Formulation and Evaluation of Chewable Toothpaste Tablets

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Abstract-

The conventional use of toothpaste packaged in plastic tubes has led to a significant environmental burden due to plastic waste accumulation. In response to this challenge, chewable toothpaste tablets have emerged as a potential solution offering both dental health benefits and environmental sustainability. This research article provides a comprehensive review of the current landscape surrounding chewable toothpaste tablets, focusing on their formulation, efficacy in dental hygiene, environmental impact, and market potential. Drawing upon existing literature and market analyses, we explore the advantages of chewable toothpaste tablets, including their potential to reduce plastic waste, utilize ecofriendly packaging materials, and promote cost-effectiveness. Furthermore, we discuss the regulatory considerations, consumer acceptance, and infrastructure requirements necessary for the successful adoption of chewable toothpaste tablets on a global scale. Through this analysis, we highlight the transformative potential of chewable toothpaste tablets in revolutionizing oral hygiene practices while contributing to environmental conservation efforts. Toothpaste tablets represent a novel approach to oral hygiene, offering a convenient, bite-sized format that, when chewed, transforms into a paste akin to traditional toothpaste. This research endeavors to develop and assess effervescent toothpaste tablets through a direct compressible method, presenting an ecoconscious alternative to conventional toothpaste. Tablets of 200 mg dosage were prepared via direct compression, with the powder blend scrutinized for various formulation attributes such as flow properties, compressibility, and porosity. Post-compression evaluations encompassed parameters like weight consistency, hardness, friability, pH, and foam formation. Following rigorous evaluation, the F3 formulation of 400 mg tablets emerged as the optimal choice, boasting favorable physicochemical attributes. These chewable toothpaste tablets offer a promising alternative for traditional toothpaste, promising improved oral hygiene outcomes.

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INTRODUCTION: -

(Fig.no.1-Toothpaste tablet)

Dental health is a fundamental component to general health, well-being, and quality of life. Dental health enables an individual to speak, eat and socialize. Dental health implies being free of chronic oro-facial pain and the absence of mouth diseases such as dental caries (tooth decay), periodontal disease (gum disease). Dental plaque is an archetypical biofilm composed of a complex microbial community. It is the aetiological agent for major dental diseases such as dental caries and periodontal disease.

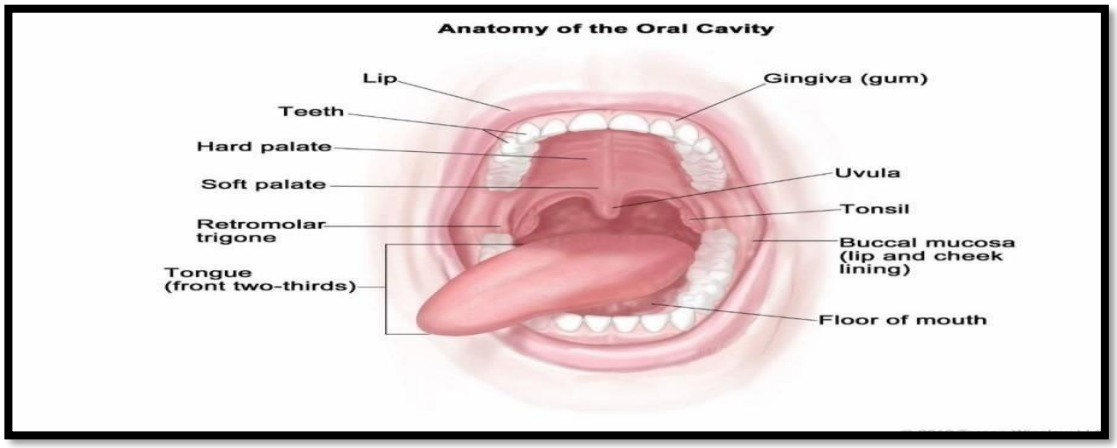
In the oral cavity, the biofilm is built on hard surfaces like a tooth, that is being continuously irrigated by saliva. Also, biofilm gets established on soft tissues such as tongue and gingival. Every year, the United Kingdom consumes 300 million tubes of toothpaste. End-to-end, that's almost 75,000 kilometers of plastic or about twice the circumference of the globe.Toothpaste tubes are typically made of a variety of polymers, and many brands have a metal layer inside the tube that is difficult to remove for recycling. A toothpaste tube takes 500 years to fully biodegrade in a landfill, which means that every tube you've ever used could still be out there in a large hole in the ground. [1,2]

This pill-shaped toothpaste will be inexpensive and simple to use. Simply bite and brush your teeth. Little has changed in the Dentifrice Delivery System. Since the first tube of toothpaste was filled, more than since the first tube of toothpaste was filled more than a century ago, the dentifrice delivery system has altered little. However, this may change with the introduction of chewable toothpaste tablets, which are less wasteful and more environmentally friendly. The chewable tablet's goal is to give a unit dose form of medication that may be conveniently provided to infants, children, and the elderly. Toothpaste is constantly evolving to better treat diseases such as caries, poor breath, gingivitis, tartar, and dental hypersensitivity. Teeth whitening has been one of the fastest-growing dental care segments in recent years, according to consumer demand for both healthy and cosmetically appealing smiles.

Oral cavity:

The oral cavity, often known as the mouth or buccal cavity, is the first part of the digestive system to be reached. It is made up of several physically distinct elements that work together to accomplish multiple functions effectively and efficiently. Lips, tongue, palate, and teeth are among these features. The mouth cavity is a unique and complicated structure with multiple different nerves and blood arteries inside it, despite its modest size. Because of its unique and diverse significance in human life, this complicated network is required.[3]

Structure and Function:-



(Fig.no.2-Anatomy of oral cavity)

The oral cavity is neighboring the lips and is composed of two separate regions, thevestibule, the area between the cheeks, teeth, and lips, and the oral cavity proper1. The lips, two flexible muscle folds that stretch from the corners of the mouth to the base of the nasal columella above and the mentolabial sulcus (fold over the chin) below surround the aperture of the oral cavity. There are three anatomic zones on the lip. The outer skin above and below the vermillion border has adnexal features including hair follicles, eccrine sweat glands, and

sebaceous glands, and is identical to the skin at other sites. The vermillion is a transitional zone with a thin stratum corneum and an increase in dermal blood vessels, giving it a reddish-purple appearance.[4]

The oral cavity is the first and most important portion of the digestive system. The mouth cavity is where the digestive process begins. The mouth cavity is where our food is first broken down. Food molecules are broken down and metabolized in the oral cavity at several distinct locations. Even in a healthy state, the mouth cavity contains a colony of bacteria that, when disturbed, might cause disease. Microbial flora can be found in many locations within the mouth cavity, providing them with home. This flora is divided into several sections, each containing viruses, bacteria, yeasts, and, in rare cases, protozoa. The microbial population in the human mouth is diverse, plentiful, and complex. The oral environment is perfect for the growth of oral bacteria because it is warm, nutrient-rich, has a constant flow of saliva, and has a pH that is close to neutral. The microbe is commonly found as a biofilm, which is a collection of bacteria embedded in an extracellular polymer matrix. This microbial community lives on a variety of surfaces in the human mouth.[5]

Tooth: -

Teeth are white, hard structures that are present in the mouth. Teeth of different vertebrate species are occasionally specialized and employed for mastication. A crown and one or more roots make up each tooth. The crown is the visible, functional section of the tooth above the gum line. The root is the invisible component of the tooth that supports and anchors it to the jawbone. The crowns and roots of different animals have distinct forms in different areas of the mouth. The teeth on one side of the jaw are virtually identical to those on the opposite side. The upper teeth are distinct from the bottom teeth and work in tandem with them. Humans have two sets of teeth: primary teeth (twenty) and permanent teeth (thirty). The eruption of primary teeth usually begins at the age of 6 months and continues at a pace of one tooth per month until the age of 2 or 2.5 years. Subtract 6 from the child's age in months up to 2 years of age to get an approximation of the normal number of teeth for that age. The first molars normally occur at the age of six, signaling the start of permanent tooth eruption. Calcification of primary teeth occurs in the womb at 3–4 months, while calcification of permanent teeth begins at birth and lasts for 8–10 years. Dentin (hard tissue that makes up the bulk of teeth), cementin (a cementlike substance that anchors dentin to the periodontal ligament), and pulp are all made up of ectoderm (loose connective tissue containing blood vessels and nerves).[4]

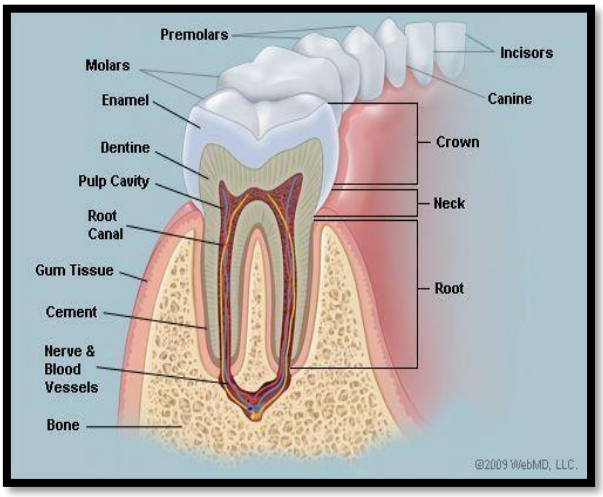
Structure of teeth:-

Four dental tissues make up your teeth. Enamel, dentin, and cementum are the three hard tissues. Pulp, or the soft, non-calcified tissue in the center of the tooth that contains nerves, blood vessels, and connective tissue, is the fourth tissue. (Figure No. 3)

Enamel: In the crown of the tooth, calcified tissue covers the dentin. Tooth enamel is unable to repair damage caused by decay or wear because it lacks active cells. These problems can only be fixed by a dentist. Anatomical Crown. The section of your tooth that is visible. Enamel covers it in most cases.

Gums are a type of gum that is used to (also called gingiva.) Soft tissues that cover and protect your teeth's roots, as well as teeth that haven't yet erupted.

Pulp Chamber is an acronym for “pulp chamber”. The pulp—the soft tissue at the middle of your teeth that contains nerves, blood arteries, and connective tissue—takes up this space.



(Fig.no.3 structure of teeth)

Function:-

Teeth provide a variety of roles in addition to mastication, such as shaping phonation kinetics, breathing, preserving a patent airway, and serving as a basis for the face's vertical dimensions. Different teeth have different roles in different types of chewing, and the entire group functions as a dynamic entity. It is because of these crucial responsibilities that tooth loss can be so traumatic.[6]

Importance of Oral hygiene: -

Oral hygiene is the practice of brushing (dental hygiene) and cleaning between the teeth regularly to maintain one's mouth clean and free of disease and other problems (such as foul breath).

Oral hygiene should be practiced regularly to avoid tooth disease and poor breath. Tooth decay (cavities, dental caries) and gum disorders, such as gingivitis and periodontitis, are the most frequent types of dental disease.

Sure, here are some key points highlighting the importance of oral health:

1. Prevention of Dental Issues: Good oral hygiene practices, such as regular brushing, flossing, and dental check-ups, help prevent common dental problems like cavities, gum disease, and bad breath.
2. Overall Health Connection: Oral health is interconnected with overall health. Poor oral hygiene can contribute to systemic health issues such as cardiovascular disease, diabetes, and respiratory infections.
3. Nutrition and Digestion: Healthy teeth and gums enable proper chewing, which is essential for effective digestion and proper nutrient absorption.
4. Social and Psychological Well-being: A healthy smile boosts confidence and self-esteem, facilitating social interactions and improving overall mental health.
5. Prevention of Tooth Loss: Proper oral care reduces the risk of tooth decay and gum disease, which are leading causes of tooth loss in adults.
6. Cost Savings: Preventive dental care is often less expensive than treating dental problems once they arise. Regular check-ups and cleanings can help avoid costly dental procedures in the long run.
7. Early Disease Detection: Regular dental check-ups allow for early detection of oral health issues, enabling prompt treatment and preventing complications.
8. Overall Quality of Life: Maintaining good oral health enhances quality of life by reducing pain, discomfort, and the need for extensive dental treatment.[7,8]

What exactly are toothpaste tablet?

Chewable toothpaste tablets represent a novel approach to oral hygiene, resembling small circular discs akin to breath mints, but with the primary function of eradicating plaque to maintain dental health. The pathogenesis of caries, or tooth decay, often involves the bacterium Streptococcus mutans, which metabolizes sugar within dental plaque, producing acidic byproducts. Over time, this acid attack leads to the demineralization and breakdown of tooth enamel, resulting in cavities.

Traditional toothpaste formulations, while effective, can sometimes pose challenges. They may deliver non-uniform doses, leading to inconsistent cleaning results, and can be messy to use. Recognizing these limitations, chewable toothpaste tablets have emerged as a promising alternative. By providing a controlled and uniform dose of toothpaste ingredients, they offer a more convenient and efficient method of maintaining oral hygiene.

The distinctive advantage of chewable toothpaste tablets lies in their ease of use and practicality. Unlike traditional toothpaste, which requires squeezing and measuring, these tablets can be simply chewed in the mouth, allowing the active ingredients to disperse and interact with dental plaque. This not only streamlines the process of brushing but also ensures a consistent and effective cleaning experience.

Furthermore, chewable tablets are designed to be chewed and not swallowed whole, emphasizing their suitability for all age groups, including children and the elderly, who may have difficulty swallowing traditional toothpaste. This feature enhances patient acceptance and compliance, promoting better oral health outcomes.

In essence, chewable toothpaste tablets offer a convenient, effective, and user-friendly solution to oral hygiene, addressing the challenges associated with traditional toothpaste formulations. Their innovative design and practical benefits make them a valuable addition to the arsenal of tools for maintaining optimal dental health.[9]

Oral care products:-

Oral care products encompass a wide range of items designed to promote dental hygiene, prevent oral health issues, and maintain fresh breath. From toothpaste to mouthwash, dental floss to chewing gum, these products play a vital role in daily oral care routines. Here's a detailed overview of some common oral care products:[10,11]

1. Toothpaste: Toothpaste is a staple in oral hygiene routines, formulated to clean teeth, remove plaque, and prevent cavities. Ingredients typically include abrasives (such as calcium carbonate or silica) for mechanical cleaning, fluoride for strengthening enamel and preventing decay, detergents (such as sodium lauryl sulfate) for foaming action, and flavoring agents for taste.[12]
2. Toothbrush: A toothbrush is essential for mechanically removing plaque and food debris from teeth and gums. Toothbrushes come in various designs, including manual and electric, with different bristle types (soft, medium, or hard) to suit individual preferences and needs.[13]
3. Dental Floss: Dental floss is used to clean between teeth and along the gumline, where a toothbrush may not reach effectively. It helps remove plaque and food particles, reducing the risk of cavities and gum disease. Dental floss comes in different types, including waxed, unwaxed, flavored, and dental tape.[14]
4. Mouthwash: Mouthwash, or oral rinse, is a liquid solution used to freshen breath, kill bacteria, and reduce plaque and gingivitis. It may contain antibacterial agents (like chlorhexidine or cetylpyridinium chloride), fluoride, and/or essential oils for their antiseptic properties.[10]
5. Chewing Gum: Sugar-free chewing gum can stimulate saliva production, which helps neutralize acids in the mouth, wash away food particles, and remineralize enamel. Some gums also contain xylitol, a sugar substitute that inhibits bacterial growth and reduces the risk of cavities.
6. Tooth Whitening Products: Tooth whitening products, such as whitening toothpaste, strips, and trays, are designed to lighten the color of teeth by removing surface stains and discoloration. Active ingredients may include hydrogen peroxide or carbamide peroxide. 7. Dental Sealants: Dental sealants are thin, plastic coatings applied to the chewing surfaces of molars and premolars to protect them from decay. They create a barrier that prevents food and bacteria from accumulating in the deep grooves and pits of the teeth.[15,16]
8. Tongue Scrapers: Tongue scrapers are tools used to remove bacteria, food debris, and dead cells from the surface of the tongue. This helps reduce bad breath and improve overall oral hygiene.
9. Orthodontic Products: Orthodontic products, such as braces, aligners, and retainers, are used to correct misaligned teeth and bite issues. Proper oral care is essential for maintaining oral health while undergoing orthodontic treatment.
10. Specialized Products: There are also specialized oral care products available for specific needs, such as dry mouth relief, sensitive teeth, or oral care for children.

Overall, incorporating a combination of these oral care products into a daily routine, along with regular dental check-ups and professional~ cleanings, is essential for maintaining optimal oral health and hygiene.

TOOTHPASTE TABLET:

(Fig.no.4 – Toothpaste tablet)

Toothpaste tablets offer a convenient and eco-friendly alternative to traditional toothpaste tubes. They are chewable versions of toothpaste that crumble and foam as you brush, eliminating the need for water. These tablets are available in natural and vegan-friendly formulations, appealing to consumers who prioritize sustainability and clean label attributes. Traditional toothpaste tubes, made of aluminum and plastic, contribute to environmental pollution and pose health risks due to microplastic breakdown. In contrast, toothpaste tablets come in minimal packaging and do not require water, reducing waste and environmental impact. [17,18]

Toothpaste tablets contain familiar toothpaste ingredients such as xylitol, calcium carbonate, sodium bicarbonate, and tartaric acid derivatives. They are available in fluoride and nonfluoride formulations and are free of preservatives like parabens. With a long shelf life and compact packaging similar to medicinal pills, toothpaste tablets are gaining popularity among users seeking natural products for oral care. [19]

Marketed Product: -[20]

(Table no. 1 – Marketed products)

Sr. No.	Brand Name	Manufacture By
1)	Bite	Kind lab, CA, Toronto, U.S.
2)	Dental tab	Dent tab GM BH Gerichtstrabe, Barlin, Germany
3)	FORISCA	Kosmetics Lane Private Limited, India
4)	Arcthek toothpast tablet	Archtek, USA
5)	Globoids toothpaste tablets	GloBoid, China

Ideal Characteristics Of Chewable Tablets:

1. Easy to chew.
2. Palatable (flavorful or worthy of flavor)
3. Appropriate size and shape
4. Instant disintegration to promote dissolution
5. All clear dosage forms are the same
6. Easy to swallow even for people who have difficulty swallowing regular tablets and capsules (about once a time)
7. Reduce the risk of drug-induced esophagitis. This occurs when the tablet becomes trapped in the esophagus and dissolves while still in contact with the delicate lining of the esophagus.
8. Tasty and comes in a variety of flavors
9. Easy to take and useful
10. Offered as a single dose, no quote required.
11. Improve consistency
12. Dosage forms that do not require water are: - Easy to carry on the go - Convenient to carry anywhere anytime.

Advantages: -

1. Natural Antibacterial Properties : Neem contains compounds that have powerful antibacterial properties, helping to fight against harmful bacteria in the mouth and prevent dental issues like cavities and gum disease.
2. Effective Plaque Removal: Neem's antibacterial properties also make it effective in removing plaque from teeth, promoting cleaner and healthier teeth and gums.
3. Soothes Gum Inflammation : Neem has anti-inflammatory properties that can help soothe gum inflammation and reduce the risk of gingivitis and periodontal disease.
4. Freshens Breath : Neem's natural properties help to neutralize odors and freshen breath, providing long-lasting oral freshness.
5. Promotes Oral Health : Regular use of Neem Toothpaste Tablets can contribute to overall oral health by maintaining a balanced oral microbiome and reducing the risk of oral infections.
6. Convenient and Travel-Friendly : The compact and lightweight nature of toothpaste tablets makes them convenient for travel and on-the-go use, eliminating the need for bulky toothpaste tubes.
7. Reduced Packaging Waste: Toothpaste tablets typically come in minimal packaging, reducing plastic waste and promoting environmental sustainability compared to traditional toothpaste tubes.
8. Easy to Use: Using toothpaste tablets is as simple as popping one into your mouth, chewing it, and then brushing as usual, making them suitable for all ages and abilities.
9. Longer Shelf Life: Toothpaste tablets have a longer shelf life compared to traditional toothpaste, reducing the likelihood of product spoilage and waste.
10. Innovative Oral Care Solution: Neem Toothpaste Tablets offer an innovative and effective alternative to traditional toothpaste, providing the benefits of neem in a convenient and eco-friendly format.

Disadvantages: -

1. Acquired Taste: Some individuals may find the taste of neem to be bitter or strong, which could be off-putting for those accustomed to milder flavors in traditional toothpaste.
2. Availability: Depending on location and distribution, Neem Toothpaste Tablets may not be as readily available in stores compared to mainstream toothpaste brands, potentially requiring special ordering or online purchases.
3. Texture Sensitivity: Toothpaste tablets have a different texture compared to traditional toothpaste, which may not be preferred by individuals who are sensitive to changes in texture or consistency.
4. Chewing Requirements: Unlike squeezing toothpaste from a tube, using toothpaste tablets involves chewing them before brushing, which may not be suitable for individuals with dental issues or those who prefer a simpler brushing routine.
5. Cost: Neem Toothpaste Tablets may be priced higher than conventional toothpaste options due to their specialized formulation and ingredients, which could be a deterrent for budgetconscious consumers.

Application:

- It is a cost-effective product; unlike capsules and coated tablets, it does not need expensive equipment or a lengthy manufacturing procedure.
- Explain the toothpaste tube reuse approach.• To optimize logistic and supply chain management, reduce the size of toothpaste tubes by reducing the water content.
- To offer glass jars/reusable containers for dry or tablet products, such as toothpaste, that are convenient to transport in areas where liquid or gel transportation is prohibited.
- Buying toothpaste in bulk for home usage will result in the least amount of unnecessary packaging. • Instead of using paper for massive packaging, we might use jute to conserve a huge number of trees each year.
- To encourage rural and urban residents to promote the concept of a healthy environment.

2) METHODOLOGY 2.1 Material and Methods: -

Table no. 2- Chemical and reagents

SR. NO.	MATERIAL	USE
1)	NEEM	ANTI-BACTERIAL
2)	CLOVE OIL	ANTI-MICROBIAL
3)	FUNNEL OIL	FLAVORING
4)	SODIUM LAURYL SULPHATE	SURFACTANT
5)	CALCIUM CARBONATE	ABRASIVE
6)	SODIUM SACCHRIN	SWEETNER
7)	ACCACIA GUM POWDER	BINDER
8)	SODIUM BEZOATE	PRESERVATIVE

Instruments and equipments :-

Table no. 3- Instrument and equipments

SR. NO.	EQUIPMENTS AND INSTRUMENTS
1)	MORTAL AND PESTLE
2)	SINGLE PUNCH MACHINE
3)	PH METER
4)	FRIABILITY TESTER
5)	MANSANTO HARDNESS TESTER
6)	VERNIRE CALLIPER
7)	BALANCE
8)	MEASURING CYLINDER

FORMULATION OF CHEWABLE TOOTHPASTE TABLETS:-

(Table no.4 – composition of chewable toothpaste tablet)

INGREDIENTS	F1	F2	F3	F4
NEEM	2gm	2.5gm	3gm	3.5gm
CLOVE OIL	0.50ml	0.75ml	1ml	1.25ml
FUNNEL OIL	0.50ml	0.75ml	1ml	1.25ml
CALCIUM CARBONATE	9gm	11gm	13gm	15gm
SLS	1gm	1.25gm	1.50gm	1.75gm
SODIUM SACHHRINE	0.25gm	0.30gm	0.35gm	0.40gm
SODIUM BENZOATE	0.25gm	0.30gm	0.35gm	0.40gm
ACCACIA GUM POWDER	1gm	1.25gm	1.50gm	1.75gm

PROCEDURE: -

Tablets of 400mg were prepared as per composition given tabel Accurately weighed the required quantity of all the ingredients.

The above-weighed ingredients were blended using the mortar and pestle to form a homogeneous powder. Then sufficient quantity of clove oil and funnel oil (as per quantity) is added into the homogeneous powder and again blended to form uniform mixture.

Then powder were compressed by single punch machine by direct compression technique.

20 tablets was prepared for the each batch.

Evaluation of chewable toothpaste tablet:-

Pre-compression parameters:[21]

Before compression the flowability properties of granules and powders were characterized by the angle of repose, flow rate, bulk density tap density, compressibility index also called carr's index, percentage porosity, and Hausner's ratio.

1)The Angle of repose:[21]

The angle of repose is defined as the maximum angle possible between the surface of a pile of powder and the horizontal plane. The frictional force in a loose powder or granules can be measured by the angle of repose is an indicator of the powder flow property.

$\tan \theta = H / R$ $\theta = \tan^{-1}$

(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

Procedure:

At definite height (H) the funnel was fixed to a stand through which the powder was allowed to flow. The angle of repose was then calculated by measuring the height and radius of the heap of the powder which was formed. Care was taken to see that the powder particles slip and roll over each other through the sides of the funnel.

(Table no. 5 Angle of repose as an indication of powder flow)

The angle of repose or degrees	Flow

< 25	Excellent
25 - 30	Good
30 - 40	Passable
> 40	Very poor

Bulk Density:[21]
The bulk density is defined as the ratio of the mass of the powder by the bulk volume in cm3 The sample was carefully introduced into a 100 ml graduated measuring cylinder.
This cylinder was dropped at 2 seconds intervals onto a hardwood surface 3 times from a height of 1inch. The bulk density of each formulation was then obtained by dividing the weight of the sample in grams by the final volume in cm3of the sample which is contained in the measuring cylinder. It was calculated by using the following equation.

Bulk density = Mass/Bulk volume

Less than or equal to 1.3g cm $^{-3}$ is good flow

Tap Density:[21]
The tap density is defined as the ratio of the mass of the powder by the tapped volume in cm3. The sample was carefully introduced into a 100 ml graduated measuring cylinder. This cylinder was dropped at 2 seconds intervals onto a hardwood surface 100 times from a height of 1inch. The tapped density of each formulation was then obtained by dividing the weight of the sample in grams by the final tapped volume in cm3of the sample which is contained in the measuring cylinder.
It was calculated by using the following given equation.

Tap density =Mass/Tap volume

Carr's index:
Carr's index which is also called as % compressibility index is an indirect method of measuring the flow of granules using the bulk densities. It was developed by Carr. The % compressibility of a powder was a direct measure of the potential powder or bridge strength and the stability of the granules. Carr's index of each formulation was calculated by using the following equation.

% Compressibility = Tap density – Bulk density/Tap density × 100

Compressibility index	Flow
5-15	Excellent

Hausner Ratio:-
Hausner predict the flow properties of powder by using interparticle friction. This is a simple index that can be determined on small quantities of powder. It is calculated by following formula:

Tapped density/Bulk density

1.00-1.11 and 1.12-1.18 excellent

Post-Compression study:-[22]
Weight variation: [22]
Weight variation was done to check whether different batches of tablets have uniformity. Weighed 20 tablets individually, calculated the average weight, and compared the individual tablet weight to average. If not more

than two tablets are outside the percentage limit and none of the tablets differ by more than two times the Percentage limit, the tablets meet the test.

Table No. 6: Weight variation specification as per I.P.

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

Hardness: [22]

The hardness of the tablet was evaluated by using a Monsanto hardness tester. It consists of a barrel containing a compressible spring held between two plungers. A lower plunger was placed in close contact with the tablet and a zero reading was taken. By turning a threaded bolt, the upper plunger was forced against a spring until the tablet fractures. The force of fracture was recorded. Ten tablets of each formulation were evaluated.

Procedure

- The hardness of tablet is tested using the Monsanto hardness tester.
- The tablet is placed across the diameter in between the spindle and anvil.
- The knob is adjusted to hold the tablet in position.
- The reading of the pointer adjusted to zero.
- The pressure is increased slowly to break the tablet.

The average value for hardness from 3-4kg/cm^3

Friability: [22]

Roche friability is used to evaluate the friability of 20 tablets from each formulation. Pre weighed tablets were placed in the friabilator plastic chamber and the friabilator was run for 4 minutes at 25 rpm. All the tablets were dedusted and weighed by the following Formulas.

Procedure

- Initially weight 20 tablets sample was placed in the friabilator.
- In the friabilator the tablets are exposed to rolling, resulting from free fall of tablets within the chamber of friabilator after 100 rotations.
- The tablets are taken out from the friabilator and intact tablets are again weighed.
- Calculate the percentage friability using following formula.

$$\%\,friability = \frac{Initial\ weight - Final\ weight}{Initial\ weight} \times 100$$

Foamability:-[22]

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.

$$Foamability = V_2 - V_1$$

Where,

V2= Volume of foam with water

V1=Volume of water

Thickness:- [22]

Variation in the tablet thickness may cause problems in counting and packaging in addition to weight variation belong the permissible limits. tablet thickness is measured by vernier caliper scale.

The diameter and punch size of tablets depends on the die and punches selected for making the tablets.
Thickness values were expressed in millimetre.
The thickness is measured by placing the tablet between two arms of the vernier caliper. Five tablets are taken and their thickness is measured.
Formula: -

$$\text{Final reading} = \text{main scale reading} + (\text{vernier scale reading} \times \text{least count})$$

RESULT AND DISCUSSION:-
Pre-compression parameter :-

Table no. 7: Result of pre-compression parameter of batch F1 to F4.

Sr. No.	Angle of repose	Bulk density	Tapped density	Carr's index(%)	Hausner ratio
F1	28.10^0	0.7871	0.4789	1.12	1.07
F2	26.70^0	0.8790	0.4950	7.378	1.12
F3	26.50^0	0.9876	0.4900	8.182	1.14
F4	27.80^0	0.8906	0.4876	6.896	1.05

Angle of repose for prepared granules were in the range of 26.50 to 28.10 which were in accordance to the limits mentioned in the Indian Pharmacopoeia. All the batch show excellent flow.
Bulk desity were in the range of 0.7871 to 0.9876 are good accordance to standard range in Indian Pharmacopoeia.
Tapped density of the powder were in the range of 0.4789 to 0.4950. They ewre in the good range. Carr' index 5-10% is excellent accordance to Indian Pharmacopoeia. Batch F2,F3,F4 show excellent %,whereas F1 show poor.
Hausner 's ratio for formulated powder was in the range of 1.07 to 1.14 which were in accordance to the limits mentioned in the Indian Pharmacopoeia. F2 and F3 show excellent ratio and F1 and F4 show good ratio.

Post-compression parameter :-

Table no 8 : Result of post-compression parameter of batch F1 to F4.

Sr. No.	Thickness (mm)	Hardness ($kg/cm^{3)}$	Weight variation (mg)	Foamability (ml)	Friability (%)
F1	4mm	4	410mg	6ml	1.4%
F2	4.1mm	3.6	408mg	8ml	0.98%

F3	4.5mm	3.5	400mg	10ml	0.92%
F4	5mm	3.8	450mg	11ml	1.6%

Thickness of the formulation was found to be in the range of 4mm to 4.5mm. which were in accordance to the standard limits. F1 to F3 have good thickness.
Weight variation test was performed and the results obtained were within the pharmacopeial limit (not more than 5%) and hence all the formulation prepared had passed the test.it ranges from 400 – 450. F3 was in the excellent range.
Hardness of the formulation was in the range of 3.5 ± 0.02 kg/cm² to 4 ± 0.02 kg/cm², which indicates that the prepared tablets were having a good strength.
Friability of prepared batch F2 and F3 tablets was found to be in the range of 0.92% to 0.98% which was less than 1% which indicates that the formulated tablets were having good strength and can be stable for long period of time.
Disintegration studies the disintegration time for formulation F1 to F4 were in the range 7-9 minutes. As the concentration of disintegrating agent in the formulation increases the time taken to disintegrate tablets were found to be decreased.
Foamability was performed as per the procedure described in methodology section. The formulated chewable toothpaste tablets having good foamability. pH of the all formulation was measured by pH meter and it was found to be within the limit.

CONCLUSION:

The present research entitled "FORMULATION AND EVALUTION OF CHEWABLE TOOTHPASTE TABLET" was carried out to replace the traditional toothpaste that we have used from the early years. Toothpaste tablets are chewable versions of toothpaste that can be chewed into a paste before brushing.
The formulation of toothpaste tablets presents a promising avenue for innovation in oral care. With a focus on sustainability, customization, and efficacy, toothpaste tablets offer a convenient and eco-friendly alternative to traditional toothpaste. By incorporating innovative ingredients, embracing digital integration, and promoting preventive approaches, toothpaste tablets have the potential to revolutionize oral hygiene practices and improve overall oral health outcomes. Through collaboration with dental professionals, education initiatives, and consumer awareness campaigns, toothpaste tablets can pave the way for a future where oral care is personalized, effective, and accessible to all.
Pre-compression studies like the angle of repose, bulk density, tap density, compressibility index, Hausner's ratio were conducted on the powder blend. The formulated tablets were evaluated for post-compression tests like weight variation, hardness, friability, pH, and foaming ability.
The results obtained at each stage of the formulation were utilized and the best formulations were selected. Finally, the F3 formulation of 400 mg tablets was selected as the best formulation because of their physicochemical characteristics. We concluded that the formulated chwable toothpaste tablets can be significantly used as an eco-friendly alternative for traditional toothpaste.

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