

ORODISPERSIBLE FILM DOSAGE FORM: A REVIEW**Dnyaneshwar H.R*., Wale K.K., Sayyed S.F., Dr. Chaudhari S.R.**

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Article Received on
23 May 2014,Revised on 18 June 2014,
Accepted on 13 July 2014***Correspondence for
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ABSTRACT

Orodispersible dosage forms are promising new approaches for drug delivery. They enable an easy application, as there is no need to drink high amounts of liquids or swallow large solid dosage forms. The aim of the study was to develop an orodispersible film (ODF) as an alternative to tablets, syrups or suppositories for the treatment of vomiting and nausea, especially for the pediatric population. Oral thin film, a new drug delivery system for the oral delivery of the drugs, was developed based on the technology of the transdermal patch. Fast-dissolving oral thin film is a solid dosage form, which disintegrate or dissolve within 1 min when placed in the mouth without drinking of water or chewing. Oral film includes various ingredients for its

formulation which includes polymers, active pharmaceutical ingredient, film stabilizing agents, sweeteners, flavours, colors, saliva stimulating agents, preservatives, surfactants etc but the first and far most a very essential ingredient which helps in film formation is a Polymer. Fast dissolving Film is prepared using hydrophilic polymers that rapidly dissolves on the tongue or buccal cavity, delivering the drug to the systemic circulation via dissolution when contact with liquid is made. Water-soluble polymers are used as film formers for fast dissolving films. The water-soluble polymers achieve rapid disintegration, good mouth feel and mechanical properties to the films. Fast-dissolving oral thin film offer fast, accurate dosing in a safe, efficacious format that is convenient and portable, without the need for water or measuring devices. In this review article the different polymers used for preparation of fastdissolving oral thin film like Pullulan, Gelatin, Sodium Alginate, Pectin, Rosin, Starch, Chitosan are discussed together with th physicochemical properties and film forming properties.

KEY WORDS:Fast dissolving films, Oral thin films, ODF. orally disintegrating dosage form.

1. INTRODUCTION

1.1 Importance of oral drug delivery systems

Fast Drug Delivery Systems are rapidly gaining interest in the pharmaceutical industry. These systems either dissolve or disintegrate generally within a minute without needing water or chewing. Recently orodispersible films have been proposed which rapidly dissolves or disintegrate into buccal cavity. Alternative to fast-dissolving tablets it definitely eliminates patients' fear of choking.^[1] Orodispersible formulations are beneficial especially for the paediatrics but also for the geriatric population as swallowing high volumes of liquids can be avoided.^[2]

An important benefit of these dosage forms is accurate dosing as compared to liquid dosage form, no water is needed and there is no fear of choking as compared to tablets and capsules.^[3] Also, although oral disintegrating tablets disintegrate quickly, their disintegrated materials remain insoluble until swallowing.^[4] The rapidly dissolving dosage forms are referred by various names by researchers like orodispersible film, mouth dissolving, quick disintegrating, orally disintegrating, mouth dissolve or melt in mouth dosage forms.^[5] These are ultra-thin postage stamp size with an active agent or pharmaceutical excipients. Since the sublingual mucosa is relatively permeable because of thin membrane and is highly perfused, rapid drug absorption and instant bioavailability is possible and this leads to quick-onset of drug action. Since the drug is directly absorbed into the systemic circulation, degradation in the gastrointestinal (GI) tract and first pass effect can be avoided.

1.2 Release mechanism^[1,2]

The delivery system is simply placed on a patient's tongue or any oromucosal tissue. Instantly wet by saliva due to presence of hydrophilic polymer and other excipients, the film rapidly hydrates and adheres on to the site of application and dissolves to release the medication for oromucosal absorption. It rapidly disintegrates or dissolves or disintegrates to release the medicine for mucosal absorption or with modification, allows for oral GIT absorption with quick dissolving properties.

1.3 Special features^[6-9]

1. Available in various size and shape.
2. Thin elegant film.
3. Un-obstructive.
4. Fast disintegration or dissolution.

5. Rapid release.
6. Mucoadhesive.
7. Quick dissolving.

1.4 Advantage^[6,10,11]

1. No risk of choking.
2. Convenient dosing or accurate.
3. No need of water to swallow or chew.
4. Small size for improved patient compliance.
5. Rapid onset of action.
6. Ease of handling and transportation.
7. Improve bioavailability for certain therapeutic ingredient.
8. Enhanced stability.
9. Taste masking.
10. No special set required for industry.
11. The drug enters the systemic circulation with reduced hepatic first pass effect.
12. Lower doses.
13. Minimal side effects.
14. Site specific and local action.
15. Non-invasive.
16. It provides dose removal possibility in emergency situation.
17. Destructive acidic environment of stomach can be avoided.

1.4.1 Comparison between orodispersible film and orodispersible tablet^[10,11,13]

Table 1: Comparison of orodispersible film and orodispersible tablet

Orodispersible film	Orodispersible tablet
It is a film	It is a tablet
Greater dissolution due to larger surface area	Lesser dissolution due to less surface area
Better durable than orodispersible tablets	Less durable as compared with orodispersible film
More patients compliance	Less patient compliance than film
Low dose can be incorporated	High dose can be incorporated
No risk of choking	It has a fear of choking

1.5 Disadvantage^[11,14]

- 1 It is hygroscopic in nature so it must be kept in dry places.
- 2 It also shows the fragile, granule property.
- 3 They require special packaging for the products stability and safety.
- 4 High dose cannot be incorporated into the oral film.

1.6 Limitations^[14]

- 1 Drugs with larger doses are difficult to formulate into ODF e.g. rifampin (600mg), ethambutol (1000mg) etc. However, research has proven that the concentration level of active can be improved up to 50% per dose weight.
- 2 Most bitter drugs should be avoided if used then co-administration of enzyme inhibitors such as aprotinin, bestatin, puromycin.

2.5 Structural features of oral mucosa^[3,10,15,116]

2.5.1 Description

The mouth or oral cavity is bounded by muscles and bones:

- 1 Anteriorly- by the lips
- 2 Posteriorly- it is continuous with the oropharynx
- 3 Laterally- by the muscles of the cheeks
- 4 Superiorly- by the bony hard palate
- 5 Inferiorly- by the muscular tongue and the soft tissues of the floor of the mouth.
- 6 The oral cavity is lined throughout with mucous membrane, consisting of stratified squamous epithelium containing small mucus- secreting glands. The mucous membrane lining of the cheeks and the lips is reflected on to the gums or alveolar ridges and is continuous with the skin of the face.

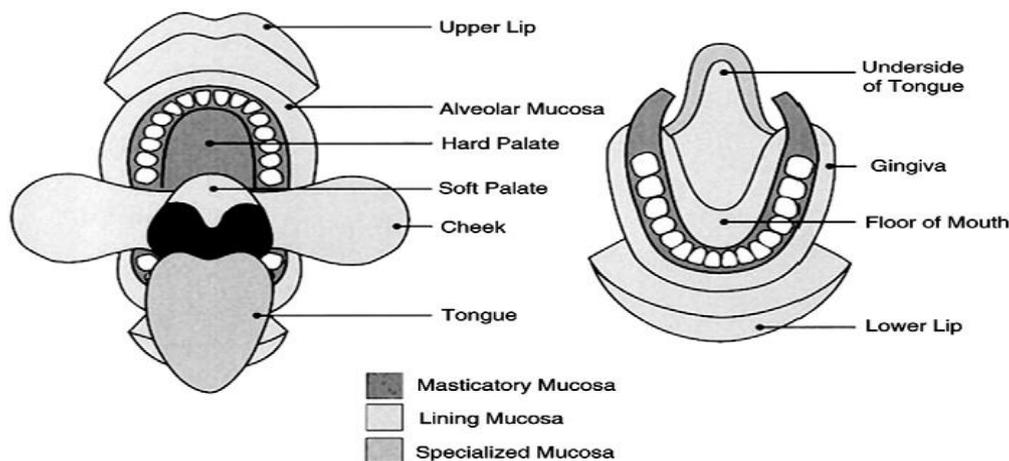


Fig 1: Structure seen in widely open mouth and the inferior surface of tongue

2.5.2 Physicochemical properties of oral mucosa

The oral mucosa presents differently depending on the region of the oral cavity being considered.

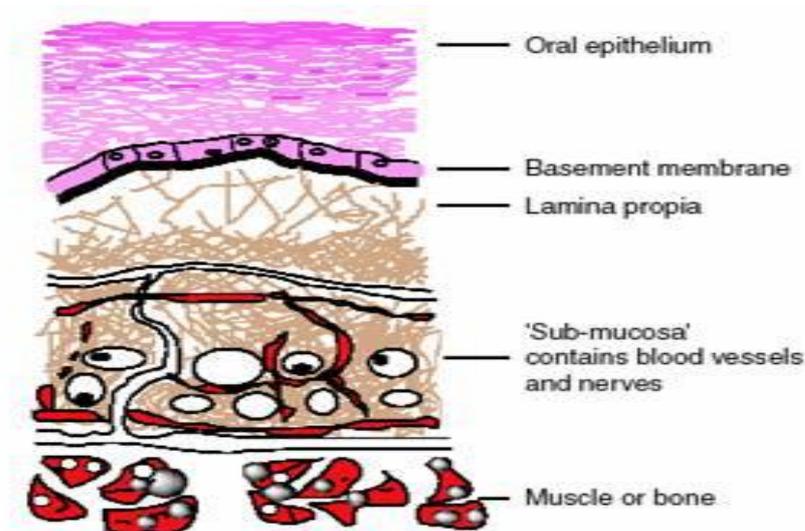


Fig 2: Layer of buccal mucosa

Buccal mucosa covers the inner cheeks and is classified as part of the lining mucosa, having approximately 40-50 cell layers resulting in an epithelium 500-600 μm thick. The epithelium is attached to underlying structures by a connective tissue or lamina propria, separated by a basal lamina. Once a given drug molecule reaches the connective tissue, it may be readily distributed, thus the permeation barrier is across the whole thickness of the stratified epithelium. The permeability barrier is located in the upper region of epithelium and is correlated with rich lipid content of this zone. As well as the keratinized epithelium, the intercellular space of the buccal mucosa is rich in lipids, but it is the difference in composition and the absence of the keratin layer that accounts for its permeation characteristics. The lipid composition in the buccal epithelium has a higher content of phospholipids, cholesterol esters, and glycosylceramides. The lipophilic nature of the cell membranes favours the pass of molecules with high log P values across the cells.

2.5.3 Tongue^[15]

The tongue is a voluntary muscular structure which occupies the floor of the mouth. It is attached by its base to the hyoid bone and by a fold of its mucous membrane covering, called the frenulum, to the floor of the mouth. The superior surface consists of stratified squamous epithelium, with numerous papillae (little projections), containing nerve endings of the sense of taste, sometimes called the taste buds.

2.6 Composition of the formulation^[6,10,17]

Formulation of orodispersible film (ODF) involves the intricate application of aesthetic and performance characteristics such as taste masking, fast dissolving, physical appearance, and mouth feel etc. The excipients used in formulation of orodispersible film are given below as per their categories. From the regulatory perspectives, all excipients used in the formulation of orodispersible film should be generally regarded as safe (i.e. GRAS-listed) and should be approved for use in oral pharmaceutical dosage forms. Components of formulation are,

1. Drug
2. Water soluble film forming polymers
3. Plasticizers
4. Saliva stimulating agent
5. Sweetening agent
6. Flavoring agent
7. Surfactant
8. Colors, Filler

Table 2: concentration of component^[6, 14, 11, 13,18]

Sr. No.	Ingredients	Amounts
1	Drug	1-30%
2	Film forming polymer	40-50%
3	Plasticizer	0-20%
4	Saliva stimulating agent	2-6%
5	Sweetening agent	3-6%
6	Flavoring agent	Q. S.
7	Surfactant	Q. S.
8	Colors, Filler	Q. S.

2.6.1 Active pharmaceutical ingredient^[10,17]

A distinctive composition of the film contains 1-30%w/w of the active pharmaceutical ingredient. Always use low dose active pharmaceutical ingredients used because high dose of drug are difficult to incorporate in fast dissolving film micronized API is useful become it enhance the texture of film and provide improved dissolution and uniformity in the fast dissolving film. A number of drugs can be used as fast dissolving oral film.

Table 3: Examples of suitable drug molecule and its category ^[10,13,14,17]

Category	Examples
Anti-emetics	Ondansetron, Granisetron, Plonosetron, Dronabinol, Aprepitant, Ramosetron, Trimethobezamide, Nabilone, Metoclopramide, Dolasetron, Dimenhydramine
Serotonin inhibitors	Fluoxetine, Setraline, Paroxetine, Fluxoamine, Citalopram and Alaproclate
5HT3 antagonists	Alosetron, Ondansetron, Granisetron, Palonosetron, Ramosetron and Tropisetron
Anti-epileptics	Carbamazepine, Clonazepam, Diazepam, Divalproex sodium, Fosphenytoin, Gabapentin, Lamotrigine, Levetiracetam, Oxacarbazepine, Phenytoin, Primidone and Valproate sodium
Anti-migraines	Almotriptan, Dihydroergotamine Mesylate, Eletriptan, Frovatriptan, Naratriptan, Rizatriptan, Sumatriptan and Zolmitriptan
Dopamine D1 and D2 antagonists	Amisulpride, Bromperidol, Cabergoline, Domperidone, Fenoldopam, Haloperidol, Metoclopramide, Metopimazine, Pergolide Mesylate, Prochlorperazine, Quetiapine, Ropinirole Hydrochloride, Sulpiride, Tiapride and Zotepine
Nootropics	Almitrine Dimesylate and Raubasine, Cevimeline Hydrochloride, Codergocrine Mesylate, Donepezil, Galantamine, Ginkgo Biloba Extract (Egb 761), Memantine, Nicergoline, Piracetam, Rivastigmine, Tacrine and Vinpocetine
Statins	Atorvastatin, Cerivastatin, Fluvastatin, Lovastatin, Pitavastatin, Pravastatin, Rosuvastatin and Simvastatin

2.6.2 Water soluble film forming polymer ^[6,10,17,19]

Water-soluble polymers are used as film formers. The use of film forming polymers in dissolvable films has attracted considerable attention in medical and nutraceutical application. The water-soluble polymers achieve rapid disintegration, good mouth feel and mechanical properties to the films. The disintegration rate of the polymers is decreased by increasing the molecular weight of polymer film bases. Some of the water soluble polymers used as film former are HPMC E3, E5 and E15 and K-3, Methyl cellulose A-3, A-6 and A-15, Pullulan, carboxymethylcellulose cello 30, Polyvinylpyrrolidone PVP K-90, Pectin, Gelatin, Sodium Alginate, Hydroxypropylcellulose, Polyvinyl alcohol, Maltodextrins and Eudragit RD108,9,10,11,12 Eudragit RL100. Polymerized rosin is a novel film forming polymer.

2.6.3 Plasticizers ^[17,20,21,22]

Plasticizer is a very important ingredient of oral strip formulation. It helps to improve the flexibility and reduce the brittleness of the fast dissolving film and by addition of Plasticizers, tensile strength and elongation can be improved. The selection of plasticizer will depend

upon its compatibility with the polymer and also the type of solvent employed in the casting of oral strip.

1.8.4 Sweetener^[7,17,21]

Sweeteners have become the essential part of the food products as well as pharmaceutical products intended to be disintegrated or dissolved in the oral cavity. Both natural and artificial sweeteners are used in the formulation to improve the palatability of the fast dissolving film. Generally sweeteners are used in the formulation in concentration of 3-6% w/w, either alone or in combination.

Table 4: Sweetener and their sweetness factor^[7]

Sweetener	Sweetness Factor
Aspartame	180-200
Sucralose	600
Neotame	7000-13000
Saccharin	300

1.8.5 Saliva Stimulating Agent^[7,17]

The rationale of employing saliva stimulating agents is to increase the rate of production of saliva that would be aid in the faster disintegration of the fast dissolving film formulations. Generally acids which are used in the preparation of food can be utilized as salivary stimulants, like- citric acid, malic acid, lactic acid, ascorbic acid etc. These are used alone or in combination between concentration 2 to 6% w/w of the film Sweeteners also act & as saliva stimulating agent.

1.8.6 Flavoring Agent^[7,13,23]

Selection of flavor is depending on which type of drug is to be incorporated in the formulation. The recognition of the oral disintegrating/ dissolving formulation by an individual depend on the initial flavor quality which is observed in the first few seconds after the product has been consumed and the after taste of formulation lasts for at least 10 min The amount of flavor required to mask the taste depend on the flavor type and its strength. Flavoring agent is used in the formulation in concentration of 10% w/w.

8.6.1 Basic taste and their taste masking agents^[8]

Salt: Butterscotch, maple, apricot, peach, vanilla, mint.

Bitter: Wild cherry, walnut, chocolate, mint, anise.

Sweet: Vanilla, fruit, and berry.

Sour: Citrus flavor, licorice, root beer, raspberry.

1.8.7 Coloring Agent^[6,17,21]

FD & C approved coloring agent is incorporated in fast dissolving film. Generally coloring agent is not exceeding concentration a level of 1% w/w in fast dissolving film. Mainly titanium dioxide is used in the formulation.

2.7 Methods of Preparation of ODF^[6,7,11,13]

Following methods which can be used for preparation of fast dissolving film such as:

1. Solvent casting method
2. Semisolid casting method
3. Hot melt extrusion
4. Solid dispersion extrusion
5. Rolling method

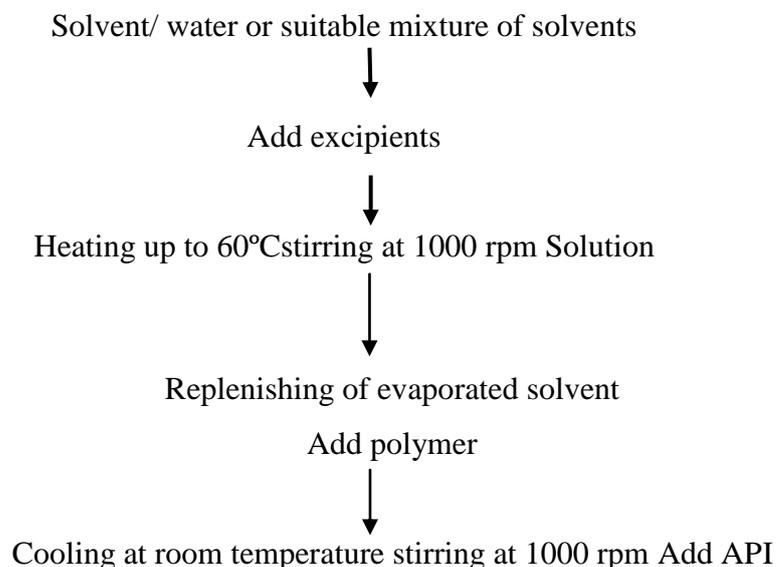
1.9.1 Solvent casting method^[6,10,18,24]

Advantages

- 1 Great uniformity of thickness & great clarity than extrusion..
- 2 Films have fine gloss & freedom from defect such a die lines.
- 3 Films have more flexibility & better physical properties.

Disadvantages

- 1 The polymer must be soluble in a volatile solvent or water.
- 2 The stable solution with reasonable minimum solid content & viscosity should be formed.



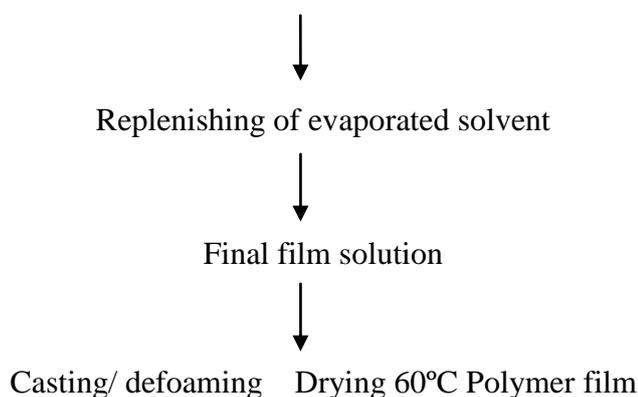


Fig. 3: Solvent casting method flow chart^[6,10,18,24]

1.9.2 Hot melt extrusion^[1,6,18,25]

In present method the mass is prepared first under the control of temperature and steering speed. Afterwards, the film is coated and dried in a drying tunnel; once again the temperature, air circulation and line speed are controlled. Then follows a slitting and in the last step the films are punched, pouched and sealed formulated Piroxicam film with Maltodextrin plasticized by glycerin by using Hot melt extrusion method.

Advantages

- 1 Without use of any solvent or water.
- 2 Fewer processing steps.
- 3 Compressibility properties of the API may not be of importance.
- 4 Better alternative for poorly soluble drugs.
- 5 More uniform dispersion because of intense mixing and agitation.
- 6 Less energy compared with high shear methods.

Disadvantages

- 1 Thermal degradation due to use of high temperature.
- 2 Flow properties of the polymer are essential to processing.
- 3 Limited number of available polymers.
- 4 All excipients must be devoid of water or any other volatile solvent.

2.8 Some approved marketed product

Table 5: Approved marketed product [6,7,8,9,10,13,23]

Product category	Ingredients	Indication/Application
Biofilm Nergy boosters Male vitality strips	Caffeine, green tree extract and guarana Maca root extract, Siberian ginseng extract, herbs enhance libido	The product maintains the energy levels It acts as an aphrodisiac and improves the libido in males.
LabtecGmbh Ondansetron Rapid film Donepezil Rapid film	Ondansetron 4 mg and 8 mg Donepezil Hydrochloride 5 mg and 10 mg	It is used in the prevention of chemotherapy and radiation induced nausea and vomiting. Treatment of mild to moderately severe dementia of the Alzheimer's type.
Paladin labs (Bioenvelop) Smoking cessation Multivitamins for kids and adults	Nicotine B6, B12, C; D3 for kids, D3 for adults	To reduce the smoking habit Multi vitamin supplement.
Novartis Pharmaceuticals' Theraflu Nighttime Thin strips	Diphenhydramine HCL 25 mg, Phenylephrine HCL 10 mg	It is used for nasal congestion, runny nose, sneezing, itchy nose and throat etc.
Pfizer Inc Listerine pocketpacs	Available in cool mint, Fresh citrus, Cinnamon and fresh burst.	These strips dissolve instantly and kill 99% of bad breath germs.
Prestige Brands Little cool sore throat strips Chloraseptic relief strip	Ascorbic acid, pectin Benzocaine, menthol	Cold/allergy Sore throat

1.11 Various technologies used in oral film formulation

 [6,9,11,13,17]

1.11.1 Soluleaves™

Soluleaves™ films can be designed to dissolve rapidly on contact with saliva, quickly releasing the active ingredients and flavours. The delivery system can be used for the cough/cold, gastrointestinal and pain therapeutic areas as well as delivering nutritional products.

1.11.2 Wafertab™

Wafertab™ is a drug delivery system that incorporates pharmaceutical actives into an ingestible filmstrip. The system provides rapid dissolution and release of actives when the strip comes into contact with saliva in the mouth. The WAFERTAB™ filmstrip can be flavoured for additionally improved taste masking.

1.11.3 Foamburst™

FOAMBURST™ is a special variant of the SOLULEAVES™ technology where an inert gas is passed into the film during production. This results in a film with a honeycombed structure, which dissolves rapidly giving a novel mouth sensation.

1.11.4 Xgel™

XGEL™ film is at the heart of Meldex International's intellectual property, used in all its film systems and its ingestible dosage delivery technologies. XGEL™ film provides unique product benefits for healthcare and pharmaceutical products: it is non-animal-derived, the film is continuous production processing provides an economic and competitive manufacturing platform.

1.12 Application ^[26,27]

Oral mucosal delivery via Buccal, sublingual, and mucosal route by use of ODFs could become a preferential delivery method for therapies in which rapid absorption is desired, including those used to manage pain, allergies, sleep difficulties, and central nervous system disorders. ODF evolved over the past few years from the confection and oral care markets in the form of breath strips and became a novel and widely accepted form by consumers for delivering vitamins and personal care products.

1 Gastro retentive dosage systems

Dissolution of the films could be triggered by the pH or enzyme secretions of the gastrointestinal tract, and could potentially be used to treat gastrointestinal disorders.

2 Diagnostic devices

Dissolvable films may be loaded with sensitive reagents to allow controlled release when exposed to a biological fluid or to create isolation barriers for separating multiple reagents to enable a timed reaction within a diagnostic device.

3 Taste masking

An important aspect of thin film drug delivery technology is the masking of the often bitter and poor taste of drug formulations.

4 Vaccination

Rotavirus vaccine is a room temperature stable quick-dissolving oral thin film delivery system for vaccines that will make vaccinations almost as simple as freshening your breath.

1.13 Packaging ^[4,6,7,26]

Single packaging is mandatory for films, which are pharmaceutical products; an aluminum pouch is the most commonly used packaging format. APR-Labtec has developed the Rapid card, a proprietary and patented packaging system. Single pouch: Soluble Film Drug Delivery Pouch is a peel able pouch for "quick dissolve" soluble films with high barrier properties. Blister card with multiple units: The blister container consists of two components: the blister, which is the formed cavity that holds the product, and the lid stock, which is the material that seals to the blister.

1.14 Nausea and vomiting ^[28,29,30,31,32, 33]

1.14.1 Definition

Nausea is the feeling of having an urge to vomit. Nausea refers to the unpleasant "queasy" feeling that you get when you're about to vomit, one that's accompanied by uncontrollable contractions of the stomach that begin before and continue during vomiting. Vomiting or throwing up is forcing the contents of the stomach up through the esophagus and out of the mouth. Nausea and vomiting aren't normally medical conditions themselves, but are commonly symptoms of a disorder or illness.

1.14.2 Causes ^[28,29,30,31,32]

Many common problems may cause nausea and vomiting:

- 1 Food allergies
- 2 Infections of the stomach or bowels, such as the "stomach flu" or food poisoning
- 3 Leaking of stomach contents (food or liquid) upwards (also called gastro esophageal reflux or GERD)
- 4 Medications or medical treatments, such as cancer chemotherapy or radiation treatment
- 5 Migraine headaches
- 6 Morning sickness during pregnancy
- 7 Seasickness or motion sickness
- 8 Severe pain, such as with kidney stones

1.14.3 Treatment ^[34,35,36,37,38]

Once the cause of vomiting has been established, symptomatic relief may be given (if appropriate) in the form of antiemetic therapy. Many classes of drugs exhibit antiemetic properties like antihistamines, phenothiazines and antipsychotic drugs.

- 1 Metoclopramide acts directly on the gastrointestinal tract and may be the drug of choice for visceral causes.
- 2 Domperidone acts at the chemoreceptor trigger zone and is especially useful for nausea and vomiting associated with chemotherapy.
- 3 Granisetron and ondansetron are specific 5HT antagonists and, as such, are particularly useful for postoperative nausea and vomiting and that associated with cytotoxic therapy.
- 4 Dexamethasone and nabilone (a synthetic cannabinoid) may be useful for patients on cytotoxic drugs, with nausea that is resistant to other therapy.

6.2.3 Evaluation of formulation

1. Physical characteristics observation ^[33,34]

Characteristics such as homogeneity, colour, transparency, flexibility, brittleness and surface of the oral films were evaluated by visual inspection.

2. Thickness ^[33,34,35]

The thickness of film is measured by micrometer screw gauge at different strategic locations. This is essential to ascertain uniformity in the thickness of the film as this is directly related to the accuracy of dose in the film.

3. Folding endurance ^[33,34,35, 36,37]

Folding endurance is determined by repeated folding of the film at the same place till the film breaks. The number of times the film is folded without breaking is computed as the folding endurance value.

4. In vitro disintegration studies ^[4,6,33,34,35]

The disintegration time limit of 30 seconds or less for orally disintegrating tablets described in CDER guidance can be applied to orodispersible films. Although, no official guidance is available for oral fast disintegrating films/strips, this may be used as a qualitative guideline for quality control test or at development stage. Typical disintegration time for films is 5–30 seconds. Disintegration time gives an indication about the disintegration characteristics and dissolution characteristics of the film. The film as per the dimensions (2 x 2 cm) required for dose delivery was placed in a petridish containing 10 ml phosphate buffer (pH 6.8). Time required for the film to break was noted as in vitro disintegration time. Petri dish was shaken with hands giving jerks. This test was performed on three films of each formulation and mean±S.D calculated.

5. Dissolution test^[6,17,34,38]

Dissolution testing can be performed using the standard basket or paddle apparatus described in any of the pharmacopoeia. The dissolution medium will essentially be selected as per the sink conditions and highest dose of the API. Many times the dissolution test can be difficult due to tendency of the film to float onto the dissolution medium when the paddle apparatus is employed. But once film gets wet it goes into the solution. Both apparatus are suitable to use and have evidence to be use. The in vitro dissolution test was carried out in a paddle dissolution apparatus. Samples of Ondansetron Hydrochloride films were exactly weighed. In this case the film of 2×2 cm (4 cm²) was dissolved in 500 ml phosphate buffer (pH 6.8) at 50 rpm. The temperature of the dissolution media was maintained at 37±0.5 °C. During the study, 5 ml of aliquots were withdrawn at 1, 2, 3, 4, 5, 6, 7 and 8 min and were replaced by fresh buffer. The aliquots were filtered using wattman filter paper and used for UV determination at 249 nm.

6. Surface pH^[33,34]

A film with too much acidic or basic pH affects the area of application and causes damages to oral mucosal membrane leading to patient discomfort. It is likely that the chemical nature of the drug and the excipients influences the pH of the prepared films. In this, the surface pH of the prepared films was measured after allowing it to wet by keeping it in contact with distilled water for a short period at room temperature. It was measured by touching to bulb of pH meter.

7. Drug content and content uniformity^[36,37]

Content uniformity is determined by estimating the API content in individual film. Limit of content uniformity is 85–115%. The film was cut in 2×2 cm in size dissolved in 50 ml of phosphate buffer pH 6.8, sonicated for 15 minutes then filter using wattman filter paper. This solution was used for UV analysis and then concentration of drug is determined for checking drug uniformity.

8. Weight variations^[33,36]

For weight variation, individual films are weighed and the average weights are calculated. Then the average weight of the films is subtracted from the individual weight of the films. A large variation in weight indicates the inefficiency of the method employed and is likely to have non-uniform drug content. This test was carried out for three films of size 2×2 cm in size cut from single film.

9. Tensile strength ^[17,38]

Orodispersible film should possess moderate tensile strength, high % elongation (%E), low Young's Modulus, and high percent of drug release. ^[67]Tensile strength is the maximum stress applied to a point at which the film specimen breaks. For the tensile strength Brookfield's TexturePro CT V1.4 CT3 Texture Analyzer was used.

The parameter used were given in Table 16.

Formula given below is used for determination of Tensile strength

$$\text{Tensile strength} = \frac{\text{Load at failure} \times 100}{\text{Strip thickness} \times \text{Strip width}}$$

Type equation here.

10. Percent Elongation ^[9,35,36]

When stress is applied, a film sample stretches and this is referred to as strain. Strain is basically the deformation of film divided by original dimension of the sample. Generally elongation of strip increases as the plasticizer content increases.

$$\% \text{ Elongation} = \frac{\text{Increase in length of strip} \times 100}{\text{Initial length of Strip}}$$

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