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A review of immediate drug release dosage forms

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Abstract

Tablets are currently the most widely used dosage form due to their ease of self-administration, compactness, and simple production. In many situations, rapid action is necessary rather than conventional therapy. Immediate release dosage forms have become an alternative to traditional oral dose forms in order to address these shortcomings. Immediately after administration, immediate medication release dose forms dissolve more quickly. Super disintegrants such carboxymethylcellulose (Croscarmellose), sodium starch glycolate (Primogel, Explotab), cross-linked polyvinylpyrrolidone (Polyplasdone), and others are employed as the fundamental method in the manufacture of tablets. After being administered to the stomach, these powerful disintegrants instantly dissolve tablets. In this area, parenteral dosage forms and instant release liquid dosage forms have both been introduced for the treatment of patients. It is possible to administer suspensions in liquid dose form using common dispersion agents as hydroxypropyl methylcellulose, AOT (dioctyl sulfosuccinate), etc. Many medications, including neuroleptics, cardiovascular medications, analgesics, antihistamines, and other medications, can be thought of as candidates for this dose form as a result of the advent of immediate release therapy. Pharmaceutical companies frequently create a certain medication entity in a new and improved dosage form as the drug entity's patent life is about to expire. While providing its patient group with a more practical dosage form or dosing schedule, a new dosage form enables a producer to extend market exclusivity.

Keywords: - Immediate release, polymers, super disintegrant.

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Introduction

For increasing markets and indications, extending product life cycles, and creating opportunities, novel drug delivery systems are being created in the current study and research [1]. Because it is simple to consume, painful, avoidable, versatile, and most importantly, patient-compliant, oral administration is the most preferred method for systemic effects. These solid formulations can be produced without sterile conditions, which make them less expensive to produce. Tablets are the preferred solid dosage form because of patient compliance, precise dosing, and efficient production. If solid dosage form technologies change in reaction to the unprecedented changes in drug discovery, such as genomics, it will have a substantial impact on the choices of excipients and equipment [2]. For the administration of poorly soluble medications containing high molecular weight proteins and peptides, the development of improved oral protein delivery technology using immediate release tablets that may release the drugs at an improved rate is particularly encouraging. Because of its low cost of manufacturing, simplicity of administration, and high levels of patient compliance, the oral route continues to be the best way to provide therapeutic medicines. Many patients need a certain therapeutic condition to start working quickly, thus a fast release of the medication is necessary. This issue affects 50% of the population, according to estimates, which leads to a high rate of ineffective treatment.

Definition

Immediate release tablets are ones that dissolve quickly and disintegrate to release the medication. A suitable diluent or carrier that is acceptable from a pharmacological standpoint and does not significantly slow down the rate of drug release and/or absorption can be used to deliver an immediate release. This phrase does not apply to drug formulations that have been adjusted to provide for "controlled," "sustained," "prolonged," "extended," or "delayed" drug release [3].

The term "release" refers to the delivery (or presentation) of the drug from the formulation to the GI tract, to body tissues, and/or into systemic circulation. For gastrointestinal tract release, pH values between 1 and 3 are best, especially at or around pH=1. A formulation as described here that contains a chemical of formula (I) or an acid addition salt of it, and is in crystalline form, releases medication under a variety of pH circumstances. In a different aspect of the invention, a formulation similar to that described here that contains a compound of formula (I) or an acid addition salt thereof releases medication under pH circumstances such as pH=1 to 3, notably at, or about, pH=1. This means that formulations of the invention, whether administered orally or parenterally, may release at least 70% (preferably 80%) of the active ingredient within 4 hours, such as within 3 hours, preferably 2 hours, more preferably within 1.5 hours, and particularly within an hour (such as within 30 minutes).

Ideal Properties [4,5]

Immediate release dosage form should

1) It should dissolve or disintegrate in the stomach within a short period In the case of solid dosage
2) Should show first absorption and dissolution of drug.
3) Rapid onset of action always seen with immediate release tablets.
4) Must be compatible with taste masking.
5) Be portable without fragility concern.
6) It should not leave minimal or no residue in the mouth after oral administration.
7) Provides pleasing mouth feel.
8) Exhibit low sensitivity to environmental condition as humidity and temperature.
9) Be manufactured using conventional processing and packaging equipment at low cost

Advantages

An immediate release pharmaceutical preparation offers

1) Improved stability, bioavailability.
2) Decreased disintegration and dissolution times for immediate release oral dosage forms.
3) Suitable for controlled, sustained release actives.
4) High drug loading is possible.
5) Ability to provide advantages of liquid medication in the form of solid preparation.
6) Adaptable and amenable to existing processing and packaging machinery.
7) Cost- effective.
8) Improved compliance added convenience

Disadvantage

1. Frequent dosing is necessary for drug with short half-life.
2. Drug release at a time may produce high plasma concentration which may produce toxicity.

Salient Features

- Drugs should possess long biological half-life for immediate release drug delivery.
- The drug is released quickly and completely in one shot.
- High bioavailability expected with immediate release dosage form.
- Lower clearance and lower elimination half-life are also requirement for immediate release drug delivery system.
- But main criterion for immediate release dosage form is poor solubility of the drug and need the immediate action of drug to treat unwanted defect or disease (Papanas et al., 2009; Natarajan et al., 2011).
- Rapid drug therapy intervention is possible.
- New business opportunities like product differentiation, line extension and lifecycle management, exclusively of product promotion.

Pharmacokinetics:

It is the investigation of ingesting, dispersing, metabolism, and excretion. Both the pace and extent of absorption are crucial since it determines when a drug reaches a therapeutic level and, consequently, when it produces a pharmacological effect. Dissolution is quick in conventional dose forms because there is a delay in disintegration. Many variables, such as tissue permeability, perfusion rate, drug binding to tissue, illness status, drug interaction, etc., affect medication distribution.

The pace of drug clearance from the body or the site of action, or biotransformation, determines the duration and intensity of effect. Reduced regional blood flow to the liver and decreased liver volume both hinder drug biotransformation by oxidation, reduction, and hydrolysis. Drugs excreted by the kidneys have a longer half-life because renal clearance is slower.

Pharmacodynamic

- Drug reception interaction impaired in elderly as well as in young adult due to undue development of organ.
- Decreased ability of the body to respond reflexive stimuli, cardiac output, and orthostatic hypotension may see in taking antihypertensive like prazosin.

- Decreased sensitivity of the CVS to α-adrenergic agonist and antagonist.
- Immunity is less and taken into consideration while administered antibiotics.
- Altered response to drug therapy-elderly show diminished bronchodilator effect of theophylline shows increased sensitivity to barbiturates.
- Concomitant illnesses are often present in elderly, which is also taken into consideration, while multiple drug therapy prescribed.

Research workers have clinically evaluated drug combination for various classes' cardiovascular agents, diuretics, anti-hypertensive etc. for immediate release dosage forms. The combination choice depends on disease state of the patient

Problems with Existing Oral Dosage Form [6,7,8]

- Patient may suffer from tremors therefore they have difficulty to take powder and liquids. In dysphasia physical obstacles and adherence to an oesophagus may cause gastrointestinal ulceration.
- Swallowing of solid dosage forms like tablet and capsules and produce difficulty for young adult of incomplete development of muscular and nervous system and elderly patients suffer from dysphasia.
- Liquid medicaments (suspension and emulsion) are packed in multidose container; therefore, achievement of uniformity in the content of each dose may be difficult.
- Buccal and sublingual formation may cause irritation to oral mucosa, so patients refused to use such medications.
- Cost of products is main factor as parenteral formulations are most costly and discomfort.

Candidate for Immediate Release Oral Dosage Form

Analgesics and Anti-inflammatory Agents [9,10,11]

Aloxiprin, auranofin,azapropazone, benorylate, diflunisal, etodolac, fenbufen, fenoprofen calcium, flurbiprofen, ibuprofen, indomethacin, ketoprofen, meclofenamic acid, mefenamic acid, nabumetone, naproxen, oxaprozin,oxyphenbutazone, phenylbutazone,piroxicam, sulindac.

Anthelmintics

Albendazole, bephenium, hydroxynaphthoate, cambendazole, dichlorophen,ivermectin, mebendazole, oxamniquine, oxfendazole, oxantel embonate, praziquantel, pyrantel embonate, thiabendazole

Anti-Arrhythmic Agents

Amiodarone HCl, Disopyramide, flecainide acetate, quinidine sulphate.

Anti-bacterial Agents

Benethamine penicillin, cinoxacin, ciprofloxacin HCl, clarithromycin, clofazimine, cloxacillin, demeclocycline, doxycycline, erythromycin, ethionamide, Imipenem, nalidixic acid, nitrofurantoin, rifampicin, spiramycin, sulphabenzamide, sulphadoxine , sulphamerazine ,sulphacetamide,sulphadiazine, sulphafurazole, sulphamethoxazole, sulphapyridine,tetracycline, trimethoprim

Anti-coagulants

Dicoumarol, dipyridamole, nicoumalone, phenindione

Anti-depressants

Amoxapine, ciclazindol, maprotiline HCl, mianserin HCl, nortriptyline HCl, trazodone HCl, trimipramine maleate.

Anti-diabetics

Acetohexamide, chlorpropamide, glibenclamide,gliclazide, glipizide, tolazamide, tolbutamide.

Anti-epileptics

Beclamide, carbamazepine, clonazepam, ethotoin, methoin, methsuximide, methyl phenobarbitone, oxcarbazepine, paramethadione, phenacemide,phenoba rbitone,phenytoin,phensuximide,primidone, sulthiame, valproic acid

Anti-fungal Agents

Amphotericin, butoconazolenitrate, clotrimazole, econazole nitrate, fluconazole, flucytosine, griseofulvin, itraconazole, ketoconazole, miconazole, natamycin, nystatin, sulconazole nitrate, terbinafine HCl, terconazole, tioconazole, undecanoic acid.

Anti-gout Agents

Allopurinol,probenecid, sulphinpyrazone.

Anti-hypertensive Agents: Amlodipine, carvedilol, benidipine, darodipine, dilitazem HCl, diazoxide, felodipine, guanabenz acetate, indoramin, isradipine, minoxidil, nicardipine HCl, nifedipine, nimodipine, phenoxybenzamine HCl, prazosin HCL, reserpine, terazosin HCl.

Anti-malaria's

Amodiaquine, chloroquine, chlorproguanil HCl, halofantrine HCl, mefloquine HCl, proguanil HCl, pyrimethamine, quinine sulphate.

Anti-migraine Agents

Dihydroergotamine mesylate, ergotamine tartrate, methysergidemaleate, pizotifen maleate, sumatriptan succinate.

Anti-muscarinic Agents

Atropine, benzhexol HCl,biperiden, ethopropazine HCl, hyoscine butyl bromide, hyoscyamine, mepenzolate bromide, orphenadrine, oxyphencylcimineHCl, tropicamide.

Anti-Neoplastic Agents and Immunosuppressants

Aminoglutethimide, amacrine, azathioprine, busulphan, chlorambucil, cyclosporin, dacarbazine, estramustine, etoposide, lomustine, melphalan, mercaptopurine, methotrexate, mitomycin, mitotane, mitozantrone, procarbazine HCl, tamoxifen citrate, testolactone.

Anti-protozoal Agents

Benznidazole, clioquinol,decoquinate,diiodohydroxyquinoline,dilox anide furoate, dinitolmide, furzolidone, metronidazole, nimorazole, nitrofurazone, omidazole, tinidazole.

Anti-thyroid Agents: Carbimazole, propylthiouracil.

Anxiolytic, Sedatives, Hypnotics and Neuroleptics

Alprazolam, amylobarbitone, barbitone, bentazepam, bromazepam, bromperidol, brotizolam, butobarbitone, carbromal, chlordiazepoxide chlormethiazole, chlorpromazine, clobazam, clotiazepam,clozapine, diazepam, droperidol,ethinamate, flunanisone, flunitrazepam, fluopromazine, flupenthixol decanoate, fluphenazine decanoate, flurazepam, haloperidol,

Cardiac Inotropic Agents

Amrinone, digitoxin,digoxin, enoximone, lanatoside C, medigoxin.

Corticosteroids

Beclomethasone,betamethasone,budesonide,cortisone acetate, desoxymethasone, dexamethasone, fludrocortisoneacetate,flunisolide,flucortolone,flutica sonepropionate,hydrocortisone,methylprednisolone, prednisolone, prednisone, triamcinolone

Diuretics

Acetazolamide amiloride, bendrofluazide, bumetanide, chlorothiazide, chlorthalidone, ethacrynic acid, frusemide, metolazone, spironolactone, triamterene.

Anti-parkinsonian Agents

Bromocriptine mesylate, lysuride maleate.

Gastro-intestinal Agents: Bisacodyl, cimetidine, cisapride, diphenoxylate HCl, domperidone, famotidine, loperamide, mesalazine,nizatidine, omeprazole, ondansetron HCL, ranitidine HCl, sulphasalazine

Histamine H,-Receptor Antagonists

Acrivastine, astemizole, cinnarizine, cyclizine, cyproheptadine HCl, dimenhydrinate, flunarizine HCl,loratadine, meclozine HCl, oxatomide, terfenadine, triprolidine.

Stimulants

Amphetamine, dexamphetamine, dexfenfluramine, fenfluramine, mazindol, pemoline.

Excipients [12]

In dosage formulations for immediate release, excipients balance the qualities of the active ingredients. To avoid contact with the active ingredients, this necessitates a thorough understanding of the chemistry of these excipients. Another concern that formulators must deal with is how much these substances will cost. Excipients play a significant role in the creation of fast-melting tablets. When used in the formulation, these inert food-grade components give the finished product the desired organoleptic qualities. A wide variety of actives can be utilised with excipients, with the exception of those actives that need masking agents.

Bulking Agents [13, 14]

Bulking agents play a big role in the creation of tablets that melt quickly. The substance provides diluent, filler, and cost-cutting properties. Moreover, increasing bulk also lowers the concentration of the active ingredient in the composition. Bulking agents enhance the textural qualities, which in turn promote the disintegration in the mouth. For increased aqueous solubility and good sensory perception, more sugar-based bulking agents are advised for this delivery system, such as mannitol, polydextrose, lactitol, DCL (direct compressible lactose), and starch hydrolystate. In instance, mannitol has a high degree of water solubility and is well absorbed by the body. Bulking agents are incorporated into the final composition in amounts ranging from 10% to 90% by weight.

Lubricants

Although though they are not necessary excipients, lubricants can help make these tablets more appealing once they dissolve in the mouth. Lubricants take away stickiness and help transfer drugs from the lips down into the stomach.

Super Disintegrants

A disintegrant is an excipient, which is added to a tablet or capsule blend to aid in the breakup of the compacted mass when it is put into a fluid environment.

Advantages

- Effective in lower concentrations
- Less effect on compressibility and flowability
- More effective intragranularly

Some super disintegrants are

1) Sodium Starch Glycolate (Explotab, primogel) used in concentration of 2-8 % & optimum is 4%.

Mechanism of Action

Rapid and extensive swelling with minimal gelling. Microcrystalline cellulose (Synonym: Avicel, celex) used in concentration of 2- 15% of tablet weight. And Water wicking

2) Cross-linked Povidone (crospovidone) (Kollidone) used in concentration of 2-5% of weight of tablet. Completely insoluble in water.

Mechanism of Action

Water wicking, swelling and possibly some deformation recovery. Rapidly disperses and swells in water, but does not gel even after prolonged exposure. Greatest rate of swelling compared to other disintegrants. Greater surface area to volume ratio than other disintegrants.

3) Low-substituted hydroxyl propyl cellulose, which is insoluble in water. Rapidly swells in water. Grades LH-11 and LH-21 exhibit the greatest degree of swelling. Certain grades can also provide some binding properties while retaining disintegration capacity. Recommended concentration 1-5% .

4) Cross linked carboxy methyl cellulose sodium (i.e. Ac-Di-sol) Croscarmellose sodium

Mechanism of Action: Wicking due to fibrous structure, swelling with minimal gelling. Effective Concentrations: 1-3% Direct Compression, 2-4% Wet Granulation.

Method Used In the Preparation of Immediate Release Tablets [15]

- Tablet molding technique
- Direct compression technique
- Wet granulation technique
- Mass extrusion technique
- By solid dispersions

Tablet Molding

- Water-soluble chemicals are utilised in this technology to make tablets that quickly dissolve and disintegrate. A hydro alcoholic solvent is used to wet the powder mixture before it is compressed at a lower pressure than that required for traditional tablets. Air drying is then used to remove the solvent. The porous texture of moulded tablets facilitates dissolving. Mechanical strength and flavour disguising qualities are two issues that are frequently faced. The mechanical strength of the tablet can be improved by using binding agents such sucrose, acacia, or poly vinyl pyrrolidone. Van Scoik used spray congealing to spray a molten mixture of hydrogenated cottonseed oil, sodium bicarbonate, lecithin, polyethylene glycol, and active component into a lactose-based tablet triturate form in order to overcome the poor taste masking characteristic.

Direct Compression Method

- Without any prior processing, tablets are compressed using this approach directly from the medication and excipient mixture. Pretreatment as wet granulation is not necessary because the mixture to be crushed must have acceptable flow characteristics and maintain cohesion under pressure. Few medications can be directly crushed into acceptable-quality tablets. The kind of disintegrant and its quantity are crucial factors. Particle size distribution, contact angle, pore size distribution, tablet hardness, and water absorption capacity are other aspects to be taken into account. These variables collectively control the disintegration. At the industrial level, the disintegrant addition method is inexpensive and simple to use.

Wet Granulation Method

- The process of wet granulation involves mildly agglomerating the powder combination using a liquid binder. A correctly controlled amount of liquid is required since an excessive amount will make the granules too hard and an insufficient amount will make them too soft and friable. Compared to solvent-based systems, aqueous solutions have the advantage of being safer to handle, but they might not be appropriate for medicines that are hydrolyzed.

Procedure

- The active ingredient and excipients are weighed and mixed.
- The wet granulate is prepared by adding the liquid binder–adhesive to the powder blend and mixing thoroughly. Examples of binders/adhesives include aqueous preparations of cornstarch, natural gums such as acacia, and cellulose derivatives such as methyl cellulose, gelatin, and povidone.
- Screening the damp mass through a mesh to form pellets or granules.
- Drying the granulation. A conventional tray-dryer or fluid-bed dryer are most commonly used.
- After the granules are dried, they are passed through a screen of smaller size than the one used for the wet mass to create granules of uniform size.

Low shear wet granulation processes use very simple mixing equipment, and can take a considerable time to achieve a uniformly mixed state. High shear wet granulation processes use equipment that mixes the powder and liquid at a very fast rate, and thus speeds up the manufacturing process. Fluid bed granulation is a multiple-step wet granulation process performed in the same vessel to pre-heat, granulate, and dry the powders. It is used because it allows close control of the granulation process.

Mass-Extrusion (Mass-Extrusion) [16, 17]

This technology involves softening the active blend using the solvent mixture of water-soluble polyethylene glycol and methanol and subsequent expulsion of softened mass through the extruder or syringe to get a cylinder of the product into even segments using heated blade to form tablets. The dried cylinder can also be used to coat granules for bitter drugs and thereby achieve taste masking.

By solid dispersions [18]

Maximizing the quantity of dispersion in the dosage form is frequently desirable when manufacturing such solid amorphous dispersions into immediate release solid dosage forms for oral administration to an environment like the GI tract of an animal like a human. This reduces the amount of solid dosage form needed to provide the target dose. According to the dosage of the medicine, it is frequently preferred that the solid amorphous dispersion has at least 30 weight percent, preferably at least wt percent, and even more ideally at least 50 weight percent or more of the solid dosage form. Such large drug loadings of dispersion in solid

dosage forms reduce the size of the dosage form, which facilitates patient swallowing and tends to increase patient compliance. A "low-solubility drug" is one that is either "substantially water-insoluble," which means that it has a minimum aqueous solubility at physiologically relevant pH (e.g., pH 1-8) of less than 0.01 mg/mL, "sparingly water-soluble," which means that it has an aqueous solubility up to about 1 to 2 mg/mL, or even low to moderate aqueous solubility, having an a The solid drug dispersions used to create the high loading, instant release dosage forms of the current invention include at least one concentration-boosting polymer. The dispersions utilised in the present invention contain enough of the concentration-enhancing polymer, compared to a control composition, to improve the drug concentration in a usage environment. The dispersions employed in the present invention, at the very least, improve concentration as compared to a control that uses crystalline medication alone. When the dispersion is supplied to a use environment, the concentration-enhancing polymer is thereby present in sufficient amounts to boost drug concentration compared to a control that contains an identical amount of crystalline drug but no concentration-enhancing polymer.

Drug-excipient compatibility studies [19]

The physical, chemical, and biological properties of the medicine and the excipients used to make the product must be taken into account for the dosage form's proper design and formulation. To create a product that is stable, effective, appealing, simple to use, and secure, the medicine and excipients must be compatible with one another. The framework for the drug's combination with the excipients in the creation of the dosage form is provided by the compatibility studies. The goal of the study was to demonstrate that the therapeutically active medication had not changed after being put through the manufacturing stages required to create tablet form. In order to conduct compatibility experiments, certain medication and excipient properties are combined and held in glass vials for a month at 55°C.

Evaluation of powder blend

The prepared blend is evaluated by following tests.

- Angle of repose
- Bulk density
- Tapped density
- Hauser's ratio
- Carr's index

Angle of repose

Angle of repose was determined by using fixed funnel method. The fixed funnel method employs a funnel that was secured with its tip at a given height (2cm), above the graph paper that was placed on a flat horizontal surface. Granules or tablet blend were carefully poured through the funnel until the apex of the conical pile just touches the tip of the funnel. Thus, with r being the radius of the base of the conical pile. Angle of repose was calculated using the following equation.

$$\theta = \tan^{-1}\left(\frac{h}{r}\right)$$

Here;

h = Height of pile

r = Radius of pile

θ = Angle of repose

Bulk density

Bulk density was determined by pouring a weighed quantity of tablet blend into graduated cylinder and measuring the height. Bulk density is the ratio of mass of tablet blend to bulk volume.

$$\text{Bulk Density} = \frac{m}{v} = \frac{m}{\pi r^2 h}$$

Here;

m = weight of powder or granules (gm.)

v = Tapped Volume (cm.3)

π = 22/7 = 3.14 r = Radius of Cylinder (cm.)

h = Height reached by powder in cylinder after tapping (cm.)

Tapped Density

Tapped density is ratio of mass of tablet blend to tapped volume of tablet blend. Accurately weighed amount of tablet blend poured in graduated cylinder and height is measured. Then cylinder was allowed to 100tap under its own weight onto a hard surface. The tapping was continued until no further change in height was noted.

$$\text{Tapped Density} = \frac{m}{v} = \frac{m}{\pi r^2 h}$$

Here;

m = weight of powder or granules (gm.)

v = Tapped Volume (cm.3) π = 22/7 = 3.14

r = Radius of Cylinder (cm.)

h = Height reached by powder in cylinder after tapping (cm.)

Hausner's Ratio

Hausner's ratio indicates the flow properties of powder and measured by the ratio of tapped density to bulk density. Hausner's ratio was determined by the given formula

$$\text{Hausner's ratio} = \frac{\text{Tapped density}}{\text{Bulk density}}$$

Carr's Index (Compressibility Index)

Compressibility is the ability of powder to decrease in volume under pressure using bulk density and tapped density the percentage compressibility of powder were determined, which is given as carr's compressibility index. It is indirectly related to the relative flow rate. Carr's compressibility index was determined by the given formula

$$\text{Carr's Index} = (1 - \frac{\text{Bulk Density}}{\text{Tapped Density}}) \times 100$$

Evaluation of Tablets

These tests are as following: -

- Appearance
- Thickness
- Hardness
- Weight variation
- Friability
- Disintegration
- Uniformity of dispersion
- Wetting Time
- Water absorption ratio
- Drug content
- In vitro Dissolution
- Stability studies

Appearance

The general appearance of tablet is its visual identity and all over elegance, shape, color, surface textures. These all parameters are essential for consumer acceptance.

Thickness

The thickness of the tablets was determined by using vernier calipers. Randomly 10 tablets selected were used for determination of thickness that expressed in Mean± SD and unit is mm.

Hardness:

The hardness of tablet is an indication of its strength against resistance of tablets to capping, abrasion or breakage under conditions of storage, transportation and handling before usage. Measuring the force required to break the tablet across tests it. Hardness of 10 tablets (randomly) from whole tablet batch was determined by Monsanto hardness tester. Hardness measured in kg/cm^2.

Weight variation

The weight variation test is carried out in order to ensure uniformity in the weight of tablets in a batch. The total weight of 20 tablets randomly from whole batch was determined and the average was calculated. The individual weights of the tablets were also determined accurately and the weight variation was calculated.

Friability test

Friability is the loss of weight of tablet in the container due to removal of fine particles from the surface during transportation or handling. Roche friabilator was employed for finding the friability of the tablets. For tablets with an average weight of 0.65 g or less take a sample of whole tablets corresponding to about 6.5 g and for tablets with an average weight of more than 0.65 g take a sample of 10 whole tablets. Roche fibrillatory is rotated at 25rpm for 4 minutes for 100rounds. The tablets were dedusted and weighed again. The percentage of weight loss was calculated using the formula

$$\%f = \frac{W_0 - W_1}{W_0} \text{ x } 100$$

Here,

%f = Percentage friability

W_0 = Initial weight (Before test)

W_1 = Final weight (After test)

Disintegration test

The USP device to rest disintegration was six glass tubes that are "3 long, open at the top, and held against 10" screen at the bottom end of the basket rack assembly. One tablet is placed in each tube and the basket rack is poisoned in 1 liter beaker of distilled water at 37± 20C, such that the tablets remain below the surface of the liquid on their upward movement and descend not closer than 2.5cm from the bottom of the beaker.

Uniformity of dispersion

Two tablets were kept in 100ml water and gently stirred for 2 minutes. The dispersion was passed through 22 meshes. The tablets were considered to pass the test if no residue remained on the screen.

Wetting Time

The wetting time of the tablets was measured using a simple procedure. Five circular tissue papers of 10cm diameter were placed in a Petri dish containing 0.2% w/v solution of amaranth (10ml). One tablet was carefully placed on the surface of the tissue paper. The time required for develop blue color due to amaranth water-soluble dye on the upper surface of the tablets was noted as the wetting time.

Absorption Ratio

A small piece of tissue paper folded twice was placed in a small Petri dish containing 6ml of water. A tablet was put on the paper. The wetted tablet was then weighed. Water absorption ratio, R was determined by using following formula

$$R = \frac{W_a - W_b}{W_b} \text{ x } 100$$

Here,

R = Water absorption ratio

W_b = Weight of tablet before water absorption

W_a = Weight of tablet after water absorption

Drug content [20]

10 tablets were powdered and 100mg drug equivalent powder dissolved in suitable media buffer or 0.1N HCl. Volume of the solution made up to 100ml by that media. Solution was filtered and diluted 100times and analyzed spectrophotometrically and further calculation carried out to determine drug content in one tablet.

In vitro drug release studies [21, 22, 23]

The immediate release tablets are subjected to in vitro drug release studies in pH 6.8 phosphate buffer or 0.1N HCl for 30 minutes to access the ability of the formulation for providing immediate drug delivery.

Drug release studies were carried out in dissolution test apparatus using specified volume 900ml of dissolution media maintained at 37±0.20C. The tablets are kept in the cylindrical basket or directly placed in medium with paddle then rotated at 100 rpm. 5ml of the sample from the dissolution medium are withdrawn at each time interval (5, 10, 15 & 30 minutes) and 5ml of fresh medium was replaced each time. The samples were filtered and from the filtrate 1ml was taken and diluted to 10ml. These samples were analyzed spectrophotometrically and further calculation was carried out to get drug release. The drug released data were plotted and tested with zero order (Cumulative % drug released Vs time), First order (Log % Remained Vs time). The in vitro dissolution kinetic parameters, dissolution rate constants, correlation coefficient and dissolution efficiency were calculated.

Stability study [24, 25]

Stability is defined as the ability of a particular drug or dosage form in a specific container to remain within its physical, chemical, therapeutic, and toxicological specifications. Drug decomposition or degradation occurs during storage, because of chemical alteration of the active ingredients or due to product instability, lowering the concentration of the drug in the dosage form.

Stability study of the dosage form must include a section for product characterization and another section to study the product stability during storage. Formulations are evaluated for their appearance, possible weight gain in drug content thickness, flatness, folding endurance, tensile strength, moisture content and moisture uptake, and invitro release study by keeping dosage form in different temperature and humidity condition after a specified time. The stability study indicates that the formulation is quite stable at different conditions of storage.

Packaging [26, 27]

Packaging is important part in formulation and development of a dosage forms because a perfect formulation that satisfies all the criteria will not pack in a proper way, there is no use of maintain precautions (quality aspect) during formulation process. Packaging is done for immediate release tablets as per the normal tablets such as blister pack, strip pack, bubble pack, tamper-resistant pack etc. But for the photosensitive drug packing should done in *alu-alu* pack

Conclusion

Most patients want immediate therapeutic effects from their medications, which results in poor adherence to conventional drug therapy and decreased overall therapeutic efficacy. The development of the rapid release pharmaceutical form gives the advantages of easy administration and convenience of dosing in one package. These pills are made to deliver the medication at a faster rate. There is an unmet need for improved manufacturing processes for pharmaceutical products with immediate release because of the limitations of current technologies, which have been mentioned above. These processes should be mechanically robust, allow for easy handling and packaging, and have production costs that are comparable to those of conventional tablets. A market exclusivity extension that is possible with an instant release dosage form boosts sales while also focusing on the underserved and undertreated patient group.

References

1. Sood R et al. Immediate release antihypertensive valsartan oral tablet: A Review. Journal of Scientific Research in Pharmacy May 2012; 1(2): 20-26.
2. Reddy KM et al. Formulation and evaluation of immediate release tablets of linezolid. International Journal of Pharmaceutical & Biological Archives 2011; 2(4): 1230-1235.
3. Patel U, Patel K, Shah D, Shah R. A review on immediate release drug delivery system. International journal of pharmaceutical research and bio-science. 2012; 1(5): 37-66.
4. Sandeep N, Gupta MM. Immediate drug release dosage form: a review. Journal of drug delivery & therapeutics. 2013; 3(2): 155 - 161.
5. Patel N, Naruka PS, Chauhan CS, Modi J. Formulation Development and Evaluation of Immediate Release Tablet of Topiramateanti Epileptic Drug. Journal of Pharmaceutical Science and Bioscientific Research. 2013; 3(2): 58 – 65.
6. Singh, A., Srinivasan, A.K., Chakrapani, L.N. and Kalaiselvi, P., 2019. LOX-1, the common therapeutic target in hypercholesterolemia: a new perspective of antiatherosclerotic action of aegeline. Oxidative medicine and cellular longevity, 2019.
7. Patel N, Natarajan R, Rajendran NN, Rangapriya M. Formulation and evaluation of immediate release bilayer tablets of telmisartan and hydtochlorothiazide. International journal of

pharmaceutical sciences and nanotechnology. 2011; 4 (3): 1477-1482.

8. Dandare MS et al. Bilayer tablet: A Novel approach for immediate release of telmisartan and hydrochlorthaizide combination. International Journal of Pharmacy & Technology April 2012; 4(1): 3970-3983.
9. Singh, A., Gowtham, S., Chakrapani, L.N., Ashokkumar, S., Kumar, S.K., Prema, V., Bhavani, R.D., Mohan, T. and Sathyamoorthy, Y.K., 2018. Aegeline vs Statin in the treatment of Hypercholesterolemia: A comprehensive study in rat model of liver steatosis. Functional Foods in Health and Disease, 8(1), pp.1-16.
10. Loyd Allen V, Nicholas, Popo vich G and Howard Ansel C. Ansel's Pharmaceutical Dosage Forms and Drug Delivery System, 8th edition. 233
11. Fast Dissolving Tablet: An Overview, Journal of Chemical and Pharmaceutical Research, 2009, 1(1): 163-177
12. Singh, A., Kumar, A. and Kalaiselvi, P., 2018. Aegeline, targets LOX1, the receptor for oxidized LDL to mitigate hypercholesterolemia: a new perspective in its anti-atherosclerotic action. Free Radical Biology and Medicine, 128, p.S41.
13. Dali Shukla, Subhashis Chakraborty, Sanjay Singh, Brahmeshwar Mishra, Mouth Dissolving Tablets II: An Overview of Evaluation Techniques, www.scipharm.at
14. Susijit Sahoo, B. Mishra, P.IK. Biswal, Omprakash Panda, Satosh Kumar Mahapatra, Goutam Kumar Jana, Fast Dissolving Tablet: As A Potential Drug Delivery System, Drug Invention Today 2010, (2), 130-133
15. Singh, A., 2022. Role of microbial metabolites in cardiovascular and human health. In Microbiome, Immunity, Digestive Health and Nutrition (pp. 137-148). Academic Press.
16. A Gupta, AK Mishra, V Gupta, P Bansal, R Singh, AK Singh, Review Article, Recent Trends of Fast Dissolving Tablet - An Overview of Formulation Technology, International Journal of Pharmaceutical & Biological Archives2010; 1(1): 1 – 10
17. Singh, A., 2022. Hyperlipidemia in cardiovascular health and digestion. In Nutrition and Functional Foods in Boosting Digestion, Metabolism and Immune Health (pp. 141-150). Academic Press.
18. A Review on New Generation Oro dispersible Tablets and Its Future Prospective, Tanmoy Ghosh, Amitava Ghosh and Devi Prasad, International Journal of Pharmacy and Pharmaceutical Sciences, 2011;3(1):1491.
19. Roh, J., Hill, J.A., Singh, A.,Valero-Muñoz, M. and Sam, F., 2022. Heart failure with preserved ejection fraction: heterogeneous syndrome, diverse preclinical models. Circulation Research, 130(12), pp.1906-1925.
20. Reddy.L.H et al., "Fast dissolving drug delivery systems: A review of the literature, IJPS., July 2002:331-336.
21. Shiv Chandra Singh, A., Yu, A., Chang, B., Li, H., Rosenzweig, A. and Roh, J.D., 2021. Exercise Training Attenuates Activin Type II Receptor Signaling in the Aged Heart. Circulation, 144(Suppl_1), pp.A14259-A14259.
22. Vaishnavi R et al. Formulation and evaluation of immediate release tablets of paroxetine HCl using different super disintegrants. International Journal of Research in Pharmaceutical and Biomedical Sciences Sept 2011; 2(3): 1095- 1099.
23. Prasanth Sai R.V., I. Pujitha, Srinivas Thota and Nagu A. Formulation and Development of Entecavir Tablets; International Journal of Research in Pharmaceutical and Biomedical sciences 2011; 2 (3) :1239-1247.
24. Boini, K.M., singh, A. and Koka, S.S., 2021. Gut Microbial Metabolite Trimethylamine N-oxide Enhances Endoplasmic Reticular Stress and Promotes Endothelial Dysfunction. Circulation, 144(Suppl_1), pp.A14071-A14071.
25. Dhakane K et al. Fast dissolving tablet: A Future prospective. Journal of Pharmacy Research 2011; 4(11): 4176-4180.
26. Ravichandran V et al. Fast dissolving tablets: A Review. Journal of Pharmacy Research 2011; 4(8): 2590-2592.
27. Theobald N, Winder B. Packaging Closures and Sealing Systems. Blackwell Publishing Ltd, 9600 Garsington Road, Oxford OX4 2DQ, UK; First published 2006