid, phthalic acid, in partially esterified form. These polymers, being acid esters, are insoluble in gastric media that have a pH of up to about 4; they are intended to hydrate and being dissolving as the tablet leave the stomach, enter the duodenum (pH of 4 to 6) and move further along the small intestine where the pH increases to a range of 7 to 8.

The primary mechanism by which these polymers lose their film integrity, thereby admitting intestinal fluid and releasing drug, is ionization of the residual carboxyl groups on the chain and subsequent hydration. Enteric coating one of method of reducing or eliminating irritation[1, 3].

4. Sustained Release Tablet

With many drugs the basic goal of therapy is to achieve a steady state blood or tissue level that is therapeutically effective and nontoxic for an extended period of time .The testing of proper dosage regimens is an important element in accomplishing this goal .A basic

objective in dosage form design is to optimize the delivery of medication so as to achieve a measure of control of the therapeutic effect in the face of uncertain fluctuation in the in vitro environment in which drug release takes place. This is usually accomplished by maximizing drug availability, i.e., by attempting to attain a maximum rate and extent of drug action through formulation also implies controlling bioavailability to reduce drug absorption rates. One of the first commercially available product to provide sustained release of a drug was Dexedrine Span capsules, made by smith kline and French .After this many more sustained release product came to the market, some successful, others potentially lethal .Each delivery system was aimed at eliminating the cyclical changes in plasma drug concentration seen after the administration of a conventional delivery system. For many disease states the ideal dosage regimen is that by which an acceptable therapeutic concentration of drug at the site of action is attained immediately and is then maintained constant for the desired duration of the treatment. The dose size and frequency of administration are correct, therapeutic steady state plasma concentration of a drug can be achieved promptly and maintained by the repetitive administration of conventional per oral dosage form .However; there are a number of potential limitations associated with this. In the context of this section a conventional oral per oral dosage form is assumed to be one that is designed to release rapidly the complete dose of drug contained therein immediately following administration. Sustained release indicates an initial release of drug sufficient to provide a therapeutic dose soon after administration and then a gradual release over an extended period

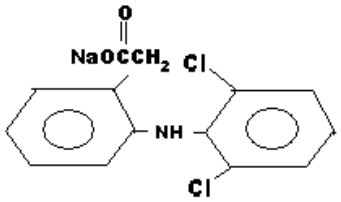
5. Dispersible Tablet

Quick-dispersing oral drug delivery systems (QD) are defined as oral drug delivery systems that dissolve or disintegrate within seconds to a few minutes after placement in the mouth and do not require water to aid swallowing. The QD systems include tablets, caplets, wafers, films, granules and powders. When QD are placed in the mouth, the dosage form disintegrates instantaneously/within a few minutes releasing the drug, which dissolves or disperses in the saliva. The saliva containing the medicament is then swallowed and the drug is absorbed in the normal way. Some fraction of the drug may be absorbed from pre gastric sites such as the mouth, pharynx, and esophagus as the saliva passes down into the stomach. In these cases, the bioavailability of drugs from QD may be greater compared to the standard oral dosage forms. Dispersible tablets are uncoated tablets that produce a uniform dispersion or suspension in water at room temperature without stirring. With the increase in the average human life span, drug administration for elderly patients has become more important. Due to decline in swallowing ability with age; a great many elderly patients complain that it is difficult to take medication in the form of tablets. Recently useful dosage form such as rapidly disintegrating or dissolving tablet, have been developed & applied clinically. The dispersible tablets allow dissolution or dispersion in water prior to administration. Dispersible tablets are easier to administer or swallow than capsules for pediatric, dysphasic patients, mentally ill, un co-operative and nauseated patients, those with conditions of motion sickness, sudden episodes of allergic attack or coughing. Sometimes it may be difficult to swallow conventional products due to unavailability of water.

5.1. Advantages

1) They are easy to swallow, so they are particularly suitable both for elderly persons with swallowing difficulties and for children.
2) They have quicker onset of action.
3) Certain dispersible tablet can also divided.
4) The bitter taste of the active substance must be masked in advance.
5) Owing to the number of possible application, the patient compliance is improved.

Diclofenac sodium



IUPAC Name: 2-[(2, 6-dichlorophenyl) amino] benzene acetic acid, monosodium salt.
Molecular formula: $C_{14}H_{10}C_{12}NO_2Na$
Molecular weight: 318.14
Melting point: 284^0C
Pharmacokinetics
Oral absorption :> 90%
Presystemic metabolism: 40%
Plasma half-life: 1-2 h
pKa: 4

Metabolism

Diclofenac is extensively metabolized by animals and humans. It is excreted as glucourenides and sulfate conjugations. It is excreted mainly through urine (20-30%) and in the bile (10-20%). In human, major metabolite is the 4-hydroxyl compound.

Therapeutic uses

- Rheumatoid arthritis.
- Osteoarthritis.
- Low back pain acute musculoskeletal disorder.
- Acute gout.
- Control of pain and inflammation in orthopedic dental and other minor surgery.
- Juvenile rheumatoid arthritis.
- Postoperative pain.

Contraindications

- Active or suspected peptic ulcer or gastro intestinal bleeding.
- Previous sensitivity to diclofenac sodium.
- Asthmatic patients in whom attack of asthma.
- Operations associated with a high risk of hemorrhage.
- History of asthma
- Renal impairment.

Objectives

1) To study the dissolution pattern of marketed Diclofenac sodium sustained release, enteric coated and dispersible tablets and interpret the results obtained.
2) To study the marketed Diclofenac sodium sustained release, enteric coated and dispersible tablets for thickness, weight variation and disintegration time and to correlate the data obtained.
3) Based on the above findings, to compare all the types and study the importance of their making and marketing.

Importance of Evaluation Test

1. Size and shape

A compressed tablets shape and dimensions are determined by the tooling during the compression process .The crown thickness of individual tablet may be measured with a micrometer which permit accurate measurement and provides information on the variation between tablets .Tablets thickness should be controlled within a $\pm$5% variation of standard value.

2. Hardness

Tablet require a certain amount of strength or hardness to withstand mechanical shocks of handling in manufacture, packaging and shipping .tablet should be able to withstand reasonable abuse when in the hands of the consumer. Adequate tablet hardness and resistance to powdering are necessary requisites for consumer acceptance. The resistance of tablets breaks under condition of storage, transportation and handling before their usage depends on their hardness. The hardness of tablets was determined for each formulation by Monsanto hardness tester. The hardness was measured in terms of kg/cm2.Monsanto Tester was used to tablet hardness. The optimum hardness regarded for uncoated tablet is 4-6 Kg/cm2.

3. Friability

The laboratory friability tester is known as the Roche friabilator, subjects a number of tablets to the combine effects of abrasion and shock by utilizing a plastic chamber that revolves at 25rpm, dropping the tablets a distance of six inches with each revolution. Normally, a pre weighed tablet sample is placed in the friabilator, which is then operated for 100 revolutions. The tablets are then dusted and reweighed. Conventional compressed tablets that loose less than 0.5 to 1.0% of their weight are generally considered acceptable. Some chewable tablets and most effervescent tablets undergo high friability weight losses which accounts for the special stack packaging that may be required for these types of tablets. When capping is observed on friability testing the tablet should not be consider for commercial use, regardless of the percentage of loss seen.

4. Thickness test

Thickness must be controlled to facillated packaging. Difficulties may encountered in the use of unit dose and other types of packaging equipments if the volume of the material being packed is not consistent. A secondary packaging problem with tablets of variable thickness relates to consistent fill levels of the same product container with a given number of dosage units. Tablet thickness is consistent batch to batch or within batch.

5. Weight variation test

The weight variation test would be a satisfactory method of determining the drug content uniformity of tablets if the tablets were all or essentially all (90to 95) active ingredient, or if the uniformity of the drug distribution in the granulation or powder form which the tablets were made were perfect. For tablets such as aspirin which are usually 90% or more active ingredient , the $\pm$ 5% weight variation should come close to defining true potency and content uniformity (95to 105% of label strength) if the average tablet weight is close to the theoretic average weight. The weight variation test is clearly not sufficient to assure uniform potency of tablets of moderate or low. Not more than two of at the individual weights may deviate from the average weight by more than the percentage deviation given in the table below and none should deviate more than twice that percentage close dose drugs, in which excipients make up the bulk of the tablet weight.

Average Weight of Tablet (mg)	Max. Percentage Difference allowed
130 or less	10
130 – 324	7.5
More than 324	5

6. Disintegration test

A generally accepted maxim is that for a drug to be readily available to the body, it must be in solution. For most tablets, the first important step toward solution is breakdown of the tablet into smaller particles or granules. The dissolution of drug from a fragmented tablet appears to control partially or completely the appearance of the drug in the blood, disintegration is still used as a guide to the formulator in the preparation of an optimum tablet formula and as in-process control test to ensure lot-to-lot uniformity.

7. Calibration curve of Diclofenac sodium

- In 0.1 N HCl – To mimic the acidic environment of stomach which comes initially in contact when the tablet is administered orally, so we use 0.1N HCl for the calibration of Diclofenac sodium tablet.
- In pH 6.8 phosphate buffer : To mimic the basic environment of intestine which comes in contact when the tablet is administered

orally and goes into intestine, so we use pH 6.8 phosphate buffer for the calibration of Diclofenac sodium tablet.

8. Dissolution test

In vitro dissolution tests have been extensively studied, developed, and used as an indirect measurement of drug availability, especially in preliminary assessments formulation factors and manufacturing methods that are likely to influence bioavailability. As with any in vitro test it is critically important that the dissolution test be correlated with in vivo bioavailability test. Two objectives in the development of in vitro dissolution test are to show,

1) That the release of drug from the tablet is as close as possible to 100%.
2) That the rate of drug release is uniform batch to batch and is the same as the release rate from those batches proven to be bioavailable and clinically.

9. Assay

The assays are the standard prescribed by Pharmacopoeias. The analyst is not precluded from employing an alternative method if he is satisfied that the method which he uses will give the same results as the Pharmacopoeial method. In the event of doubt or dispute, the methods of analysis of Pharmacopoeia are alone considered official. Assay methods should not only be specific for the chemical but also for stability determination. Non-specific methods of assay are also frequently used: e.g. most aromatic substances show an absorption, which can form the basis of an assay, in the region 260-300 nm; this absorption is characteristics of the aromatic ring. Under quantitative assays, the procedures of quantitative analytical chemistry are applied to the analysis of materials used in pharmaceuticals. In analytical chemistry it is important to gain the information about the qualitative and quantitative composition of substances and chemicals i.e. to find out what a substance is composed of and exactly how much. In qualitative analysis, the details regarding the presence or absence of one or more components are obtained, while in qualitative analysis, the details regarding how much of the pure components is present is available.

6. Materials and Methods

Materials

Three different types of tablets were purchased from Pradip Medical Satara. All other chemicals were received from the pharmaceutics laboratory in our college Chemicals used: 0.1 N HCl, pH 6.8 phosphate buffer, methanol

Type	API	Strength
A(Sustained Release)	Diclofenac Sodium	100mg
B (Enteric Coated)	Diclofenac Sodium	50mg
C (Dispersible)	Diclofenac Sodium	50mg

Methods

1) Shape

It is an organoleptic property so it was determined physically.

2) Hardness

The tables were placed between the jaws of Monsanto hardness tester and its screw was slowly rotated until the tablet was braked. The reading was noted in terms of kg/cm^2 and it was repeated for five tablets. It should be more than 4 kg/cm.

3) Friability

20 tablets were weighed and placed in the friabilator, then the friabilator was made to run for four min at 25 rotation/min or 100 rotations. The tablets were again weighed and the percent loss in weight was calculated.

4) Thickness

Thickness test of tablets were important for uniformity of tablet thickness, was measured using micrometer. Calculated the least count of the micrometer. Tablet was holded in the measuring anvils and the readings on the main scale and thimble scale was noted. The procedure was repeated at least three times and the total reading was calculated of the micrometer.

5) Weight variation

20 tablets were selected randomly and weighed and their average weight was determined.

6) Disintegration test

Put one tablet into each tube, suspended the assembly in beaker containing 0.1N HCl and operate without the disc for 2 hrs. Unless otherwise stated in the individual monograph. Remove the assembly from liquid. No tablet shows signs of cracks that would allow the escape of the contents or disintegration, apart from fragments of coating. Replace the liquid in the beaker with mixed phosphate buffer pH 6.8,add a disc to each tube and operate the apparatus for a further 60 min. Remove the assembly from liquid. If the tablet fails to comply because of adherence to disc, repeat the test on a further 6 tablets without the discs. The tablets pass the test if all six have disintegrated.

7) Dissolution test or Drug release

The dissolution was started with 0.1N HCL for 2 hr. & the samples were withdrawn at 15min Intervals. After 2 hr. the product was transferred to pH 6.8 phosphate buffer medium and the dissolution was carried out for 45min. and the samples were withdrawn at 5min. intervals. Both the volume was maintained at 1000ml. The absorbance of each sample was observed in UV Visible spectrophotometer at 276nm against blank reagent.

8) Calibration procedure of diclofenac sodium in 0.1N HCl using UV method

a) Preparation of standard solution of diclofenac sodium in 0.1N HCl

Accurately weighed 100mg of the drug was dissolved in 100 ml of solvent i.e. 0.1N HCl. 1ml of the aliquot from the above solution was withdrawn. And added to 100 ml of volumetric flask the volume was adjusted to 100 ml to prepare final stock solution having concentration of 10 μg/ml.

b) Scanning of diclofenac sodium in 0.1N HCl

The standard solution of the drug was scanned through 200-400 nm regions on schimadzu UV-1700 spectrophotometer. The λmax was determined.

c) Procedure

From the standard solution aliquots of 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 ml were transferred to 10 ml volumetric flasks and final volume was made to 10ml with 0.1N HCl to prepare solution in the concentration in the range of 1-10 μg/ml. The absorbance values of these solutions were measured at λmax of 276 nm using double beam UV spectrophotometer against a blank of 0.1N HCl.

9) Calibration procedure of diclofenac sodium in pH 6.8 phosphate buffer using UV method

a) Preparation of standard solution of diclofenac sodium in phosphate buffer pH 6.8

Accurately weighed 100mg of the drug was dissolved in 100 ml of solvent i.e. phosphate buffer pH 6.8. 1 ml of the aliquot from the above solution was withdrawn. And added to 100 ml of volumetric flask the volume was adjusted to 100 ml to prepare final stock solution having concentration of 10 μg/ml.

b) Scanning of diclofenac sodium in phosphate buffer pH 6.8

The standard solution of the drug was scanned through 200-400 nm regions on schimadzu UV-1700 spectrophotometer. The λmax was determined.

c) Procedure

From the standard solution aliquots of 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 ml were transferred to 10 ml volumetric flasks and final volume was made to 10 ml with phosphate buffer pH 6.8 to prepare solution in the concentration in the range of 1-10 μg/ml. The absorbance values of these solutions were measured at λmax of 276 nm using double beam UV spectrophotometer against a blank of phosphate buffer pH 6.8.

10) Assay

Weighed and powdered 20 Tablets, weighed accurately quantity of powder containing about 50mg Diclofenac Sodium, shaked with 60ml of methanol in 200ml volumetric flask and diluted to volume with methanol. Diluted 5ml of this solution to 100ml with methanol and measured the absorbance of the resulting solution at the 285nm. Calculated the content of $C_{14}H_{10}Cl_2NNaO_2$ from the absorbance obtained by repeating the procedure using

Diclofenac Sodium RS in place substance under examination.

Observations

Table 1. Shape

Type	Strength in (mg)	Shape
Sustained Release	100	Rounded
Enteric Coated	50	Rounded
Dispersible	50	Rounded

Table 2. Hardness (Kg/cm^2)

Sr. No	Dispersible (DT)	Enteric coated (EC)	Sustained Release (SR)
1	8	8.5	8.8
2	8.2	8.2	9
3	8.5	8.3	8.5
Avg.	8.23	8.33	8.76

Table 3. Friability test

TABLETS	DT		EC		SR	
	WT BEFORE TEST	WT. AFTER TEST	WT. BEFORE TEST	WT. AFTER TEST	WT. BEFORE TEST	WT. AFTER TEST
1	294	294	218	218	299	299
2	281	274	224	221	298	296
3	293	293	211	210	297	296
4	295	296	218	217	299	297
5	294	294	210	210	299	299
6	295	294	224	223	303	303
7	299	298	220	218	306	304
8	298	297	217	216	295	294
9	292	292	217	215	307	307
10	297	297	222	220	291	290
AVG.	293.8	292.9	218.1	216.8	299.4	298.5

Table 4. Weight variation test (gm)

Sr. No.	DT	EC	SR
1	0.2940	0.2224	0.2918
2	0.2819	0.2176	0.3020
3	0.2932	0.2178	0.2951
4	0.2971	0.2207	0.3035
5	0.2928	0.2248	0.3016
6	0.2983	0.2102	0.2998
7	0.2999	0.2115	0.2941
8	0.2957	0.2182	0.2970
9	0.2940	0.2241	0.2982
10	0.2956	0.2184	0.2993
11	0.2941	0.2221	0.2918
12	0.2812	0.2174	0.2954
13	0.2934	0.2177	0.3031
14	0.2975	0.2201	0.3021
15	0.2921	0.2246	0.2991
16	0.2987	0.2103	0.2992

Continued			
17	0.2991	0.2114	0.2974
18	0.2953	0.2185	0.2980
19	0.2944	0.2246	0.2981
20	0.2951	0.2181	0.2971
Avg.	0.2941	0.2185	0.2980

Table 5. Thickness (cm)

Sr. No	Dispersible	Enteric coated	SR
1	0.94	0.68	0.32
2	0.96	0.68	0.31
3	0.96	0.70	0.32
Avg.	0.953	0.686	0.321

Table 6. Disintegration test (min)

Sr. No.	Medium	DT	EC
1	Observation in 0.1N HCl	-	No signs of cracking and softening after 1 hr.
2	Observation in pH 6.8	3 mins	19.4 min

Table 7. Calibration curve of Diclofenac Sodium in 0.1N HCL

Sr. No	Conc.(mcg/ml)	Absorbance
1	2	0.013
2	4	0.024
3	6	0.037
4	8	0.050
5	10	0.061
6	12	0.073

Table 8. Calibration curve of Diclofenac sodium in pH 6.8 phosphate buffer.

Sr. No	Conc.(mcg/ml)	Absorbance
1	1	0.0316
2	2	0.0578
3	3	0.0912
4	4	0.1178
5	5	0.1432
6	6	0.1666
7	7	0.1881
8	8	0.2146
9	9	0.2429
10	10	0.2694

Table 9. In vitro dissolution of Diclofenac sodium sustained release tablet:

Sr. No	Time (hr)	Absorbance			% Drug release(DR)			Mean% DR	SD
		1	2	3	1	2	3		
1	0.5	0.0091	0.0088	0.0115	6.21	6.04	8.04	8.41	0.97
2	1	0.0087	0.0095	0.0098	5.97	6.65	6.78	20.55	5.38
3	1.5	0.0117	0.0121	0.0091	8.18	8.48	6.27	29.64	3.94
4	2	0.0121	0.0127	0.0112	8.48	8.92	7.81	42.87	5.54
5	2.15	0.0689	0.0769	0.0541	52.24	50.08	56.78	53.03	3.41
6	2.30	0.1879	0.1210	0.1619	72.84	57.72	75.46	68.67	9.57
7	2.45	0.2127	0.2991	0.2781	77.16	87.38	95.58	84.14	6.05
8	3	0.3321	0.3411	0.3921	97.82	95.84	115.3	96.51	1.13

Table 10. In vitro dissolution of Diclofenac sodium enteric coated tablet.

Sr. No.	Time (hrs)	Absorbance			% Drug release(DR)			Mean %DR	SD
		1	2	3	1	2	3		
1	0.5	0.0101	0.0136	0.0133	7.00	9.47	9.36	8.61	1.39
2	1	0.0247	0.024	0.0243	17.77	17.48	17.48	17.57	6.16
3	1.5	0.0485	0.0303	0.0314	35.34	21.90	22.72	26.65	7.53
4	2	0.0581	0.0391	0.0419	42.41	28.40	30.46	33.75	7.56
5	3	0.0695	0.0520	0.0505	52.78	35.77	37.58	42.01	9.36
6	4	0.0740	0.0737	0.0760	53.59	39.53	42.00	45.04	7.50
7	5	0.1021	0.1089	0.1228	58.47	45.63	50.10	51.42	6.51
8	6	0.1394	0.1283	0.1501	64.93	48.99	54.83	56.26	8.06
9	7	0.1689	0.1724	0.1812	70.04	56.63	60.22	62.29	6.94
10	8	0.1998	0.1954	0.2438	75.39	60.61	71.06	69.02	7.59

Table 11. Assay (For find percentage purity) of Diclofenac sodium tablets.

Sr. No.	Time (min)	Absorbance			% Drug release(DR)			Mean % DR	SD
		1	2	3	1	2	3		
1	5	0.5214	0.5351	0.5589	88.64	91.02	95.12	91.60	3.29
2	10	0.6555	0.6436	0.6619	111.86	109.84	112.98	111.56	1.58
3	15	0.7159	0.7278	0.7267	122.34	124.34	124.21	123.65	1.14

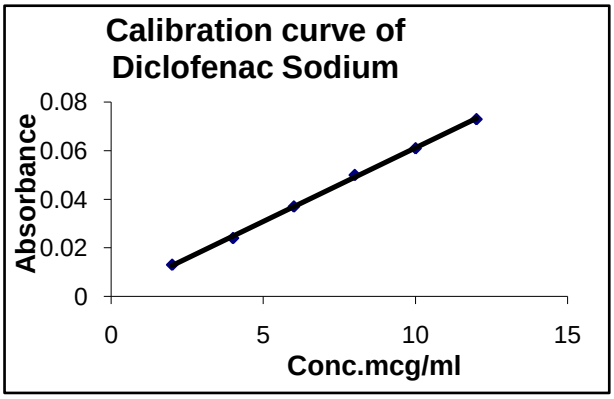


Fig. 1: Calibration curve of Diclofenac Sodium.

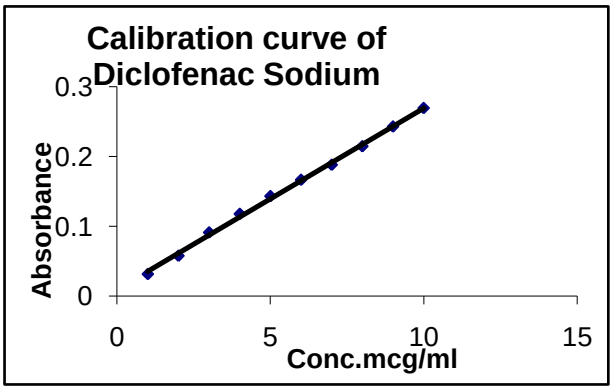


Fig. 2: Calibration curve of Diclofenac Sodium.

Results and Discussion

The various evaluation tests for different types of Diclofenac sodium tablets were performed and the results were interpreted,

Sr. No.	Parameters	Result	IP Limit	Remarks
1	Shape	The shapes of all the types of tablets were found to be rounded.	-	
2	Hardness	The hardness of all types of tablets were found to be in the range 8.23 to 8.76 kg/cm^2	More than 4kg/cm^2	Passed
3	Friability	Friability test for all the types of tablets were found to be in the deviation of 0.9%.	Not more than 1%	Passed
4	Thickness	Thickness of all the types of tablets were found to be in the range of .0.3 to 0.9%	-	-
5	Weight variation	The weight variation tests for all the types of tablets were found to be in the deviation of 7.5%	Refer pt 5 page no.13	Passed
6	Disintegration	The disintegration time for enteric coated tablet was found to be 19.4 min. and the dispersible tablet disintegrated within 3 min.	-	-
7	Drug release	From the release data it was found that the sustained release tablet releases 69.02% drug at the end of 8 hours, the enteric coated tablet releases 96.5% drug at the end of 3 hours and	-	-

		the dispersible tablet releases 123.65% drug at the end of 15minutes.		
8	Assay	The percentage purity of sustained release, enteric coated and dispersible tablet were found to be 83.59%, 86.93%and 91.48% respectively.	99%-101%	Failed

Conclusion

Thus, the objectives set by the company for all the types of the tablets were achieved with great success. All the three tablets compared with official standard for hardness, thickness, weight variation, friability, disintegration, percentage drug release and percentage purity were found within the range. From dissolution studies it was found that Diclofenac sodium was slowly released in sustained release tablet compared to that of enteric coated tablet and drug release from dispersible tablet was very fast. Percent drug releases of all three tablets were different which the objective of the pharmaceutical company was.

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