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Variousapproachestowardstastemasking: Anoverview

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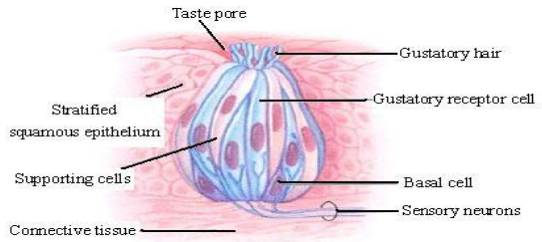
ABSTRACT
Taste masking is the process of masking the bitter taste of drug for improving the patient compliance. As the taste masking is for all the drug but it is mainly seen in the drug of pediatric & geriatric patient. Taste maskingis improve by reducing the affinity o drug with taste receptor. Taste masking is done by application of polymer, amino acid, sweetening agent, & flavoring agent and also by removing of those group which are responsible for the bitter or unpleasant taste.To overcome this problem, many techniques have been developed to mask the bitter taste of drugs. These techniques are not only mask the bitter taste of drug but also enhance the bioavailability and performance of drug dosage form. It includes adding sugars, flavors, sweeteners, use of ipoproteins, numbing taste buds, granulation, use of adsorbates , coating drug, microencapsulation, multiple emulsion, viscosity modifier, vesicles and liposomes, prodrug and salt formation, inclusion and molecular complexes, solid dispersion and Ion Exchange Resins (IERs) which have been tried by the formulators to mask the unpleasant taste of the bitter drugs. The present review article highlights different technologies of taste masking with respect to dosage form and novel methods of evaluation of taste masking effect.
Keywords: Taste, Taste masking, Taste masking techniques, Taste evaluation, E-tongue

I. INTRODUCTION

Oral administration of bitter drugs with an acceptable degree of palatability is a key issue for health care providers, especially for pediatric patients [1].Taste masking is defined as a perceived reduction of an undesirable taste that would otherwise exist. The ideal solution to reduce or inhibit bitterness is the discovery of a universal inhibitor of all bitter tasting substances that does not affect the other taste modalities such as sweetness or saltiness [2].Taste-masking techniques are applied to mask or overcome the bitter or unpleasant taste of active pharmaceutical ingredients/drugs to achievepatientacceptability andcompliance.Oral administration of bitter or unpleasant tasting drugs is often thebiggest barrier for patient groups, such as pediatrics and geriatrics.



(Fig. 1: Anatomy and Physiology of taste bud)

In the past few years, significant progress has been made in the area of taste-masking by applying novel strategies and techniques, such as hot-melt extrusion and microencapsulation. Masking of bitter taste of drugs is an important parameter for the improvement of patient compliance [3].

1.1. TASTE MASKING TECHNOLOGIES

Taste masking is defined as aperceived reduction of undesirable taste that would otherwise exist. Methods commonly used for taste masking involves various physical and chemical method that prevent the interaction of taste bud with drugs, Two approaches are commonly utilized to overcome bad taste of the drug.Taste-masking techniques often go hand in hand with the formulation technology. In short, they need to be mutually compatible. For example, coated particles obtained after fluid-bed coating should be able to withstand the tablet compression process used for the final dosage form (tablet) manufacturing. The commonly used industrial techniques/methods of taste-masking include organoleptic methods, polymer coating, hot-melt extrusion, microencapsulation, complexation, and spray-drying.

1. By reducing the solubility of drug in the pH of saliva(5.6 - 6.8).
2. By altering the affinity and nature of drug which will interact with the taste receptor.

An ideal taste masking process and formulation should have the following properties.
1) Involve least number of equipments processing steps.
2) Effectively mask taste with as few excipients which are economically and easily available.
3) No adverse effect on drug bioavailability.
4) Least manufacturing cost.
5) Can be carried out at room temperature.
6) Require excipients that have high margin safety.
7) Rapid and easy to prepare [4, 5]

1.2. MATERIAL USED FOR COATING

- Synthetic polymers (Eudragits)
- Proteins, Gelatine, and Prolamines (Zein)
- Zeolites

It is classified based on the type of coating material,coating solvent system, and the number of coating layers. Hydrophobic polymers, lipids, sweeteners and hydrophilic polymers can be used as coating materials,either alone or in combination. Multilayer coating has been used to overcome thechallenges of coating imperfections, which otherwise lead to a decline in the taste masking performance, especially for the aggressively bitter drugs. The corematerials were coated with a first smooth and uniform spacing layer, which can minimize the coating imperfections during the second layer coating and canalso act as an instant barrier between the taste receptors and the bitter core materials [6].

1.3. ORGANOLAPTIC METHODS

This is the simplest and most convenient method of taste-masking. It involves adding a combination of sweeteners (sucralose, aspartame) and flavors (orange, mint) to mask the unpleasant taste of low to moderately bitter actives. In addition, effervescent agents (sodium bicarbonate, citric acid) can also be added to improve the mouth feel.Some formulations may include a bitterness blocking agent that masks the bitter taste or the perception of bitter on the tongue. Such bitter blockers may include adenosine monophosphate, lipoproteins, or phospholipids. These agents compete with the bitter active to bind to the G-protein coupled receptors on the tongue (receptor sites that detect bitter), thus suppressing the bitter taste [7].It has also been found that sodium chloride can be added to a formulation to mask bitterness as in the preparation of pioglitazone hydrochloride orally disintegrating tablets.

1.4. POLYMER COATING

The simplest option is direct coating that provides a physical barrier over the drug particles with a composition that is insoluble in the mouth. Hydrophobic or hydrophilic.Polymers, lipids, and sweeteners can be used as coating materials, alone or in combination to produce a single or multi-layer coat. Methacrylic acid and methacrylic ester copolymers (Eudragit E-100, RL 30D, RS 30D, L30D-55, and NE 30D) have been effectively used for taste-masking with polymer coat levels varying from 10% to 40%, depending on the drug bitterness [8].Fluid bed is often the technique of choice.Most recently, alternate approaches such as application of molten lipids [glycerylpalmitostearate (Precirol® ATO-5, Gattefosse, France) and glycerol behenate(Compritol® 888-ATO, Gattefosse, France)] on the surface of drug particles has beenused as a solvent-free alternative.

1.5. HOT MELT EXTRUSION

Hot-melt extrusion (HME) offers a relatively newer approach to taste-masking and provides advantages such as absence of organic solvents in the process, fewer processing steps, continuous operation, and scale-up capabilities [9].For the purpose of taste-masking, the bitter active is mixed with other ingredients in a dry state. The mixture is filled in a hopper, conveyed, mixed, and melted by an extruder. The process subjects the materials to a heating process under intense mixing to obtain the taste-masked extrudates. The extrudate can then be milled or micronized to obtain taste-masked granules or particles, which are then incorporated into a suitable dosage form. Twin screw extruders are one of the most popular extruders and provide advantages such as short transit time, material feed, high shear kneading, and less over-heating.

1.6. MICROENCAPSULATION

Microencapsulation is a technology with a long history in the pharmaceutical industry, and taste-masking represents an expanded area of its application. In principle, microencapsulation provides the opportunity to encapsulate the bitter active and thus prevent its contact with taste buds. Microcaps is one such well-recognized technology that applies coacervation/phase separation to produce differentencapsulated polymeric membranes. The process primarily consists of formation ofthree immiscible phases, formation of the coat, and deposition of the coat. Theformation of the three immiscible phases is accomplished by dispersing the coreparticles in a polymer solution. A phase separation is then induced by change in thetemperature of polymer solution; change in the pH, addition of a salt, non-solvent, orby inducing a polymer-polymer interaction. This leads to deposition of the polymercoat on the core material under constant stirring. The core particles coated by thepolymer are then separated from the liquid phase by thermal, crosslinking, ordesolvation techniques

leading to rigidization of the coat [10].Microcaps are used inconjunction with Advatabcompressed ODT technology.

1.7. COMPLEXATION

Cyclodextrins have been extensively used for taste-masking bitter drugs by forming inclusion complexes with the drug molecule. Cyclodextrins are unique bucket-shaped cyclic oligosaccharides containing at least six D-(+)-glucopyranose units attached by alpha-(1,4)-glucosidic bonds with a molecular structure of hydrophobic cavity and hydrophilic exterior. The formation of inclusion complexes and its type depends on several factors like drug properties, processes involved, the equilibrium kineticsM, formulation excipients, and the desired final dosage form and delivery system. Tastemasking is achieved by the interaction of cyclodextrins with proteins of the taste buds or by inhibiting the contact of bitter drug molecules with taste buds.

Ion exchange resins provide an alternative to cyclodextrins to achieve taste-maskingby complexation [11].Ion exchange resins are high molecular weight polymers withcationic and anionic functional groups. The preparation of the taste-masked complexinvolves suspending the resin in a solvent in which the drug is dissolved. The drugresincomplex formed is referred to as drug-resinate, which prevents direct contact ofthe drug with taste buds, thus providing taste-masking during administration. Uponingestion, the resin exchanges the drug with the counter ion in the gastrointestinaltract, and the drug is released to be absorbed. Commercially available ion exchangeresins that may be used for taste-masking are based on methacrylic acid –divinylbenzene polymer and styrene - divinyl benzene polymer.

1.8. SPRAY DRYING

Spray-drying provides an alternate approach to taste-masking by applying a physical barrier coating. The bitter drug is either dissolved or dispersed along with the polymerin a suitable solvent followed by spray-drying. The process usually consists of threedifferent steps: (1) atomization of feed into a spray, (2) spray-air contact (mixing and iflow) followed by drying, and (3) separation of dried product from the air. The processprovides the option of using aqueous and non-aqueous solvents. The dried productoften includes granules or beads containing taste-masked encapsulated drug. Theamount of polymer coat can sometimes retard the drug release, and thereforerequires careful polymer selection and process design to afford taste-masking. Also,the formulation and processing can affect whether or not the polymer is "coated" onthe surface or dispersed. The quality of taste-masking depends on providing a co-dispersion. Some of the advantages of spray-drying include (a) less processingtime being a single step process, (b) scale-up capability, and (c) wide variety in thechoice of solvent and polymerate.

1.9. TASTE MASKING WITH FLAVOURS, SWEETENERS & AMINO ACID

This technique is the foremost and the simplest approach for taste masking, especially in the case of pediatric formulations, chewable tablets, and liquid formulations. But this approach is not very successful for highly bitter and highly water soluble drugs. Artificial sweeteners and flavors are generally being used along with other taste-masking techniques to improve the efficiency of these techniques.Numerous their combination because of its spicy and slight anesthetic effect. To support the taste masking capabilities of clove, honey vanilla or artificial vanilla flavor is preferred. Calcium carbonate, citric acid, or sodium bicarbonate may be included in the formulation if effervescence is required. Drugs, which can be taste masked by this composition, include acetaminophen, aspirin, ketoprofen, H2-blockers, etc [12]. A composition comprising of anethole, eucalyptol (provides cooling, vapor action), and methyl salicylate (inhibits bitterness) can be used to mask the unpleasant taste of thymol, leaving the consumer with a pleasanttaste perception [13].Sodium citrate dihydrate, sodium saccharin, refined sugar, and flavors have been used to mask the bitter taste of ibuprofen when formulated as a syrup with pyridoxine HCl [14].

Table 1: Taste masking with flavors, sweeteners and amino acid

Sl. No.	Drug(s)/Active Agent(s)	Type of Formulation	Taste Masking Agent(s)
1	Eucalyptus oil	MouthwashesFenchone, borneolorisoborneol	
2	Aspirin	Medicated floss	Sodium phenolate
3	Thymol		–Anethole, eucalyptol andmethylsalycilate
4	Ibuprofen	Syrup	Sodium citrate dehydrate ,Saccharine &refined Sugar

1.10. TASTE MASKING WITH LIPOPHILIC VEHICLE

Oils, surfactants, polyalcohols, and lipids effectivelyincrease the viscosity in the mouth and coat thetaste buds, and therefore they are potential

tastemaskingagents. Guaifenesin has improved taste whenmixed with carnauba wax and magnesium aluminiumsilicate and then melt-granulated [15].The taste of cimetidine can be improved by granulating it with glyceryl monostearate [16].Gabapentin (acyclic amino acid, a drug for seizures) has improved taste whencoated with gelatin and then mixed with partially hydrogenated soybean oil and glyceryl monostearate [17].The taste of isoprothiolane can be masked by mixing it with hydrogenated oil at 80°C and spraydried. The resulting granules are coated with hydroxypropyl methylcellulose. Acetaminophen granules are sprayed with molten stearyl stearate, mixed with suitable tablet excipientsand incorporated into a taste-masked, chewable tablet formulation. Bitterness-free syrup ofcarbetapentanecitrate, diphenhydramine HCl acetaminophen, and Noscapine HCl can be formulated using polygylcerine fatty acid ester, glycerin, and chained triglycerides.

Table 2: Taste masking with lipophilic vehicle

S. No	Drug(s)/active agent(s)	Technique/formulation	Taste masking agent
1	Guaifenesin	Melt granulation	Carnauba wax and Magnesium aluminiumsilicate
2	Cimetidine	Granulation	Glyceryl monostearate
3	Gabapentin	Coating	Gelatin and mixture of partially hydrogenated soyabeen& GlycerylMonostearate
4	Isoprothiolane	Spray drying and coating	Hydrogenated oil and HPMC
5	Acetaminophen	Spraying/tablet	Molten stearylStearate
6	Acetaminophen, diphenhydramine, carbetapentane citratetryglycerides and noscapine HCl	syrup	poly fatty acid ester, glycerine& chained

1.11. TASTE MASKING WITH BY COATING WITH HYDROPHILIC VEHICLE

This is the simplest and most feasible option toachieve taste masking. The coating acts as a physicalbarrier to the drug particles, thereby minimizing interactionbetween the drug and taste buds. Coatingof chewable tablets provides excellent taste maskingwhile still providing acceptable bioavailability. Aspecialized technique, i.e., micro emulsion technology,has been used for taste masking of powders, chewabletablets, and liquid suspensions.

1.12. CARBOHYDRATES

The taste of orally administered drugs can be masked by coating the drug with carbohydrates. Bitter solid drugs such as pinaverium bromide, a spasmolytic, has no bitter taste when formulated in an organoleptically acceptable manner by polymer coating with amixture of cellulose or shellac and a second filmforming polymer soluble at pH less than 5 [18].A preparation of the anti-ulcerative drug propanthelinebromide is coated on low substituted sphericalhydroxypropyl cellulose and further coated with ethylcellulose to mask the unpleasant taste while readilyreleasing the active ingredients. Taste masking of ibuprofen has been successfully achieved by using theair-suspension coating technique to form microcapsules,which comprise a pharmaceutical core ofcrystalline ibuprofen and a methacrylic acid copolymer(Eudragit) coating that provides chewable taste-maskedcharacteristics [19].

1.13. PROTEIN, GELATIN& PROLAMINES

Prolamines are zein, gliadin, and hordein. Various antibiotics, vitamins, dietary fibers,analgesics, enzymes, and hormones have been effectively taste masked using prolamine coatings. The taste masking is effective over a prolonged storage period. Besides effectively masking the taste of the bitter drug, prolamine coating does not affect the immediate bioavailability of the active substance. Zein or gliadin in combination with plasticizer were highly effective incontrolling the release of the active substance from the encapsulated particle and masking the unpleasant taste of the coated active substance [20]Granules consisting of cetraxate hydrochloride, corn starch, and Macrogol-6000 were coated with a mixture of Eudragit S-100, talc, and silica to mask bitter taste [21, 22].

Remoxipride, a D2-dopamine receptor antagonist, is well tolerated and completely absorbed after oral administration. Because of its extremely bitter taste, remoxipride is not a good candidate for oral administration. So, a palatable oral suspension of the drug was developed using microencapsulation, which provides complete bioavailability, but has a delayed absorptionrate of 3 h. In comparison, absorption was delayed only 1.6 h in a capsule form and only 1.0 h in an aqueous solution of 0.5% sodium lauryl sulfate.

1.14. ZEOLITE

Bactericidal feeds for domestic animals generally impart bitter taste to the formulation and

may create feeding aversion among the animals during the treatment [23].To improve the taste of such formulations, the active agent (tiamulin fumarate) may be dissolved methanol, supported on mordenite-type zeolite or starch, dried, and further premixed with the supports to produce sustained-release, bitterness-free granules. The resulting formulation has stronger bactericidal effect onMycoplasma, Staphylococcus, and Corynebacterium [24].Given table summarizes taste masking of drugs by polymercoating.

Table 3: Tastemaskingbycoatingwith polymer

S. No	Drug(s)/active agent(s)	Technique	Polymer(s) used
1	Pinaverium bromide	Coating	Cellulose or shellac
2	Propantheline bromide	Coating	L-HPC, EC
3	Ibuprofen	Air-suspension coating	Eudragit
4	TriprolidineHCl	Dispersion coating	HPMC
5	Dimenhydrinate	–	Eudragit or CMC or starch
6	CefeaneldaloxateHCl	Granulation and coating	PVP, EC, HPMC,Trisodium citrate
7	Enoxacin	Granulation and coating	HPC, HPMC, EC
8	Sparfloxacin	Granulation and coating	L-HPC, EC, HMC/EC, HPMC, titanium dioxide and sucrose fatty acid ester mixture

Note:HPMC:Hydroxypropyl methyl cellulose; HEC: Hydroxyethyl cellulose; HPC:Hydroxypropyl cellulose; L-HPC: Low substituted hydroxypropyl cellulose; CMC:Carboxy methyl cellulose; PVP: Polyvinyl pyrollidone; EC: Ethyl cellulose; MCC: Microcrystalline cellulose; PEG: Polyethylene glycol

II. TASTE MASKING BY ION EXCHANGE RESINS

Ion-exchange resins (IERs) are high molecular weight polymers with cationic and anionic functional groups. The most frequently employed polymeric network is a copolymer of styrene and divinylbezene. Ion-exchange resins are used in drug formulations to stabilize the sensitive components, sustain release of the drug, disintegrate tablets, and mask taste. Drug canbe bound to the resin by either repeated exposure of the resin to the drug in a chromate graphic column or by prolonged contact of resin with the drug solution. Drugs are attached to the oppositely charged resin substrate, forming insoluble adsorbates or resonates through weak ionic bonding so that dissociation of the drug-resin complex does not occur under the salivary within the gastrointestinaltract (GIT). Drug molecules attached to the resin are released by exchanging with appropriately charged ions in the GIT, followed by diffusion of free drug molecule out of the resins.

Ion exchange resins can be classified into fourmajor groups:

. Strong acid cation-exchange resin.
. Weak acid cation-exchange resin.
. Strong base anion-exchange resin.
. Weak base anion-exchange resin.

Strong acid cation resins (sulfonated styrenedivinylbezene copolymer product) function throughout the entire pH range and can be used for masking the taste of basic drugs. Weak acid cation exchange resins function at pH values above 6.0. Similarly, strong baseanion-exchange resins function throughout the entire range and can be used for masking the taste of acidic drugs, while the weak base anion exchange resins function well below pH 7.0 [25].

Table 4: Tastemaskingwithcomplexingagent& Ion exchangeresins

S. No	Drug	Resin/complexing agent
1	Carbetapentane citrate	Cyclodextrin
2	Ibuprofen	Hydroxypropyl b-cyclodextrin
3	Gymnemasylvestre	β-cyclodextrin
4	Chlorpheniramine maleate	Indion CRP 244, indion CRP 254
5	Diphenhydramine HCl	Indion CRP 244, indion CRP 254
6	Buflomedil	Amberlite IRP 69
7	Orbifloxacin	Amberlite IRP 69
8	Chloroquine phosphate	Indion 234

2.1. TASTE MASKING APPROCHES & EVALUATION OF TASTE MASKING

1) Extent of the bitter taste of the API.
2) Required dose load.
3) Drug particulate shape and size distribution.
4) Drug solubility and ionic characteristics.
5) Required disintegration and dissolution rate ofthe finished product.

6) Desired bioavailability.
7) Desired release profile.
8) Required dosage form.
9) Taste masking absorption
11). Taste Masking with Lipophilic Vehicles lipids and lecithins
12). Taste Suppressants and Potentiators
13). Taste masking by gelation
14). Formation of salt and derivative
15). Use of Amino Acids and Protein Hydrolysates
16). Miscellaneous.
a) By effervescent agents
b) Rheological modification
c) Continuous multipurpose melt (CMT) technology
d) Wet Spherical Agglomeration (WSA)

2.3. EVALUATION

Taste, to think of, is a very subjective perception. Depending on individuals, theperceived taste may vary to different degrees. Quantitatively evaluate taste sensation, following methods have been reported in literature.
1. Panel testing (human subjects)
2. Measurement of frog taste nerve responses.
3. Multichannel taste sensor/ magic tongue
4. Spectrophotometric evaluation/ D30's value

2.4. A- IN VIVO TESTING

1. Panel testing (human subjects)

The panel testing is a psychophysical rating of the gustatory stimuli. In vivo taste evaluation carried out on a trained taste panel of 5-10 healthy volunteers organoleptic sense, with their prior consent. On placing the dosage form in mouth for 60 sec, bitterness recorded against pure drug using a numerical scale.

2.5. B- IN VITRO TESTING

1. Multichannel Taste Sensor / Magic tongue

Invention of "E-Tongue" electronic sensor array technology overcomes this problem, which is a device for recognition, quantitative multicomponent analysis and artificial assessment of taste and flavor. It recognizes three levels of biological taste includingreceptor level (Taste buds in humans, probe membranes in E-Tongue), circuit level (neural transmission in humans, transducer in E-Tongue), and perceptual level (cognition in the thalamus humans, computer and statistical analysis in the E-Tongue).

The probes consist of a silicon transistor with proprietary organic coatings, which govern the probe's sensitivity and selectivity, and measurement done potentiometrically. Each probe is cross selective to allow coverage of full taste profile and statistical software interprets the sensor data into taste patterns.

III. RECENT APPROACHES IN DEVELOPMENT OF TASTE MASKING

Yajima [26]developed a method of taste masking using a spray-congealing technique to mask the bitter taste of clarithromycin. Glyceryl monostearate and aminoalkyl methacrylate copolymer E (AMCE) were selected as ingredients. The palatability and taste of optimized formulation (CAM: GM: AMCE, 3:6:1) were significantly improved, compared with conventionallycoated granules. Later, Yajima, Umeki, and Itai [27]evaluated the effects of operating conditions in the spraycongealing process on taste masking release and the micromeritics properties of clarithromycin wax matrix showed that the congealing speed of melt droplets was the dominant factor in masking the bitter taste of drug. Ishikawa et al. prepared and evaluated tablets containing bitter tasting granules masked by the compression method. PirenzepineHCl and Oxybutynin HCl were used as model drugs and Eudragit E-100, microcrystalline cellulose, hydroxypropyl cellulose, and magnesium stearate were used as excipients. The resultsshowed that there was rapid in vitro release of Oxybutynin and Pirenzepine at pH 1.2. The tabletsdisintegrated within 20 seconds into the saliva of the volunteers and they did not report a bitter taste after disintegration.

Tozaki et al. [28]developed a multichannel taste sensor system to detect the suppression of bitterness by sweet substances. Quinine was used as a bitter drug and sucrose assweetners.The results showed that the suppression of the bitterness of quinine by sucrosecould be quantified by using the multichannel system.

Salazar de Saavedra and Saavedra Cuadra [29]developed and applied a sensorial response model to determine the design and taste of the oral liquid pharmaceutical dosage form. Acetaminophen was used as the model drug. It was found that a mixture of sweeteners and an essence was the most efficient way of masking the bitter taste of acetaminophen.

Pearnchob, Siepmann, and Bodmeier [30] investigated the potential of shellac to provide moistureprotective and taste-masking coatings as well as extended-release matrix tablets. The efficiency of shellac to achieve moisture protection and taste masking was compared with that of hydroxypropyl methylcellulose (HPMC). The stability of acetylsalicylic acid was higher in tablets coated with shellac compared with HPMC-coated systems, irrespective of the storage humidity. Therefore, lower shellac coating levels were required to achieve the same degree of drug

protection. Shellac coatings also effectively mask the unpleasant taste of acetaminophen tablets.

Carbo et al. [31]developed a coating composition that masks the undesirable taste of a pharmaceutically active ingredient that is consumed orally. The coating composition has polyvinyl acetate, and a dimethylaminoethyl methacrylate and neutral methacrylic acid ester(Eudragit E100). Optionally, an alkaline modifier, such as triethanol amine may be included in the coating composition to enhance release of the active ingredient.

Meneaud, Al-ghazawi, and Elder developed a water dispersible formulation of Paroxetine for immediate oral administration. It comprises a dry blend of paroxetine, a water soluble dispersing agent (polyvinyl pyrollidone/calcium carbonate/sodium starch glycolate), and a taste-masking agent (Eudragit L30D55/bcyclodextrin/ lecithin/Polacrilin K) as a dispersible powder along with flavors and sweeteners.

Yu and Roche [32]formulated taste-masked pharmaceutical liquid formulations of Levofloxacin for oral administration. The liquid composition utilizes a ‘‘reverse enteric coating,’’ which is soluble in the acidic pH of the stomach, generally about 1-4, but relatively insoluble at the nonacidic pH of the mouth. The coatings encapsulate the active ingredient and thereby effectively mask its taste and also provide for rapid release and absorption of the drug, which isgenerally desirable in the case of liquid dosage forms.

IV. FUTURE SCOPE OF TASTE MASKING

Bitter drug is a measure problem of paediatrics and children. Children cannot administer bitter drug so this approach is very useful to mask the bitter taste of drugs by resin complex. Resin forms insoluble complex with the drugs and complex form is palatable to the different age children. The drug release from complex is similar as drug is released from different formulations. In future this technique is very useful in masking of taste of many bitter drugs. The bitter drugs like Ofloxacin Hydrochloride, dicyclamine, hydrochloride, ciprofloxacin hydrochloride, Ofloxacin, Chloramphenicol can be easily handled with suspension, microemulsion, solid dispersion form without losingpotency with good feeling effect in mouth. In future there may be modified with latest polymers in different grading system. Flavor may be added to the formulation to betterment of tastes. Bitter drugs are best for many disease so we can modify the formulations for treating the children with suitable additives. Eudragit grade polymer, resin complex are the good substitute to mask the taste of formulations used in paediatrics. SEM and TEM are the good technique for particles shape and size and may be very useful tools in future to develop better agreement dosage form with nanoparticles. Nano particles are better absorbed from different dosage forms. Nano suspension and emulsions are formulated for better efficacy and tastiness to the patients. Patient agreement is important for the pharmacist to administer the drug so drugs are better designed and masked to the market for future development. Future scope of bitter drug masking will increase in broad sense in the industry and public in coming years.

V. CONCLUSION

Taste masking of bitter drugs has significantly improved the quality of treatment provided to suffering patients, especially children. There are so many effectivetechniques and methodologies that are constantly being researched and developed in the pharmaceutical field in response to the need of taste masking. Applicability of all these approaches varies from drug to drug and depends on the type of dosage form required. The ideal solution to bitterness reduction or inhibition is the discovery of a universal inhibitor of allbitter-tasting substances that does not affect the other taste modalities such as sweetness. But to date there is no single substance that acts as the universal inhibitor of a bitter taste. Research for the same has been performed for a long time.The type of technology used depends largely on the physical and chemicalproperties of the drug substance and the desired final dosage form. Advances intaste-masking technologies throughout the past few years have enabled thepharmaceutical industry to provide commercial products with improved patientacceptability and compliance, especially with pediatric and geriatric populations; alongwith enhanced convenience for patients on the go. More companies are turning totaste-masking expertise to complement their product portfolios for oral dosage forms. Lipoproteins composed of phosphatidic acids and beta-lactoglobulin [33].It is also suggested that the multichannel taste sensor for the detection of suppressionof bitterness by sweet substances [34]and other sensory evaluations of oral dosage forms of bitter drugs with taste inhibitors need to be further investigated for future applications. This would help in the development of more palatable and acceptable dosage forms.

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