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MOUTH DISSOLVING FILMS: A NOVEL CONVENIENT DOSAGE FORM FOR RAPID RELIEF

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ABSTRACT:
With advancement in the therapeutic evolution, novel drug delivery has been started appearing growing immediately into the new dosage forms called as Mouth Dissolving films, also known as Orally Disintegrating films. They are specially designed for dissolving locally inside the mouth, do not require water for disintegration and exerts its therapeutic effect immediately due to easy accessibility to oral mucosa. It also leads to the higher bioavailability as the first pass metabolism is bypassed. Pediatric, Geriatric and Dysphagic patients are highly benefitted through these dosage forms who have difficulty in swallowing thus promoting a patient compliance. These Dosage forms can be specially developed using Solvent Casting Method. Apart from these other methods are also used like Hot Melt Extrusion Method, Rolling Method, Semisolid casting method, Solid dispersion extrusion methods etc. Materials such as Active Pharmaceuticals Ingredients, Saliva Stimulating agents, Plasticizer, Surfactants, Artificial Sweeteners, Film forming Polymers, Superdisintegrants and desired solvent can be employed for the preparation. Prepared films can be evaluated for various attributes like Folding Endurance, Content Uniformity, Disintegration time, Assay %, Tack Test, Tensile Strength, Surface pH, Percentage elongation, Swelling Properties, Dissolution test, Moisture Absorption, Moisture Loss etc. This article provides an overview regarding Mouth dissolving films, its preparation and Evaluation. Novel technologies developing the mouth dissolving films of the different therapeutic category have been a part of the research of many pharmaceuticals researchers. Technological and economical investment of the global authorities is required for enhancing this technological boon as an alternative approach among others conventional dosage forms.

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***Keywords**: Active Pharmaceutical Ingredients; Dysphagic, Geriatric; Pediatric, Solvent Casting Method*

INTRODUCTION:

Patients need more convenient dosage form for the treatment of the disease. They seek the rapid response from the drug dosage forms that is administered to them in one side where as in other side they seek the comfortless while taking the drugs. No patients desire that there is occurrence of discomfort and uneasiness while talking the drug. Intended dosage forms should be accepted more and easily by the patient. There are different routes for the administration of the drug to patient. Intramuscular route, Intravenous route, Rectal route, Oral Route etc. are some of the route currently in the practice. Among them Oral route is mostly preferred by the patient. Patient does not feel the sense of the pain while delivering the drug through this route. Noninvasiveness is the most useful benefits associated with the oral route. All these factors promote the patient compliance (Pawar, et al. 2019)

While taking the desired drug through the oral route, one may need the water during administration while in the other hand dosage form that bypasses the need of water for having the drug. While taking the drug with the aid of water , patient need to place the dosage form in the mouth cavity followed by the drinking of the water for the purpose of swallowing. But this practice becomes sometimes difficult for certain group of the patient i.e. geriatric (patients with higher age), Pediatric (Child patients) and moreover the patients who have difficulty in swallowing. Normally patients who suffer from the disease called dysphagia feels extreme difficulties for taking the drug with the swallowing process. Normally thirty five percent population are found to have suffered from this type of disease. (Patil, et al. 2014). So as a alternative for those patients different types of dosage forms like mouth dissolving films, Sublingual films etc are being developed. Disadvantages of the different traditional dosages like the capsules and the tablets are suppressed through the development of the dosages form like oral dissolving films or Mouth dissolving films. The first idea was coined in the year 1970. (Mankar, Biyani and Umekar 2020)

Among the others dosage forms, Mouth dissolving films are considered be more economical and safest dosage forms. It has eliminated the water requirement for the administration into the patients. One have to just place the film on the tongue which will the help of the saliva present over there gets wetted and dissolves in fastest way thus releases the drug**.** (Vidyadhara, et al. 2015) Desires shape and texture of the prepared film shall be decided based on the demand of the patients and the competitive market penetration strategy. Suitable surfactants, sweetening agents, Polymers for the formation of Film, Saliva stimulator, Plasticizers, colors, flavors etc. are incorporated for film preparation. Mouth dissolving films are promoted in the market as the best alternative due to the various reasons like prevention of choking in the throat, portable for the carrying, local actions of the drugs can be achieved etc. (Panchal, et al. 2012) In case of ulcers of

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mouth, pain in the teeth, ulcer of mouth cavity, Cold Sores or when Local anesthetic is desired, role of mouth dissolving films comes into the existence. (Neeta, et al. 2012)

Oral Cavity's Anatomical Overview (Gupta, Bisht and Rao 2019)
Before the formulation of Mouth dissolving film we should have clear idea about the anatomy of the mouth/buccal cavity because the drug has to pass through the oral cavity to give the desired action. There are different types of cells in the mouth cavity. Mouth cavity is covered by the special cells called Mucosa cells which helps in avoiding the first pass metabolism of the drug and helps in delivering the drugs into the systemic circulation. Mucous cells are found in the mouth cavity which helps in the secretion of mucous over there. Mucous is slipper in nature and helps for lubrication and moreover it is protective in nature. Comparatively Mucosal cells of the oral cavity have higher permeability in compared to the skin i.e. minimum of 4 to maximum of 1000 times than that of skin. (Patil, et al. 2014)

Categorization of Mouth Dissolving Films (Aggarwal, et al. 2011)
Flash Release: These types of the films are usually found with the single layer and are used for getting both the local or systemic effects. Usually these types of films are found with the thickness of 20 to 70 micrometer and the area lies between 2 to 8 cm^2. Highly soluble hydrophilic polymers are used for the formation of these types of films. Usually the drug is used in the form of solid solution. Like other films they are also intended to be kept in the tongue and the maximum dissolution time expected for these type of films is 60 seconds.

Mucoadhesive melt away wafer: These are either single layered or they are multi layered in the structure having the area in the range of 2-7 cm^2. Usually the thickness is observed to be in the range of 50 to 500 micrometer for these types of films. Polymers which are hydrophilic in nature and soluble in water are preferred for formulation. They are not supposed to be placed on the tongue and the drug to be used for the formulation is solution of solid or Drug particle suspension. They are placed on the Buccal or the gingival region. This type of Mouth Dissolving films are expected to have the disintegration within the few seconds.

Mucoadhesive sustained release wafers: These are the Multilayered in structure and are normally 50 to 250 micrometer in thickness with area in the range of 2 to 4 cm^2. For the formation of these types of films very low soluble or comparatively non soluble types of polymers are used. These are also used for the having the systemic or having the local effect in the gingival region. These types of films are expected to have higher dissolution time i.e. maximum up to 8 to 10 hours. Drug in the form of Solution of solid or in the form of suspension are used.

Commercially various types of films are available in the market manufactured by different reputed companies of the world. Product called Listerine was manufactured by Pfizer Company

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using the Cool Mint which is used for freshening of the mouth. Triaminic has been commercialized by popular company Novartis using the Dextromethorphan Hydrobromide and it is being used for suppressing the Cough. Similarly Rapid film of Donepezil for the treatment of Alzheimer's disease is available in the market which is manufactured by Labtec. Gas-X is manufactured by Novartis in which the API used is Simethecone and used for against the Flatulence. Theraflu Setofilm, is another popular brand of Mouth Dissolving film using the API Ondansetron and used for the Nausea Prevention. (Rekha, et al. 2014)

Characteristics of Mouth Dissolving Films (Pawar, et al. 2019)

1. Thickness should be minimum and appearance should be attractive
2. Should have ability to get disintegrated faster
3. They should not cause any difficulty while swallowing
4. Should provide good feel in the mouth while taking
5. Should be free from possible residues
6. Should be in different required sizes

Working Mechanism: (Desu, et al. 2013)

Saliva which is found in the mouth cavity wets the Mouth Dissolving Film to the maximum level and it causes the rapid swelling followed by disintegration. After disintegration drug molecule gets entered into the blood vessels found in the mucosa cells in the Oral Cavity.

Benefits associated with Mouth Dissolving Films (Saxena and Singh 2022)

1. First pass metabolism is bypassed.
2. Entry of the drug in direct ways to systemic circulation shows rapid effects.
3. Protects the possible degradation of the drug in the upper and Lower Gastrointestinal tract.
4. No any food/Drink interaction.
5. Considered as potable dosages forms.
6. Patients of dysphagia, Pediatric and geriatric patients feels easy for the administration.
7. No any compulsion to carry water for having the drug.
8. Bioavailability that is obtained while taking the drug through oral cavity is comparatively enhanced.
9. Patients do not feel any discomfort for administration.

Drawbacks associated with Mouth Dissolving Film (Ketul, et al. 2013)

1. These Dosage forms may absorb the moisture upon standing so may suffer with Hydrolytic degradation.
2. It does not support the higher dose.
3. It may be a bit costly for the packaging.
4. Drug may be affected by various environmental factors like moisture upon storage.

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Drug character Requirements. (Siddiqui, Garg and Sharma 2011)

1. Drug should be acceptable taste.
2. Drug should not have higher dose than 40 mg.
3. Drug molecule should be relatively smaller.
4. There should not be problem of solubility.
5. Drug should have ability to pass conveniently through mucosal cells in oral cavity.
6. Drug should not undergo ionization process in mouth cavity.

Materials required:

Composition (Ghodake, et al. 2013)

Desired drug or API is the prerequisite for the formation of film. API commonly used in the concentration of 5 to 30 %. Apart from the API, different types of polymers that may be natural or synthetic are required for the formation. Polymers are usually considered in the concentration of 45 % and water solubility is the most desirable character for the polymer intended. Agent for the purpose of imparting the plasticizing effect i.e. plasticizer, which are used in the concentration up to 20%. Apart from these, material for stimulating the saliva is also used in the concentration of minimum 3 to maximum of 6%. Sweetening agents are used for enhancing the sweetness in the concentration of 3-6%. Moreover various agents like surface active agents, Flavors, colors are used in required quantity. All the materials used for the formulation should be compatible with each other i.e. one should not affect the properties of the other materials.

Active Pharmaceuticals Ingredients (Joshua, et al. 2016)

For providing the desired therapeutic effect, Active pharmaceutical ingredients are fully responsible. They are chosen based on the therapeutic action required. API having the higher solubility in the water are desirable in the mouth dissolving film. Besides this API having comparatively lower solubility can also be linked with different surfactant so as to enhance the solubility. They must be sufficiently micronized for the better formulation so that the risk of having residues after the administration will be minimized. Several classes of the drugs such as anti-migraine drug, antihypertensive agents, Antiepileptic drugs, Antiparkinson drugs, Antitussive etc. can be used during the formulation of Mouth Dissolving film.

Film forming Polymers (Pathare, Hastak and Bajaj 2013)

Usually for preparing the Mouth Dissolving Films, polymers which are hydrophilic in nature are used which dissolves in tongue. Polymers used for film forming should be soluble in water which shall promotes fast disintegration, gives better mouth feels and should possess the good Mechanical Properties. HPMC E3/E5/E15/K3, Methyl Cellulose A-3/A-6/A-15, PVP-K 90, Pullulan, Pectin, sodium salt of alginate, Gelatin, Polyvinyl Alcohol (PVA), Hydroxy Propyl Cellulose, Eudragit RL100, Polymerised Rosin, Maltodextrins etc.

Ideal Properties of polymers used for film formation:

1. It should be nontoxic and should be non irritant.

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2. It should not cause any reaction with other components in the formulation.
3. It should leave good sensation in the mouth
4. It should have proper wetting and spreadability ability.
5. It should be easily available.
6. It should have a high film forming capacities

In the present days both natural and synthetic polymers are widely used for film preparation. Both the categories have their own advantages and disadvantage. Pectin, Pullulan, Gelatin, Starch, Alignate salt of sodium, Maltodextrin etc are various natural polymers where as HPMC of various grades like E5/E15, Sodium salt of carboxy methyl cellulose, Hydroxyl Propyl Cellulose, Rosin derivatives undergone polymerization etc are various synthetic types of Polymers used for the formation of Mouth Dissolving films. (Nagar, Chauhan and Yasir 2011)

Plasticizers (Juluru 2013)
Plasticizers are the important excipient which provides the flexibility and thus reducing the brittleness of the prepared film. Plasticizers plays important role for increasing the flow along with the polymer strength. The plasticizers to be used during the formulation shall be compatible with the other ingredients thus providing the adequate stability to the products. Normally 0-20% w/w concentration of plasticizers with respect to dry polymer weight is used. Commonly Plasticizers used are derivatives of Phthalate like diethyl Pthalate, dibutyl phthalate, dimethyl Pthalate, polyethylene glycols with low molecular weight, Castor oil, tributyl citrate, acetyl citrate, triethyl citrate, glycerol, triacetin, Different problems like strips peeling, Cracking, blooming, film cracking, film splitting might be encountered with improper use of Plasticizers.

Agents for Stimulation of Saliva (Wanjari 2014)
These are key ingredient whose novel role is to stimulate the production of saliva inside the oral cavity thus allowing rapid wetting, disintegration and dissolution. Their efficacy determines how strongly they can stimulate the saliva and helps in wetting and disintegration. Citric acid and its derivative, Ascorbic acid and its derivative, Maleic acid and its derivative, Lactic acid etc. are normally used for stimulation of Saliva.

Surfactants (Sharma, et al. 2015)
Surfactants are responsible for enhancing wettability and promoting solubility of the formulation. Surfactant's efficacy determines the solubility and wettability of the formulation thus helping the fastest release of the drug out of the dosage forms. Some Examples of Surfactants used for formulation of Mouth Dissolving Film are Polysorbates, Benzalkonium Chloride, Sodium Lauryl Sulphate etc.

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Sweetening agents (Kaur and Garg 2018)

Formulated films must have a pleasant taste. They should not be noxious in nature. To make the mouth dissolving film more patient friendly, different sweetening agents shall be employed in the formulation. Sweetening agents intended to be used must be sufficiently soluble in water and should be colorless in nature so that no additional color will be imparted in the desired formulation. Some of the examples of the sweetening agents that are used in the mouth dissolving films are Fructose, Sucrose, Glucose, Polyhydric alcohol such as Mannitol, Sorbitol, Artificial Sweetening agents such as Sachharin, Aspartame, Sucralose, Neotame, etc.

Flavoring Agents (Ghodake, et al. 2013)

Flavoring agents are the crucial excipients as they enhance the acceptability of the formulation thus increasing the patient compliance. They sufficiently mask the taste of any noxious API. These Flavoring agents are selected from various synthetic oleo resins and flavor oils, various leaves, fruits and flowers extracts of the plant. Depending upon requirements, flavors can be used alone or in the combination. Various flavors such as Peppermint, Menthol, Raspberry, Mixed fruits, Vanilla, Sweet Mint , Cinnamon, Chocolate, Pineapple etc can be used. Type of the flower and strength of the flavour determines the amount to be used.

Colors:

To promote physical appearance, colors are used. Color chosen during the formulation should not be toxic and should not cause any interaction with other components. They should not cause any irritation to the human organ during administration. Different colors such as natural or artificial colors can be employed for the formulation.

Preparation techniques of Mouth Dissolving films:

Solvent Casting Method (Raza, et al. 2019)

In this method of preparation, we take the different types of excipients for the preparation. Polymers are used for the purpose of film formation; Plasticizers are used for the purpose of giving the required rigidity for the prepared film. Another important material required is Superdisintegrants that helps for the faster dissociation of drug molecule out of the prepared film. Colouring agents are used so that we can have film that is attractive in the nature. Flavouring agents are used to increasing the palatability of the formulation. Required sweetness level can be imparted into the film by using different types of sweetness enhancing agents. As the initial step, we proceed for the soaking of the polymer in the water and solution which is viscous in nature is formed. All the materials along with intended drug molecule are put into the solution of the polymers which are subjected for the sonication. After proper sonication, melt is then poured into the petridishes. It shall be allowed for drying to obtain the film.

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Semi Solid Casting Method (Bala, et al. 2013)
In this method two types of solution are separately prepared. One is the solution of the Water Soluble polymer where as another solution is of the polymers which are not soluble in the acids. These two prepared solution then are allowed for mixing. Another step is the preparation of the solution of the Plasticizing agents, Plasticizer. It is also added to above solution which results in the formation of gels. This gel formed is used for film formation. The ratio of acid insoluble polymer to water soluble polymer should be 1:4.

Hot Melt Extrusion Method (Bhattarai and Gupta 2015)
In this method, we don't have to use water as solvent. In this method device called Extruder is utilized for the formation of the film and we shall use the process of heating inorder to give appropriate shape. We should be extremely careful during the Casting process and the Drying process while preparing the Oral film by this method. Active pharmaceutical Ingredient which is in the dry powder state is allowed to be filled in the hopper, which is later subjected for heating after proper mixing. Heat sensitive molecule may get degraded on using this process. Not all the drugs are suitable for these methods.
Rolling Method (Arya, et al. 2010)
Preparing the Film using this method is a bit easy. Drying of the film and cutiing into the desired shape is done through the use of the rollers. That's why is also called rolling method.
Solid Dispersion Extrusion Method (Saxena and Singh 2022)
It uses the amorphous hydrophilic types of polymers as inert carrier for the dispersion of one or more APIs using the method like Hot Melt Extrusion. Immiscible components are subjected for extrusion with the drug and finally dispersions of the solid are made. Films are then prepared by using the dies.

Various Patented Technologies (Desu, et al. 2013)
XGel:
It is extensively used film technology in the pharmaceutical Industry which was originally brought by the agency named as Bio-Progress. It is widely elaborating the product development revolution to meet the market requirements.

Soluleaves: Different Pharmaceutical and Non Pharmaceutical products like agents for Mouth Freshening, Chocolates and Vitamin derivatives use this technology. In other words Flavors release products uses this technology for pleasant and efficient delivery of the Active Pharmaceutical Ingredients in the mouth.
Wafertab: Films allows the incorporation of API after casting in this patented delivery system.

Foamburst: In September, 2004, this new patent was granted for the foamed film made capsules. A honeycomb structure is formed after blowing the gas into the film. Gas is incorporated to fill the void space.

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Micap: In 2004, Micapplc agreement with Bio-Progress water soluble films in 2004 for combining its experts in technology for microencapsulation. It is offering the new delivery mechanism for smoking sensation products.

Evaluation Parameters

Morphology (Juluru 2013)

Scanning Electron Microscopy (SEM) at definite magnifications can be used for study of Morphology of the prepared Mouth Dissolving films

Folding Endurance (Upreti, et al. 2014)

Folding endurance depicts how rigid the film is. It can be determined by taking the certain area of the film and then folding at 180^0c angle of plane in the same place up to when the film gets broken. The number of time it takes to break from the folding place denotes its folding endurance.

Thickness of Film (Bhyan, et al. 2011)

Uniformity in the drug content is affected by one of the factor i.e thickness. Physical stability, appropriate packing etc are also affected by the thickness. Measurement of thickness can be done through the use of calibrated digital calipers or the calibrated Micrometer screw gauge.

Organoleptic Evaluation (Saini, et al. 2012)

Mouth dissolving films preliminary resides inside the oral cavity before the drugs goes into the systemic circulation. Hence the formulation must be organoleptically compatible and acceptable. Appropriate amount of sweetness and the flavors should be present in the mouth dissolving films in order to have higher patient compliance. For the Flavors, they can be detected physically with the smelling sensors present in the nose and for the taste, They can be tested with the tongue. In order to minimize the direct exposure of the taste and flavors to human, several In-vitro tests can be performed .Taste sensors specially designed apparatus can be used for determining the taste and sweetness level. Several experiments using the electronic tongue

Dissolving Time in Mouth (Keshavarao, et al. 2011)

Dissolving time of the prepared film shall be determined in order to predict the actual time that will take for dissolving the film and releases the active moiety into the oral cavity. A beaker is taken in which 50 ml of the phosphate buffer having pH 6.8 is kept and film is allowed to remain in this solution in order to determine the Dissolving time in the Mouth.

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Disintegration study (Maddela and Nalluri 2019)
It shall be performed in order to predict the disintegrating behavior of the prepared Mouth Dissolving Films. It can be performed by two methods namely Drop method and petridish method.
Drop Method: In this method, in the glass slide certain area of the prepared Mouth Dissolving Films (For. E.g. 1 cm^2) shall be kept and on a petridish, it shall be placed planar. Calibrated pipette shall be used for placing a drop of the distilled water on film. Time taken for dissolving and creating a hole in the mouth dissolving film by the drops shall be noted, which gives the disintegrating time for that film.
Petridish Method: Certain area of the mouth dissolving film (For e.g. 4 cm^2) shall be kept in the petridish with distilled water in it. The time taken for complete dissolving of the film in the petridish shall be noted as disintegrating time of the prepared film.

Invitro-Dissolution Test (Somwanshi and Thonte 2018)
Different media such as Phosphate Buffer pH 6.8 can be considered as dissolution medium for determination of the release rate of the drug. Basket type apparatus can be used for the test which shall contain certain volume of water. The film shall be placed in the basket and the temperature of the basket should be maintained at 37±0.5°Cand agitation speed shall be maintained at around 50 rpm. Certain volume of sample for example shall be taken at different time intervals and compensation shall be done with fresh water. The samples then be analyzed by UV spectroscopically at definite wavelength and the cumulative percentage drug release can be calculated.

Dryness test/Tack Test (Irfan, et al. 2015)
It determines how efficiently the film gets adhered. A piece of paper is allowed for pressing between the strips. Currently different instruments are found available for the Tack test. Previously paint industry used this test but now a days, it is extensively used for Mouth dissolving films also.

Drug Content Uniformity (Prabhu, et al. 2011)
In order to find the actual content of the drug loaded in the individual Mouth dissolving films, Drug Content Uniformity test is done. For this Prepared films of appropriate size (For e.g. 25 cm^2) can be transferred into a graduated flask which shall contain certain volume of distilled water (For. E.g. 100 ml). The flask then shall be shaken for about 4 hours in a mechanical shaker. After completion of shaking the solution shall be filtered and diluted with distilled water up to suitable dilutions. Absorbance of the diluted solution shall be shall be measured at certain wavelength (For e.g. 230 nm) using a placebo patch as a blank and finally drug content can be calculated.

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Surface pH (Pawar, et al. 2019)

It is necessary to determine the surface pH of the formulation for assuring appropriate distribution of the drug in the site and to determine the non irritancy behavior of the film. Surface pH can be determined by using the apparatus known as pH meter. Film surface is touched with the rod after it is made wet by the distilled water. Since the Oral Mucosa is viable to irritation at acidic or basic pH, determining and optimization of it becomes the crucial during the formulation.

Tear Resistance Value (Desu, et al. 2013)

The formulated mouth dissolving films may break or rupture due to the different reasons. They must be sufficiently resistant to rupture so that the physical stability of the formulation can be maintained. Tear resistance is the measure of resistance of mouth dissolving film to rupture and is calculated by subjecting the film to a constant rate of the distortion. Maximum stress or force needed to rupture the film is measured in Newton's or Pound-Force. After the measurement of the stress and respective strain, a curve shall be plotted between the stress and strain and by measuring the area of the curve, Toughness of the film can be predicted.

Accelerated Stability Study (Bhyan, et al. 2011)

Formulation may degrade or lose its physical or chemical characteristics with increasing time. Thus Stability study is the most important aspect of the formulation. Accelerated condition can be applied to the formulation depending on the stability zone based on stability guideline and kept for stability. Usually RH of 75± 5% and temperature of $40\pm2^{O}C$ is recommended for climatic zone IV for accelerated stability study for the period of 3 month and 6 month.

Swelling Property (Mankar, Biyani and Umekar 2020)

Determination of swelling property of the mouth dissolving film is most important aspect of evaluation as this affect the stability and packaging of the formulation. For determining it, Film sample can be weighed and can be placed in steel wire mesh which is previously weighed. Simulated Saliva solution shall be taken and the wire mesh containing the film shall be submerged into certain volume of the medium in a plastic container. After the constant weight of the film is attained, then it is taken out, weighed and degree of swelling can be calculated as below:

Degree of swelling = Wt-W0/W0,

Where Wt. =Weight of the film at time t, and W0 is the initial weight of the film.

Contact Angle measurement (Irfan, et al. 2015)

Mouth Dissolving Films shall be subjected to wetting, disintegration and dissolution. Contact angle measurement is done to predict the behavior of the mouth dissolving films. Instruments called Goniometer can be employed for the measurement of the contact angle. Temperature plays a crucial role and it should be clear that the temperature should be normal room temperature. The Double Distilled water is used for determination of contact angle. For the procedure a drop of

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distilled water can be placed on the surface of the dry film. Images of the water droplets can be taken with the help of digital camera and digital pictures can be analyzed by image J1.28 v software (NIH, USA) for determining the angle.

Weight Variation (Panchal, et al. 2012)
Prepared Mouth Dissolving film should be have weight uniformity. For this certain number of mouth dissolving films can be taken and weighed in the analytical balance individually.Average weight of the films can be calculated and maximum and the minimum deviation from the average weight shall be determined.

Drug –excipient compatibility study (Rekha, et al. 2014)
Stability of the formulation of mouth dissolving films depends upon the Drug-Excipient compatibility. Selection of the excipients thus becomes the crucial part during the formulation. There must not be undesired interaction between the drug and the chosen excipient. Physical, Chemical and Mechanical properties of the Active pharmaceutical ingredients and the excipients used shall be studied to find out any adverse chemical reaction. Incompatible excipients may lead to the unstable formulation and causes the inefficacy of the products. Thus Drug-Excipient compatibility is most important. Fourier Transform Infrared Spectroscopy (FTIR), Differential scanning calorimetry (DSC), thin layer chromatography and X-ray diffraction technology can be used to assess possible drug excipient interaction.

Percentage Moisture Absorption (Momin, et al. 2019)
Mouth dissolving film might absorb moisture content when placed in the environment having high humidity and gain certain weight. So, percentage moisture absorption is calculated in order to know the physical stability of the film in the high humid condition. Certain number of film shall be taken and shall be weighed accurately. Desiccators with the chemical namely saturated solution of aluminum chloride are considered. Certain humidity condition shall be maintained inside the desiccators (For e.g. 79.5%). Film shall be kept in the desiccators for about 72 hours and weighed again. Percentage moisture absorption can be calculated as:
Percentage Moisture Absorption=Final weight-Initial Weight /Initial Weight *100

Percentage Moisture Loss (Momin, et al. 2019)
Percentage moisture loss is determined for assuring the integrity of the films in the dry condition. For this, certain area of the film is taken and weighed in the analytical balance. Desiccators having the chemical namely calcium chloride is considered and the prepared films are kept in these for about 72 hrs followed by removal and reweighing. Percentage moisture loss can be calculated as:
Percentage Moisture Loss= (Initial Weight –Final Weight)/Initial Weight

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Obstacles/Challenges that are faced during formulation of mouth dissolving films (Jadhav, Galgatte and Chaudhari 2013)

1. Problem associated with drug solubility.
2. Special taste masking agent required for the unpalatable drugs.
3. Difficulty in having the uniformity in the dosage.
4. Financial challenges for arranging the packaging materials.
5. Problems on storage of the drugs with preservation of the content.

Storage/Packaging (Aggarwal, et al. 2011)

Prepared Mouth Dissolving films shall be properly stored and preserve so that the formulation will be stable for long term use. Unit dose packaging is usually recommended for the Mouth dissolving film because once the films are opened from the packing materials for use, they may take the moisture, may get degraded by the light or humidity present in the environment. Packaging of the several Mouth Dissolving films in a single pouch or packaging is thus not preferred. There are various factors that we must be concern while choosing the packaging material. Packaging materials should not have any adverse effects/negative effects on the product quality. They should not harm the stability of the formulation and should be non reactive as much as possible. Packaging materials should have higher efficiency for protecting the intended drug. It should not impart any toxicity or it should not produce harmful substances upon storage. Previously quality assured packaging materials shall be used for the packaging process. There should not be any exchange of the color and taste between the drug and the packing material. Packaging materials intended to be used shall be approved by international regulatory authorities like FDA. They should be of sufficiently high quality and able to protect the drug from the various environmental degrading factors. (Gupta, Bisht and Rao 2019) Pouches made from the plastic/foil/paper/aluminum, Pouch for single/unit dosage, Pouch for large number of films/Multiple films etc are commonly used packaging materials for these types of dosage forms. (Chandramouli, et al. 2022)

CONCLUSIONS:

Pharmaceutical technologists have been continuously involving for novel drug development process. Their continuous efforts have made it possible for achieving the rapid therapeutic effect to the patients in case of the emergency. Easy handling, Portable for the transportation, Non compulsive water requirement, and fastest relief to the patient are the key factors that attract the population of patients towards this dosage form. Novel technologies developing the mouth dissolving films of the different therapeutic category have been a part of the research of many pharmaceuticals researchers. Technological and economical investment of the global authorities is required for enhancing this technological boon as an alternative approach among others conventional dosage forms.

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REFERENCES

Aggarwal, J., Singh, G., Saini, S., & Rana, A. (2011). Fast Dissolving Films: A Novel Approach to Oral Drug Delivery. *International Research Journal of Pharmacy, 2*(12), 69-74.

Arya, A., Chandra, A., Sharma, V., & Pathak, K. (2010). Fast Dissolving Oral Films: An Innovative Drug Delivery System and Dosage Form. *International Journal of ChemTech Research, 2*(1), 576-583.

Bala, R., Pawar, P., Khanna, S., & Arora, S. (2013). Orally Dissolving Strips:A New Approach to Oral Drug Delivery System. *International Journal of Pharmaceutical Investigation, 3*(2), 67-76.

Bhattarai, M., & Gupta, A. K. (2015). Fast Dissolving Oral Films: A Novel Trend to Oral Drug Delivery System. *Sunsari Technical College Journal, 2*(1), 58-68.

Bhyan, B., Jangra, S., Kaur, M., & Singh, H. (2011). Orally Fast Dissolving Films:Innovations in Formulation and Technology. *International Journal of Pharmaceutical Sciences Review and Research, 9*(2), 50-57.

Chandramouli, M., Shivalingappa, R. P., Basavanna, V., Doddamani, S., Shanthakumar, D. C., Nagarajaiah, S. R., et al. (2022). Oral Thin-films From Design to Delivery: A Pharmaceutical Viewpoint. *Biointerference Research in Applied Chemistry, 13*(2), 1-23.

Desu, P. K., Brahmaiah, B., Nagalakshmi, A., Neelima, K., Nama, S., & Baburao, C. (2013). An Overview on Rapid Dissolving Films. *Asian Journal of Pharmaceutical Research, 3*(1), 15-23.

Ghodake, P. P., Karande, K. M., Osmani, R. A., Bhosale, R. R., Harkare, B. R., & Kale, B. B. (2013). Mouth Dissolving Films: Innovative Vehicle for Oral Drug Delivery. *International Journal of Pharma Research and Review, 2*(10), 41-47.

Gupta, P., Bisht, A., & Rao, N. G. (2019). Fast Dissolving Oral Films:A Comprehensive Review. *World Journal of Pharmaceutical and Medical Research, 5*(7), 116-127.

Irfan, M., Rabel, S., Bukhtar, Q., Qadir, M. I., Jabeen, F., & Khan, A. (2015). Orally Disintegrating Films: A Modern Expansion. *Saudi Pharmaceutical Journal, 24*(5), 537–546.

Jadhav, Y. G., Galgatte, U. C., & Chaudhari, P. D. (2013). Challenges in Formulation Development of Fast Dissolving Oral Films. *Indo American Journal of Pharmaceutical Research, 3*(8), 6391-6407.

Joshua, J. M., Hari, R., Jyothish, F. K., & Surendran, S. A. (2016). Fast Dissolving Oral Thin Films: An effective Dosage Form for Quick Releases. *International Journal of Pharmaceutical Sciences Review and Research, 38*(1), 282-289.

Juluru, N. S. (2013). Fast Dissolving Oral Films: A Review. *International Journal of Advances in Pharmacy, Biology and Chemistry, 2*(1), 108-112.

Kaur, P., & Garg, R. (2018). Oral Dissolving Film: Present and Future Aspects. *Journal of Drug Delivery and Therapeutics, 8*(6), 373-377.

Keshavarao, K. P., Mudit, D., Gunashekara, K., Anis, S., Singh, M. N., & Ajay, K. (2011). Formulation and Evaluation of Mouth Dissolving Film Containing Rofecoxib. *International Research Journal of Pharmacy, 3*(2), 273-278.

Ketul, P., Patel, K., Patel, M., & Patel, N. (2013). Fast Dissolving Films:A Novel Approach to Oral Drug Delivery. *International Journal of Pharmacy Teaching & Practices, 4*(2), 655-661.

Maddela, S., & Nalluri, B. N. (2019). Development Of Zolmitriptan Mouth Dissolving Films: Formulation Variables,. *Asian Journal of Pharmaceutical and Clinical Research, 12*(4), 273-279.

Mankar, J., Biyani, D., & Umekar, M. (2020). Oral Thin Film: Advanced Oral Dosage Form. *Global Journal of Pharma and Allied Sciences, 1*(5), 1-7.

Momin, M., Lalka, S., Mhatre, S., & Mistry, S. (2019). Formulation Development and In-Vitro Charaterization of Fast Dissolving Polymeric Film of Olanzapine for the Management of Panic Attack of Schizophrenia. *International Journal of Pharmaceutical Sciences and Research, 10*(4), 1765-1774.

Nagar, P., Chauhan, I., & Yasir, M. (2011). Insights into Polymers: Film Formers in Mouth Dissolving Films. *Drug invention today., 3*(12), 280-289.

Neeta, Dureja, H., Bhagwan, S., Seema, & Dahiya, J. (2012). Fast Dissolving Tablets: An Overview. *Novel Science International Journal of Pharmaceutical Science, 1*(5), 228-232.

Panchal, M. S., Patel, H., Bagada, A., & Vadalia, K. R. (2012). Formulation and Evaluation of Mouth Dissolving Film of Ropinirole Hydrochloride by Using Pullulan Polymers. *International Journal of Pharmaceutical Research & Allied Science, 1*(3), 60-72.

Pathare, Y. S., Hastak, V. S., & Bajaj, A. N. (2013). Polymers Used for Fast Disintegrating Oral Films:A Review. *International Journal of Pharmaceutical Sciences Review and Research, 21*(1), 169-178.

Patil, P. C., Shrivastava, S., Vaidehi, S., & Ashwini, P. (2014). Oral Fast Dissolving Drug Delivery System:A Modern Approach for Patient Compliance. *International Journal of Drug Regulatory Affairs, 2*(2), 49-60.

Pawar, R., Sharma, R., Sharma, P., & Darwhekar, G. (2019). A Review on Mouth Dissolving Film. *Journal of Drug Delivery and Therapeutics, 9*(6), 206-210.

Prabhu, P., Malli, R., Koland, M., Vijaynarayana, K., D'Souza, U., Harish, N. M., et al. (2011). Formulation and evaluation of fast dissolving films of. *International Journal of Pharmaceutical Investigation, 1*(2), 99-104.

Raza, S. N., Kar, A. H., Wani, T. U., & Khan, N. A. (2019). Formulation and Evaluation of Mouth Dissolving Film of Losartan Potassium Using 3^2 Factorial Design. *International Journal of Pharmaceutical Sciences and Research, 10*(3), 1402-1411.

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ISSN 2063-5346

Rekha, M., Sultana, S., Mahathi, K., Praveen, P., Prathima, B., & Seethadevi, A. (2014). Novel Oral Drug Delivery System: Fast Dissolving Buccal Films. *Americal Journal of Pharmacy and Health Research, 2*(12), 17-41.

Saini, P., Kumar, A., Sharma, P., & Visht, S. (2012). Fast Disintegrating Oral Film:A recent Trend of Drug Delivery. *International Journal of Drug Development and Research, 4*(4), 80-94.

Saxena, A., & Singh, T. (2022). Oral Dissolving Films:A Comprehensive Review on Recent Perspectives and Current Approach to Effective Drug Delivery. *Journal of Drug Delivery and Therapeutics, 12*(2), 139-147.

Sharma, D., Kaur, D., Verma, S., Singh, D., Singh, M., Singh, G., et al. (2015). Fast Dissolving Oral Films Technology: A Recent Trend for an Innovative Oral Drug Delivery System. *International Journal of Drug Delivery, 7*(2), 60-75.

Siddiqui, M. N., Garg, G., & Sharma, P. K. (2011). A Short Review on "A Novel Approach in Oral Fast Dissolving Drug Delivery System and Their Patents". *Advances in Biological Research, 5*(6), 291-303.

Somwanshi, S. V., & Thonte, S. S. (2018). Formulation Development and Invitro Evaluation of Elitriptan Fast Dissolving Oral Films. *International Journal of Pharmaceutical Sciences and Drug Research, 10*(6), 447-453.

Upreti, K., Kumar, L., Anand, S. P., & Chawla, V. (2014). Formulation and evaluation of mouth dissolving films of paracetamol. *International Journal of Pharmacy and Pharmaceutical Sciences, 6*(5), 200-202.

Vidyadhara, S., Sasidhar, R. L., Balakrishna, T., & Vardhan, M. S. (2015). Formulation of Rizatriptan Benzoate Fast Dissolving Buccal Films by Emulsion Evaporation Technique. *International Journal of Pharmaceutical Investigation, 5*(2), 101-106.

Wanjari, D. (2014). An overview on Fast Dissolving Oral Strips. *International Journal of Bioassays, 3*(7), 3185-3187.