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A Palatable Revolution In Oral Hygiene – Exploring the Brilliance of Chewable Toothpaste Tablets

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ABSTRACT

These days, everyone is highly conscious of the use of toothpaste. There are medicinal and herbal toothpastes on the market right now. There is fierce competition among toothpaste manufacturers to produce better formulas that can stave off dental issues. Chewable tablets that must be broken and licked between the teeth in order to be consumed. These tablets are used to people who find swallowing unpleasant as well as youngsters who have trouble swallowing. Chewable tablets are characterized by their smooth breakdown, agreeable flavor, and absence of bitter or unpleasant aftertaste. Chewable tablets are an ideal dosage form for individuals who are elderly, young, or traveling and may not always have access to water. The gum core, which may or may not be coated, makes up the content of a chewable tablet. An insoluble gum foundation made up of fillers, antioxidants, sweeteners, and flavoring ingredients makes up the core. It is flavored with something to improve its taste. There are several components that go into making chewable pills. The main formulation factors that apply to both regular (swallowed) and chewable tablets include flow, lubrication, disintegration, organoleptic qualities, compressibility, compatibility, and stability; however, the main focus of this formulation is on the organoleptic features of the active drug components. The purpose of this review article is to investigate dental issues with sparing on a modified tablet dosage form, such as a toothpaste tablet, which will help to reduce plastic waste and be more affordable, eco-friendly, and beneficial to dental health.

Keywords: Toothpaste, Chewable tablet, Granulation, Compression, Foaming

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INTRODUCTION

Oral health is essential to people's overall well-being and quality of life.[1] Since the dawn of time, toothpaste has been a necessary component of oral health care. In China and India, toothpaste formulas have existed from 300–500 BC.[2] In order to cure oral disorders like caries, poor breath, gingivitis, tartar, and dental hypersensitivity, toothpaste has undergone significant progress.[3] One kind of dentifrice used to clean, maintain, and enhance dental health is toothpaste. In addition to its primary purpose of maintaining oral hygiene, toothpaste has an abrasive effect that cleans teeth of food particles and dental plaque. One dental and oral health concern that our nation is still addressing is caries. The prevalence was 90.05 percent, according to the household health survey conducted in 2004. One of the microorganisms implicated in the pathophysiology of caries is *Streptococcus mutans*. Within dental plaque, these bacteria will change sugar to acid. Caries results from the resulting acid's breakdown and demineralization of the tooth. Chewable tablets are a product of toothpaste preparations that enable inconsistent dosages and unfeasible usage. Chewable pills are not meant to be ingested whole; instead, they are usually chewed in the mouth before swallowing. A chewable tablet's main purpose is to deliver a unit amount of medication that is appropriate and easy to provide to elderly or young patients who have difficulty swallowing tablets whole. Chewable tablets offer a number of unique benefits, including increased patient acceptance, patient convenience (no need for water when swallowing), product distinctiveness from a marketing standpoint, faster drug absorption, enhanced therapeutic agent effectiveness due to the reduction in size that occurs during mastication of the tablet before swallowing, and improved bioavailability because the chewable tablet has a smooth form, wonderful taste, and doesn't leave an unpleasant aftertaste.[4]

What Exactly Are Toothpaste Tablets?

Chewable toothpaste tablets, which are little, round discs that resemble breath mints and are composed only of natural ingredients, are intended to remove plaque from teeth. Once inside your mouth, you'll use your teeth usually your stronger, larger back molars to shatter the tablet. Paste pills are made up of the dry ingredients found in toothpaste. Much put it in your mouth, wet your toothbrush, and use the bristles to massage the tablet, much like you would a cleaner.[5]

An environmentally friendly substitute for toothpaste is toothpaste tablet form. These items are useful since they are portable and resistant to temperature fluctuations. As a result, consumers can forget about carrying around heavy toothpaste tubes or worrying about the paste drying out from an accidental cap leak. When traveling, chewable toothpaste tablets are a good way to keep your teeth clean. Users can use the containers for quick cleanings even without a toothbrush because

they are compact and readily packed into suitcases.[6]

Chewable tablets offer several advantages, including increased dissolution, improved patient acceptance, convenience, and potential for rapid action. They can be used as a substitute for liquid dosage forms and have a faster absorption of drugs. However, their large size can pose challenges during swallowing, making chewable tablets superior. The reduction in size during mastication enhances the effectiveness of the medicinal agent, making them a unique product with potential marketing opportunities.

Chewable tablets, which contain bad-tasting drugs and have high dosage levels, have several disadvantages. Prolonged chewing can cause facial muscle pain, and they are hygroscopic, requiring dry storage. They have fragile, effervescence granules, and require careful handling due to their insufficient mechanical strength. Proper packaging is necessary for safety and stabilization of stable drugs. Additionally, the presence of flavoring agents may cause oral cavity ulcers.[7]

COMPONENTS OF CHEWABLE TABLETS[8]

Table 1: Components of Chewable Tablet

Sr. no.	Category	Example	Uses
1	Abrasive	Calcium carbonate, pyrophosphate	Clean and polish teeth
2	Surfactant	Sodium lauryl sulphate	Removes soft dental plaque
3	Diluent	Mannitol, sorbitol, lactose	Improve content uniformity
4	Binder	Starch paste, acacia, gum, alginate	Prevents separation of liquid and solid ingredients
5	Sweetener	Guar gum, sodium saccharine, aspartame	Pleasant taste
6	Flavour	Peppermint, menthol aqua mint, essential oil	Acts as refresher
7	Antibacterial	Triclosan, Acetyl pyridinium	Control dental plaque
8	Lubricant	Magnesium stearate	Prevent sticking of granules to dish and punches
9	Glidant	Colloidal silicon, talc	To improve flow properties of granules

METHOD OF PREPARATION

Toothpaste Tablets are prepared by three methods Wet granulation method, Dry granulation method, Direct compression method

Wet granulation method

It's the most popular and extensively applied technique. A number of procedures are involved in this approach, including weighing the components, mixing, granulating, and screening the damp pass, as well as drying, lubricating, and compressing the tablets. The main active ingredient, diluent, disintegrant are blended together, and then it is allowed to flow through the sieve (sifting). Stirring constantly, solutions of the binding agent are added to the starting mixture. To prevent the pill from becoming very wet, there should be an adequate amount of binding agent added. Inadequate wetting of the powder can result in excessively soft granules that may break down

during lubrication, making tablet compression challenging. The most popular technique for drying tablet granules is tray drying. However, fluid-bed dryers, a cutting-edge method, may eventually replace tray drying as the most popular way. The granules are allowed to flow through the screen after drying; typically, nylon cloth with a mesh size of 60 to 100 is utilized. Lubricant is supplied as fine powder after dry granulation, which is necessary for the die cavity to be properly filled (Figure 1) and to create the tablets, the remaining lubricant is added to the granulation, well blended, and compressed.

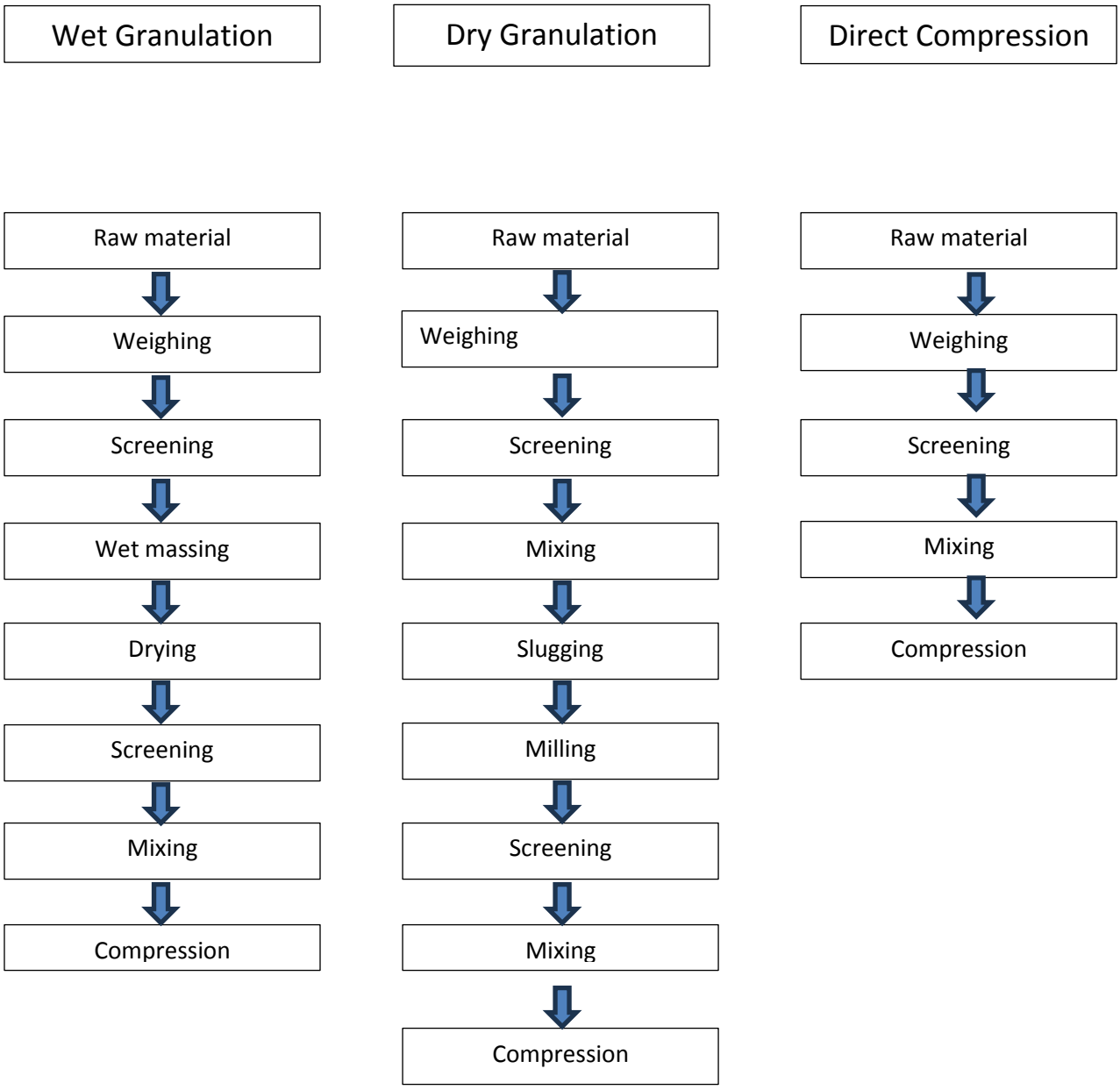

Figure 1: Methods of Tablet Preparation[8]

Dry granulation method-

This process is used to prepare tablets; slugging may be necessary to produce the granules if the ingredients are extremely sensitive to moisture or cannot withstand high temperatures during the drying process. Dry granulation, also known as twofold compression, typically removes a number of processes that require slugging the quantity of powder. The slug is created by blending the lubricant, diluent, and active substance. As a result, the mill or the mesh pass the compressed slug through.

Direct compression method

The powdered substance is directly compressed into tablets using a process known as direct compression. If the medicine makes up the majority of the tablet's overall weight, then direct compression is used (Figure 1). It is possible to construct tablets with a drug ingredient content of no more than 25% and a suitable diluent that serves as the drug's carrier or vehicle. The tablets made using the aforementioned procedure are fed through a compression machine, which may include one or more stations[8].

CHEWABLE TOOTHPASTE TABLETS:

Tablets that must be broken and chewed in between teeth in order to be consumed. Children with swallowing difficulties and adults who find swallowing unpleasant are prescribed these medications. Whether or not you actually chew the tablets, they should dissolve smoothly and moderately in the mouth. The makeup of a chewable tablet comprises of gum core, which may or may not be coated. Chewable tablets are frequently used when the active ingredient is intended to work locally rather than systemically. An insoluble gum foundation made up of fillers, antioxidants, sweeteners, and flavoring ingredients makes up the core. The range of the gum base percentage is 30–60%. Because it is not hygroscopic, mannitol is frequently used as an excipient in chewable tablets for medications that are sensitive to moisture[9]**.**

Pre-compression Parameters:

Prior to compression, the following factors defined the flowability features of powders and granules: Hausner's ratio, bulk density, tap density, compressibility index, also known as Carr's index, and angle of repose**.**

The angle of repose:

The greatest angle that can exist between a powder pile's surface and a horizontal plane is known as the angle of repose. The angle of repose, which is a measure of the powder flow attribute, can be used to calculate the frictional force in loose powder or grains**.**[10]

$$\tan \theta = H / R$$

$$\theta = \tan\text{-}1(H/R)$$

Where, θ is the angle of repose

H is the height of the pile

R is the radius of the base of the pile

Angle of repose as an indication of powder flow

Table 2: The angle of repose

The angle of repose or degrees	Flow
< 25	Excellent
25 – 30	Good
30 – 40	Passable
> 40	Very poor

Bulk Density:

The mass of the powder divided by the bulk volume, expressed in cm^3, is the definition of bulk density. An appropriately sized 100 ml graduated measuring cylinder was filled with the sample. This cylinder was dropped three times from a height of one inch onto a hardwood surface at intervals of two seconds. The weight of the sample in grams was then divided by the sample's ultimate volume in cm^3 inside the measuring cylinder to get the bulk density of each formulation. It was calculated by using the following equation.[11]

$$\text{Bulk Density} = \frac{\text{Mass}}{\text{Bulk Volume}} \quad \text{___(1)}$$

Tapped Density:

The mass of the powder divided by the tapped volume, expressed in cm^3, is the definition of the tap density. An appropriately sized 100 ml graduated measuring cylinder was filled with the sample. This cylinder was dropped 100 times from a height of 1 inch onto a hardwood surface at intervals of 2 seconds. The weight of the sample in grams was then divided by the sample's final tapped volume in cm^3, yielding the tapped density of each formulation that was kept inside the measuring cylinder. It was computed with the aid of the provided equation.[11]

$$\text{Tapped Density} = \frac{\text{Mass}}{\text{Tap Volume}} \quad \text{___(2)}$$

Carr's index:

The % compressibility index, commonly known as Carr's index, is a technique that indirectly measures granule flow by utilizing bulk densities. Carr's index was the one who developed it. The percentage compressibility of a powder served as a gauge for the stability of the granules and the possible strength of the powder or bridge.[12]

$$\%\ \text{Compressibility} = \frac{\text{Tapped Density} - \text{Bulk Density}}{\text{Tapped Volume}}\ X\ 100 \quad \text{___(3)}$$

Carr's Index as an indication of powder flow

Table 3: Carr's Index

Compressibility index	Flow
5 - 15	Excellent
12 - 16	Good
18 - 21	Fair to passable
23 - 35	Poor
33 - 38	Very poor
> 40	Very very poor

Hausner's ratio:

The powder's flowability is shown by the Hausner's ratio. A Hausner's ratio below 1.25 indicates a satisfactory flow, The equation calculates it.[13]

$$\text{Hausner's Ratio} = \frac{\text{Tapped Density}}{\text{Bulk Density}} \quad \text{___(4)}$$

POST COMPRESSION EVALUATION:

Organoleptic Properties:

These include the outer appearance of the tablet such as shape, size, color, odor etc.

Weight Variation:

To determine whether different batches of tablets are uniform, weight variation was tested. 20 tablets were weighed separately, the average weight was determined, and the weight of each tablet was compared to the average. The tablets pass the test if no tablet deviates from the % limit by more than two and if no tablet differs from the percentage limit by more than twice.[10] Weight variation specification as per I.P

Table 4: Average weight

Average weight (mg)	Maximum % difference
130 or less	10%
130 - 324	7.5%
> 324	5%

Thickness:

A Digital Vernier Caliper was used to measure the thickness of each of the ten tablets that were randomly chosen from each batch.

Hardness:

The hardness of the tablet was assessed by utilizing a Monsanto hardness tester. It is made up of two plungers and a barrel with a compressible spring inside. A zero reading was obtained by putting a lower plunger in close proximity to the tablet. The upper plunger was pushed up against a spring until the tablet broke by rotating a threaded bolt. The fracture's force was noted. For every formulation, ten pills were assessed.

Friability:

The friability of twenty pills from each formulation is assessed using Roche friabilator. The plastic chamber of the friabilator was filled with pre-weighed tablets, and the device was operated at 25 rpm for four minutes. All the tablets were dedusted and weighed by the following Formulas[14]

$$\% \text{ Friability} = \frac{\text{Initial Weight} - \text{Final Weight}}{\text{Initial Weight}} \text{ X } 100 \quad \text{___(5)}$$

Foamability:

The Foamability of the formulated product was estimated by adding a tablet into a 100 ml graduated measuring cylinder containing the required amount of distilled water. The initial volume of the measuring cylinder was recorded. Then the measuring cylinder was shaken 10 times. The final volume was recorded after the production of foam[15]

$$\text{Foam Expansion} = \frac{\text{Volume of Foam}}{\text{Volume of Solution}} \quad \text{___(6)}$$

pH:

The pH of the solution was measured using a pH meter by dissolving 3 tablets in 3 beakers containing 200 ml of water[11]

In-Vitro disintegration time:

The breaking down of a tablet into smaller parts is called disintegration. The in-vitro disintegration time of a tablet was determined using a disintegration test apparatus with a mesh aperture of 2 mm that operates at a rate of about 28–32 cycles per minute and keeps the water temperature at 37–2 °C.

In-Vitro release study:

Using the USP Dissolution Testing Apparatus II (Paddle type), the rate of release of toothpaste tablets can be determine. Fill the dissolution vessels with required dissolution medium and maintain temperature at 37^0C. Set the paddle at appropriate RPM. Withdraw sample at specific time interval and dilute it with dissolution medium. Analyze the sample at particular wavelength against blank.[16]

CONCLUSION:

It is decided that the toothpaste tablets that have been produced would be a better option than the toothpaste used traditionally because they are easy to use and chewable. They offer precisely controlled doses of the active substance in a handy, portable packaging. They can also be made to cover up undesirable chemicals or stabilize unstable drugs. Simple to use when traveling. Because toothpaste tablets are waterless, they can be taken anytime and anywhere. They also don't require chemical preservatives**.** Because they allow for self-administration, tablets are well-liked by both

patients and healthcare professionals. In addition to the API, other ingredients are included in the formulation of a chewable toothpaste tablet to ensure that the patient receives the API in the right amount. Newer and more effective tablet dosage forms are being created as a result of technological advancements and growing awareness of the need to modify the traditional tablet to improve acceptability and bioavailability. Assign the patient the dosage form that they find most convenient to use. Chewable tablets are categorized here according to the route of administration they take and the kind of drug delivery system they represent, so that each dose form can be understood.

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