



## Orodispersible Films and their Patent Technology's as A Novel Drug Delivery Systems

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### ABSTRACT

Orodispersible film is fast growing drug delivery and offers advantages over conventional oral dosage forms, therefore can be used as an alternative to conventional dosage form. Orodispersible films are convenient to swallow, self-administrable, rapidly hydrates, disintegrates and dissolves in the oral cavity or buccal cavity which makes it a versatile platform for drug delivery. The design of adequate orodispersible films requires comprehensive expertise of pharmaceutical properties of drug and polymers along with a commendable selection of manufacturing process. The aim of this review is to provide marketing advantages of orodispersible film over conventional dosage forms and their formulation composition, manufacturing techniques and their different patented technological platform that has already in the market, manufactured by various distributors and their salient features.

**Keywords:** Orodispersible film, Patent, Innovative, Conventional.

### INTRODUCTION

Oral drug delivery is a fast growing and highly dynamic segment in pharmaceutical and biotechnological industry because oral route is one of the most preferred routes of drug administration. Pharmaceutical and biotechnological companies are continuously finding innovative dosage form that may increase the bioavailability of drug, cost effective, and ease of administration which leads to high level of patient compliance and generally oral formulation that has a lower cost of production. But approximately 40-75% of chemical entities are not well absorbed after oral administration due to many reasons, which leads to poor bioavailability. The oral route is problematic because of difficulty in swallowing for geriatric, pediatric patients and psychiatric patients and also for patients suffering from dysphagia. Recently orodispersible films have start gaining acceptance or popularity among consumers because of rapid disintegration or dissolution, self-administration without the use of water<sup>1</sup>. Orodispersible films are fast dissolving dosage form and are more stable and resistant when compared with orodispersible tablets which are brittle and fragile. The design of efficient orodispersible films requires a comprehensive knowledge of the pharmaceutical and pharmacological properties of the drug and polymers along with selection of appropriate manufacturing process. Generally orodispersible films are referred as a thin and flexible layer of polymer with or without a plasticizer. Orodispersible films have shown the capabilities of improving the onset of action by reducing the dose frequency and enhancing drug efficiency, as the dose frequency is reduced it eliminates the risk of side effects of drug.

When compared with other traditional dosage forms it stands out to be superior in terms of enhanced

bioavailability, high patient compliance. Ideally an orodispersible films should have sufficient drug loading capacity, fast dissolution rate or long residence time at the site of administration, and acceptable formulation stability. It should be non-toxic, biocompatible and biodegradable<sup>2</sup>. The above article endeavors to review the general aspects of orodispersible films, polymers that are employed for the preparations, the critical aspects of manufacturing processes and the evaluation of the orodispersible film, and the patents technological platform that has been developed.

### Why orodispersible films? Particular features for patient and companies

The design of orodispersible films is generally based on two important factors, target the population and drug therapy provided. However, the choice of the type of pharmaceutical dosage form may become difficult when specific target includes young children's whose age is between 8-10 years and geriatric patients, therefore the development of specific type of dosage form that can be easily swallowed have no issues in administrating and is suitable for both geriatric and pediatric patients is a challenging task. The process of swallowing involves synchronized actions of several muscles and nerves and it is assumed that at the age of 12 safe swallowing ability is developed<sup>3,4</sup>. Therefore liquid or orally disintegrating dosage form is mostly preferred among pediatric or geriatric population segments, thus orodispersible films appeared as a suitable alternative to patients having swallowing difficulties and is more suitable and convenient dosage form when compared with other conventional dosage form.



### Advantages of Orodispersible Films from Patient's Perspective

Orodispersible films have several advantages over conventional dosage form and they are <sup>5,6,7</sup>:

- Pediatric, geriatric and psychiatric patients can easily administer orodispersible films
- It is desirable for patients suffering from motion sickness, dysphagia, repeated emesis, hypertension, paralysis and mental disorder.
- There is no need of water for administration of films hence no risk of choking.
- Orodispersible films rapidly dissolved and disintegrated in the oral cavity because of large surface area which lowers dosing interval, improves onset of action, efficacy and safety profile of drug.
- Accuracy in the administered dose is assured
- The drug directly enters into the systemic circulation by avoiding hepatic first pass metabolism.
- Improved patient compliance
- Orodispersible films are more flexible, compliant and can be easily handled, storage and transported.
- Orodispersible films tend to be flexible, portable and they are not fragile, where as oral disintegrating tablet requires special package for transportation.
- As large surface area is accessible by the orodispersible film therefore this leads to quick disintegration and dissolution in the oral cavity within seconds.
- Orodispersible films can be consumed at any time or place as per the convenience of the individual
- As the first pass effect is avoided so a dose of a drug can be reduced which leads to reduction in side effects associated to molecule.

### Market advantages

From marketing perspective this new Orodispersible film technology offers the opportunity to extend revenue life cycles for pharmaceutical companies whose drug patents are about to expire and soon be vulnerable for generic competition. Moreover this type Orodispersible film formulation can also be designed to reduce methods of tampering associated with abuse and misuse of prescription drugs <sup>8</sup>.

### Major Limitations Related to Orodispersible Films

Orodispersible films have some limitations these are <sup>9,10</sup>:

- High dose cannot be incorporated into strip.
- Packaging of orodispersible films requires special equipment's and it is difficult to pack.
- The drugs which cause irritation to mucosa cannot be administered.

- Orodispersible films are usually hygroscopic in nature; therefore special precaution should be taken for longer preparation.
- Combining more than two drugs are is very difficult because both the dissolution rate and disintegration time are obstruct by the co administration of a drug in films.

### Composition used for the preparation of orodispersible films

These are the components used in the preparation are<sup>11-14</sup>:

- Active pharmaceutical ingredients
- Film shaping polymers
- Plasticizer
- Saliva stimulating vehicles
- Sweetening vehicles
- Flavoring vehicles
- Coloring vehicles
- Surfactant

### Active pharmaceutical ingredients

API can be from any class of drugs that can be administered orally or through buccal mucosa. A typical orodispersible film contain 1-50% w/w of the active pharmaceutical ingredient, for effective formulation it is essential that the API incorporated is micronized as this enhance the texture and provide uniformity to orodispersible film and provide rapid dissolution. Various categories of drugs can be used for formulating orodispersible films which includes antiemetic, neuroleptics, analgesics, antiallergics, sedatives, hypnotics, diuretics, antibacterial, cardiovascular agents, and drugs for erectile dysfunction.

Drugs used for orodispersible films should have these ideal characteristics:-

- The drug should have pleasant taste.
- The drug incorporated should have low dose.
- The drug should have good stability and soluble in water as well as saliva.
- The drug should be partially unionised at the pH of oral cavity.
- The drug should have the ability to permeate through oral mucosa.
- Drug should exhibit low sensitivity to environmental conditions.
- Drug should leave minimal or no residue in mouth after administration.
- Drug should have an acceptability of taste masking properties.

## Film shaping polymer

Polymer selection is the most important and disparaging factor for affluent development of mouth dissolving films as the tensile strength of mouth dissolving film (MDFs) depends on the category of polymer used. Polymers are the foundation of mouth dissolving film (MDFs) formulation. The entire polymer used is water-soluble as they rapidly disintegrate and provide good mechanical properties and good mouth feel effects to the films. Polymers can be used solitary or incorporation with others polymers to reach the desired film properties; both synthetic and natural polymer can be used. The polymers employed in mouth dissolving oral films should be:

- Lacking of leachable adulterations
- Have good moistening and extension property
- Nontoxic and non-irritant
- Have sufficient shear and tensile strengths.
- Have excellent film forming ability
- Have a good shelf life

Examples of natural and synthetic polymers that are used in orodispersible films are :-

<b>Natural polymers</b>	Gelatin, pectin, sodium alginate, polymerized resin, pullulan, xanthane gum, maltodextrin, starch.
<b>Synthetic polymers</b>	Hydroxyl propyl methyl cellulose (HPMC), methyl cellulose (MC), sodium carboxy methyl cellulose (SCMC), polyvinyl alcohol (PVA), polyvinyl pyrrolidone (PVP)

## Plasticizers

Plasticizers are applied to enhance the pliability or elasticity which increases the automated holdings of film such as tensile potency and expansion of the mouth dissolving film (MDFs). Plasticizer reduces the brittleness of mouth dissolving film (MDFs) by enhancing the strength of the polymer. Selection of plasticizers depends on its similarity with polymers, drugs as well as other excipients. With the help of plasticizer the flow properties of polymer will get superior and it also enhances the robustness of the polymer. Some examples of plasticizers used in preparation of mouth dissolving films (MDFs) are: - Polyethylene glycol (PEG), low molecular PEG, polypropylene glycol, dibutyl, castor oil, Glycerol, diethyl phthalate. Glycerol is better plasticizer for films prepared by using PVA. Polyethylene glycol (PEG) is used for both HPC and PVA films.

## Saliva stimulating vehicles

The motive to utilize saliva brace agent is to raise the rate of blossoming of saliva as this direct enhance the disintegration time of mouth dissolving films (MDFs) and the film will dissolve faster in the oral cavity. Generally food grade acids can be used as saliva stimulating agent;

most widely applied saliva stimulating vehicles are citric acids, ascorbic acids, tartaric acids, lactic acids, malic acids. Among them citric acid is most preferred and widely used. These vehicles are applied solitary or in coalition with other vehicles, in the range 2-6% w/w of the strip.

## Sweetening vehicles

A sweetener has begun to be essential components in both food products and in pharmaceutical products that are intended to be splinter or dissolved in the oral cavity. Sweetening agents are utilized to disguise the bitter taste of the drugs. Two types of sweeteners are adopted to enhance the savour of the mouth dissolving formulation they are natural sweetener and synthetic sweetener. Artificial sweetening vehicle has aquire more popularity in pharmaceutical formulation. Natural sweetening vehicle are ribose, glucose, mannose, fructose, galactose, sucrose, corn syrups or fructose. Whereas examples of artificial sweeteners are saccharin, sucralose and aspartames.

## Flavoring vehicles

The selection of flavouring agent depends on the type of drug, age, taste of the people. Flavouring vehicles can be solitary or in coalition with other vehicles. 10% w/w flavours are preferably added in the formulation. The following flavours are used in pharmaceutical preparation: menthol, cinnamon, clove, orange, mint, lemon, vanillin peppermint, apple and pineapple. They act by imparting flavours and odour of their own and have anesthetic effect on sensory receptors associated with taste.

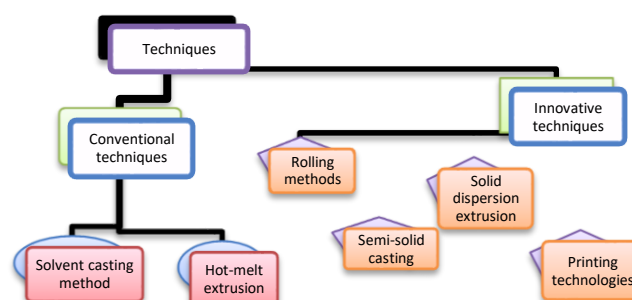
## Coloring vehicles

Food, Drug and Cosmetic (FD&C) has consent to the use of coloring agents while formulating mouth dissolving films (MDFs), the colour incorporated should not exceeding 1% w/w of the formulation, e.g. Titanium dioxide is most commonly used.

## Surfactant

Surfactants are adopted to improve the wettability, solubility and dispersability of the films so that the film gets dissolved within seconds and release the dynamic pharmaceutical agent rapidly. Most widely utilized surfactants are Sodiumlauryl sulphate, Tween 80, Polaxamer 407 etc.

## MANUFACTURING PROCESS OVERVIEW



**Conventional methods**

In solvent casting methods an aqueous or hydro-alcoholic mixtures of Excipients containing (Polymer, plasticizer, saliva stimulating agent, citric acid, sweetening agents) and drug substance cast onto a petridish which is then dried at 60°C and cut into desired shapes and sizes. On the other hand, In Hot-melt extrusion method a mixtures of polymers, drug and other excipients shaped into a film by melting all the components and passed it through orifice to obtain a homogenous matrix which is cut into desired shapes and sizes<sup>14,15,16</sup>. Both these techniques provides orodispersible films with good characteristics but solvent casting method is most widely used because it is cost-effective when compared with hot-melt extrusion method. Another conventional methods used for preparing orodispersible films are semisolid casting method and solid dispersion methods. In semisolid casting consists a gel mass is casted using heat controlled drums and obtained by adding an acid insoluble polymer to main liquid mixture in 1:4 ratio. Where as in solid dispersion extrusion method drug is dissolved in appropriate solvent, and then added into the melt of suitable polymer obtained below 70°C without removing liquid solvent. Then with the help of dyes solid dispersion are shaped into films of desired shape and sizes<sup>17</sup>.

**Innovative Methods**

In inventive manufacturing process Rolling method and Ink jet printing technique is used. Rolling method involves drug solution or suspension having film forming polymer are subjected to metallic roller where the film is dried and cut into desired shapes and sizes<sup>18</sup>. Another technique like printing technology methods can also be used for preparation of orodispersible film that seems to be highly flexible and cost-effective. Printing technologies are widely used in the pharmaceutical industry to label, identify and to avoid counterfeit production. However the major limitation with the printing technology is low speed production. Later Flexographic printing technology is introduced which is more feasible for industrial production of orodispersible films. It contains a rotary printing process in which the drug solution or suspension is metered by an anilox roller which is transferred to printing cylinder that prints the drug free film after unrolling the daughter roll<sup>19,20</sup>.

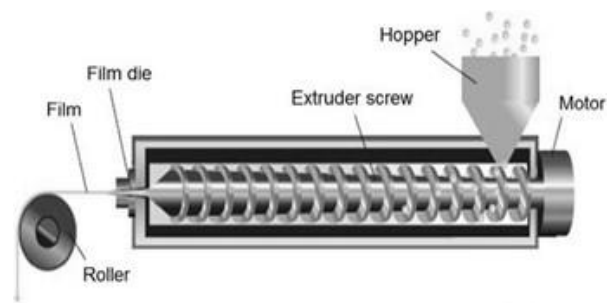


Fig B: Hot-melt extrusion machine

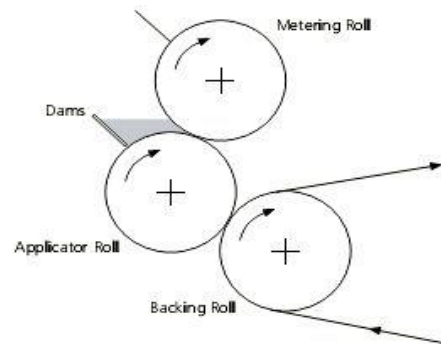


Fig C: Rolling machine for film

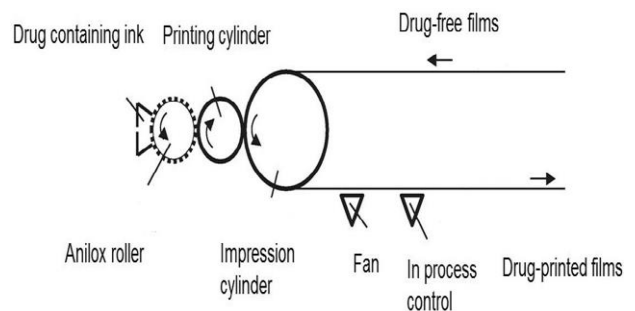


Fig D: Flexographic printing technology

**PATENTED TECHNOLOGICAL PLATFORM OF ORODISPERSIBLE FILMS**

These are the technological platform that has been developed by the companies<sup>21,22</sup>

• **BEMA®**

BEMA drug delivery technology consists of a small, bioerodible polymer film which quickly adhere to the oral mucosa less than 5 sec with a backing layer that assures the unidirectional flow of the drug. BEMA stands for bio-erodible mucoadhesive drug delivery system. BEMA films were designed to rapidly deliver either local or systemic level of drug across mucosal membranes for time sensitive conditions or to facilitate administration of drug with poor oral absorption. The multilayer buccal film can rapidly deliver dose of a drug to oral mucosa and dissolved completely within 15-30 min. This technology is developed to deliver several drug substance especially if quick onset of the action is required or oral dosing is not optimal or intravenous injections are unable. The first product developed and marketed using BEMA technology was onsolis (fenatyl buccal soluble film) in 2009 for the management of cancer pain in opioid tolerant adults. The

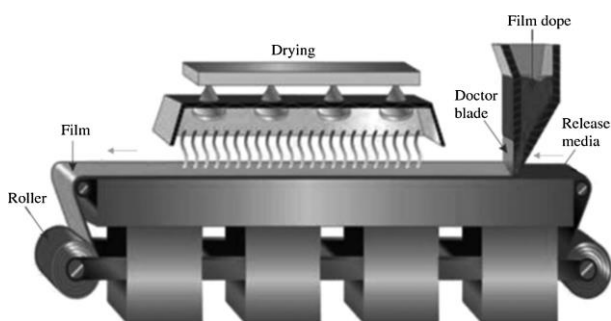


Fig A: solvent casting machine

production of onsolis has been temporarily closed in the US due to FDA concerns regarding manufacturing process, but in the second half year of 2014 the company re-launched its product. Currently BEMA technology is applied to improve the delivery of other therapies<sup>23</sup>.

- **SmartFilm®**

SmartFilm technology was developed by Seoul pharma, A south Korean pharmaceutical company, smartfilm have a high dose loading capacity about 140mg and are capable of incorporating both hydrophilic and hydrophobic drugs, bitter taste can be masked by taste masking agents. In 2012 the company launched Vultis® containing 140.45 mg of sildenafil citrate, the sildenafil smartfilm is a fast dissolving film its bitter taste is masked by sodium hydroxide and magnesium oxide<sup>24,25</sup>.

- **Biodegradable transmucosal film**

Auxilium pharmaceuticals have developed biodegradable transmucosal films that adhere to the upper gum, preferably above the back molar, where it dissolves completely. Biodegradable transmucosal films is the most effective way to deliver drug substance and to achieve the same therapeutic levels with lower doses due to high rate of drug absorption when compared with the other conventional dosage forms, where drug absorption is lowers due to shorter onset of action or reduction of first pass metabolism and probably less frequent dosing. The company is using this technique to incorporate drug for the treatment of overactive bladder, management of pain and androgen replacement therapy. In 2005 the company signed a licensing agreement with Pharmaform to receive exclusive worldwide rights to develop, manufacture and market analgesic compounds using Pharmaform transmucosal delivery system for the treatment of chronic and acute pain<sup>26,27</sup>.

- **Thinsol™**

Thinsol™ is another patented technology developed by Paladin labs. It is a water based, enzymatically-digested carboxymethylcellulose film that is suitable for the rapid delivery of pharmaceutical and nutraceutical active ingredients. Thinsol may offer significant advantages over other edible film technologies as this technology allows development of products that other may not be able to formulate in a film strip format such as products that are heat sensitive and those that require high drug loads on each strips. Thinsol can accommodate active ingredients in a quantity of up to 60% of the overall weight of the films allowing for the development of a film strip containing over 100mg of the active ingredients like most film strip technology Thinsol doesn't require heat during manufacturing process. Using Thinsol films can be dried at low temperature from the source such as hot air or infrared technology. Thinsol is fast dissolving as it leaves no residue in the mouth, being a water based system there is no need for the use of alcohol or other solvent during its production and it can be dried at low temperature<sup>28</sup>.

- **Pharmafilm®**

One of the pioneer companies in the oral film industry that owns a protected drug delivery technology is MonoSol Pharmafilm, their technology is more stable and robust when compared with other conventional dosage form with a loading capacity of 80 mg. the film is based on a polymeric matrix of hydroxypropylmethylcellulose dissolves rapidly and rapid drug absorption can be achieved. the company claims that the Pharmafilm can be used for both fast dissolving system and buccal delivery. Drugs like ondansetron hydrochloride, monteleukast sodium, rizatriptan, donezepil hydrochloride have been incorporated in pharmafilm. This technology is also available for slow release sublingual formulation. MonoSol company has also establish a strategic partnership to develop biotechnology sublingual and buccal films based on pharmafilm technology such as oral films contain anti diabetic drug or flu vaccine. MonoSol company with midatech has developed nanoinsulin pharmafilm (buccal film technology) for the treatment of diabetes<sup>29,30,31</sup>.

- **Versafilm™**

Versafilm patent technology was developed by IntelGenx technologies Corp. Versafilm™ is an edible film used for the instant delivery of savory flavors to food substrate. Versafilm is used as a system of choice requiring immediate onset of action. Maximum 40 mg of the drug can be incorporated in the versafilm™ and disintegration time can be brought from 30 sec to 10 min and it can be sublingual. The IntelGenx Corporation in association with RedHill Biopharma recently developed rizatriptan versafilm™ quick release film for the treatment of migraine<sup>32,33,34</sup>.

- **Rapidfilms®**

Rapidfilms® is a patented technology developed and commercialized by Labtec GmbH. Rapidfilms® are fast dissolving thin films made from water soluble polymers, non mucoadhesive, which can vary from single to multilayer design system. These films offer strong advantages to patients and combine the convenience of a liquid with the stability and dosing accuracy of a tablet. The film is based on a PVA-starch mixture which is plasticized by PEG. Up to 30 mg of the drug can be incorporate into Rapidfilms®. Ondasetron Rapidfilms® were the first oral films that have been approved worldwide, and there have been at least three more rapidfilms® products in European markets<sup>35,36,37,38</sup>.

- **Quicksol®**

SK Chemicals developed Quicksol® technology, a wide variety of drug substances can be accommodated by using quicksol® techniques. But only two drug available in the market produced by quicksol® techniques they are Montfree ODF (monteleukast) and Mvix-S ODF(mirodenafil). Mvix-S is a 50mg oral film which is thin and light. Mvix ODF absorption is 16.7% higher than Mvix tablet<sup>39,40</sup>.

- **Bio-FX<sup>®</sup>**

NAL Pharmaceuticals developed Bio-FX<sup>®</sup> fast onset oral cavity ODF, it is an oral film which is formulated with a BIO-FX<sup>®</sup> absorption enhancer system which increases the sublingual and oral cavity absorption of the drug substance through oral mucosa. The aim is to increase the oral bioavailability of the drug by avoiding the first pass metabolism and gastrointestinal degradation. Bio-FX<sup>®</sup> films are formulated as single layers films with mucoadhesive polymers like polyvinylpyrrolidone. To improve the taste and mouth feel taste, masking agents has been incorporated. Currently there are no products in the market developed by Bio-FX<sup>®</sup> some are under development<sup>41,42</sup>.

- **Eluting Bandage Platform**

Pharmedica Company has innovated and patented the Eluting bandage platform which is a multifunctional, multilayer, intraoral drug delivery method in which mucoadhesives film is applied to the internal mouth tissue. The bandage disintegrates and dissolves as treatment progresses. Eluting bandages enables needle-free transmucosal delivery of drug by administering medicine directly into the blood stream, bypassing the hepatic first pass effect and digestive systems. Eluting bandage platform is a multifunctional device which can be used for large range of products like prescription products. Pharmedica Company was developing oral formulation of insulin for the treatment of diabetes<sup>43</sup>.

- **Schmelzfilmen**

The Hexal Company developed Schmelzfilmen or melting film. The company has also marketed their four products which are- olanzapine, sildenafil, donepezil and resperidone. These all are mainly cellulose based films. In olanzapine oral film ethyl cellulose is the film forming polymers and the film was plasticized by dibutylsebate. HPMC can also be used as film forming polymers<sup>44,45</sup>.

- **XGel<sup>™</sup>**

XGEL film is introduced by Meldex international intellectual property, used in all film system. XGEL is a non-animal derived film which is suitable for vegetarians. These films can be taste masked, colored and layered and also have the capabilities to incorporate active pharmaceutical ingredients. The XGEL film is soluble in both hot and cold water<sup>46,47</sup>.

- **Soluleaves<sup>™</sup>**

Bioprogress Company introduces Soluleaves<sup>™</sup>, these are designed to dissolve rapidly when comes in contact with saliva and quickly release the active ingredients and flavors. This makes films excellent for delivering large range of products that require fast release in the mouth. Soluleaves<sup>™</sup> films are designed to adhere to the mucous membrane and release the active ingredients slowly over 15 minutes. This can be used for flavor release products

such as mouth freshness, confectionary and vitamins products<sup>47</sup>.

- **Fast-Onset sublingual bilayer film**

Cynapsus Company developed fast-onset sublingual bilayer film technique. Apomorphine was developed by this technique. The apomorphine in its neutral form is easily oxidized which makes it difficult to incorporate into film, therefore non-neutral form of apomorphine is loaded in one film layer and a neutralizing agent is incorporated in other film layer, separated from each other. The neutralizing agent t dissolves rapidly when comes in contact with the saliva allowing drug substance to rapidly absorbed by sublingual membrane. Clinical trials of this film demonstrate that maximum blood levels were reach with in 20 min of administration. This sublingual bilayer film proved that it also works in most severe case of Parkinson's disease<sup>48,49</sup>.

- **Orally and Adhesive Disintegrating films**

Japanese company Kyukyu pharmaceuticals has its own oral film technology these are orally disintegrating films which dissolves in 10 to 30 seconds, other is Adhesive and disintegrating film that adhere to the oral mucosa and disintegration time vary from 30 minutes to 8 hrs. Kyukyu pharmaceuticals in collaboration with Nippon Kayaku developed buccal films of fentanyl of which phase II trial has been conducted. Recently company started to develop buccal films for the treatment of for the treatment of cancer related pain and nicotine dependence<sup>50,51,52,53</sup>.

- **Buccal Wafer**

Buccal wafers or wafer tab is introduced by LTS Lohman, Buccal wafers is a drug delivery that incorporates Pharmaceutical actives into an indigestible filmstrip, as this provides rapid dissolution and release of active substance when come in contact with saliva. Buccal wafers can be prepared in a variety of shapes and sizes and is ideal for delivery various medicines that require fast release. Pfizer company has launched Listerine<sup>®</sup> pocket packs as a mouth freshener<sup>47</sup>.

- **Transmucosal Drug delivery patches**

Elsohly laboratories Inc, Aoxing pharmaceuticals introduced transmucosal patches, transmucosal patch are used to deliver various dugs, and some patches are used to deliver anesthetics and analgesics for dental procedures. Transmucosal patch has advantages over syrups or tablet as it provide site-specific delivery of drug due to mucoadhesion, accuracy in dose is assured, local delivery for prolonged period, unidirectional release of drug due to backing layer<sup>54,55</sup>.

## CONCLUSION

In recent years administration of drug via orodispersible film has been very popular, as it offers advantage over conventional dosage form like patient compliance, convenience of administration, enhanced bioavailability as the drug avoid hepatic metabolism. But orodispersible

drug delivery platform is under surveillance from both start-up and established pharmaceutical companies. The companies hustle to develop vast range of films for oral, buccal, sublingual and transdermal route. Orodispersible films encounter several challenges during the phase of

formulation development and manufacturing. These issues can be overcome by optimizing the overall formulation. The future of orodispersible films looks very good and promising.

#### Oral film technological platform their owner or distributor, marketed products and their salient feature

S. NO	Name of patent technology	Owner/ Distributor	Salient features	Marketed products	Reference
1	BEMA <sup>®</sup> (Bio-erodible mucoadhesive)	BioDelivery science international (BDSI)/ KunWha Pharmaceutical Co Ltd; Meda AB; TTY Biopharm Co Ltd	Bio-erodible mucoadhesive films that adhere quickly to oral mucosa.	<ul style="list-style-type: none"> <li>➤ Onsolis.</li> <li>➤ BEMA<sup>®</sup> Granisetron</li> <li>➤ BEMA<sup>®</sup> Buprenorphine.</li> <li>➤ BEMA<sup>®</sup> Triptan</li> <li>➤ BEMA<sup>®</sup> Zolpidem</li> <li>➤ BUNAVIL</li> </ul>	23
2	SmartFilm <sup>®</sup>	Seoul Pharma Co Ltd/ Pfizer Inc	These Oral films have high dose loading capacity.	<ul style="list-style-type: none"> <li>➤ Vultis<sup>®</sup></li> </ul>	24,25
3	Biodegradable transmucosal films	Auxilium Pharmaceuticals	These films adhere to the upper gum preferably above the back molar.	<ul style="list-style-type: none"> <li>➤ Rotavax<sup>™</sup></li> <li>➤ Fentanyl</li> <li>➤ Oxybutynin</li> </ul>	26,27
4	Thinsol <sup>™</sup>	Paladin Labs BioEnvelop's <sup>™</sup>	These fast dissolving films disintegrate within 5-30 sec and allows drug loading up to 60% w/w.	–	28
5	Pharmafilm <sup>®</sup>	MonoSol Rx LLC/ C.B. Fleet Company/ Reckitt Benckiser Pharmaceuticals/ Prestige Brands	Films can be used for both fast dissolving and buccal delivery and maximum 80mg of the drug can be loaded.	<ul style="list-style-type: none"> <li>➤ Pedia Lax<sup>®</sup> Quick Dissolve Strips.</li> <li>➤ Suboxone<sup>®</sup> Sublingual Film.</li> <li>➤ Chloraseptic<sup>®</sup></li> <li>➤ Zuplenz<sup>®</sup></li> </ul>	29,30,31,57
6	Versafilm <sup>(™)</sup>	Intelgenx Technology Corp	Disintegration time of this film can be brought from 30 sec to 10 film, maximum 40mg drug can be loaded and film can also be sublingually administered.	–	32,33,34
7	Rapidfilms <sup>®</sup>	Labtec GmbH / APR Applied Pharma Research/ Norgine (Europe and Middle East, Africa and Australasia) / SciClone Pharmaceuticals, Inc (China and Vietnam) / Takeda Canada	Fat dissolving rapid films based on water soluble polymers, non mucoadhesive film and can be vary from single to multilayer design, these films can accommodate upto 30 mg of drug	<ul style="list-style-type: none"> <li>➤ Setofilm<sup>®</sup> Ondansetron</li> <li>➤ Rapidfilm<sup>®</sup> Ondissolve<sup>™</sup></li> <li>➤ Zolmitriptan ODF</li> <li>➤ RapidFilm<sup>®</sup> Aripiprazole ODF</li> <li>➤ Olanzapine ODF</li> <li>➤ Donepezil ODF</li> </ul>	35,36,37,38
8	Quicksol <sup>®</sup>	SK Chemicals Co Ltd	Wide variety of drug substance can be accommodated	–	39,40,58
9	Bio-FX <sup>®</sup>	NAL Pharma	Bio-FX absorption enhancer is used, this increases the absorption of drug substances through oral mucosa.	–	41,42
10	Eluting bandage platform	Pharmedica	Multipurpose and multi-functional device that can be used for large range of products from fresh breathers to prescription products.	–	43
11	Schmelzfilmen	Hexal Pharmaceuticals	These are mainly cellulose base film and currently four marketed product has seen they are olanzapine, sildenafil, donepezil and resperidone.	<ul style="list-style-type: none"> <li>➤ Olanzapin HEXAL<sup>®</sup> SF Schmelzfilm</li> <li>➤ Aripiprazole HEXAL<sup>®</sup> SF Schmelzfilm</li> <li>➤ Risperidon HEXAL<sup>®</sup> SF</li> <li>➤ Donepezil-HCl Hexal<sup>®</sup> SF</li> <li>➤ SildeHEXAL SF (Tornetis)</li> </ul>	44,45
12\	Soluleaves <sup>™</sup>	Bioprogress	these films designed to dissolve rapidly when comes in contact with saliva and quickly release the active ingredients and flavors in mouth.	<ul style="list-style-type: none"> <li>➤ Nicotine</li> </ul>	46,47

13	Fast-Onset sublingual bilayer film	Cynapsus Therapeutics	These films permit fast mucosal absorption of the drug in mucosa.	➤ Apomorphine	48,49
14	Orally and Adhesive Disintegrating films	Kyukyu Pharmaceutical Co Ltd/ mochida pharmaceutical /Teva Pharma Japan Inc/Kyukyu Pharmaceutical Co Ltd; Nippon Kayaku Co Ltd	orally disintegrating films which dissolves in 10 to 30 seconds, other is Adhesive and disintegrating film that adhere to the oral mucosa and disintegration time vary from 30 minutes to 8 hrs.	➤ Amlodipine OD Film ➤ Voglibose OD Film ➤ Olopatadine ➤ Hydrochloride OD Film ➤ Zolpidem Tartrate OD Film ➤ Loratadine OD Film ➤ Waplon	50,51,52,53
14	Buccal Wafers	LTS Lohamn/ Pfizer	Pharmaceutical active substances are incorporated into indigestible filmstrip, this provides rapid dissolution and release of active substance when come in contact with saliva, this can be prepared in a variety of shapes and sizes and is ideal for delivery various medicines that require fast release.	➤ Listerine® pocket packs® ➤ Sudafed PE™ ➤ Banadryl® ➤ NiQuitin strips 2.5 mg oral film	47
15	Transmucosal drug delivery patces	Aoxing pharmaceuticals/ EISohly laboratories Inc	patches are used to deliver anesthetics and analgesaics for dental procedures.	–	54,55

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