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Der Pharmacia Lettre, 2011, 3(1): 152-165
(http://scholarsresearchlibrary.com/archive.html)

ISSN 0975-5071
USA CODEN: DPLEB4

Formulation and Characterization of Fast Dissolving Buccal Films: A Review

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ABSTRACT

There is always increasing demand for patient convenience and compliance related research and a novel method is the development of fast dissolving buccal films, which dissolve or disintegrate instantly on the patient buccal mucosa. This fast dissolving drug delivery system (FDDS) is suited for the drugs which undergo high first pass metabolism and is used for improving bioavailability with reducing dosing frequency to mouth plasma peak levels, which in turn minimize adverse/side effects and also make it cost effective. In the present review, recent advancements and literature regarding fast dissolving buccal films is compiled and it suggests that this delivery system can be adopted by various pharmaceutical companies in the future at the large scale.

Key-words: Fast dissolving buccal films, solvent evaporation method, bioavailability enhancement.

INTRODUCTION

Fast-dissolving buccal film drug delivery systems have rapidly gained acceptance as an important new way of administering drugs. They are usually used for pharmaceutical and nutraceutical products. It is the newest frontier in drug delivery technology that provides a very convenient means of taking medications and supplements. There are multiple fast-dissolving over the counter and prescribed products on the market worldwide, most of which have been launched recently. There have also been significant increases in the number of new chemical entities under development using a fast-dissolving drug delivery technology.

Now the main question arises that what are fast dissolving buccal films. A fast-dissolving buccal film drug delivery system, in most cases, is a film containing active ingredient that dissolves or

disintegrates in the saliva remarkably fast, within a few seconds without the need for water or chewing. Some drugs are absorbed well from the mouth, pharynx and esophagus as the saliva passes down into the stomach. In such cases, bioavailability of drug is significantly greater than those observed from conventional tablet dosage form. Most fast-dissolving delivery system films must include substances to mask the taste of the active ingredient. This masked active ingredient is then swallowed by the patient's saliva along with the soluble and insoluble excipients.

Fast dissolving buccal films use a dissolving film to administer drugs via absorption in the mouth (buccally or sublingually) and/or via the small intestines (enterically). A 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. Fast dissolving buccal films drug delivery has emerged as an advanced alternative to the traditional tablets, capsules and liquids often associated with prescription and over the counter medications. Similar in size, shape and thickness to a postage stamp, thin film strips are typically designed for oral administration, with the user placing the strip on or under the tongue or along the inside of the cheek. Different buccal delivery products have been marketed or are proposed for certain diseases like trigeminal neuralgia, meniere's disease, diabetes and addiction.

Improved patient compliance is a primary benefit of the fast-dissolving drug delivery systems. Other benefits of fast-dissolving films include ease of swallowing [1], no water necessary for administration, and accuracy of dosage. This fast-dissolving action is primarily due to the large surface area of the film, which wets quickly when exposed to the moist oral environment. These additional, superior benefits allow patients to take their medication anytime and anyplace under all circumstances. The fast dissolving buccal film drug delivery system offers a giant leap forward in drug administration by providing a new and easy way of taking medication.

Many fast-dissolving tablets are soft, friable, and/or brittle (such as the lyophilized dosage forms) and often require specialized and expensive packaging and processing. These tablets are either very porous or inherently soft-molded matrices, or tablets compacted at very low dissolution/disintegration time. The delivery system is simply placed on a patient's tongue or any oral mucosal tissue [2]. Instantly wet by saliva, the film rapidly hydrates and adheres onto the site of application. It then rapidly disintegrates and dissolves to release the medication for oral mucosal absorption or with formula modifications, will maintain the quick-dissolving aspect but allow for gastrointestinal absorption to be achieved when swallowed.

Formulation of fast dissolving buccal film involves the application of both aesthetic and performance characteristics such as strip-forming polymers, plasticizers, active pharmaceutical ingredient, sweetening agents, saliva stimulating agent, flavoring agents, coloring agents, stabilizing and thickening agents. From the regulatory perspectives, all excipients used in the formulation of oral drug strips should be approved for use in oral pharmaceutical dosage forms. In recent application of fast dissolving buccal films it has been made possible that vaccines can be provided to infants in impoverished area against rotavirus [3]. Table 1 illustrates the recently FDA approved fast dissolving films.

Table 1: FDA approved Fast Dissolving Buccal Films: [4-6]

S.NO	Drug	Year	Use	Company
1.	Suboxone® (Buprenorphine and Naloxone	31/08/2010	Sublingual film indicated for maintenance treatment of opioid dependence and should be used as part of a complete treatment plan to include counselling and psychosocial support.	Reckitt Benckiser Pharmaceuticals Inc.
2.	Zuplenz	January 2010	Prevention of postoperative, highly and moderately emetogenic cancer chemotherapy-induced, and radiotherapy-induced nausea and vomiting.	PharmFilm® technology
3.	Ondansetron	23rd March 2010	Prevention and treatment of Chemotherapy and Radiotherapy Induced Nausea and Vomiting ("CINV") in adults as well as children aged equal or above 6 months, and the prevention and treatment of Post Operative Nausea and Vomiting (PONV) in adults and children aged equal or above 4 years.	APR Applied Pharma Research s.a. ("APR") and Labtec GmbH ("Labtec")
4.	Zelapar	October 2005.	Treatment for Parkinson's disease.	Valeant Pharmaceuticals International Inc.

Salient Features of Fast Dissolving films:

Fast dissolving buccal films provide ease of administration for patients who are mentally ill, disabled and uncooperative; requires no water; have quick disintegration and dissolution of the dosage form. They can be unobstructive and can be designed to leave minimal or no residue in the mouth after administration and also provides a pleasant mouth feel. This delivery system has no risk of chocking. It allows high drug loading and has the ability to provide advantages of liquid medication in the form of solid preparation. Fast dissolving films are adaptable and ameanable to existing processing and packaging machinery, cost effective and have excellent mucoadhesion. Fast dissolving films can be formulated in various shapes and sizes [7-11].

Advantages of fast dissolving buccal films:

Fast dissolving films are easy to administer and handle, hence leads to better patient compliance. Fast dissolving buccal film is a drug delivery film that is placed on a mucosal or in oral cavity. They provide suitability for a wide variety of drugs. It has improved bio-availability for certain therapeutic ingredients. It has small size for improved patient compliance. As most of the drugs are unpalatable, fast dissolving buccal films usually contain a medicament in taste masked form. Films has ability to dissolve rapidly without the need for water provides an alternative to patients with swallowing disorders as a result of extremities and dysphasia, and to patients suffering from nausea, such as those patients receiving chemotherapy. The large surface area available in the strip dosage form allows rapid wetting in the moist buccal environment. It is also used for local and systemic delivery. Because of availability of larger surface area it leads to rapid disintegration and dissolution in the oral cavity. The sublingual and buccal delivery of a drug via thin film has the potential to improve the onset of action, lower the dosing, and enhance the efficacy and safety profile of the medicament. Film is more advantageous as it is stable, durable and quicker dissolving than other conventional dosage forms. As compared to drops or syrup formulations, precision in the administered dose is ensured from each of the strips. Films also enable improved dosing accuracy. Film not only ensures more accurate administration of drugs

but also can improve compliance due to the intuitive nature of the dosage form and its inherent ease of administration. Since the first pass effect can be avoided, there can be reduction in the dose which can lead to the reduction in side effects associated with the molecules. Thin film formulations must ensure that the integrity of the drug remains constant over time.

Disadvantages

- It is hygroscopic in nature so it must be kept in dry places.
- It also shows the fragile, effervesces granule property.
- They require special packaging for the products stability and safety.

Formulation considerations:

Formulation involves the intricate application of aesthetic and performance characteristics such as taste masking, fast dissolving, physical appearance, mouth feel *etc*. Fast dissolving film is a thin film with an area of 5-20 cm^2 containing an active ingredient. The immediate dissolution, in water or saliva respectively, is reached through a special matrix from water-soluble polymers. Drugs can be incorporated up to single dose of 15 mg [4]. Formulation considerations have been reported as important factors affecting mechanical properties of the films, such as shifting the glass transition temperature to lower temperature. The excipients used in formulation of fast dissolving buccal films are also discussed in detail. From the regulatory perspectives, all excipients used in the formulation should be generally regarded as safe (*i.e.* GRAS-listed) and should be approved for use in oral pharmaceutical dosage forms.

Active pharmaceutical agents:

The active substance is may be from any class of pharmaceutically active substances that can be administered orally or through the buccal mucosa respectively. According to literature, API can be added from 5%-25% w/w of total weight of polymer. For the effective formulation, dose of drug should be in mgs (less than 20 mg/day). The drugs which are potent, show high first pass metabolism and patient non- compliant are best candidates for fast dissolving buccal films. Researchers have shown interest in development of fast dissolving films for drugs like: Pediatrics (antitussive, expectorants, antiasthamatics), Geriatrics (antiepileptic, expectorants), Gastrointestinal diseases, Nausea (*e.g.* due to cytostatic therapy), Pain (*e.g.* migraine), CNS (*e.g.* antiparkinsonism therapy).

Among which preferred active agents include chlorpheniramine maleate, brompheniramine maleate, dexchloropheniramine, triprolidine hydrochloride, acrivastine, azatadine maleate, loratidine, phenylephrine hydrochloride, dextromethorphan hydrochloride, ketoprofen, sumatriptan succinate, zolmitriptan, loperamide, famotidine, nicotine, caffeine, diphenhydramine hydrochloride, and pseudophedrine hydrochloride, and their amounts per strip can be well known in the art.

Polymers

A variety of polymers are available for preparation of fast dissolving buccal films. The polymers can be used alone or in combination to obtain the desired film properties. The film obtained should be tough enough so that there won't be any damage while handling or during transportation. The robustness of the strip depends on the type of polymer and the amount in the formulation. The various polymers to make fast dissolving films include cellulose or cellulose

derivatives, pullulan, gelatin, hydroxypropylmethyl cellulose, hydroxyethylcellolose, hydroxypropylcellulose, polyvinylpyrrolidone, carboxymethylcellulose, polyvinylalchohal, sodium alginate, xanthine gum, tragacanth gum, guar gum, acacia gum, methylmethacrylate co-polymer and hypromellose are most commonly used for preparation of fast dissolving films. Modified starches are also used for preparation. Due to low cost of this excipient it is used in combination of pullulan to decrease the overall cost of the product. Pullulan is a natural polymer obtained from nonanimal origin and does not require chemical modification. About 50 to 80 percent w/w of pullulan can be replaced by starch in the production of fast dissolving films without loss of required properties of Pullulan. Combination of microcrystalline cellulose and maltodextrin has also been used to formulate fast dissolving films. Kulkarni *et al.*, 2010 explored different polymers for use in formulation of oral fast dissolving strips. Different polymers *viz.*, HPMC E15, HPMC K4M, HPMC E5, PVP, PVA, gelatin, eudragit RL100 and pullalan were used to formulate fast dissolving buccal films; by solvent casting method. Results confirmed that pullalan is best polymer for oral fast dissolving strips [12].

Plasticizers:

Plasticizer [13-14] is a vital ingredient of the fast dissolving buccal films formulation. The mechanical properties such as tensile strength and elongation to the films can be improved by the addition of the plasticizer. It also helps to improve the flexibility of the strip and reduces the brittleness of the strip. They also improve the strip properties by reducing glass transition temperature of the polymer. The flow of polymer also gets better by the addition of the plasticizer. Variations in their concentration affect these properties. The selection of the plasticizer will depend upon its compatibility with the polymer and also the type of solvent employed in its casting. Plasticizers include glycerine, sorbitol, propylene glycol, polyethylene glycol, triacetin, di-butylpthalate, triethyl citrate, acetyl triethyl citrate and other citrate esters. Typically the plasticizers are used in the concentration of 0-20% w/w of the dry polymer weight [15]. Inappropriate use of the plasticizer may lead to film cracking, splitting, peeling of the strip and it may also affect the absorption rate of the drug.

Surfactants:

Surfactants are used as solubilizing or wetting or dispersing agents so that the film gets dissolved within seconds and release active agent immediately. Surfactants also improve the solubility of poorly soluble drugs in fast dissolving buccal films. Some of the commonly used are polaxamer 407, sodium lauryl sulfate, benzalkonium chloride, benzthonium chloride, tweens and spans *etc* [16].

Sweetening agents:

Sweeteners have become the important part of pharmaceutical products intended to be disintegrated or dissolved in the oral cavity. The classical source of sweetener is sucrose, dextrose, fructose, glucose, liquid glucose and isomaltose. The sweetness of fructose is perceived rapidly in the mouth as compared to sucrose and dextrose. Fructose is sweeter than sorbitol and mannitol and thus used widely as a sweetener. Polyhydric alcohols such as sorbitol, mannitol, and isomalt can be used in combination as they additionally provide good mouth-feel and cooling sensation. Polyhydric alcohols are less carcinogenic and do not have bitter after taste which is a vital aspect in formulating oral preparations. The artificial sweeteners have gained more popularity in pharmaceutical preparations. Saccharin, cyclamate and aspartame are the first

generation of the artificial sweeteners followed by acesulfame-K, sucralose, alitame and neotame which fall under the second generation artificial sweeteners. Acesulfame-K and sucralose have more than 200 and 600 time sweetness. Neotame and alitame have more than 2000 and 8000 time sweetening power as compared to sucrose. Rebiana which is a herbal sweetener, derived from plant *Stevia rebaudiana* (South American plant) has more than 200 -300 time sweetness [17].

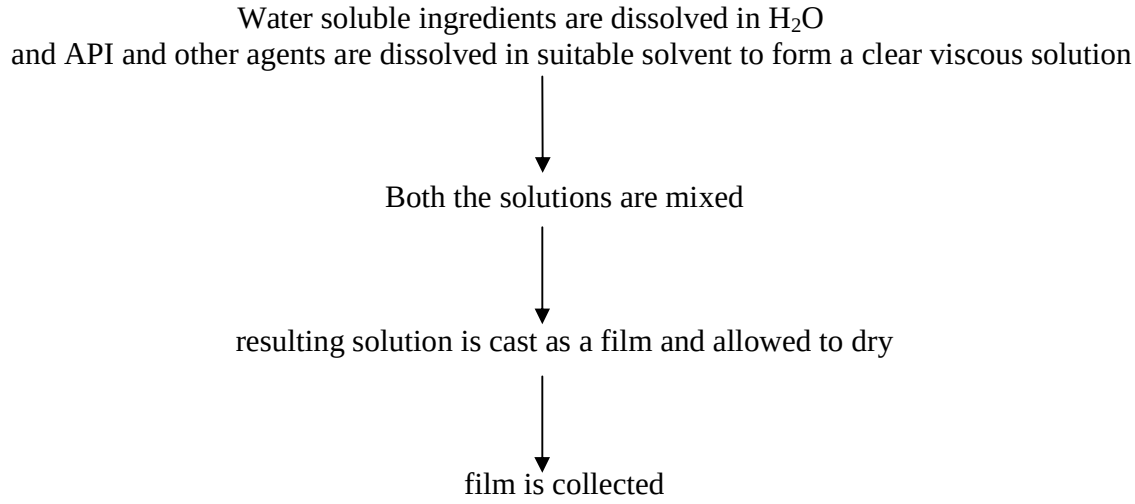
Saliva stimulating agents:
The purpose of using saliva stimulating agents is to increase the rate of production of saliva that would aid in the faster disintegration of the rapid dissolving strip formulations. Generally acids which are used in the preparation of food can be utilized as salivary stimulants. Citric acid, malic acid, lactic acid, ascorbic acid and tartaric acid [18] are the few examples of salivary stimulants, citric acid being the most preferred amongst them.

Flavoring agents:
Flavoring agents can be selected from the synthetic flavor oils, oleo resins, extract derived from various parts of the plants like leaves, fruits and flowers. Flavors can be used alone or in the combination. Any flavor can be added such as essential oils or water soluble extracts of menthol, intense mints such as peppermint, sweetmint, spearmint, wintergreen, cinnamon, clove, sour fruit flavor such as lemon , orange or sweet confectionary flavors [19] such as vanillin, chocolate ,or fruit essence like apple , raspberry, cherry, pineapple. The amount of flavor needed to mask the taste depends on the flavor type and its strength.

Coloring agents:
A full range of colours is available including FD& C colors, EU colours, natural colouring agents, and natral juice concentrates, pigments such as titanium oxide, silicon dioxide and zinc dioxide and custom pantone-matched colours. These all coloring agents should not exceed concentration levels of 1% w/w. these agents are incorporated when some of the formulation ingredients or drugs are present in insoluble or suspension form.

Methods of manufacture of fast dissolving films:
One (or a combination) of the following processes may be used to manufacture the oral films:
- Solvent casting
- Hot-melt extrusion
- Semisolid casting
- Solid dispersion extrusion
- Rolling.

Solvent Casting:
Fast dissolving buccal films are preferably formulated using the solvent casting method, whereby the water soluble ingredients are dissolved to form a clear viscous solution and the drug along with other excipients is dissolved in suitable solvent then both the solutions are mixed and stirred and finally casted in to the Petri plate and dried.



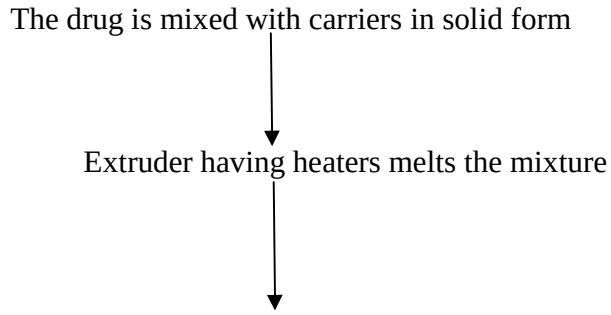
Water soluble hydrocolloids used to prepare films are hydroxypropylmethylcellulose, hydroxypropylcellulose, pullulan, sodium alginate, pectin and carboxymethylcellulose [20]. Table 2 shows the examples of fast dissolving films which are formulated by solvent casting method in literature.

Table 2: Examples of fast dissolving films prepared by solvent casting method given in literature

S.No	Drug	Polymers	Plasticizers	Sweeteners
1.	Ondansetron [5-6]	Polyvinylalcohal, polyvinyl pyrrolidone, Carboopol 934P	Propylene glycol or PEG 400	Mannitol or sodium saccharin
2.	Maltodextrin [21]	Polyvinylalcohal	Glycerol	Glycerine
3.	Salbutamol [22]	HPMC	Glycerol	Aspartame

Hotmelt extrusion:

Hot metal extrusion is commonly used to prepare granules, sustained release tablets, transdermal and transmucosal drug delivery systems [23]. Melt extrusion was used as a manufacturing tool in the pharmaceutical industry as early as 1971.



Advantages of hot melt extrusion are fewer operation units, minimum product wastage, possibility to scale up, an anhydrous process, absence of organic solvents, include shorter temperature and shorter residence time of the drug carrier mix and better content uniformity.

Semisolid casting:

Solution of water soluble film forming polymer is prepared

↓

Resulting solution is added to a solution of acid insoluble polymer
(*e.g.* cellulose acetate phthalate, cellulose acetate butyrate)

↓

Appropriate amount of plasticizer is added so that gels mass is obtained

↓

Finally the gel mass is casted in to the films or ribbons using heat controlled drums. The thickness of the film should be about 0.015-0.05 inches. The ratio of the acid insoluble polymer to film forming polymer should be 1:4.

Solid dispersion extrusion:

The term solid dispersions refer to the dispersion of one or more active ingredients in an inert carrier in a solid state in the presence of amorphous hydrophilic polymers.

Drug is dissolved in a suitable liquid solvent

↓

Then solution is incorporated into the melt of polyethylene glycol, obtainable below 70° C

↓

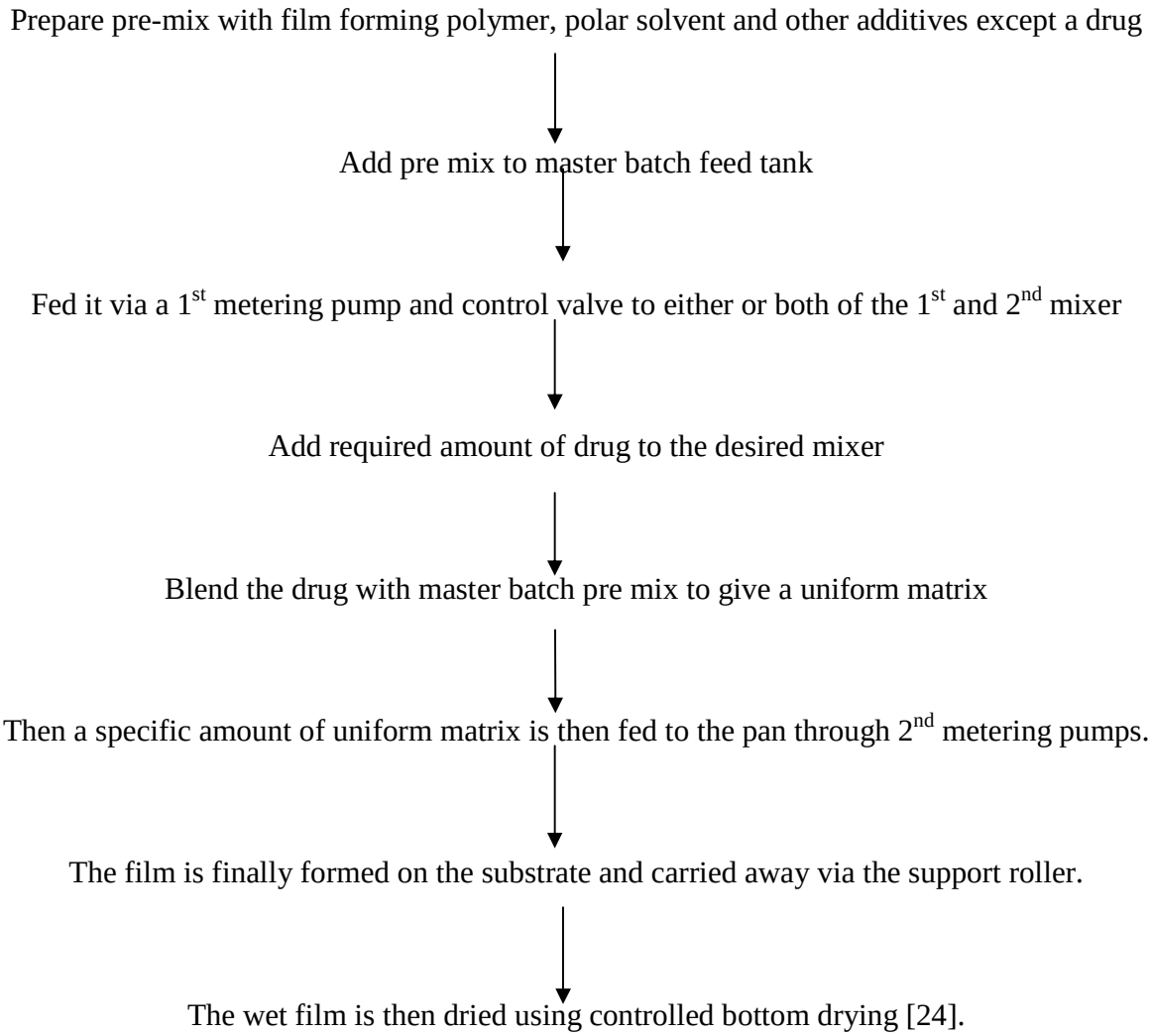
Finally the solid dispersions are shaped into the films by means of dies.

Precautions while preparing sold dispersions:

The selected solvent or dissolved drug may not be miscible with the melt of the polyethylene glycol and polymorphic form of the drug precipitated in the solid dispersion may get affected by the liquid solvent used.

Rolling method:

In this method the film is prepared by preparation of a pre-mix, addition of an active and subsequent formation of a film.



Characterization of fast dissolving films:

Drug-excipients interaction studies:

Assessment of possible incompatibilities between an active drug substance and different excipients plays an important part of the formulation stage during the development of solid dosage form. Fourier Transformer Infra Red Spectrum (FTIR), Differential scanning calorimeter (DSC), thin layer chromatography and X Ray Diffraction (X-RD) can be used to assess possible drug excipient interaction. DSC allows the fast evaluation of possible incompatibilities, because it shows changes in appearance, shift of melting endotherms and exotherms, and variation in the corresponding enthalipies of the reaction [5].

Thickness:

Thickness test can be carried out using an electronic micrometer [25]. The thickness of the film sample should be measured at five locations (center and four corners), and the mean thickness is calculated. Samples with air bubbles, nicks or tears and having mean thickness variation of greater than 5% are excluded from analysis.

Folding endurance:
To determine folding endurance, a strip of film is cut and repeatedly folded at the same place till it broke. The number of times the film could be folded at the same place without breaking gives the value of folding endurance.

Swelling index:
The studies for swelling index of the film are conducted in stimulated salivary fluid. The film sample is weighed and placed in a preweighed stainless steel wire sieve. The mesh containing the film is submerged into 50 ml of stimulated salivary medium contained in a mortar. Increase in weight of the film is determined at each interval until a constant weight is observed. The degree of swelling is calculated using the formula:

$$SI = w_t - w_o / w_o \quad (1)$$

Where SI is the swelling index,
w_t is the weight of the film at time "t", and
w_o is the weight of film at t = 0

Uniformity of drug content:
This parameter can be determined by dissolving known weight of film by homogenization in 100 ml of stimulated saliva of pH 6.8 for 30 min with continuous shaking.

Tensile strength:
The tensile strength (psi) is the property of the film that requires a load to cause load deformation failure of film. Nafee *et al.*, 2003 evaluated this mechanical property by using Instron Universal Testing Instrument (model F. 4026), Instron Ltd., Japan, NITK, Surathkal) with a 5-kg load cell. Film strips in special dimension and free from air bubbles or physical imperfections were held between two clamps positioned at a distance of 3 cm. During measurement, the strips were pulled by the top clamp at a rate of 100 mm/min; the force and elongation were measured when the film broke. Results from film samples, which broke at and not between the clamps, were not included in the calculations. Measurements were run in triplicate for each film. Tensile strength is also defined as the maximum stress applied to a point at which the film specimen breaks and can be computed from the applied load at rupture as a mean of three measurements and cross-sectional area of fractured film from the following equation [26].
Tensile strength (N/mm^2) = breaking force (N) / cross sectional area of sample (mm^2) (2)

Percent elongation:
The percent elongation is measured when the film snaps as sufficient force applied so as to exceed the elastic limit. Percentage elongation can be obtained by following equation:
Elongation at break (%) =increase in length at breaking point(mm) / original length(mm)X100%. (3)

Palatability test:
Palatability study is conducted on the basis of taste, after bitterness and physical appearance. All the batches are rated A, B and C grades as per the criteria. When the formulation scores at least one A grade, formulation is considered as average. When the formulation scores two A grade

then it would be considered as good and the one with all three A grade it would be the very good formulation [5].

Grades: A= very good, B= good, C=poor.

Disintegration test:
Disintegrating time is defined as the time (second) at which a film breaks when brought into the contact with water or saliva. The disintegration time is the time when a film starts to break or disintegrate. Thickness and mass play a role in determining the dissolvable films physical properties [5]. Disintegration test is done by Disintegration apparatus.

Dissolution test:
Dissolution is defined as the amount of drug substance that goes into the solution per unit time under standardized conditions of liquid/solid interface, temperature and solvent concentration. *In vitro* release studies are carried out in modified USP XXIII apparatus (paddle over disk) [27].

Permeation studies:
Permeation studies are carried using the modified Franz diffusion cell by using porcine buccal mucosa. The mucosa is mounted between the donor and receptor compartment of Franz diffusion cell. The receptor compartment is filled with buffer and maintained at 37 °C ± 0.2 °C and the hydrodynamics were maintained by stirring with a magnetic bead at 50 rpm. One previously weighed film is placed in intimate contact with the mucosal surface of the membrane that should be previously moistened with a few drops of simulated saliva. The donor compartment is filled with 1 ml of simulated saliva of pH 6.8. Samples are withdrawn at suitable interval, replacing the same amount with the fresh medium. The percentage of drug permeated is determined by measuring the absorbance by selected analytical method.

Stability study:
Stability study of fast dissolving films is carried out for all the batches according to ICH guidelines. After predetermined time intervals, the films are evaluated for the drug content, disintegration time and physical appearance.

Packaging:
In the pharmaceutical industry it is vital that the package selected adequately preserve the integrity of the product. Expensive packaging, specific processing, and special care are required during manufacturing and storage to protect the dosage of other fast dissolving dosage forms. A variety of packaging options are available for fast dissolving films. 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, which is specially designed for the Rapid films. The rapid card has same size as a credit card and holds three raid films on each side. Every dose can be taken out individually. The material selected must have the following characteristics:

- They must protect the preparation from environmental conditions.
- They must be FDA approved.
- They must meet applicable tamper-resistant requirement.

- They must be non-toxic.
- They must not be reactive with the product.
- They must not impart to the product tastes or odors [28].

Foil, paper or plastic pouches: The flexible pouch is a packaging concept capable of providing not only a package that is temper- resistance, but also by the proper selection of material, a package with a high degree of environmental protection. A flexible pouch is usually formed during the product filling operation by either vertical or horizontal forming, filling, or sealing equipment. The pouches can be single pouches or aluminum pouches.

Single pouch and Aluminum pouch: Soluble film drug delivery pouch is a peelable pouch for "quick dissolve" soluble films with high barrier properties. The pouch is transparent for product display. Using a 2 structure combination allows for one side to be clear and the other to use a cost-effective foil lamination. The foil lamination has essentially zero transmission of both gas and moisture. The package provides a flexible thin film alternative for nutriceutical and pharmaceutical applications. The single dose pouch provides both product and dosage protection. Aluminum pouch is the most commonly used pouch.

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. The blister package is formed by heat –softening a sheet of thermoplastic resin and vaccum-drawing the softened sheet of plastic into a contoured mold. After cooling the sheet is released from the mold and proceeds to the filling station of the packaging machine. The semi –rigid blister previously formed is filled with the product and lidded with the heat sealable backing material. The film selection should be based upon the degree of protection required. Generally the lid stock is made of aluminum foil. The material used to form the cavity is typically a plastic, which can be designed to protect the dosage form from moisture [28].

Barrier Films: Many drug preparations are extremely sensitive to moisture and therefore require high barrier films. Several materials may be used to provide moisture protection such as Polychlorotrifluoroethylene (PCTFE) film, Polypropylene. Polypropylene does not stress crack under any conditions. It is an excellent gas and vapour barrier. Lack of clarity is still a drawback.

Applications of fast dissolving buccal films:

Vaccines:

Fast dissolving buccal films film can be delivered in the form of vaccine which is stable at room temperature so it is quickly dissolved in mouth and in saliva. Rotavirus vaccine prepared in United states is a room temperature stable fast-dissolving buccal film delivery system for vaccines that will make vaccinations almost as simple as freshening your breath. This delivery system exhibits many advantages which include: improved patient compliance, improved bioavailability, reduction in the costs associated with storage and distribution, handling and administration.

Controlled and Sustained release film:

Sustained release buccal film is applicable in hospital preparations and various polymers like chitin and chitosan derivatives are used as excipients. They contribute to expansion of

application, decrease toxicity, wound dressings, oral mucoadhesive and water-resisting adhesive by virtue of their release characteristics and adhesion [29].

Taste masking:

Taste masking is an essential requirement for fast dissolving tablets for commercial success. Fast dissolving buccal films dissolve or disintegrate in patient's mouth, thus releasing the active ingredients which come in contact with the taste buds and hence this property becomes critical for the patient compliance. In taste masking, drugs with unacceptable bitter taste can be microencapsulated into pH sensitive acrylic polymers by solvent evaporation and solvent extraction techniques. These polymers microspheres showed efficient taste masking and complete dissolution in a short period [30].

Orally disintegrating films:

Fast dissolving buccal films are based on a water-soluble polymer. The film has the ability to dissolve rapidly without the need for water provides an alternative to the patients with swallowing disorders and to patient suffering from nausea, such as those patients receiving chemotherapy [31]. Various formulations of fast dissolving films are available commercially are listed in Table 3.

CONCLUSION

Fast dissolving buccal films have gained popularity because of better patient compliance, rapid drug delivery system, drug is directly absorbed into systemic circulation, first pass metabolism and degradation in gastrointestinal tract can be avoided. Fast dissolving buccal films can be a better option to optimize therapeutic efficacy of various active pharmaceutical ingredients in the future.

Table 3: List of marketed formulations of fast dissolving films is: [4-6]

S. No	Product	Brand name	Manufactured by
1	Dextromethorphan HBr (cough suppressant), Diphenhydramine Citrate(cough and cold), Breath Strips	Delsym, DexAlone	MonoSolRx
2	Doneprezil rapid dissolving films, Ondansatron rapid dissolving films	Zofran.	Labtec Pharma
3.	Life-saving rotavirus vaccine to infants		Johns Hopkins undergraduate biomedical engineering students.
4.	Methylcobalamin fast dissolving films, Diphemhydramine HCl fast dissolving films, Dextromethorphan fast dissolving films, Folic Acid 1mg fast dissolving films, Caffeine fast dissolving films	Methicol, Benadryl, Delsym, DexAlone.	Hughes medical corporation
5.	Altoid cinnamon strips, Boots vitamin c strips, Cool shock peppermint strips, Benzocaine films, Caffeine films		Dow chemical company
6.	Listerine Pocket Paks Breath Freshening Strips		Pfizer's Warner-Lambert consumer healthcare division

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