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A Review on Taste Masking Techniques for Bitter Drugs

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ABSTRACT

Taste is mainly a function of taste buds in the mouth. In the formulation for pediatric & geriatric, bedridden & non-cooperative patients the main challenge to the compounding pharmacist is to mask the taste of obnoxious and bitter drugs, the result is patient not receiving the optimal therapeutic value of their medication. Taste masking is the main factor in the development of the dosage form. It opens the doors for new inventions and patents. Many techniques have been developed which not only improve the taste of a molecule but also the formulation and performance of the molecule. The main objective of the present review is to explore different methods, technologies, and evaluations to mask the obnoxious taste of drugs so that patients can use these drugs without hesitation of taste.

INTRODUCTION

It was claimed in former days that the medicines with a tart taste are both further productive and more remediable. With the advent of multiple formulation techniques, this idea was reversed. For health care providers, particularly for pediatric and geriatric patients, oral admin of bitter drugs with an up to the standard degree of palatability has become a key issue in recent times. The deliciousness is the synthesis of sensory perceptions as well as the taste and odor, and the texture, shape, and temperature of the goods to a lesser extent. Taste transduction requires molecular contact by taste receptor cells, which exist in different structures known as TASTE BUDS. The role of taste buds is to spread information to the central nervous system about the taste of the molecules. Each type of taste affects the receptor cells utilizing separate mechanisms. G protein transducin mediates the transduction of most bitter and sweet compounds, while ion channels are used to transduce salty and sour compounds. The dissociation of transducin into the alpha and beta subunits decreases the amount of cAMP and stimulates phospholipase C, which releases second messenger IP3 and DAG. The effect of this dynamic sequence of biochemical events is that taste cells send an indication to the brain that is perceived as bitter and unpleasant. So avoiding contact between the active component and taste bud may cover the bitter taste. Levels of herbal molecules involved in the therapy have a bitter taste. The disagreeable and inappropriate taste can be altered by suitable techniques described below. Great numbers of industrially feasible techniques have been investigated meant for the taste mask of bitter drugs for the last two decades. The present editorial gives an impression of past and current pictures of taste-masking techniques. [1.2]

The physiology of taste buds

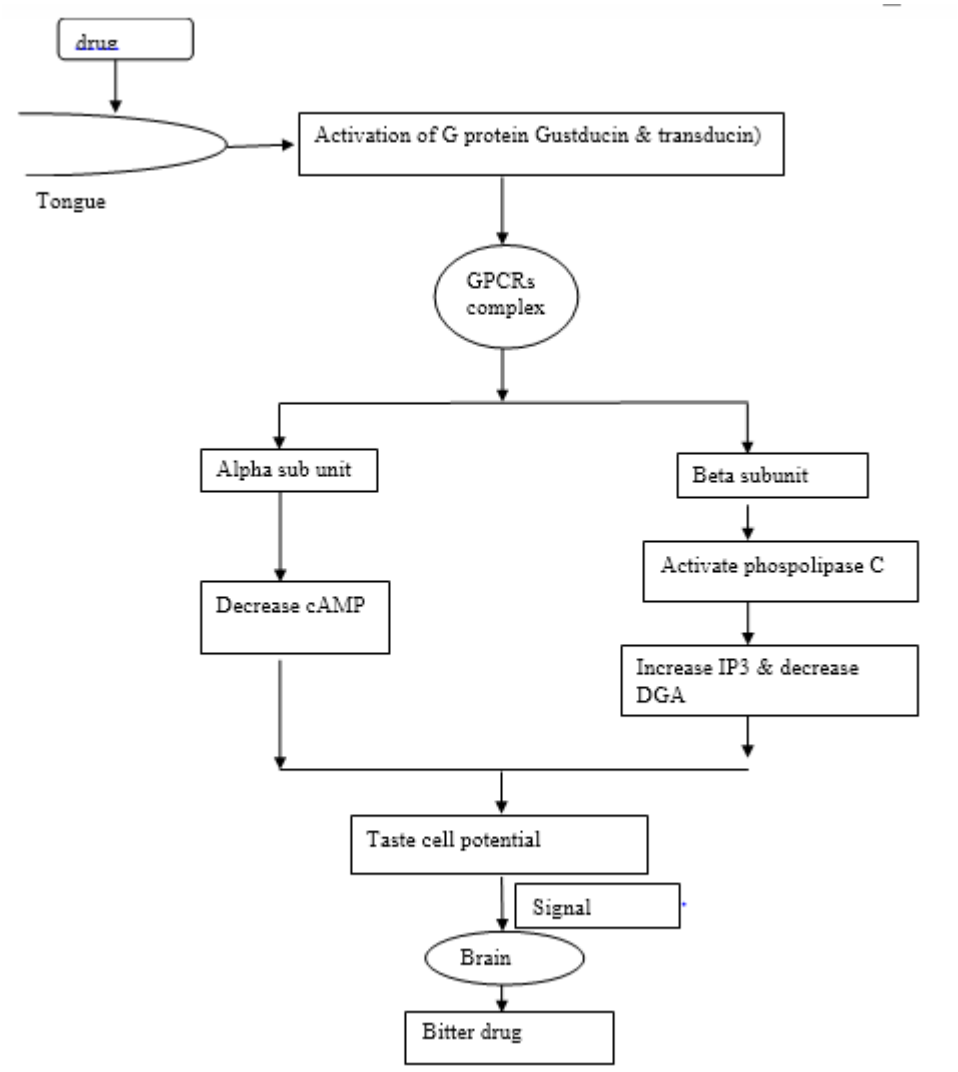
For device, some technique for the mask the taste of formulations, the fundamental understanding of physiology, and the execution of taste buds is very important.

Taste buds are structures in the shape of an onion which contain among 50 and 100 cells. The active ingredient that is taken orally in water / uncoated / mouth dissolve dosage forms first come into contact through the oral cavity, wherever they are absorbed by the saliva, and pass through the taste aperture. There, they interact either with exterior proteins known as taste receptors or with ion channels called pore-like proteins. These interactions cause a change in the taste cells that activate them to send chemical signals to the brain that turn into

neurotransmission. Salty and sour responses are answers of the form of ion channel, whereas sweet and bitter are responses to surface protein. The electrical reactions that give the signal to the brain originate from a varying concentration of charged atoms or ions within the cell of taste. Typically these cells bear a net negative charge. Tastants change this condition by using various means to increase positive ion concentration within the taste cell. This depolarization allows neurotransmitters to be released by the taste cells, causing neurons attached toward the taste cells to send electrical signals to the mind.

In the case of bitter savor, like quinine, stimuli work by binding on the surface of the taste cell with G-protein coupled receptors. That then causes the alpha, beta, and gamma protein subunits to split and release a near enzyme. This enzyme then transforms a precursor to a "second messenger" inside the cell. The next messenger causes the release of calcium ions (Ca++) from the cell's endoplasmic reticulum. The subsequent calcium ion build-up inside the cell results in depolarization and release of neurotransmitters. The signal sent to the brain now will be perceived as a bitter taste. A means of decreasing the overall reaction to one stimulus would be to initiate a second stimulus, based on the recent theory that taste cells be able to recognize and process all the different stimuli. This is based on the supposition that variations between stimulus responses are not so much a difference between the neurons firing and non-firing, but rather the difference in the amount of dismissal. This hypothesis is the foundation of the present research discussed in this paper. The ability to change certain stimuli's responses through the addition of extra stimuli. Active blocking of the taste receptors can be accomplished by also covering the surface aperture or fighting within the channel itself to reduce the net result of the firing of bitter stimuli. While the introduction of opposing stimuli is part of the masking mechanism, it is important to entire the experience and creates a pleasant taste for the user with different flavors and sweetness profiles. (3-5)

The magnitude of the bitter taste of the active constituent, a total dosage of the drug, drug particulate form and size distribution, solubility and ionic characteristics of the medication, formulating factors in terms of disintegration and dissolution time, target discharge rate and bioavailability are all considerations that are taken into account through the taste-masking formulation and type of dosage form. (6-11)



Especially for pediatric formulations, taste masking has always been an integral part of formulating. Advanced novel formulating methods have been used over nearly the last three decades to boost the esthetics of the final products. The present analysis compiles both the age-old conventional methods and novel techniques for masking taste.

Conventional methods:

Taste masking by sweeteners, flavors, and proteins

This technique is the easiest and extremely oldest method to enhance the taste properties of the active constituent of the formulations. Use different amino acids such as glycine, alanine, leucine, etc. may enhance the masking of tastes. Anticholesterolemic saponins containing food, beverages, and pharmaceuticals are combined with amino acids for the masking of tastes [12]. Once treated through papain in the presence of amino acids ethyl L-leucine, ethyl

L-iso leucine, ethyl L-valanine, cysteine HCl and 40°C sodium carbonate in water for 20 minutes, the whey powder resulted in tasteless and odorless powder[13]. The taste of ampicillin improved markedly by glycin preparation of its granules and triturated them by additional amounts of glycine, sweeteners, flavors, and eventually compressed into tablets [14,15]. Sweeteners such as sucrose and its derivatives, sodium saccharin, aspartame, monosodium glycyrrhizinate, and flavoring agents such as lemon water, vanillin, citrus, etc. Be able to be used to prepare syrup and medications can be uniformly distributed in syrup to prepare masked formulations for taste. To mask the taste, starch and sorbitol could be used as excipients through vanilla flavor, pork flavor, and citrus flavor. Gelatine and flavoring agents probably block the bitter taste of tannic acid by thickness action while cooled into a jelly [16]. A gelatin gum like formula that contains tannic acid, gelatine, chocolate flavor, and tannic acid flavor covered with water. In the pharmaceutical industry, natural source-based flavoring and perfuming agents are broadly used to mask the bitter taste of drugs. To boost the aesthetic parameters to the formulations, the range of flavoring agents supposed to be complemented with sweetening mediators and coloring agents. [17,18]

Taste-masking by Increase in viscosity

The formulations prepared with viscosity-providing agents such as gums or carbohydrates will minimize contact through taste buds and spread of bitter substance from saliva to taste buds. This process was used for taste masked liquid preparation containing comparatively huge amounts of disagreeable degustation medicines. The structure of such a formulation consists of a taste-masking liquid base with an elevated viscosity caused by thickening agents such as polyethylene glycol with methylcellulose and sodium carboxy. These types of formulations will add more active ingredients than normal strength.[19]

Taste masking using Lipids

Oils, surfactants, and polyalcohols can successfully enhance mouth viscosity and avoid drug contact with taste buds. Chloroquine taste-masking be preserved using a similar principle. Multiple emulsions, O / W / O, containing paraffin because oil can cover bitter chloroquine taste[20]. It was possible to control the use of glyceryl diester of C6-C22 fatty acid or diglycerin or sucrose fatty ester bitter taste of oral pharmaceuticals. An aqueous solution containing quinine sulfate from rapeseed oil among diglyceride and sucrose it covers the bitter taste with ester. Therefore every excipient that can pass on viscosity in the mouth and

taste bud coating can be used effectively for taste masking. In pharmaceuticals, formulations with a significant excess of lecithin or lecithin-like substance are believed to regulate the bitter taste. [21] Research on taste masking of hydrophobic products have also been carried out on lipid-coated pellets.[22]

Taste masking using anesthetic agents and taste potentiators

The taste buds can temporarily be anesthetized using local anesthetic agents like phenol and phenolic derivatives. These agents cause numbness of taste buds and hence the sensory buds will not be able to recognize the bitter taste. However, the period for this numbness remains for 4 to 5 seconds. Fine powder of beeswax, sodium phenolate, and active substance mixed with crosco vegetable oil, lime floss sugar, and converted into lozenges. This formulation produced numbness of taste buds [23]. Formulations like mouthwashes or cough drops like eucalyptus oil can be masked by adding fenchone, borneol.

Potentiators increase the perception of the taste of sweeteners and mask the unpleasant taste. Various potentiators include thaumatin, neohesperidine dihydrochalcone (NHDC), and glycyrrhizin increase the perception of sodium or calcium saccharinates, saccharin, acesulfame, cyclamates etc. Thaumatine along with sugar alcohols to improve taste masking of bromhexine [24].

Taste masking with salt preparation

Salt preparations have been successfully used to mask the taste by decreasing the solubility of drugs into saliva or by altering the chemical group, which is responsible for bitter taste. Most salts of organic compounds are formed by the addition or removal of the proton to form an ionized drug molecule, which is then neutralized with a counter ion. Penicillin prepared as the N-N' dibenzylethylene diamine acetate salt is a tasteless material. The magnesium salt of aspirin is almost tasteless. Bitter tasting decongestants, antihistamines, antitussive expectorants effectively taste-masked using magnesium trisilicate/ fumed silica absorbate that is undetectable in the mouth yet provides a high degree of bioavailability. [25-26].

Taste masking with effervescent formulations

The effervescent formulation contains components that can produce effervescence, like sodium bicarbonate, due to the liberation of carbon dioxide. Sodium bicarbonate reacts with

the acid when the effervescent preparation is added to water. The solution remaining after effervescence is known as carbonated water. The medicament dissolves in the carbonated water which serves to mask the bitter, saline, or nauseous taste of medicament. Studies carried out on effervescent granules of cetirizine showed better patient compliance [27].

Taste masking by Prodrug formulation of the drug

A prodrug is a chemically modified inert drug precursor that upon biotransformation liberates the pharmacologically active drug. By changing the molecular configuration of the parent molecule, the magnitude of a bitter taste response or taste receptor-substrate adsorption constant may be modified. Prodrugs can be used to increase or decrease the aqueous solubility, mask bitterness, increase lipophilicity, increase absorption, decrease local side effects, and alter membrane permeability of the parent molecule [28] For example. 7-7'succinylditheophylline. Erythromycin estolate. In aqueous solution, erythromycin exists as a protonated form which has a solubility in water. Lauryl sulfate salt of Erythromycin estolate, a prodrug, is water-insoluble. It does not impart bitter taste when comes in contact with taste buds unlike parent drug [29]. The palmitate ester of chloramphenicol, a prodrug, used in pediatric suspension shows good patient compliance. And propoxyphene napsylate, the tasteless and sparingly soluble derivative of Propoxyphene, clindamycin-2 palmitate, a prodrug of clindamycin[30].

Coating Techniques

The coating is one of the most widely used technique in industry for taste masking. Numbers of bitter drugs are formulated as coated dosage forms. In the coating process, the core material is coated with appropriate materials which prevent the rapid release of the drug in saliva but allow the release of drug in the gastrointestinal tract where the drug is expected to be absorbed. Coating not only masks the taste but also improves patient compliance by improving aesthetic quality.

Coating with sugar solution is one of the oldest techniques for taste masking. Drugs could be granulated along with hydrophilic vehicle and prepared granules can be coated with sugar to serve the purpose of taste masking. The study was carried out for masking the bitter taste of Cefeanal daloxate hydrochloride. Granules of lactose and cornstarch containing Cefeanal daloxate hydrochloride were prepared by using the ethanolic solution of polyvinyl pyrrolidine and then coated with ethyl cellulose. They were further coated with a coating

solution containing lemon oil, sodium saccharin, and sucrose and hydroxypropyl cellulose. The prepared granules were evaluated and results showed good bioavailability with taste masking [31]. Protein solution could also be used as a coating material. Aqueous whey protein solutions containing plasticizers, glycerol and sorbitol and maltodextrin as film formation promoting agent, were used as a coating material for taste masking of bitter component [32].

Polymeric film coating is the most widely used industrial technique for taste masking. Various film formers like povidone, acrylate derivatives, Hydroxypropyl cellulose, Hydroxypropyl methylcellulose (HPMC), etc. can be used for coating. Film former like povidone gives clear, glossy, and hard film while acrylates give transparent and elastic film [33]. Bitter drugs in granules form can be coated with film formers to provide taste-masked formulation. Steryl alcohol and Eudragit 100 were used for taste masking of macrolide antibiotics. The drug was mixed with molten stearyl alcohol (at 70 °C) and Eudragit 100. The prepared mixture was spray granulated. The dried granules were mixed with sugar and Hydroxypropyl cellulose (HPC) to give taste-masked dry syrup [34]. The same technique was used to mask the bitter taste of quinidine using Eudragit E 100 as film former [35]. In this technique, quinidine sulfate was dispersed in water at room temperature with 4-8% sodium lauryl sulfate (SLS) and different hydrophilic and lipophilic plasticizers (7-15%). This wet mass was granulated and then compressed to form tablets. Tablets were coated in a coating pan with Eudragit E 100 and characterized by disintegration and taste masking. Another coating technique was used for drug diphenhydramine. In this technique drug along with other diluents were milled and sieved to select core particles having the size in between 63-212 micron. Core particles were coated with various polymers like Surelease, Aquacoat, Ethocel 7,10, 45 & 100, and Eudragit E 100 with suitable plasticizer [36].

Taste masking of ibuprofen has been successfully achieved by using the air suspension coating technique to form microcapsules, which comprises a pharmaceutical core of crystalline ibuprofen and methacrylic acid copolymer coating that provides chewable taste-masked characteristics High molecular weight lipid excipients can be used in hot melt coating technique for drug-like Ibuprofen. In this technique lipid excipients glyceryl behenate is mixed with surfactant Labrasol™ and Ibuprofen was coated using the above-prepared blend in a top spray fluid bed coater. Lipid coated granules were mixed with microcrystalline cellulose and filled either in capsule or can be directly compressed to prepare a tablet, serves the

purpose of taste masking of Ibuprofen [37].

Microcrystalline cellulose-based pellets containing bitter drugs can also be coated to achieve taste masking. Studies based on MCC-based pellets (315-710µm) containing different quinine sulfate concentrations prepared by extrusion-spheronisation and then coated with an aqueous suspension of Eudragit® EPO, dibutyl sebacate or stearic acid in a fluid bed coater resulted in acceptable taste and texture. The adsorbates of bitter drugs like metha pyrilene were coated with a 4:1 ratio of ethylcellulose HPMC mixture and the results showed a reduction in the bitter taste of drug. [38]. One more example for taste masking along with the fast onset of action is required, thus novel technique was developed for taste-masked orally disintegrating tablets. In this technique, active ingredient with the bitter taste was dissolved in water and mixed with silica. Drug adsorbed on silica was introduced in a fluidized bed granulator and coated with a polymer. Granules were produced by wet granulation of sugar alcohols, sweeteners and flavor with a binder solution. The mixture obtained by this method was taste masked can be compressed in to tablet [39]. Fast disintegrating, taste-masked products can be prepared by using WOWTAB technology. Active pharmaceutical ingredient retained on #80 mesh, coated with Aquacoat plasticized with triacetin in the Wurster air suspension column, and then coated API was incorporated into WOWTAB technology containing polysaccharides, lubricants, sweeteners and flavors. Results showed fast disintegration and masking of taste [40].

New techniques like DUPONT can also serve the purpose. The same technique was used for the coating of small individual particles that are below 50 microns and even down to a few microns. Here particles with API can be coated with polymers, surfactants, and other materials to modify their bitter taste [41].

There are certain polymers, which on combination showed more viscous compared to individual forms. This synergetic interaction is enhanced when the polymers are combined under supercritical conditions. This technique not only provides taste masking it also enhance drug loading as a result of enhanced exposure of hydrophobic domains, within the polymer structure. In one experiment, pullulan and carboxymethyl cellulose, which on combination showed more viscous form than their forms. These polymeric solutions were combined along with drug particles under supercritical conditions like liquid CO2, 35°C and 80atm, maintained in the reactor with stirrer forming solid films around the bitter drug particles when the solvent was evaporated [42].

Taste masking by solid dispersion

The solid dispersion of one or more drugs in an inert carrier of solid-state is prepared by physical mixing, by a solvent evaporation method. Inert carriers that can be used for solid dispersion preparation are sugar carriers like sucrose, galactose, dextrose, trehalose, Various PEG derivatives, or PVP. Here the drug is entrapped in the carrier, so it prevents the contact of the drug with the taste buds. The mass of the drug griseofulvin was prepared using malt dextrin as a hydrophilic carrier by a common solvent method or melting method followed by drying in a desiccator over anhydrous CaCl2, and then the product is crushed, pulverized and sealed. The resulted formulation was taste masked [43] The above-mentioned method was used for masking the bitter taste of antihistaminic. The bitter drug famotidine and sugar alcohol and were mixed and the mixture was processed to form solid pharmaceutical preparation [44]. The model bitter drugs Acetaminophen, ketoprofen, and trypsinogen were also successfully masked by using Polyethylene glycol (PEG), Eudragit RS (EU) and lipid tripalmitin (TP) as excipients. An excipient and a drug (typically 50% drug loading, 10.0 g batch) were plasticized and then mixed with supercritical CO_2 at operating pressure between 200 – 300 bar and temperature between 40 – 55□C. This resulted into polymeric mixtures with the taste-masked formulation.[45]

Solid dispersion prepared by melt extrusion can also be used for taste masking of drugs like Verapamil hydrochloride using methacrylic acid copolymer EUDRAGIT® as matrix former. The powders were fit separately into a twin-screw extruder, processed above the glass transition temperature of the polymer, and finally milled. As a result, the intensity of the bitter taste was reduced significantly. This is a more used technique than film coating in the case where small particles are needed [46-49].

Taste masking using inclusion complex

This is one of the latest and current techniques for the taste masking with the beneficial advantage of enhanced solubility of the poorly soluble drug. Complexation of drugs with complexing agents modifies the biopharmaceutical parameters like drug dissolution rate and thus it masks the bitterness of the drug. Cyclodextrin (CD) is the most widely used complexing agent. Cyclodextrins are cyclic oligosaccharides, which can form host inclusion complex both in solution and in the solid phase. Molecules or functional groups that cause unpleasant taste can be hidden from the sensory receptors by encapsulating them within the cyclodextrin

cavity. These complex molecules are strongly hydrated on the outer surface thus they do not get attached to the taste bud. Various types of cyclodextrins are used for complexation according to the property of drug eg. Beta cyclodextrin, gama CD, hydroxypropyl βCD, methyl βCD, etc. Reconstituted suspension of the CD-drug complex can be prepared for pediatric and geriatric patients. [50-52]

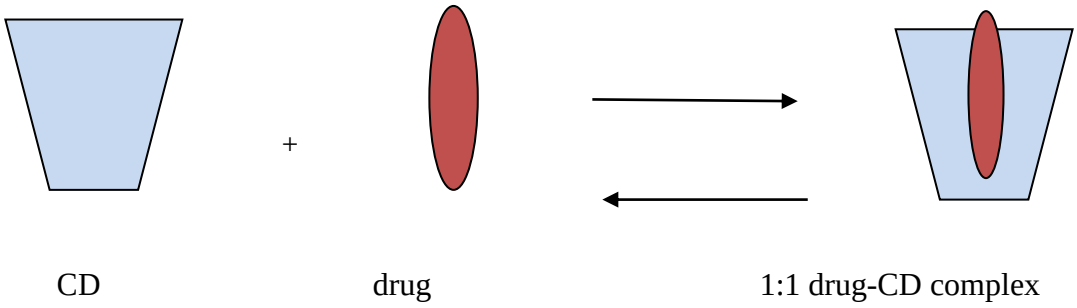


Fig no 1: Inclusion complex by cyclodextrin

A physical mixture of drug and beta-cyclodextrin was prepared using high shear mixing and phase solubility study showed the strongest binding of drug with beta-cyclodextrin and results in taste-masked formulation [53] Dextromethorphan was taste masked using same polymer complexation technique. The taste-masked Dextromethorphan formulation was prepared by wet complexation of the active ingredient and cyclodextrin in solution, which is then dried to form taste-masked complexed drug powder. The drug powder was mixed with flavors, film-forming polymers, and solvents, on a carrier substrate, which provided an improved taste masking formulation. Complexes of caffeine and organic acids formed by rapidly cooling individual hot aqueous solution of caffeine and gentisic acid and the resulting microcrystalline powder precipitate was washed with H_2O and dried under vacuum at 80°C and finally packed giving taste-masked formulation. [54]

Taste masking by Ion exchange resin

Ion exchange resins are high molecular weight water-insoluble polymers and so are not absorbed by the body and therefore inert and safe for use. Ion exchange resins have either acidic or basic functional group and they can be broadly classified as strong acid cation exchange resin (Amberlite IRP-69), Weak acid cation exchange resin (Amberlite IRP –65, carbopol 934 P, Kyron T-114), Strong base anion exchange resin (Amberlite IRP-276), Weak base anion exchange resin (Dimethylamine resins).

The complex of cationic drug and weak ion exchange resin does not break at the pH of saliva but at a high cationic concentration in stomach free drug is immediately released. Thus while passing through mouth, the drug remains in complex form and thereby imparting no bitter taste in the mouth. The peripheral vasodilator buflomedil was been taste masked by bonding to a cation exchange resin such as Amberlite IPR 69 at 60% resinate powder. The Amberlite IRP 64 resin powder is also recommended with isopropyl alcohol as a solvent. The dried powder was incorporated into the oral formulation. The same technique was used to formulate the taste-masked formulation of clarithromycin. Ion-exchange resin complex was prepared by dispersing clarithromycin in cacao fat at 35 to 50°C and atomizing to get fine granules and then suspended in of polyvinyl acetate diethyl amino acetate at 0°C, spray dried and tested for taste masking. The results showed good bioavailability and no bitter taste. Drug-resin complex dissolves completely in a pH=7.4 solution within 5~10 minutes. The ion exchange resin drug complex can be compressed to prepare an orodispersible tablet for drugs like levocetirizine dihydrochloride. In this technique the drug resinate complex was prepared by dispersing drug solution in resinate solution, Tulsion 335, for 360 minutes at a various temperature between 25º C- 80º C and then filtered through Whatman filter paper. Solvates were evaporated to get dry powder. The dried drug: resin complex (DRC) powder was then compressed to form an orodispersible tablet. Here, the drug, which gets dispersed in mouth, will not show any bitterness due to its complexation with resin molecule [55-59].

Nanotechnology-based taste-masking techniques Microencapsulation

Microencapsulation is a modified form of film coating differencing only in the size of the particle to be coated and the methods by which coating is achieved. The bitter drug particle is held in the polymer matrix or polymer film and thus the taste of drug can be successfully masked. Several polymers have been successfully used in the microencapsulation technique includes gelatine, polyvinyl alcohol, ethylcellulose, cellulose acetate phthalate, and styrene-maleic anhydride. The microencapsulation was achieved by wet spherical agglomeration along with the modified phase separation coacervation method. The bitter taste of chloroquine diphosphate was masked by microencapsulation technique, in which coating materials were obtained from Vinyl pyridine compounds and microencapsulated products formulated in suspension and found to have acceptable taste [60] Microencapsulation using phase coacervation was used for model bitter drug Beclamide [61] Conventional chewable and effervescent tablets were prepared from microencapsulated drug-using gelatine as a

polymer. Incubation of unmodified cornstarch in an aqueous solution of drug and converting them into microencapsulated particles could also mask the taste of the bitter drug. Diphenhydramine (DPH) was incubated with starch at different temperatures (35 to 55^0C) for different periods (1 to 4 hours). DPH-loaded starch particles were then dried and results revealed taste masking of the parent drug. Taste masking can be improved by a combination of encapsulation and CO_2 based techniques. Acetaminophen and pseudoephedrine hydrochloride (PE) were used as a model bitter drug and different Eudragits, ethyl cellulose (EC), cellulose acetate (CA) with different plasticizers and emulsifying agents as excipients for encapsulation. Coated particles were mixed with supercritical carbon dioxide and composite polymeric particles (50–300mm) showed sustained release and some taste-masking [62].

A new reverse enteric polymer, which collapses above pH 4 unlike Eudragit E, which is permeable above pH 5, was conceptualized and synthesized. Taste masking of cefuroxime axetil was evaluated by polymeric encapsulation. Polymers inhibited polymorphic transformation of cefuroxime axetil, which led to the conclusion that the new reverse enteric polymer provides a new technology platform for formulating taste-masked and immediate-release products such as granules, film-coated and chewable tablet [63].

A nanoparticle is a submicroscopic solid particle with a size ranging from 10 nm-1 µm. Polymers that can be used for the preparation of nanoparticles include albumin, ethylcellulose, casein, gelatin, polyesters, polyanhydrides, and polyalkyl cyanoacrylates. As the drug particles are individually coated they prevent drug contact with taste bud and thus mask the bitter taste of drugs. Those nanoparticles can also be delivered in the form of nanosuspension or nanoemulsion for pediatric and geriatric patients. Nanotechnology can be used for taste masking of fish oils, salts, alkaloids, and sulfa drugs. [64,65]. Lipid nanoparticles containing omega –3 fatty acids as an alternative of fish oil capsules were developed. Lipids like Dynasan 118 and adipic acid were used with sodium dodecyl sulfate (SDS), TPGS and polyvinylpyrrolidone (PVP) are used as stabilizers. Lipid nanoparticles were prepared by high-pressure homogenization using a Micron LAB 40 (APV Homogenizers, Unna, Germany). Further addition of citrus food flavor covered taste and odor, which further represents an easy swallowable formulation with taste-masking effect [66].

The neural technique can also be used for taste masking. In this technique, a heat-sensitive

model drug with a strong bitter taste was selected. Injecting the suspensions containing drug substance and different levels of cellulose type polymers with plasticizers into spray dryer developed fine particles. These fine particles resulted in to taste masked formulation.

Liposomes and multiple emulsions:

Liposomes are carrier molecules comprising several layers of lipids, in which the bitter drug is entrapped within the lipid molecule. Oils, surfactants, polyalcohols and lipids effectively increase the viscosity in the mouth due to which the time of contact between the bitter drug and taste receptors decreases, thus improving the overall taste masking efficiency. Inhibition of bitterness of drugs by phospholipids such as phosphatidic acid, phosphatidylinositol, soya lecithin, etc has been reported. Multiple emulsions are also a good approach for the taste masking of bitter drugs. This is achieved by dissolving the drug moiety in the inner aqueous phase of w/o/w emulsion with good shelf-life stability. o/w/o emulsion is a type of multiple emulsion in which water globules themselves containing dispersed oil globules, conversely w/o/w emulsions are those in which internal and external aqueous phases are separated by the oil. Both types of multiple emulsions are prepared for Chloroquine sulfate and reported to be partially effective in masking the bitterness of the drug.

CONCLUSION

Numbers of herbal origin and chemically synthesized active therapeutics have a bitter taste. With the use of novel formulation techniques as well as novel Excipients, the bitter and unacceptable taste can be masked successfully. Formulation attributes in terms of taste, texture, and appearance can now be modified to impart better formulation aesthetics. Sugarcoating, syrups, lipids, amino acids, proteins are very widely used Excipients for taste masking. There are a number of polymers are available for film coating, sugar coating technique yet remain versatile in the herbal industry. This is mainly due to cost-effectiveness and uses semi pure extracts in the formulation, which has unacceptable color. Film coating has the additional advantage of making the formulation pH-dependent and thus targeting the drug release at the desired site of the gastrointestinal tract. Apart from sugar coating and film coating techniques, the compression coating method can also be adopted. The use of hydrophilic polymers for coating, solid dispersion, complexation, and hot-melt extrusion is the most widely explored method in the pharmaceutical industry. Ion exchange resins adsord the drug and form complex. Dry syrups and an orodispersible formulation containing ion

exchange resin can be formulated for geriatric and pediatric patients. In the era of nanotechnology, the drug can be converted to nanoparticles. Polymer coated nanoparticles can be delivered in form of nanosuspension and nanoemulsion. Neural network technique is one of the latest optimizing methodologies.

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