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Oral Disintegrating Film Comprehensive Review

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Abstract:

Oral dissolving films (ODFs) are advanced oral dosage forms designed for application onto the buccal mucosa, offering both local and systemic therapeutic effects. These films are often preferred over conventional oral drug delivery systems due to their flexibility, ease of use, and improved patient comfort. ODFs leverage the bioadhesive properties of certain polymers, which, upon hydration, adhere to specific mucosal regions for prolonged periods. This allows them to bypass first-pass metabolism and enhance bioavailability. Additionally, they are self-administrable, cost-effective, and exhibit high patient compliance. Among the various techniques used for formulating ODFs, the solvent casting method is the most widely employed. Typically, hydrophilic polymers are combined with other excipients to create films that disintegrate rapidly, releasing the active pharmaceutical ingredients (APIs) within seconds. ODFs provide multiple advantages, including ease of access, simple administration and withdrawal, strong mucosal retention, low enzymatic degradation, cost-efficiency, and enhanced patient compliance. These attributes contribute to their growing potential for commercial and therapeutic application. This review focuses on the mechanism of action, advantages, formulation components, preparation methods, evaluation parameters, and currently marketed ODF products. It also discusses advancements in novel fast-dissolving technologies within this drug delivery platform.

Keywords: Solvent casting method, Rolling Method, flexible films, Compressed film based-systems, Mucoadhesive sustained release films.

INTRODUCTION

The oral route remains the most preferred method for drug administration due to its convenience, ease of self-administration, and cost-effectiveness. It is widely accepted by patients and accounts for nearly 60% of all available pharmaceutical dosage forms, primarily as oral solid dosage forms. However, challenges such as low bioavailability, delayed onset of action, and difficulty swallowing (dysphagia) have

prompted the pharmaceutical industry to explore alternative dosage forms, including parenterals and liquid orals.[1]

Among the innovations in oral drug delivery, Fast Dissolving Oral Films (FDOFs) or Orally Disintegrating Films (ODFs) have emerged as an advanced, patient-friendly alternative. These are ultra-thin, flexible films that rapidly disintegrate or dissolve upon contact with saliva, usually within seconds, without the need for water or chewing.[2] This dosage form is especially beneficial for populations such as pediatric, geriatric, bedridden, and emetic patients, as well as in emergency conditions like allergic attacks or sudden coughing episodes.[3]

FDOFs are composed of hydrophilic polymers that allow for rapid dissolution in the buccal cavity, enabling systemic drug absorption via the oral mucosa. The oral mucosa offers a high degree of vascularization and permeability—4 to 1000 times greater than the skin—leading to quick onset of action and improved bioavailability, particularly for drugs with extensive first-pass metabolism and low doses.[4]

Advantages of Orally Disintegrating Films

Orally disintegrating films offer multiple benefits:

- Ease of administration without water[5]
- Improved patient compliance, especially in children and the elderly6
- Enhanced bioavailability through pre-gastric absorption[7]
- Improved stability due to the solid-state nature of the film[8]
- Reduced choking risk, which is critical in pediatric care
- Masking of bitter taste, a key factor in pediatric drug acceptability

This delivery system is particularly suitable for children, who often struggle with traditional dosage forms due to taste preferences, swallowing difficulties, and increased sensitivity to drug toxicity. However, pediatric formulations must also consider the safety of excipients,[9] as some compounds safe for adults can be toxic in neonates and infants. Furthermore, regulatory changes—such as the 2007 Pediatric Regulation—have emphasized the importance of tailoring drugs to children's physiological needs, requiring specialized formulations and strengths.[10]

Despite these challenges, Orally Disintegrating Films have shown great promise as a pediatric-friendly dosage form, especially for drugs like Topiramate (TPM), which is widely used for epilepsy management in children.[11]

- Hydroxypropyl methylcellulose (HPMC)
- Guar gum
- Polyethylene oxide (PEO)

And plasticizers like:

- Glycerin
- Sorbitol

These excipients were tested across a range of concentrations to optimize the film for:

- Rapid disintegration
- Acceptable mechanical properties
- Palatability
- Drug content uniformity
- Stability

Classification of oral films

There are 3 types of oral films, they are:

1. Flash release/Fast dissolving films (placed on the tongue)

2.Mucoadhesive melt away films (gingival or buccal region)

3.Mucoadhesive sustained release films (adhere to the buccal mucosa)

FAST DISSOLVING TECHNOLOGY30

1. Lyophilized systems
2. Compressed film-based types

1. Lyophilized systems:

This technology involves taking a suspension or solution of drug with other structural excipients, by using mould or blister pack, which forms film-shaped units.[13]

2. Compressed film based-systems

The standard film technology by direct compression of excipients is used to produce this system. The film technologies have different levels of hardness and friability depending on method of manufacturing.[14]

Oral Thin Films

It is also called as oral wafers. Form the past few years the oral thin films are evolved in confection and oral care markets in the form of breath strips[15]

Advantages of orally FDFs:

1.ODFs can be administered without water, anywhere& anytime.[16]

2.Larger superficial area (LSA) films aid in rapid disintegration as well as in dissolution of the bodies oral cavity.[17]

3.Promoting mouth-freshening property.[18]

Oral Mucosa

Three layers of cells make up the oral mucosa:

Stratified epithelium: The basement membrane separates this outermost layer in the oral cavity from the connective tissue.[19]

Lamina propria: Positioned beneath the basement membrane, this layer consists of connective tissue.

Submucous membrane: Acting as the oral cavity's lowest layer

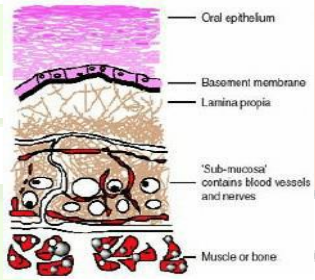

Figure 1. Structure of oral mucus

Composition of Oral Disintegrating Films

Oral softening films are a fine layer with parts ranging from 5 to 20 cm2 containing drugs. The formulation allows for loading drugs up to 30 mg. From a supervisory standpoint, for use in oral pharmaceutical dosage forms, all additives contained in the formulation must be licensed for application and generally recognized as safe. [20]

Components of Formulation:

• Drug

• Film-forming polymers

• Plasticizers

• Salvia stimulating agents

• Sweetener

Film Forming Polymers

Your paragraph provides important insight into the role of hydrophilic polymers in the formulation of Orally Disintegrating Films (ODFs). However, it could benefit from improved clarity, grammar, and academic tone. Here's a refined version of your text with clearer structure, better flow, and improved readability.[21]

Role of Hydrophilic Polymers in Orally Disintegrating Films

Hydrophilic polymers are essential in the formulation of orally disintegrating films due to their ability to facilitate rapid disintegration, enhance mouthfeel, and impart desirable mechanical properties such as flexibility and tensile strength.[22] To achieve optimal film characteristics-including hydrophilicity, flexibility, stability, and pleasant sensory attributes polymers are often used in combination with other polymers rather than individually[23]

One of the most critical decisions in ODF formulation is the selection of an appropriate polymer, as it directly influences key film properties such as disintegration time, mechanical strength, and drug release profile. Typically, the polymer content should constitute at least 45% of the total dry film weight, with 60%–65% being the recommended range to ensure the desired performance characteristics.[24]

Importantly, there is a correlation between the molecular weight of the polymer and its disintegration behaviour. As the molecular weight increases, the rate of film disintegration tends to decrease, potentially affecting the film's efficacy in delivering the active pharmaceutical ingredient (API) rapidly.[25]

Would you like to include examples of commonly used hydrophilic polymers like HPMC, pullulan, or PEO, along with their specific advantages and limitations in ODF formulations? That could strengthen this section further, especially if you're writing a research paper or literature review. The polymers selected for oral thin films must meet the following criteria[26]

- Non-irritating and non-toxic without impurities
- Have favorable spreadability and wetting property
- Exhibit sufficient tensile, peel, and shear strengths
- Willingly existible and cost-effective
- Low molecular weight and soluble in water
- Display outstanding film-creating ability
- Keep a long shelf life

Polymers

Polymers are the most important ingredient of the oral fast dissolving film.

Plasticizers

Plasticizers improve flexibility and reduce brittleness of FDFs and by addition of plasticizers, tensile strength and elongation can be improved.[27]

Sweetening Agents

Both natural and artificial sweeteners aided to improve palatability of FDFs. Commonly, these agents are used in a minimal amount the is 3-6%w/w, either alone or in combination. The classical sources of sweetener are sucrose, dextrose, fructose, glucose, liquid glucose and isomaltose. The artificial sweeteners are acesulfame-K, sucralose, alitame and neotame which fall under the second-generation artificial sweeteners.[28]

Saliva-stimulating Agent

They increase production of saliva helps in faster disintegration of rapid dissolving films formulations.

Stabilizing-Agents

Agent included in a formulation to render it stable physically such as preserving consistency of a solution known as stabilizing agent. Common stabilizing agents are xanthan gum, locust bean-gum and carrageenan, pullulan gum.[29]

Flavouring Agents

Recognition of oral disintegrating/dissolving formulation by an individual depend on initial flavour quality observed in first few seconds after product has been consumed & after taste of formulation least for 10 min.[30]

Colouring Agents

These are the agents which gives suitable colour to the formulation and should have the approval from FD & C act and concentration of these colouring agents not exceed more than 1 % of orally.[31]

Method of film formulation

There are almost 4 method foe the film formulation

1. Solvent casting method
2. Hot Melt Extrusion
3. Semisolid Casting Method
4. Rolling Method

1. **Solvent casting method** [33]

The most average methodology for assembling ODFs with water dissolvable excipients, polymers, and drugs broke up in de-ionized water is dissolvable projecting; as a result, a homogenous combination is accomplished by utilizing high shear powers produced by a shear processor. The pre-arranged arrangement is poured onto a petri plate and the dissolvable is

permitted to dry by presenting it to high temperatures to create great quality movies. The dissolvable projecting strategy was utilized to make an orodispersible film of tianeptine sodium utilizing different grades of Lycoat and HPMC. In the dissolvable projecting procedure, the film framing polymer is generally absorbed a reasonable dissolvable short-term. In view of basic physicochemical highlights of the API, like softening point, shear responsiveness, and polymorphic structure,[34] the kind of API that should be remembered for ODF characterizes the ideal dissolvable. The medication's similarity with the dissolvable and other excipients is considered prior to finishing a detailing. The presence of caught air rises during the detailing system can affect the consistency of the completed film. With the assistance of a vacuum siphon, the blend is deaerated. The dissolvable projecting strategy was likewise utilized to make a mosapride orodispersible film definition.[35] In the projecting system, the consistency of the answer for be poured is vital. Pullulan focuses going from 2% to 8% outcome in a low thickness arrangement that makes film projecting basic. Anastrozole quick dissolving films were additionally effectively made utilizing the dissolvable projecting strategy with HPMC (E5) and polyvinyl liquor (PVA).

Figure no: 2 Solvent casting method flow chart

2. Hot Melt Extrusion

In hot-liquefy expulsion, dry parts for the film are warmed and homogenized by an extruder screw until they are liquid and blended. The extrudate is driven into the fundamental film shape by a level expulsion kick the bucket. Lengthening rollers can influence the thickness and strength of the film while it is as yet hot and adaptable. In the wake of cooling and cutting the expelled film, the hot soften expulsion procedure is talked about.[36]

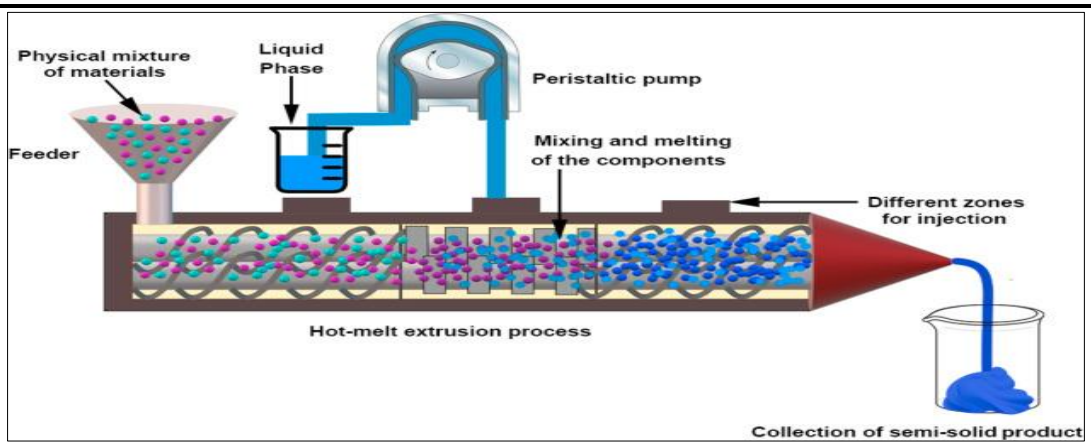

Figure no: 3. Hot Melt Extrusion

3. Semisolid Casting Method

A film-shaping polymer arrangement that is water solvent is made. The resultant arrangement is joined with a polymer arrangement that is corrosive insoluble (for example cellulose acetic acid derivation phthalate, cellulose acetic acid derivation butyrate). To acquire gel mass, an adequate measure of plasticizer is utilized. At last, the gel mass is shaped into the movies or strips utilizing heat-controlled drums. Somewhere in the range of 0.015 and 0.05 creeps of film thickness ought to be utilized.[37]

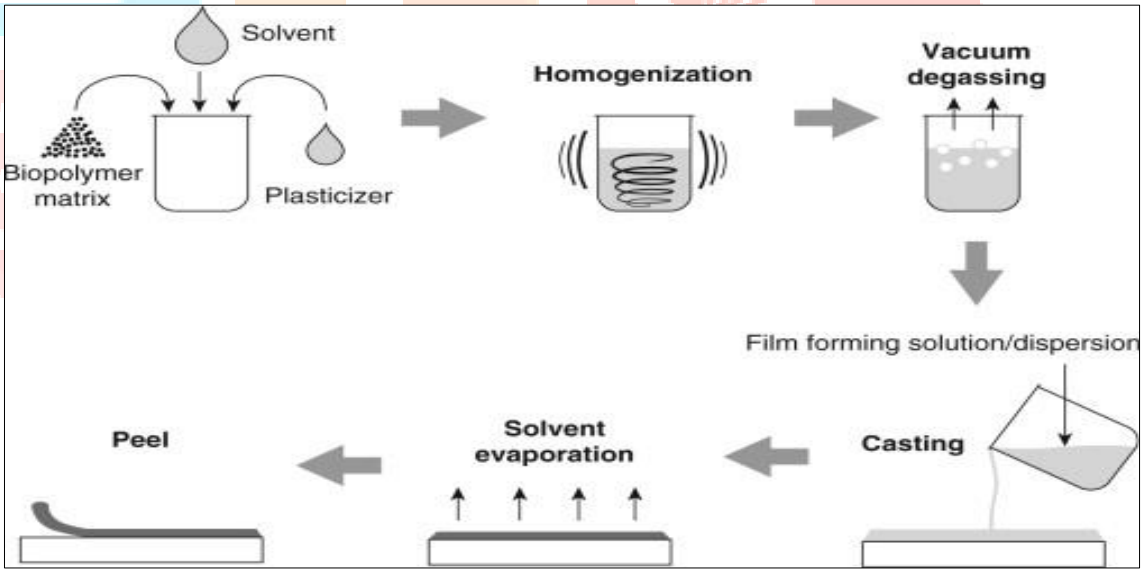

Figure no. 4: Semisolid Casting Method

4. Rolling Method

This strategy includes making a pre-blend, adding a functioning, and afterward producing a film. Set up a pre-blend in with a film-framing polymer, a polar dissolvable, and different added substances (barring a medication) and add it to the expert clump feed tank. A first metering siphon and control valve ought to be utilized to take care of it to either of the first and second blenders. Add the required measure of medicine to the blender you've chosen. Consolidate the drug with the expert cluster pre-blend to get a uniform grid.. Second metering siphons convey a foreordained measure of uniform framework to the dish. At long last, the film is framed and

shipped to the help roller on the substrate. The wet film is dried by means of controlled base drying.[38] The most generally utilized solvents are water and a combination of water and liquor.

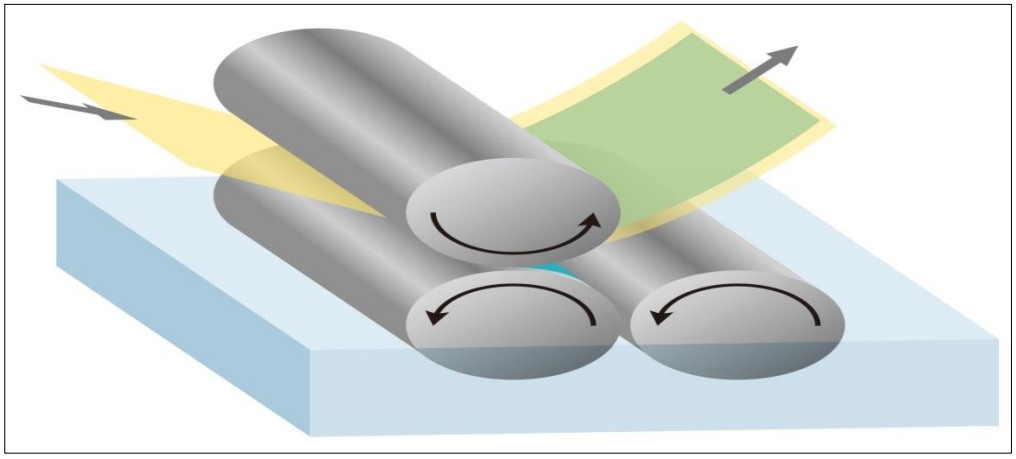

Figure no. 5: Rolling Method

Evaluation Parameters

1. Thickness Test
2. Tack Test
3. Youngs Modulus
4. Tail flick Test
5. Thermodynamic Stability Study
6. Drug Content
7. Viscosity
8. Tensile Strength
9. Folding Endurance
10. Weight of films
11. % Elongation
12. Swelling Properties
13. Disintegration Time
14. Surface pH
15. Content Uniformity
16. Dissolution test

Table no. 1: Marketed Preparation of Mouth Dissolving Film

Product	API	Manufacturer	Use
Listerine	Cool Mint	Prfizer	Mouth Ulcer
Benadryl	Diphenylhydramine HCL	Prfizer	Antiallergic
Suppress	Menthol	InnoZen,® Inc	Cough Suppressant
Klonopin wafers	Clonazepam	Solvay Pharmaceutical	Antianxiety
Theraflu	Dextromethorphan	Novartis	Antiallergic
Orajel	Menthol/Pectin	Del	Mouth Freshner

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