



A Game-Changer In Oral Care: Unraveling The Formulation Secrets Of Toothpaste Tablet

Mukesh T Mohite¹, Krisha Mirani^{2*}

¹Faculty at Dr. D. Y. Patil College of Pharmacy, Akurdi, Pune, 411044, Maharashtra, India.

^{2*}Student at Dr. D. Y. Patil College of Pharmacy, Akurdi, Pune, 411044, Maharashtra, India.

***Corresponding Author:** Krisha Mirani

*M.Pharm (Department of Quality Assurance), Email : miranikrisha@gmail.com, Mob No: 9096103044

Abstract:

In this review, toothpaste tablets are looked at as a possible alternative to traditional toothpaste. When chewed, the solid form of toothpaste tablets dissolves in the mouth and becomes a frothy substance that may be used for brushing. In addition to flavor, texture, packaging, and environmental sustainability, the assessment looks at how well they work to get rid of plaque, prevent cavities, and freshen breath. The findings show that toothpaste tablets might be a convenient and worthwhile option for oral hygiene, with advantages comparable to those of traditional toothpaste. Additionally, they provide benefits including mobility, less packaging waste, and the possibility to enhance oral hygiene practices. To investigate long-term impacts, user preferences, and difficulties with pill dissolving and flavor variations, more study is needed. In summary, toothpaste tablets offer a viable substitute for conventional toothpaste, providing a practical and ecologically responsible means of keeping one's dental health.

Keywords: Oral hygiene, Environmental sustainability, Toothpaste, Toothpaste tablet.

INTRODUCTION

As well-being mindfulness in the populace is expanding step by step these days, well-being is a fundamental piece of the developing populace due ordinary way of life and the food propensities we have in our life. Oral well-being is over dental well-being. It incorporates strong gums, hard and lips, linings of the mouth and throat, tongue, lips, salivary glands, biting muscles, and upper and lower gums.

The rima assumes a focal part for the admission of root nourishment and security against microbial diseases. The World Health Organization (WHO) depicts oral well-being as a condition liberated from the mouth and facial torment, mouth and throat malignant growth, oral contamination and bruises, periodontal (gum) disease, caries, tooth misfortune, and different illnesses and problems that limit an individual's ability in gnawing, biting, grinning, talking, and psychosocial prosperity.

The World Health Organization defines oral health as "the state of not having chronic mouth and facial pain, oral and throat cancer, oral infections and sores, periodontal (gum) disease, tooth decay, tooth loss, and other diseases and disorders that limit an individual's capacity for biting, chewing, smiling, speaking, and psychosocial wellbeing." [1]

Why is oral health so important?

Oral cleanliness is the act of brushing (dental cleanliness) and cleaning between the teeth consistently to keep up with one's mouth clean and unfettered from illness and different issues (like foul breath). Oral cleanliness ought to be drilled consistently to stay away from tooth infection and unfortunate breath. Tooth rot (pits, dental caries) and gum issues, like gum disease and periodontitis, are the most successive sorts of dental problems. Brushing two times every day is suggested, yet preferably, the mouth ought to be cleaned after every dinner. Interdental cleaning is similarly basically as significant as tooth brushing with regards to cleaning between the teeth. This is on the grounds that a toothbrush can't arrive between the teeth and thus just eliminates around half of the plaque on the surface.

Loss, fossettes, and interdental brushes are a few instruments for cleaning in between the teeth. Perhaps the most important and essential aspect of total health and a requirement for overall well-being is oral health. Oral health is intimately correlated with overall health. On the one hand, a variety of persistent and viral illnesses that cause mouth symptoms might endanger dental health. [1]

ORAL CAVITY:

The mouth serves as the site of entrance for the respiratory and digestive systems. It is composed of numerous physically separate components that work together to successfully complete a variety of tasks. These include the lips, tongue, palate, and teeth. Despite its small size, the mouth cavity has a distinct and intricate structure that contains a variety of various nerves and blood vessels. This intricate network is necessary because of its distinctive and varied relevance in human life.

The vestibule, the space between the cheeks, teeth, and lips, and the oral cavity proper make up the oral cavity, which is located next to the lips. The mouth's opening is surrounded by the lips, the mentolabial sulcus (a fold over the chin), and

two flexible muscle folds that extend from the corners of the mouth to the base of the nasal columella above. The lip has three anatomical zones. Similar to the skin at other locations, the outer skin above and below the vermilion border possesses adnexal characteristics such as hair follicles, eccrine sweat glands, and sebaceous glands. An increase in cutaneous blood vessels and a thin stratum corneum give the vermilion, a transitional zone, its colour as reddish - purple.[2]

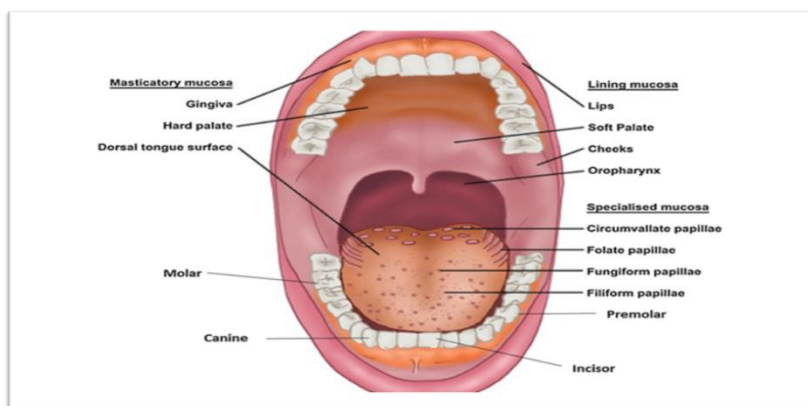


Fig no. 1. Anatomy of Mouth

The lips (labia), the inside of the cheeks (buccal), the teeth and gums (gingivae), the hard and soft palates, the floor of the mouth, and therefore the tongue are the parts of the rima that are most easily apparent. The muscles, nerves, blood vessels, glands, joints, and especially the top (maxilla) and lower (mandible) jaw bones, which support and work with the visible components, are not visible but unquestionably significant. The rima oris starts at the point where the mucosa lining the inside of the lips and the vermilion border of the lips converge and extends posteriorly to the palate glossal folds or arch. The palatopharyngeal folds, which mark the start of the oropharynx and the location of the digestive and respiratory systems, are located beyond the palatoglossal folds.[2]

ORAL MUCOSA:

An inner bodily space, such as the rima oris, the gastrointestinal, urinary, and reproductive systems, may be lined by mucosa, a moist, soft tissue membrane. The oral mucosa is made up of three layers: the surface epithelium, the lamina propria, which supports the epithelium and is composed of a layer of loose animal tissue (the papillary layer) and a deeper layer of dense irregular animal tissue (the reticular layer), and the sub-mucosa, which is also composed of dense irregular animal tissue.

First, the hard palate and gingiva are covered by the keratinized mucosa known as the masticatory mucosa. The abrasive and mechanical forces applied during the masticatory processes necessitate a stronger and more rigid masticatory mucosa. The risk of infection from foreign bacteria and pathogens found in food and other objects that enter the mouth increases if the masticatory mucosa is damaged in any way. The lining mucosa, in contrast, covers a much greater portion of the oral cavity than the other types of mucosa and is non-keratinized. This non-keratinized mucosa can also be divided into smaller groups of tissues, such as the buccal mucosa and labial mucosa, which line the cheeks and the lips and the lining of the lips, respectively.

The specialised mucosa that covers the dorsum of the tongue is the third kind of oral mucosa. The lining of the tongue and the masticatory mucosae, which contain taste and sense receptor nerve ends, combine to form the dorsum of the tongue. These salivary glands release saliva, a slimy, viscoelastic substance mostly composed of water and mucins. This mucus has a number of functions, including lubricating the masticatory muscles and assisting in the formation of a coating over the gingiva and mouth cavity to guard against infections and abrasions. [3]

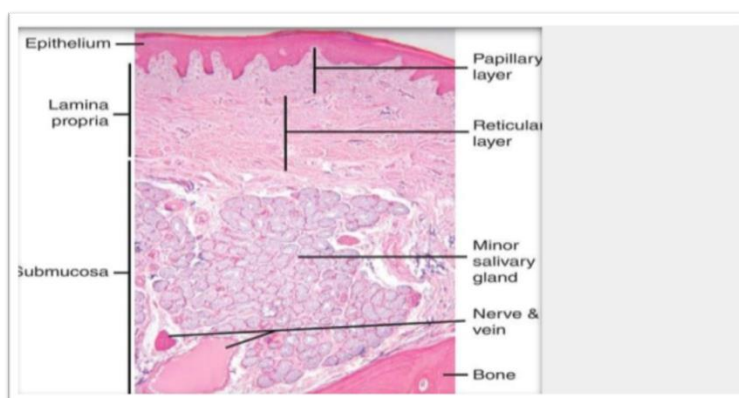


Fig no. 2. The above illustrated picture shows different layer of oral Mucosa

TEETH:

In the mouth, there are white, sturdy structures called teeth. Sometimes, the teeth of various vertebrate species are specialized and used for mastication. Each tooth consists of a crown and one to many roots. The visible, functioning portion of the tooth above the gum line is called the crown. The tooth's inconspicuous root is what holds and secures it to the jawbone.

Humans have two sets of teeth that they will have their entire lives. The first set, called the deciduous teeth, begins to erupt around the age of six months, and the second set, called the permanent teeth, begins to appear around the age of twelve. The reason for this is that because the deciduous teeth stop growing as the human body develops and grows, a larger set of teeth must be used to replace them. The oral cavity of the typical adult has four different kinds of teeth. The mouth can be split into four regions or quadrants so that each tooth can be identified and given a name. Each quadrant's teeth are numbered 1 through 8, always beginning in the center. [3]

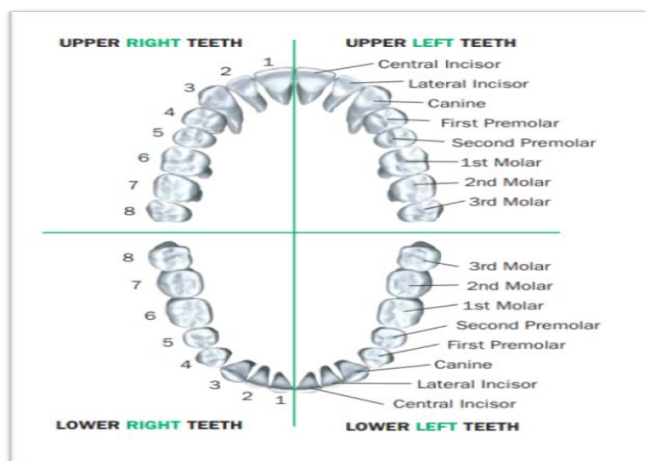


Fig no.3. Different types of teeth and their location

In the oral cavity of an adult, there are four different types of teeth: incisors, canines, premolars, and molars.

1. **Incisors:** The front teeth of the mouth, which are flat with sharp edges. They primarily serve the purpose of cutting and biting the food in the mouth cavity during the initial bite.
2. **Canines:** Deeply rooted teeth with long, sharp tips. They are seated next to the canines. They are used to rip food. The canines are the mouth's most sharply angled teeth.
3. **Pre-molars:** They take a seat behind the canines. They feature one or two roots and two protruding tips called as "cusps." They grind and partially rip food as part of their function. Premolars are effective in tearing and grinding food because of their wide surface area and flat biting surface, which helps transform solid food pieces into an easily digestible mush.
4. **Molars:** back teeth with four or five cusps on each one. Typically, upper molars have three roots. Usually, lower molars have two roots. Their task is to chew and pulverize food for simple digestion.

The crown, neck, and root are the three parts that make up a tooth. A complex network of nerves and blood arteries may be found in the tooth's root part, which extends through the jawbone and into the pulp chamber in the heart of the tooth. The gingiva surrounds the tooth's neck, which is located in the midst of the crown and roots. The enamel-covered top of the tooth that is visible above the gingiva edge is known as the crown. They consist of four hard tissues—dentin, cementum, enamel, and bone—and three distinct hard or mineralized tissues.

- **Crown:** The part of the tooth that we are able to observe because it is the only part of a healthy tooth that should be visible is the tooth's white crown.
- **Enamel:** The tooth's crown is the top, which is coated with enamel and is visible above the gingival edge. The white, highly mineralized layer known as enamel shields the tooth's inside, which is softer. It is the toughest component in the body and has the largest concentration of minerals, yet it is prone to erosion from acids and from bacterial growth. The enamel layer can be as thick as 2 mm to adequately protect the sensitive dentin and nerves inside a tooth. 96% of the ingredients used to make enamel are inorganic, including calcium hydroxyapatite ($\text{Ca}_5(\text{PO}_4)_3(\text{OH})$).
- **Dentin:** Dentin makes up the majority of the tooth's tissue. The base of the tooth is made up of dentin, which supports the enamel that protects the crown. The pulp, which is enclosed by the dentin and serves as its blood, nerve, immune, and reparative systems, maintains the health of the dentin and, by extension, the odontoblasts that create it. The medium components of dentin, namely collagen, are secreted and mineralized by the odontoblasts that border the pulp's perimeter. The odontoblast process, which extends partially through the dentin in a particularly dentinal tubule, is a long apical or distal cytoplasmic process that is a characteristic of each odontoblast.
- **Cementum:** The cementum that covers the outside of the root is a tough, bone-like substance. At the tooth's neck, the cementum and enamel connect.

- Root canal: Each root has a root canal that runs the length of it and carries the blood vessels and nerves into the pulp chamber. The body can maintain the health of the tooth by supplying it with nutrients and oxygen through its root system.
- Periodontal ligaments: The jaw's root is attached to it by thousands of minute fibers known as periodontal ligaments, which serve as shock absorbers and stabilizers.[4]

FUNCTIONS OF TEETH:

Teeth are important for the digestion process because they help break down food that enters the mouth, lowering its surface area to help with swallowing, digesting, and choking risk. Additionally, they contribute significantly to speech and communication through their facial expressions.

Our ability to consume and chew food is the main purpose of our teeth. Before swallowing, food should be broken down in the mouth to help in digestion. For adequate nutrition and all of the health advantages that follow, good digestion is crucial.[4]

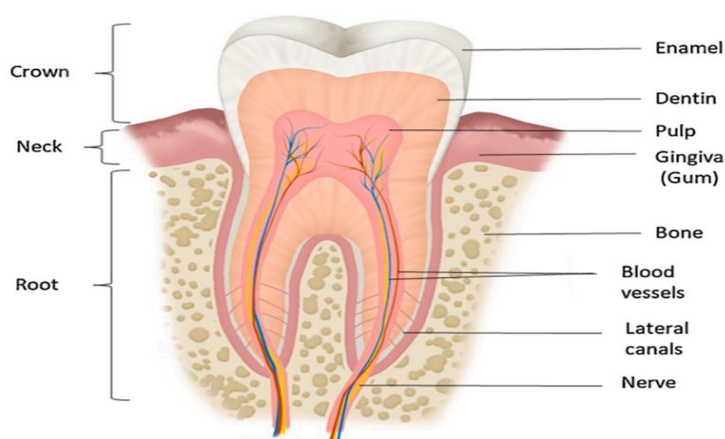


Fig. no. 4 Parts of a tooth

DENTAL DISEASES:

Periodontal disease (gum disease) and dental caries (tooth decay) are the two basic hallmarks of dental disease. Both disorders are mostly brought on by a material known as "plaque."

➤ **Dental Plaque:** Dental plaque attaches to tooth surfaces and is mostly composed of microbial aggregates held together by a mucinous ground material. It is referred to as material alba, dentobacterial plaque, gelatinous plaque, microcosm, oral detritus, and sordes and ranges in colour from white to yellowish grey. It starts off as a soft mass that quickly grows after a few days of not cleaning your teeth. This is called soft plaque. If plaque accumulates in the mouth, it will react with chemicals in the saliva to form a hard, white substance that gathers around the teeth. Tartar or calculus is the term for this. Once it reaches this level, brushing alone will not get rid of the tartar. Plaque bacteria have the ability to turn carbohydrates into acid. The decay process then starts as the acid assaults and erodes the surfaces of the teeth. The creation of plaque occurs in stages.

1. The first stage includes the bacteria adhering to the acquired pellicle. Salivary glycoproteins, lipids, mucin, exoproducts (any exocellular product), and phosphoproteins immediately after the teeth have been cleansed form an acellular layer on the cleaned enamel surface.
2. In stage 2, *Streptococcus sanguinis* (*S. sanguinis*) forms flimsy, reversible van der Waals connections, giving the bacteria their first footing to begin colonising the tooth surface. The pili (hair-like extensions that are present on the surface of some species of bacteria) allow the bacteria to attach themselves to the hydroxyapatite surface if they are not eliminated.
3. In Stage 3, organisms that couldn't originally cling to the pellicle begin to cling permanently to the first layer of bacteria on the surface of the tooth through adhesion-receptor interactions. The connected bacteria begin to reproduce and form tiny colonies.
4. In stage 4, The early colonizers have already established themselves successfully. As a result, the bacterial colony that has come to be known as dental plaque grows more complicated as the bacterium population keeps expanding and consumes more oxygen. Zones that are anaerobic are produced as a result of the increased demand for oxygen. As the bacteria continue to mature, the rate of cell division eventually declines because there is a shortage of space on the oral surface and an increase in the need for food for development. A pseudo steady-state climax community eventually forms. By this time, a thick layer of tooth tartar is apparent.
5. In stage 5, these microorganisms are able to spread throughout the oral cavity and will restart the cycle by colonizing new surfaces because these biofilms can form on any surface inside the oral cavity. [6,7]



Fig.no.5 Illustration of Dental Plaque

➤ **Periodontal Disease:** The term "periodontitis" is a broad term used to describe conditions that affect the gingiva and harm the bone and soft tissue that hold the teeth in place in the jaws. A further illness produced on by the complicated interaction between bacterial infection and host defence is periodontitis, which can be identified by attachment and bone loss around the teeth. The three phases of this disease are :

1. Mild: The disease called gingivitis occurs when too much plaque is allowed to build up around the tooth's neck and gums get inflamed.
2. Moderate: If gingivitis persists, the gums around the teeth become loose, enabling more plaque and germs to enter the periodontal tissues and erode the bone supporting the teeth. Periodontitis is the medical term for this ailment.
3. Advanced: If periodontitis is left untreated, the bone support will eventually be so low that the tooth will lose its stability and fall out.[7,8]

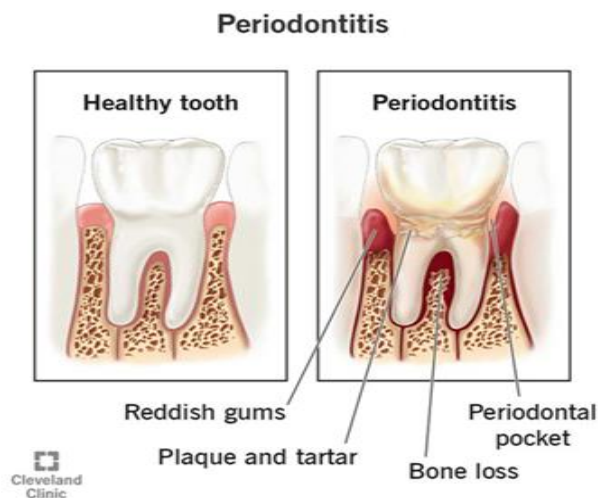


Fig no.6. Illustration of Periodontitis

➤ **Dental Caries:** Dental caries is the commonly used word for tooth decay. This occurs as a result of plaque bacteria in the mouth converting carbohydrates into acid. After that, the acid damages the teeth. While decay can develop on any surface, it most frequently happens in the fissures and hollows on the biting surfaces of teeth as well as in the spaces in between teeth where food likes to gather and bacteria can grow.

It is a complex, progressive condition in which a tooth's surface structure deteriorates over time. This is brought on by the hydroxyapatite's irreversible solubilization by the acids generated by the bacteria during their metabolic processes. Increased uses of sugary meals and beverages as well as persistently bad oral hygiene worsen this. The development of dental caries is not an overnight occurrence, thus takes place in different stages

1. Apart from the white spot lesions (WSL) visible on the enamel surface, there are no symptoms in the early stages of tooth decay. These specific WSLs develop on the smooth surfaces of the teeth as a result of underlying enamel demineralization. These lesions develop when plaque that has accumulated on the surface and has not been disturbed for a long time is exposed to prolonged exposure. The enamel surface becomes demineralized and decalcified when it is exposed to the acids that the plaque bacteria produce. At pH 5 to 6, tooth enamel begins to demineralize.
2. As a result of persistent demineralization, the enamel begins to deteriorate in the second stage. The likelihood of the tooth's surface breaking up due to enamel degradation, which would result in permanent harm, is increased. As the enamel layer is compromised at this time, dentin hypersensitivity begins to emerge. The tooth may shatter and dentin

decay will begin if the enamel decay is not prevented. When this stage is achieved, the person's discomfort will become more intense, and their sensitivity to stimuli will rise. When acid attacks the enamel, tooth decay sets in. Usually, the only way to identify early-stage decay that appears between teeth is by using radiography.

3. When decay reaches the tooth's delicate pulp in the third stage, the nerve becomes damaged, and extremes of heat and cold will hurt. Microorganisms that penetrate the dentin cause an inflammatory reaction that, if left untreated, can result in recurrent episodes that permanently destroy normal tissue while also diminishing the body's capacity to heal itself. Blood vessels and nerves begin to perish as a result of bacteria expanding the root canals, and exudate begins to develop.
4. The infection may spread throughout the pulp at this point, leading to the development of an abscess. The tooth may need to be pulled because this is quite painful. [8,9,10]

HOW TO RECOGNISE DENTAL CARIES:

Dental disease has a few outward indications or symptoms that the patient may experience.

- If the tooth is lightly tapped, it aches.
- There might be some swelling adjacent to the tooth in the mouth.
- The side of the face where infection has occurred might be swollen.[11,12]

Oral Care products:

Items for oral care are those that are used to maintain proper oral hygiene, clean the mouth, and refresh the breath. The market is filled with a wide variety of oral care items. The market adds to the complexity of the selecting process. Different methods can affect how people choose oral hygiene products. In order to locate the perfect dental care formulation that suits their needs, individuals should use a personalized approach, which is at the top of the list. With the right selection, oral hygiene products have been used by humans for many years. The most popular health and beauty products are toothpaste and mouthwashes, and there is a high demand for these dental products. Products in this category include chemical and botanical products. A variety of new products to enhance the oral care. [13]

CONCEPT OF TOOTHPASTE TABLET:

The paste that we have all used since we were kids is now available in tablet form. Alternatives that are all-natural and suitable for vegans are available, and the pills froth and disintegrate as you brush (no water is needed). The tabs may be packaged in recyclable materials or reused jars. Companies may also offer refills. There are no sticky pastes, yet it has the same cleansing advantages as toothpaste. Preservatives Paraben and sodium benzoates are used in toothpaste to prevent drying and to give it a creamy feel, which is not necessary for tabs. Tabs are safe and environmentally friendly since they are dry and contain little to no preservatives. They have a minimal carbon impact since they are easy to carry in tab form.[14,15,16]

Consumers give features like sustainability and clean labelling a high priority when making purchases of personal care products. Reusable and sustainable products are readily available on store shelves. The packaging materials used in conventional toothpaste tubes, on the other hand, are bad for the environment. The tubes need a lot of time, effort, and recycling to make because they are made of metal and plastic. Over time, toothpaste tubes degrade into microplastics, endangering the environment as well as the health of people and animals. Therefore, toothpaste pills are becoming a useful fix. The outcomes of toothpaste tablets, which are tiny, chewable pieces that may be broken down into a paste before brushing, are similar to those of ordinary toothpaste.[17]

Without the use of water, toothpaste tablets employ ingredients found in toothpaste, such as xylitol, calcium carbonate, sodium bicarbonate, and derivatives of tartaric acid. They are tightly packaged, much like medicine tablets. If stored effectively, they can last for a very long period. Customers seeking for natural items can be drawn to the product. [19,20]

FORMULATION INGREDIENTS FOR TOOTHPASTE TABLET:

1. **Abrasives:** One of the essential components of any contemporary toothpaste is abrasives. They are regarded as an inactive component in the formulation since they do not lower the risk of cavities, although playing a very active function in eliminating plaque and stains from the teeth and gingiva. It is crucial to use the right abrasives since they must be strong enough to remove plaque and germs from tooth surfaces without harming the enamel. They were the main ingredient in the original toothpastes and are often an insoluble component of the toothpaste. Abrasives like calcium carbonate, sodium bicarbonate, hydrated silica, and dicalcium phosphate are frequently employed. Plaque stains, or germs must come into touch with the abrasive for it to be effective. The bonds between the substrate and the surface can be broken by the contact's tensile and shear stresses. The substrate particles are removed from the surface and enter the toothpaste solution when this link is broken. When the solution spits out, the substrate then exits the mouth.
2. **Humectants:** They prevent the water loss. They also provide a creamy texture. These short-chained polyalcohols include propylene glycol, polyethylene glycol, and the extremely concentrated aqueous solution known as sorbitol.
3. **Bleaching/Whitening agents:** By eliminating stains from the enamel surface, all toothpastes assist whiten teeth to some extent. Since there is no one particular shade of white teeth, the colour of teeth is a hotly contested subject.

Teeth will eventually get discoloured as a result of dietary choices, heredity, and behaviours like smoking. Due to depressions and microscopic grooves in the structure of the enamel, extrinsic stains develop on the tooth's outer layer. Due to these flaws, stains-causing chemicals like coffee and red wine are retained and can adhere to the surface. Chemicals like peroxides, citrates, and pyrophosphates as well as specific enzymes and surfactants are among the ingredients listed in literature as being effective at removing stains.

4. **Foaming agents:** In order to improve the cleansing action of the toothpaste and remove the filth from the oral cavity, foaming agents promote the toothpaste throughout the oral cavity. Additionally, they provide a sense of thickness and contentment due to the amount of foam they contain. For foaming agents, surfactants are chosen that have great foaming, dispersion, suspension, penetration, cleaning, and hard water resistance characteristics as well as no toxicity or irritation. To facilitate easier interaction between the ingredients in the toothpaste/mouthwash and the teeth, surfactants reduce the surface tension of the aqueous environment in the oral cavity. They cut through plaque and disintegrate it.

Additionally helpful for cleaning the teeth, the foamy action of the surfactants helps to eliminate dirt and imparts a fresh sensation. The dispersion of tastes in toothpaste and toothpaste tablet is another job for the surfactant. Taste and smell are also taken into consideration because they are consumed by the mouth. Sodium lauryl sulphate is the one that is currently used most commonly. Other examples include sodium lauryl sarcosinate, sodium alkylsulfo succinate, sodium cocomonoglyceride sulfonate, and sucrose fatty acid esters.

5. **Sweeteners:** Sweeteners also make toothpaste and mouthwash taste better by imparting a gentle, sweet flavour. The most often used sweeteners are glycerol, sorbitol, and sodium saccharin. A sweetener called xylitol is said to have anti-caries properties.
6. **Buffers:** To prevent the toothpaste from being acidic, which can harm the teeth, these substances are included. Trisodium phosphate, sodium citrate, sodium hydroxide, and pyrophosphates are a few examples of buffers.
7. **Fluoride:** The main component in toothpaste that works to stop tooth decay is fluoride. On toothpaste tubes, you could notice a list of three different types of fluorides. These include stannous fluoride (SnF₂), sodium fluoride (NaF), and sodium monofluorophosphate (MFP). Fluoride content in toothpaste for kids between the ages of 18 months and 6 years is typically 500 parts per million (ppm). Typically, toothpaste for adults and kids aged 6 and older contains 1000 or 1450 ppm of fluoride.
8. **Binding agent:** Binders are employed to provide a suitable level of viscoelasticity and prevent the separation of excipients and API. Additionally, they affect how the toothpaste tablet dissolves, foams, rinses, and has other properties in the oral cavity. Sodium carboxymethylcellulose (CMC) is now the most extensively used binder.
9. **Active Ingredients:** The primary therapeutic effects of toothpastes come from their active components. It is significant to remember that, just like with every medication or substance used in medicine, there are certain clinical indications for its usage. Additionally, if taken improperly, there might be adverse consequences (AEs). The amount of active chemicals used in toothpaste tablets is currently rising. [21,22,23]

METHOD OF PREPARATION OF TOOTHPASTE TABLET.

Tablets are prepared by 3 main manufacturing processes,

1. **Wet granulation:** All-herbal active ingredients with non-volatile components were used to create wet granules, which were then bonded by organic materials like guar gum, Xanthan gum, or acacia gum. Wet granules of the correct particle size were created using an elementary domestic process and dried outside in the sun.
2. **Dry Granulation:** It was made by mixing dry granules with the other components, such as powders, natural flavouring agents, and volatile oil.
3. **Direct Compression:** subsequently it only involves a few processing stages, direct compression is the easiest and most cost-effective way to make tablets. Spray-dried tablets have revolutionised the tablet production process and given direct compression new opportunities. Tableting compression refers to the method of directly compressing tablets from powder mixtures of the active ingredient so that they flow uniformly in the dies and form a film compact. [24]

FUTURE OF TOOTHPASTE TABLET.

The market for toothpaste tablets is anticipated to increase at a rate of 6.20% from 2021 to 2028, when it is projected to reach a value of USD 48.54 million. The toothpaste tablets market research from Data Bridge Market Research offers analysis and insights into many different factors that are predicted to be present throughout the course of the forecast period as well as their effects on market growth. The market for toothpaste tablets is expanding at an accelerated rate due to rising urbanisation.

One of the key reasons propelling the market for toothpaste tablets is the rise in health consciousness throughout the world. Increased demand for toothpaste tablets due to their portability and convenience, as well as their widespread use because they are one of the most important dental innovations in oral care and promote the idea of good oral hygiene, spur market expansion.

The market is further impacted by the growing usage of products as zero-waste alternatives to traditional paste, travel-friendly products, and products that are environmentally friendly. Additionally, the market for toothpaste tablets is

favourably driven by rising urbanisation, increased consumer knowledge of toothpaste tablets, and an upsurge in consumer preferences towards healthy lifestyles. Furthermore, in the projected period of 2021 to 2028, the market consumers would benefit from the introduction of natural flavour toothpaste tablets given in sustainable and environmentally friendly packaging options.[25,26, 27]

CONCLUSION:

The modern and upgraded versions of the ancient and conventional usage of toothpaste are toothpaste tablets. These are simple, portable, and cost-effective as well. Every year, almost 1.5 billion toothpaste are dumped in landfills. Prior to a few years ago, toothpaste and other dental products frequently contained micro bead abrasives.

These are now prohibited in many nations because they are harmful to the environment. Preservatives are employed in most types of toothpaste to prevent deterioration because of the water content's high potential for bacterial growth, but since the tablets are dry, they don't need them. Other than that, both products employ the same fundamental components. Additionally, the composition of toothpaste contains.

REFERENCES:

1. Importance of Oral Hygiene in Oro-Dental Diseases: A Review Study. (2019). E-ISSN, 2349–9788.
2. Dotiwala, A. K., & Samra, N. S. (2021). StatPearls Publishing; Treasure Island (FL). April 19, 2021. Anatomy, Head and Neck, Tongue.
3. Moore, K. L., Dalley, A. F., & Agur, A. (2010). Clinically Oriented Anatomy. Clinically Oriented Anatomy.
4. Britannica.com website: <https://www.britannica.com/science/tooth-anatomy>.
5. Chaturvedi, M., & Punj, A. (2018). Human oral microflora. International Journal of Current Advanced Research, 7.
6. Selwitz, R. H., Ismail, A. I., & Pitts, N. B. (2007). Dental caries. Lancet, 369(9555), 51–59. doi:10.1016/S0140-6736(07)60031-2
7. Noviani, G. A., Sopianah, Y., & Ambarwati, T. (2022). Knowledge about dental and oral health with gingivitis in adolescents. The Incisor (Indonesian Journal of Care's in Oral Health), 6(1), 135–143. doi:10.37160/theincisor.v6i1.14
8. Naseem, S., Fatima, S. H., Ghazanfar, H., Haq, S., Khan, N. A., Mehmood, M., & Ghazanfar, A. (2017). Oral hygiene practices and teeth cleaning techniques among medical students. Cureus, 9(7), e1487. doi:10.7759/cureus.14870 to 30 percentage water.
9. National Institutes of Health (U.S.). (2001). Diagnosis and management of dental caries throughout life. NIH Consensus Statement, 18(1), 1–23.
10. Arnold, M. J. (1998). Antiplaque Oral Composition. U.S.Patent 5804165 A.
11. Gray, H. (2005). Gray's Anatomy: The Anatomical Basis of Clinical Practice. New York: Elsevier Churchill Livingstone.
12. Valm, A. M. (2019). The structure of dental plaque microbial communities in the transition from health to dental caries and periodontal disease. Journal of Molecular Biology, 431(16), 2957–2969. doi:10.1016/j.jmb.2019.05.016
13. Albaghli, F., Zhou, Y., Hsu, C.-C., & Nibali, L. (2021). The effect of plaque control in the treatment of Oral Lichen Planus with gingival manifestations: a Systematic Review. Community Dental Health, 38(2), 112–118. doi:10.1922/CDH_00202Albaghli07
14. Thosar, N. (2016). Changing trends in oral hygiene and plaque control in children. J Dent Oral Care, (2), 79–83.
15. Gaffar, A., Afflitto, J., & Nabi, N. (1997). Chemical agents for the control of plaque and plaque microflora: an overview. European Journal of Oral Sciences, 105(5 Pt 2), 502–507. doi:10.1111/j.1600-0722.1997.tb00237.x
16. Priyal, G., Jose, M., Nayak, S., Pai, V., & Prabhu, S. (2021). Evaluation of efficacy of different tooth paste formulations in reducing the oral microbial load - An in vivo study. Biomedicine (Trivandrum), 41(2), 465–471. doi:10.51248/v41i2.1059
17. Siraj, E. S., Pushpanjali, K., & Manoranjitha, B. S. (2019). Efficacy of stevioside sweetener on pH of plaque among young adults. Dental Research Journal, 16(2), 104–109. doi:10.4103/1735-3327.250966
18. Löe, H. (1967). The gingival index, the plaque index and the retention index systems. Journal of Periodontology, 38(6 Part II), 610–616. doi:10.1902/jop.1967.38.6_part2.610
19. Marion, J. (2019, March 29). Toothpaste tablets: A New Way to brush your teeth. Retrieved June 20, 2023, from HowStuffWorks website: <https://health.howstuffworks.com/wellness/oral-care/products/toothpaste-tablets-new-way-to-brush-teeth.htm>
20. Bauer, S. (2020, October 21). Should you trade your tube for toothpaste tablets? Retrieved June 20, 2023, from Shape website: <https://www.shape.com/lifestyle/mind-and-body/toothpaste-tablets>
21. 300 million toothpaste tubes go to landfills. (n.d.). 230. doi:10.1038/s41415-021-2926-y.
22. Colloids and Surfaces B: Biointerfaces | Journal | ScienceDirect. com by Elsevier. (n.d.). Colloids and Surfaces B: Biointerfaces | Journal | ScienceDirect.Com By.
23. Peppermint toothpaste tablets. (2021). BDJ Team, 8(6), 47–47. doi:10.1038/s41407-021-0664-2
24. Kumari, D. (2019). Formulation Development and Evaluation of Herbal Toothpaste for Treatment of Oral Disease. Journal of Drug Delivery and Therapeutics, 9. doi:10.22270/jddt.v9i4-s.3344

25. Kanjanakij, B., 2019. Cheww.co, a toothpaste tablet manufacturer, who wants to reduce 10,000 plastic tube wastes in the first marketing year. a day magazine.
26. Hurwitz, M. M. (2014). Oral Hygeine Tablets and Capsules for Direct Oral Delivery of Active Ingredients. Patent, 8728446(2).
27. Toothpaste tablets: the future of toothpaste. (2021). British Dental Journal, 230(10), 683. doi:10.1038/s41415-021-3094-9.