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Techniques Employed for Taste Masking

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ABSTRACT

Disagreeable taste is one of the important formulation problems encountered with most of the drugs. The methods most commonly involved for achieving taste masking include various chemical and physical methods that prevent the drug substance from interaction with taste buds. The simplest method involves use of flavor enhancers. In earlier days it was believed that the drugs having bitter taste are more efficient as well as more curable. This concept has been reversed with development of numerous formulation techniques. The bitter taste of the drugs which are orally administered often contributes to patient non-compliance in taking medicines, especially for children and elderly. The taste of a pharmaceutical product is an important parameter for governing compliance. Thus, taste masking of oral pharmaceuticals has become an important tool to improve patient compliance and the quality of treatment especially in pediatrics. Therefore, formulation of taste masked products is a challenge to the pharmacists.

INTRODUCTION:

Taste, smell, texture and after taste are important factors in the development of dosage forms. These are important factor in product preference. Good flavor and texture are found to significantly affect sell of the product. Undesirable taste is one of the important formulation problems encountered with most of the drugs. The methods most commonly involved for achieving taste masking include various chemical and physical methods that prevent the drug substance from interaction with taste buds. The simplest method involves use of flavor enhancers. In earlier days it was believed that the drugs having bitter taste are more efficient as well as more curable. This concept has been reversed with development of numerous formulation techniques. In recent era oral administration of bitter drugs with an acceptable degree of palatability becomes key issue for the health care providers, especially for pediatric and geriatric patients. Palatability is the combination of sensory perceptions including taste and smell and to a lesser extent texture, appearance and temperature of the products. Taste transduction involves the interaction of molecule with taste receptor cells, which reside in specific structures known, as taste buds.

Based upon the recent theory that taste cells can interpret and process all the different stimuli, a method of diminishing the overall response to one stimulus would be to introduce a second stimulus. This is based upon the assumption that differences among responses to stimuli are not so much a distinction between firing and non-firing of the neurons, but instead the difference in the amount of firing. This theory is the basis for the current research being presented in this paper: the ability to transform the responses of certain stimuli by introducing other stimuli. Effective blocking of the taste receptors can be accomplished by either coating the surface pore or competing within the channel themselves to reduce the net effect of the bitter stimuli firings. While the introduction of competing stimuli is part of the masking system, specific flavours and sweetness profiles are essential to complete the experience and produce a pleasant taste for the consumer[1-3].

To obtain an understanding of the reasoning behind this research, a basic understanding of the physiological and psychological events that occur simultaneously in the experience known as taste is necessary. The earlier teaching of a taste map of the tongue showing distinct areas responding to certain stimuli has been replaced with a new theory. The most recent theory is that all taste buds respond to all stimuli. These stimuli include sweet, sour, bitter, salt, and umami.

Taste buds are onion-shaped structures containing between 50 to 100 taste cells[4]. Chemicals from food or oral ingested mendicants are dissolved by the saliva and enter via the taste pore. There they either interact with surface proteins known as taste receptors or with pore-like proteins called ion channels. These interactions cause electrical changes within the taste cells that trigger them to send chemical signals that translate into neurotransmission to the brain. Salt and sour responses are of the ion channel type of responses, while sweet and bitter are surface protein responses. The electrical responses that send the signal to the brain are a result of a varying concentration of charged atoms or ions within the taste cell.

Anatomy of tongue

The tongue is a versatile organ with specialized functions like taste and speech. Beneath a cover of taste buds, the tongue is almost entirely made up of muscles. The muscles of the tongue are essential for its bodily movement and intrinsic manipulations, required for actions like speech, articulation, and deglutition or swallowing, whistling, licking and even cleaning teeth up to some extent.

The tongue is partly in the oral cavity and partly in the pharynx. The part in the oral cavity is the mobile part of the tongue that is seen in the mouth. The pharyngeal part is situated behind and is fixed. While the fixed position anchors the tongue, it is the free anterior portion in the oral cavity that can change shape and be manipulated for the tongue to execute its various actions.

Tongue muscles

The muscles of the tongue belong to two groups intrinsic and extrinsic. Intrinsic muscles lie entirely within the tongue; that is their origin and insertions are inside the tongue. There are four groups of them;

- Superior
- Inferior longitudinal
- Transverse or horizontal
- Vertical

The tongue is a highly muscular organ in the mouth. The tongue is covered with moist, pink tissue called mucosa. Tiny bumps called papillae give the tongue its rough texture. Thousands of buds cover the surfaces of the papillae. Taste buds are collections of nerve-like cells that connect nerves running into the brain.

The tongue is anchored in the mouth by webs of tough tissue and mucosa. The tether holding down the front of the tongue is called the frenum. In the back of the mouth, the tongue is anchored into the hyoid bone. The tongue is vital for chewing and swallowing food as well as speech.

The four common tastes are sweet, sour, bitter and salty. A fifth taste called umami results from tasting glutamate (present in monosodium glutamate). The tongue has many nerves that help detect and transmit taste signals to the brain, because of this, all parts of the tongue are able to detect four common tastes; the commonly described taste map of the tongue does not really exist.

Taste bud anatomy

Taste buds are composed of groups of about 40 columnar epithelial cells bundled together along their long axes. Taste cells within a bud are arranged such that their tips form a small taste pore, and through this pore extend microvilli from taste buds contain cells bear taste receptors and it appears that most taste buds contain cells that bear receptors for 2-3 of the basic tastes.

Interwoven among the taste cells in a taste bud is a network of dendrites of sensory nerves called taste nerves. When taste cells are stimulated by binding of chemicals to their receptors, they depolarize and this depolarization is transmitted to the taste nerves fibres resulting in an action potential that is ultimately transmitted to the brain. One interesting aspect of this nerve transmission is that it rapidly adapts after initial stimulus, a strong discharge is seen in the taste nerve fibres but within a few seconds, that response diminishes to a steady-state level of much lower amplitude.

Once taste buds are transmitted to the brain, several efferent neural pathways are activated that are important to digestive function. For example, tasting food is followed rapidly by increased salivation and by low level secretary activity in the stomach.

Physiology of taste

The sense of taste is medicated by groups of cells called taste buds which sample oral concentrations of a large number of small molecules and report a sensation of taste to centers in the brainstem. In most of the animals, including humans, taste buds are most prevalent on small pegs of epithelium on the tongue called papillae. The taste buds are themselves too small to see without a microscope, but papillae are readily observed by close inspection of the tongue's surface. To make them easier to see, put a couple of drops of blue food colouring on the tongue of a person. Also you will see a bunch of little light coloured bumps mostly fungi from papiallae stand out on a blue background. In addition to signal transduction by taste buds, it is also clear that the sense of smell profoundly affects the sensation of taste. The sense of taste is equivalent to excitation of taste receptors for a large number of specific chemicals have been identified that contribute to the reception of taste. These include receptors for such chemicals such as sodium, potassium, chloride, glutamate and adenosine. Perception of taste also appears to be influenced by thermal stimulation of the tongue. In some people, warming the front part the tongue produces a clear sweet sensation, while cooling leads to a salty or sour sensation.

Perception of taste

Taste is a sensory response to chemical stimulation of taste receptors by tastants [5]. There are five basic tastes that have been identified: salty, sweet, sour, bitter, and umami[6]. Of these, bitter taste perception is considered the most complex modality[7].

Earlier theory of taste perception was based on taste map, wherein distinct areas of the tongue were shown to respond to certain stimuli[8]. However, according to the latest theory, all taste buds respond to all stimuli[9]. Taste buds are onion-shaped structures comprising 50 to 100 taste receptor cells[10]. The tastants interact with surface proteins (as in the case of sweet and bitter taste) known as taste receptors or with pore-like proteins (as in the case of sour and salty taste) called ion channels. These interactions lead to electrical changes within the taste cells that trigger them to send chemical signals that transform into neurotransmission to the brain[11,12]. The brain then perceives the signal as bitter, salty, sweet, sour, or umami.

Based upon the recent theory that taste cells can interpret and process all the different stimuli, a method of diminishing the overall response to one stimulus would be to introduce a second stimulus. This is based upon the assumption that differences among responses to stimuli are

not so much a distinction between firing and non-firing of the neurons, but instead the difference in the amount of firing. This theory is the basis for the current research being presented in this paper: the ability to transform the responses of certain stimuli by introducing other stimuli. Effective blocking of the taste receptors can be accomplished by either coating the surface pore or competing within the channel themselves to reduce the net effect of the bitter stimuli firings. While the introduction of competing stimuli is part of the masking system, specific flavours and sweetness profiles are essential to complete the experience and produce a pleasant taste for the consumer[13-15].

There are number of factors that are taken into consideration during the taste-masking formulation like,

i. Extent of the bitter taste of the active component,

ii. Total dose of the drug,

iii. Drug particulate shape and size distribution,

iv. Solubility and ionic characteristics of drug,

v. Formulations characteristics in terms of disintegration and dissolution rate,

vi. Desired release rate and bioavailability and

vii. Type of dosage form[16-21]

Taste masking has always been the integral part of formulation especially for pediatric formulations. During almost last three decades advanced novel formulation techniques have been utilized to improve the aesthetics of the final products. Some of the techniques adopted for taste masking are as follows.

1. Taste masking by amino acids, sweeteners, flavors and proteins

2. Taste-masking by Increase in viscosity

3. Taste masking using Lipids

4. Taste masking using anesthetic agents and taste potentiators

5. Taste masking using anesthetic agents and taste potentiators

6. Taste masking with effervescent formulations
7. Taste masking by Prodrug formulation of the drug
8. Coating Techniques
9. Taste masking by solid dispersion
10. Taste masking using inclusion complex
11. Taste masking by Ion exchange resin
12. Nanotechnology based taste masking techniques

i. Microencapsulation

ii. Liposomes and multiple emulsions

The use of a number of drugs including antibiotics which have undesirable tastes has been increasing[22].

Techniques Employed for Taste Masking

The methods commonly employed for achieving effective taste masking include various physical and chemical methods that prevent the drug substance from interaction with the taste buds.

A) Use of flavor enhancers:

The materials for taste masking purpose have often been classified depending upon the basic taste that is masked[23]. Flavoring and perfuming agents can be obtained from either natural or synthetic sources. Natural products include fruit juices, aromatic oils such as peppermint and lemon oils, herbs, spices and distilled fractions of these. They are available as concentrated extracts, alcoholic or aqueous solutions, syrups or spirit[24]. Apart from these conventional materials many compositions have been found to show effective taste masking abilities with improved flavor such as alkaline earth oxide, alkaline earth hydroxide or an alkaline hydroxide[25]. Another composition includes phosphorylated amino acid such as phosphotyrosine, phosphoserine, and phosphothreonine and mixtures thereof[26]. Anethole effectively masked bitter taste as well as the aftertaste of zinc, which is use in treating the common cold[27]. Clove oil and calcium carbonate, which has been found to be particularly

useful to mask the unpalatable active in formulations which are intended to be chewed or dissolve in mouth prior to ingestion in solution[28].

B) Applying polymer coatings:

Coating of drugs using a suitable polymer offer an excellent method of concealing the drug from the taste buds. The coated composition may be incorporated into much number of pharmaceutical formulations, including chewable tablet, effervescent tablets, powder, and liquid dispersion[29, 30, 31].

Multiple encapsulated flavor delivery systems has been developed which is useful in chewing gum, pharmaceuticals preparations as well as other food products[32].

C) Complexation with ion exchange resins:

The adsorption of bitter drugs onto synthetic ion exchange resins to achieve taste coverage has been well documented. Strong acid cation resins (sulfonated stynedivinylbenzene copolymer product) can be used for masking the taste of basic drugs[33]. Polystyrene matrix cation exchange resins have been used to mask the bitter taste of chlorpheniramine maleate, ephedrine hydrochloride, and diphenhydramine hydrochloride[34]. Extreme bitterness of quinolones has been achieved by ion exchange resin such as methacrylic acid polymer cross linked with divinylbenzene[35].

D) Inclusion complex formation with cyclodextrins:

Cyclodextrin is the most widely used complexing agent for inclusion complex formation which is capable of masking the bitter taste of the drug either by decreasing its solubility on digestion or decreasing the amount of drug particles exposed to taste buds there by reducing its perception of bitter taste. Bitter taste of ibuprofen and gymnima sylvestre has been effectively masked by cyclodextrin[36, 37].

E) Other techniques:

These include solubility-limiting methods, incorporation of drugs in vesicles and liposome, and chemical modification[38, 39]. The solubility limiting method can be applied to a number of drugs whose taste profiles are dependent on aqueous solubility.

Chemical modification such as derivatization or lipophillic counter ion selection may be an effective method for reducing aqueous solubility and taste Erythromycin monohydrate, a

bitter tasting drug with a solubility of 2 mg/ml is chemically converted into erythromycin ethyl succinate, the aqueous solubility is reduced to the < 50 mcg/ml. This form is tasteless and can be administered as a chewable tablet. Incorporation of drugs into vesicles or liposomes is although an ideal technique, yet a challenge to formulate without altering the regulatory status of the product (in vitro dissolution kinetics, physical or chemical stability or bioavailability)[38].

Table No.: 1 Examples of various taste masking techniques are illustrated below

Table 1. Examples of Various Taste Masking Techniques

API	Taste Masking Agent	Comment	Reference
Sweetener, flavorant, and other excipient addition			
Epinephrine	Aspartame, acesulfame potassium	Reduction in bitter taste of API	[20]
Cetirizine hydrochloride	Aspartame, sucralose, lemon flavor, and citric acid	Palatable formulation obtained, addition of citric acid enhances lemon flavor note	[21]
Famotidine	Aspartame, menthol flavor, and peppermint flavor	Palatable formulation which was comparable to ethyl cellulose coated formulation	[22]
Denatonium benzoate	Sodium cyclamate, zinc sulfate	Zinc sulfate inhibited bitterness of API and did not interfere with sweetness attributed by sodium cyclamate	[23]
Complexation			
Primaquine phosphate	Beta cyclodextrin	Complete taste masking of API	[24]
Lornoxicam	Beta cyclodextrin	Complete taste masking of API	[25]
Ibuprofen	Hydroxy propyl beta cyclodextrin	Bitterness of API, decreased to an extent	[26]
Dextramethorphan HBr	Beta cyclodextrin and gamma cyclodextrin	Bitterness of API, decreased to an extent	[27]
Coating			
Acetaminophen	Shellac	Tablet coating was done, which taste masked bitter API taste	[28]
Theophylline	Acrylic polymer containing hydroxy propyl methyl cellulose	Tablet coating was done, which taste masked bitter API taste	[29]
Oxybutynin HCl	Aminoalkyl methacrylate copolymers	Coating of API particles by microencapsulation was found to be effective	[30]
Diclofenac sodium	Ethyl cellulose	Coating of API and diluent particles by microencapsulation was found to be effective	[31]
Matrix entrapment			
Primaquine phosphate	Mono ammonium glycyrrhyzinate pentahydrate	API was entrapped in polymeric matrix by solid dispersion technique and taste masked formulation was achieved	[32]
Ondansterone Hydrochloride	Indion 294	API was entrapped in cationic exchange resinous matrix by ion exchange method and taste masking of API was achieved to an extent	[33]
Paracetamol	Gellan gum	API was effectively taste masked in gel matrix	[34]
Chloroquine phosphate	Egg phosphatidyl choline	API was effectively taste masked in lipoidal matrix	[35]
Prodrug formation			
Chloramphenicol	Palmitate ester	Taste masked drug which converts into its active form intestinal esterases	[36]
Nalbuphine HCl	Alkyl esters	Taste masked drug which converts into its active form plasma esterases	[37]
Ibuprofen	Ibuprofen basic salts	Taste masked API synthesized	[38]
Aspirin	Aspirin magnesium salt	Taste masked API synthesized	[39]

Anesthetizing agent like sodium phenolate, which numb the taste buds sufficiently within 4-5 seconds is helpful in inhibiting the perception of bitter taste of the formulation[40]. Substances like lipids, carbohydrate, lecithin, gelatin and polyamines has been effectively used for taste masking of drugs[41].

Another novel technique employing multiple emulsions has also been reported. By dissolving drug in the inner aqueous phase of w/o/w emulsion under condition of good shelf

stability, the formulation is designed to release drug through oil phase in the presence of gastric fluid[42].

In one of the method drugs with bitter taste are combined with nonionic surfactants to form composites by hydrophobic interactions resulting in taste masking[43].

Selection of Taste Masking Technique

Appropriate selection of a taste masking technique is a must for developing a palatable and economical formulation. *Figure 1* illustrates drug properties that are to be considered while selecting a taste masking technique. For instance, a drug that is extremely bitter cannot be taste masked with sweeteners or flavorants alone, and intermediary techniques like coating or matrix entrapment should be used. An ionic drug can be taste masked with ion exchange resins. A lipophilic drug can be taste masked by entrapping it into a lipoidal matrix. *Figure 2* illustrates various economical aspects to be considered when selecting a taste masking technique. Although variations are possible, in general simple techniques are more economical as compared to intermediary ones.

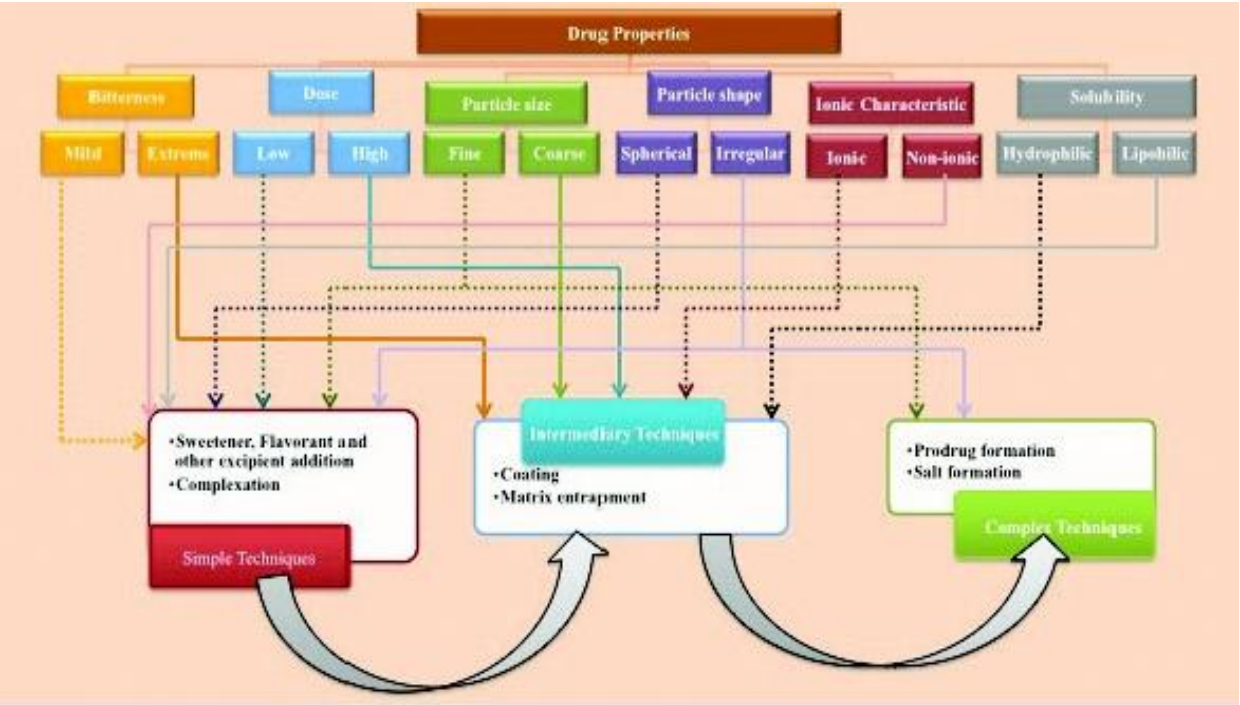

Figure No.: 1. Drug properties that are to be considered while selecting a taste masking technique. (Based on drug properties, one should adopt the directed techniques. if those fail then the subsequent [gray arrow] techniques should be adopted.)

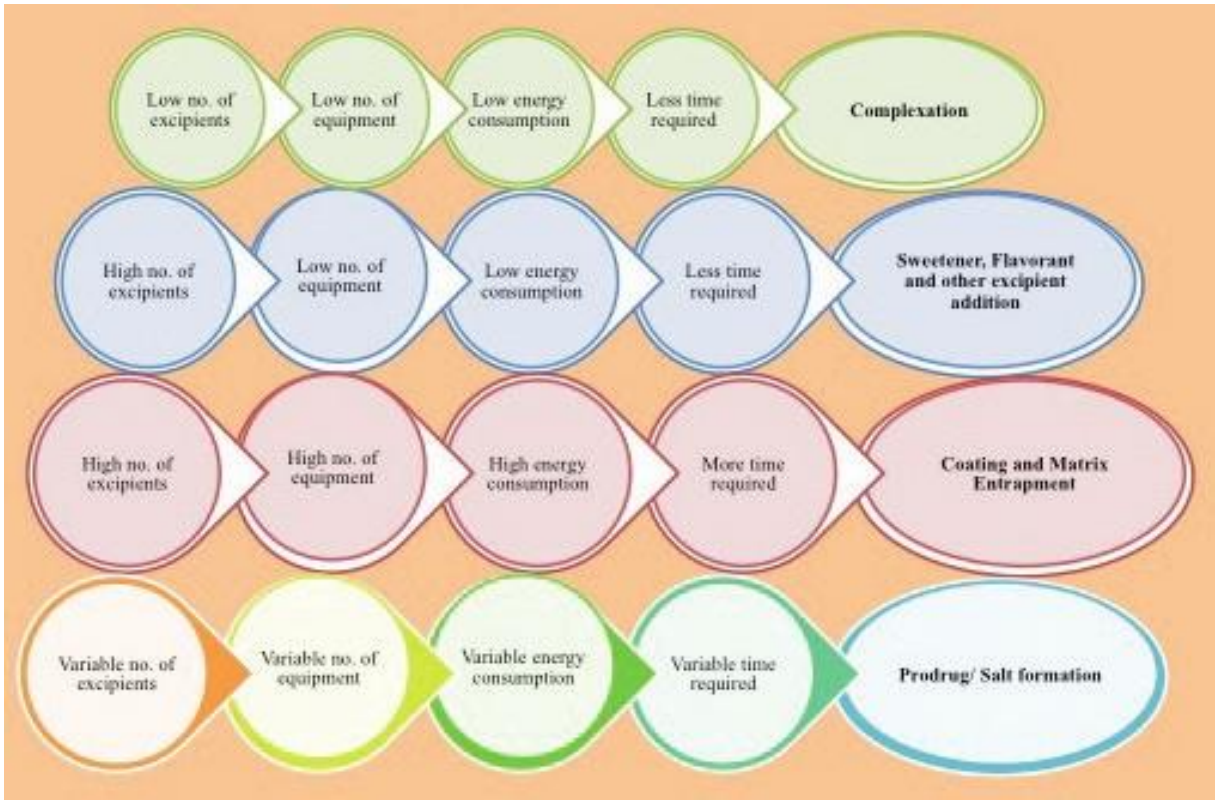

Figure No.: 2. Economical aspects of various techniques.

Techniques Employed for Taste Masking of Different Dosage Forms

The drug i.e. the active pharmaceutical ingredient is finally formulated in a suitable dosage form such as tablet, powder, liquid, etc.

I) Tablets:

Most of the tablets can be effectively masked for their taste by applying inert polymer coatings that prevent the interaction of the drug substance with the taste buds. Nevertheless, attempts have been made time and again by several workers to investigate and explore the use of newer materials in bad taste abatement and good taste enhancement.

II) Granules / Powders:

Granules for reconstituting as liquids (e.g. sachets, sprinkle capsules & powders) hold a high share of pediatric and geriatric market. A large number of patents on the topic highlight the significance of the same. Thus, taste masking of granules becomes an important priority in product development and varied technologies and methodologies exist for the same as illustrated below.

III) Liquids:

They present a major challenge in taste masking because the majority of pediatric preparations are syrups and suspensions although, the aforementioned methodologies have-also had been used for improving liquid taste and few patents in this area are worth mentioning.

Evaluation of Taste Masking Effect

Sensory analysis has been used in developed countries for years to characterize flavors, odors, and fragrances. Historically expert provided formulation scientist with subjective data on the composition of one product with another. Nowadays, sensory analysis employs objective or analytical methods and subjective or hedonic method[44].

Evaluation of the taste masking effect from coated microsphere can de done by determining the rate of release of the drug from the microspheres. Similarly for evaluating the taste masking effect by ion exchange resin, the drug release rate can serve as an index of the degree of masking achieved. Other methods include evaluation by a trained flavor profile panel and time intensity method in which a sample equivalent to a normal dose was held in mouth for 10 seconds. Bitterness level are recorded immediately and assigned values between 0-3[45].

Sensory Analysis

Sensory analysis has been used in developed countries for years to characterize flavors, odors and fragrances. In recent times much progress has been made in development of instrumentation methods for characterizing odors and flavors. These methods are often more useful in aroma and flavor research than in product development where formulation are usually complex and sensory methods can provide equally reliable data on overall flavor character. Sensor analysis employs objective or analytical methods and subjective or hedonic methods.

A. Subjective Methods

1. Preference Test

a. Paired Testing

b. Triangle Testing

2. Hedonic scale

B. Objective Methods

1. Difference Test

a. Paired Difference Test

b. Triangle Difference Test

c. Duo-trio Test.

2. Ranking Test

3. Analytical

a. Flavor Profile

b. Time-Intensity Test

c. Single Attribute Test

A. Subjective Methods:

Subjective method assesses the performance of a flavored product using a large number of untrained analysts. Field "Pretest" generally falls in this category. Often several preparations are tested against control. Untrained analysts are used and methods are characterized by spontaneity and results are often biased by emotional and personal attitudes.

1. Preference Tests:

a. Paired testing

Paired testing compares the taste of two samples, that is, how sweet, bitter, sour or salty they are. Because untrained analysts are employed in such tests, associative effects are not easily quantified. Detection of a difference between samples may be associated with a bias, which would be analogues to the bias attached to things considered different, odd, bad or good. Since analysis of the bias is as important as the magnitude of sample difference, routine testing is not useful in product development. Yet these tests are beneficial in market decision-making because results are based on user preference.

b. Triangle testing:

Like paired tests, triangle test do not provide quantitative data on differences between similar or dissimilar samples. These tests are designed to limit bias and improve confidence in the selection process. They provide quantitative difference between samples. Usually three preparations are tested; two are identical, where as the third is different in one or several respects. Because data generated by triangle testing is largely subjective, criteria for determining accuracy of results and hence validity of prediction from such test are poorly defined and nonexistent. Statistically, the triangle testing is preferred because there is only 33.3% chance of guessing, and only a limited number of test are required compared to a 50% chance of error in paired testing.

2. Hedonic Scale:

The term hedonic applies to a scalar measure used to describe the degree of acceptance of a flavor. Hedonics are designed to recognize a fixed point of neutrality (zero point) for a flavor.

This allows rating the flavor on the basis of the degree of its negative or positive sensation on a scale. Negative numbers on the degree of unpleasantness, whereas the positive numbers reflect the degree of accepting of flavoring agent.

Hedonics in pharmaceutical flavor work provide subjective estimate of the degree of acceptance of a totally flavored product. They are most useful for trained flavor panelists who can apply a continuum of positive numbers to describe the intensity of a specific element f a flavored product. This has the disadvantage that a continuum of positive number ignores the neutral point and thus compares the relative acceptance to the relative acceptance level for a product based on the performance against a reference.

B. Objective Method:

Objective methods in flavor test generally use a small panel of trained analysts with standardization methods of identifying various tastes. The panel members act like an instrument and use their carefully controlled senses to analyze organoleptic quality of a product in such a way that emotional basis is eliminated.

1. Difference tests:

A. Paired-difference test:

Paired-difference test are useful in screening formulation studies. This test includes a benchmarked product designated as control sample and a treatment sample. Two groups of samples pair are tested. In one group each pair contains a treatment and a control specimen. In the other group, the pair contains only treatment or only control. Sample The primary question is "Are the sample same or different?" samples are randomly coded in order to eliminate bias. Finding difference between samples then follows this: "Are there difference between the sample?" after completing this test, the panel director analyzes the data concludes that there are no perceptible differences between samples. However comments from panelist suggest that some perceives slight "after taste" difference, where as other do not. With this information the director decides to perform a confirmatory test using a triangle difference test.

B. Triangle Difference Test

The objective of the panel director is to determine which sample is to differs in "lingering bitter after taste". In each group two samples are alike and contain either control formulation or the reformulated product. Third sample is different but also contains either control formulation or the reformulated product. The samples are presented in straight line and six possible different sample positions.

C. Duo- Trio Test:

In duo- trio test, the panel director designates one sample usually control, as the reference, In addition, several pairs of samples are given to panelists, each consisting of one control and one treatment sample. All samples are labeled in a randomized fashion. The task of the panelists is to identify the pair that is similar in performance to the reference control sample.

2. Ranking Tests

Ranking tests are used when more than two samples are to be evaluated. If six samples are to evaluate of a formulation for sweetness difference, the task panel is to rank the series in order from the least to most sweet. A typical rank test score sheet is shown in the below Table.

Table No.: 2 Typical Rank Test Score Sheet

Sample	Intensity
A	2
B	1
C	2
D	0
E	3

Intensity Score:

0 = absent, 1 = threshold, 2 = moderate, 3= moderate ranking test are useful to formulation scientist because they provide information about a specific characteristic of flavor or aroma. Ranking test is also used to determine which formulation is most or least bitter.

3. Analytical Test:

a. Flavor profile:

The flavor profile is widely used descriptive analytical test. It is based on a natural process, often performed instinctively, for evaluating and comparing flavor. A flavor profile measure s objectively, qualitatively the perceptible factors of a product that is aroma flavor by mouth, feeling factor and after use sensations.

b. Time Intensity Study:

The Arther D. Little flavor Laboratories, 1954, developed this method of flavor analysis. It is useful in time dependent product quality assessment. Panelist record after taste impression as a function of time and several sessions are allowed until a consensus is arrived at. Data from the test sessions are compiled and graphically summarized with intensity on Y-axis and time on X-axis.

c. Single-Attribute Tests:

Single attribute test is valuable in quality control and routine release testing of products by manufacturer. The technique is similar to the flavor profile method, except that the panel concentrates on one attribute only. For example a product during a mixing step at manufacture relative to time and temperature can be investigated by single attribute.

CONCLUSION:

Unpleasant taste is one of the important formulation problems encountered with most of the drugs. The methods most commonly involved for achieving taste masking include various chemical and physical methods that prevent the drug substance from interaction with taste buds. The simplest method involves use of flavor enhancers. In earlier days it was believed that the drugs having bitter taste are more efficient as well as more curable. This concept has been reversed with development of numerous formulation techniques. The bitter taste of the drugs which are orally administered often contributes to patient non-compliance in taking medicines, especially for children and elderly. The taste of a pharmaceutical product is an important parameter for governing compliance. Thus, taste masking of oral pharmaceuticals has become an important tool to improve patient compliance and the quality of treatment especially in pediatrics. Therefore, formulation of taste masked products is a challenge to the pharmacists.

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