**How Ingredients in Your Toothpaste Can Impact Your Health and Wellness Dr. Christina Rahm**

**April 18, 2022**

**Introduction**

For many years, dentists have always encouraged people to use dentifrice or more commonly known, toothpaste while brushing their teeth, citing the numerous health benefits of some of the many ingredients that make up toothpaste. However, several individuals have always ignored such advice and decided to use recommended toothpastes, while others just stick to water and a brush. In reality, application of clinically approved toothpaste when brushing is the first step towards achieving desirable oral health or hygiene. This is because it is one of the essential acts that a person can perform for the benefit of his or her teeth since toothpastes contain numerous ingredients that can deter a wide range of oral health complications like bleeding gum, dental caries (cavities), plague and several others. Therefore, this literature review is focused on discussing some of the health benefits of the numerous ingredients that are used to manufacture clinically approved toothpastes. These ingredients include; Baking soda, menthol, carboxymethylcellulose, sodium cocylisethionate, Stevia, Hydrogen Peroxide, and Dolomite. Additionally, the potential health risks associated with the use of toothpastes that are rich in fluoride will also be highlighted.

**Baking Soda**

As established above, the use of toothpaste is essential for achieving and maintaining oral health. The primary components of dentifrice include abrasive agents, a surfactant, a binder, and a humectant. The primary objective of application of toothpaste is to eliminate dental plaque and several foreign particles that stem from divergent food types that an individual consumes. Apart from eradication of plague and foreign debris, toothpaste also acts as a breath freshener and tooth whitener. To help realize these functions, several dentifrice producers have incorporated baking soda also known as sodium carbonate as one of the ingredients used to manufacture toothpaste. Baking soda is a mineral salt consisting of bicarbonate ions and sodium ions. According to Valkenburg et al (2019), baking soda is a nontoxic substance hence, it is mild on the gums and oral mucosa. In various types of commercial toothpastes, sodium bicarbonate primarily functions as an abrasive agent. Numerous studies on comparative dentine abrasion assessments have illustrated that the insensitivity of baking soda has minimal coldness on the teeth surface (Valkenburg et al, 2019). Additionally, baking soda has been clinically proven to contain alkaline properties, hence it can neutralize acidic conditions within the oral cavity. This makes it an efficient means of deterring the onset of tooth decay, which is primarily triggered by acids produced by oral bacteria. Moreover, the alkaline nature of the baking soda also assists in neutralizing acidic constituents of various tooth-staining chemicals including the chromogens found in red wine and tea. This is very useful in limiting the staining capacities of such chemicals hence promoting whitening of teeth and the overall oral hygiene.

Additionally, Vaz et al (2019) also argue that teeth-whitening toothpaste containing baking soda mechanically eliminates pigmented chromophores and biofilms located on the external surface of the dental enamel. Moreover, consistent utilization of dentifrice containing baking soda elements alters the dental enamel surface, reduces tooth pigmentation, moderates the adhesive nature of dental biofilms and chromophores, and significantly changes teeth coloration. Moreover, Sharma et al (2022) also confirmed that fluoride dentifrices with approximately 20 percent of sodium carbonate has the capacity to provide numerous oral health assistances, especially when utilized as an adjunct to consistent teeth brushing, thus such toothpastes are clinically recommended for all individuals, especially those dealing with periodontal conditions.

**Sodium Carboxymethyl Cellulose (CMC) –Dentifrice**

This compound has been among the most essential ingredients used to manufacture toothpastes. The primary function of sodium carboxymethyl cellulose ( CMC) in the toothpaste is to homogeneously combine the liquid and solid components of the dentifrice together thus giving it a molding flow, sufficient viscosity, levitated brightness levels, and delicateness (Epple, Meyer & Enax, 2019). For these reasons, toothpastes that lack formulations for unique properties can utilize CMC as an adhesive ingredient. It is important to note that CMC is scarce in high-end and unique property toothpastes. Due to its special properties, sodium carboxymethyl cellulose has various health benefits. For instance, because of its desirable constant replacement capability, outstanding salt lenience, and high resistance to acidic conditions, CMC toothpaste can effortlessly extrude hence showing healthier teeth appearance and convey a charming and comfy tooth-feel (Epple, Meyer & Enax, 2019).

Feura, Yang & Schoenfisch (2020) also argue that CMC offers a suitable polymer that can be utilized in periodontal pockets because of its unique features like its adherence to oral tissue surfaces, bio-compatibility, and its ability to increase the viscosity of any solution. Carboxymethylcellulose is currently utilized as a steadying and condensing stabilizer in many types of dental composite materials and toothpastes. For instance, for its adhesive effect, carboxymethylcellulose has been applied in buccal formulations to increase the retention within the periodontal pockets where it can attach to proteins found inside the gingival tissue and salivary pellicles (Feura, Yang & Schoenfisch, 2020).

**Stevia**

There is increasing research supporting the therapeutic potential of stevia glycosides, including dulcoside A, steviolbioside, rebaudiosides, and stevioside, in managing a variety of health conditions such as diabetes, obesity, and hypertension. According to Shinde & Winnier (2020), stevia mouth rinse and chewing gums are also an effective way of treating dental caries. Additionally, studies of the alcoholic extracts of stevia have also been performed to elucidate the possible benefits of stevia in oral health. Such studies have shown an improved oral health conditions for individuals using stevia products such as toothpastes and mouth wash especially in terms of improved mouth pH, plaque eradication and dental caries management (Shinde & Winnier, 2020).

Additionally, stevia has also played a key role in the treatment of various health issues. For instance, obesity and its associated comorbidities remain a serious clinical concern. Significant efforts have been directed towards the management of the situation. However, the majority of such efforts including anti-obesity drugs, lifestyle adjustments, and clinical interventions have achieved uninspiring success. Thus, introduction of novel tactics to battle obesity plus other challenging health conditions like diabetes are urgently required. Ray et al (2020) states that stevia rebaudiana, which is a natural sweetener, has spawned noticeable interest among medical experts because of its impacts on glucose homeostasis, inflammation, and hypertension. Unlike artificial sweeteners that have several side effects, steviol glycosides are known to have limited health risks, and due to its high sugar contents, which is higher than sucrose, they are effective means of managing diabetes (Ray et al., 2020). Other studies have also indicated that taking about 1000 mg of stevia on a daily basis can drop an individual’s glucose levels by up to 18%, especially in individuals coping with type 2 diabetes (Ray et al., 2020). Similarly, regular consumption of about 750.0 gm of stevioside reduces systolic blood pressure. Therefore, using toothpaste that are rich in stevioside can significantly improve the overall health condition of a person.

**Hydrogen Peroxide**

Hydrogen peroxide is commonly used as a bleaching agent in many products. However, in toothpastes, hydrogen peroxide is mostly used as a whitening agent. This is because it can easily eradicate various types of food pigments on the enamel and tooth discolorations. This chemical works by eliminating extrinsic and in certain situations extrinsic stains. This makes dentifrices with hydrogen peroxide more suitable for whitening the teeth than those that utilize high clearing silica. Silica-toothpastes only eradicate external stains found on the external layer of the tooth. Another peroxide chemical that has numerous health benefits is carbamide peroxide. This chemical can be used as a home-remedy by clinicians when performing a dental operation. According to a study conducted by Bidra et al (2020) on whether oral products containing hydrogen peroxide can increase teeth whitening process, hydrogen peroxide products such as mouth rinses significantly elevate the rate of teeth whitening process. Apart from teeth hygiene, hydrogen peroxide has also been proven to reduce the severity of sore throat. Bidra et al (2020) state that a sore throat is chiefly caused by bacterial infection. Therefore, cleansing the mouth with substances containing hydrogen peroxide such as toothpastes made of hydrogen peroxide can aid in reducing pain by killing the bacteria and assisting to eradicate the infection.

Additionally, because of its antibacterial properties, hydrogen peroxide also has the potential to manage various gum disorders (Bidra et al., 2020). For instance, oral plaques are normally associated with a thin film of bacteria known as biofilm. When an individual uses dentifrice made of hydrogen peroxide, the constituents of hydrogen peroxide discharges oxygen that assists in killing the bacteria hence eliminating the plaque. Another health benefit of using toothpastes rich in hydrogen peroxide is that it aids in diminishing minor oral sores such as canker sores or cuts. Gargling mouthwash made of hydrogen peroxide helps in killing bacteria colonies that might have invaded such wounds thus promoting speeding healing (Bidra et al., 2020). One noticeable advantage of using hydrogen peroxide toothpastes is that solutions of such dentifrices can easily reach the back of the oral cavity where most dental floss cannot reach.

According to Karadas & Hatipoglu (2015), mouth rinses have become famous oral health agents in recent years. This is because such products contain mineralizing healing properties and work by chemically regulating cariogenic bacteria within the oral cavity. Since many people are acutely worried about their oral health, the number of toothpastes and mouth rinses containing hydrogen peroxide have increased significantly (Karadas & Hatipoglu, 2015). It has been confirmed that hydrogen peroxide is capable of penetrating the teeth and discharge chemical elements which attack and disintegrate chromophore bonds found on the tooth surface. This process leads to the elimination of stains hence whitening of teeth. Additionally, Karadas & Hatipoglu (2015) also states that the extent of teeth whitening depends on method of application and duration of use. For instance, individuals who use dentifrice rich in hydrogen peroxide on a regular basis are more likely to report complete elimination of stains than those who use such toothpastes inconsistently.

Wang et al (2020) also indicate that combining nano-catalysts with hydrogen peroxide has attracted much interest in oral biofilm eradication. Even though hydrogen peroxide has been utilized in oral health for germ removal and stain removal, the probable anxiousness and safety because of its high dosage has posed a serious challenge. However, nano-catalysts like iron oxide nano-enzymes that have peroxidase-like action can stimulate the ability of hydrogen pexoide to terminate various oral bacteria and prevent the onset of dental caries (Wang et al., 2020). At the same time, such combinations will significantly reduce the hydrogen peroxide dosage hence limiting its toxic abilities.

**Dolomite**

Dolomite is a mineral compound that consists of numerous mineral elements that are essential for oral health. Toothpastes rich in dolomite are known to aid in bone maintenance and promote enamel rigidity. Some of the minerals that make up dolomite include calcium, phosphorus, potassium, and magnesium. Li et al (2018) state that calcium is an essential integrative constituent of the body and therefore it is vital for ensuring good health. Several studies have illustrated that regular calcium consumption is beneficial to human health because it helps deter and manage skeletal-associated disorders like osteoporosis. Due to such enormous health benefits, many toothpaste manufacturers are currently using dolomite which is a good source of calcium as one of the ingredients used to make toothpastes.

The human body utilizes calcium elements found in the toothpaste to yield a substance called crystalline calcium phosphate (Li et al., 2018). This compound is used by the body to make the hardest part of the tooth called enamel. Due to its hardness, the enamel shields the inner delicate parts of the tooth. Additionally, calcium also is used in skeletal establishment, thus lending the jawbone the prerequisite strength and mechanical firmness to hold the tooth roots within their sockets. It is important to note that low levels of calcium in the body is likely to lead to widening of the teeth sockets thus the teeth become loose and eventually fall off. Therefore, regular use of toothpastes rich in dolomite is a significant means of boosting the body’s calcium level which leads to healthy jawbone and enamel. According to Palacios (2006), phosphorus also plays a major role in promoting bone health. This is because phosphorus is key in the formation of crystalline calcium phosphate, which is used in the formation of enamel. Moreover, phosphorus also aids in skeletal formation and remodeling by combining with calcium. Thus, insufficient quantities of phosphorus in the body means reduced calcium absorption rates hence unhealthy bones.

Unhealthy bones lead to weak jawbones and loose teeth (Palacios, 2006). Therefore, toothpastes that are made of dolomite are essential in promoting oral health since it boosts phosphorus levels in the body thus leading to sufficient bone formation and remodeling. This in turn results in the formation of strong enamel and jawbone.

Apart from calcium and phosphorus, dolomite also contains certain levels of magnesium. Magnesium also works in conjunction with calcium and phosphorus to form strong and healthy tooth enamel and uphold bone density. Palacios (2006) argues that a person should consume at least 1:2 ratio of calcium to magnesium on a daily basis. Thus, dolomite-toothpastes are essential in boosting the quantity of these minerals in the body. Another important mineral compound found in dolomite is potassium.

Potassium has several oral health benefits to human beings. Firstly, potassium combines with magnesium to aid blood acidity regulation. For instance, when the blood becomes highly acidic, the acids within the blood can extract calcium ions from the jawbone and enamel hence they become weak. A supplement of potassium can assist the skeletal and teeth to utilize calcium more efficiently by ensuring that blood acidity levels are kept at an optimal level. Apart from blood acid regulation, potassium can also aid the teeth in several ways (Luo, Zhang, Tang & Liu, 2019). For instance, when an individual uses toothpaste containing potassium nitrate, the compound penetrates into the enamel where it reduces the rate of fluid flow through the tubules by clogging the tubules. This process minimizes dental sensory nerves actions and inhibits sensory impulses from reaching the brain, thus reducing tooth sensitivity. Similarly, a study conducted by Sharma, Shetty & Uppoor (2012) also showed that potassium nitrate mouth rinse and dentifrice are capable of minimizing the level of dental hypersensitivity. According to the study outcome, the participants who used potassium nitrate-dentifrice reported a significant decrease in dental hypersensitivity than those who used dentifrices without potassium nitrate. These results illustrate some of the oral health benefits of dolomite when used as an ingredient in the production of toothpastes.

**Menthol**

Menthol is a naturally occurring substance found in most herbs including eucalyptus, peppermint, and pennyroyal. Menthol has been utilized in various health products including toothpastes and mouthwashes (Chinsembu, 2016). One of the most significant oral health benefits of menthol is its ability to deter most dental syndromes. It delivers a minty scent, chilling sensation, and good taste. This keeps the oral cavity consistently fresh and hygienic thus preventing the onset of dental complications such as caries and gingivitis. According to Martínez-Pabón & Ortega-Cuadros (2020), menthol has been applied in dental hygiene products because of its organoleptic properties, which entail a cooling sensation and good taste, and its brief life span which stop it from amassing in organisms. Moreover, menthol also has antimicrobial characteristics which aid in eradication of several species of bacteria found within the oral cavity.

**Sodium cocylisethionate**

Sodium coccylisethionate (SCI) is a solid compound that occurs naturally in coconut oil. SCI shows high foaming capacity producing a stable lather. This property makes SCI a good ingredient that makes the toothpaste tablets foam (Horton & Vu, 2019). Such foams make aid in stain removal hence making the teeth sparkling clean and free of dental disorders.

**Ethanol**

Piekarz et al (2017) conducted a study focused on the application of dentifrice containing ethanolic extract of Polish propolis (EEP). In the study, 51 participants with divergent oral health disorders of gingiva were categorized into two study clusters. The control cluster was given toothpaste lacking EEP while the study cluster was given similar toothpaste but with EEP. Piekarz et al (2017) evaluated modified sulcus bleeding index, simplified oral hygiene index, and approximal plaque index in three successive phases. In the course of each evaluation, oral swabs were used for bacteriological booster. The outcome of the study indicated a substantial decrease in the approximal plaque index, and modified sulcus bleeding index for the study cluster. Moreover, the results also confirmed some statistically noticeable variances in oral hygiene index values, where the study cluster showed an improved oral hygiene index values compared to the control group. These results affirmed that the utilization of toothpaste containing ethanol or EEP, as in this case, aid in upholding microbiome equilibrium within the oral cavity. However, the absence of ethanol components in a toothpaste contributes to the appearance of qualitative and quantifiable alterations in the oral cavity microbiome (Piekarz et al., 2017). A similar study conducted by Morawiec et al (2013) also confirmed that ethanol-containing dentifrices are particularly effective in elevating oral hygiene since such toothpastes reduce the incidences of gingivitis caused by dental plaque. Morawiec et al (2013) also witnessed qualitative and quantitative transformations in the oral cavity microbiome. Therefore, ethanol-containing toothpastes can be applied as a natural adjuvant to assist persons that are extremely vulnerable to periodontal disorders since ethanol has the capacity to eradicate or reduce the quantity of pathogenic oral microbiome.

**Health Hazards Associated with Fluoridated Toothpastes**

Several studies have indicated that high concentration of fluoride can negatively affect human health. One of the most prominent side effects of fluoride is that it can significantly increase the danger of fluorosis. Fluorosis is an enamel flaw that stems from enduring consumption of high quantities of fluoride, especially during tooth-formation period. Therefore, the risk of developing fluorosis is significantly higher in children since young people normally swallow large quantities of toothpastes while brushing their teeth. According to Gu, Wei & Ling (2020), dental fluorosis, which is the prominent indication of initial phases of long-lasting fluorosis, is triggered by disproportionate consumption of fluoride in the course of tooth growth. Severe cases of dental fluorosis can go with bone fluorosis. This health condition can also lead to systematic impairment to endocrine, cardiovascular and nervous structures among others.

Due to numerous health risks associated with using highly concentrated fluoride toothpastes, Gu, Wei & Ling (2020) state that dental experts such as dentists should elucidate the most suitable fluoride concentration in toothpastes, especially for those used by children. This will go a long way in reducing the risks of fluorosis and skeletal fluorosis. Furthermore, oral health clinicians should certify that supplementary sources of fluoride do not elevate the peril of dental fluorosis among children and comprehensively examine the efficacy of fluoride toothpaste in deterring root surface dental carries in adults. Finally, Gu, Wei & Ling (2020) state that toothpaste producers should endeavor to advance the performance of fluoridated dentifrices by guaranteeing that every characteristic of the paste exploits the bioavailability of fluoride and create active agents that can aid in decreasing the rate of oral disorders.

**Conclusion**

In summary, this literature review has categorically confirmed the numerous oral health values associated with all toothpaste ingredients. Toothpastes are by far the most effective means of achieving optimum oral well-being. This is because toothpastes are made of numerous ingredients that have divergent properties. Most of the ingredients such as baking soda, ethanol, methanol, and sodium cocylisethionate have antibacterial properties that help in reducing the number of dental biofilms or oral microbials hence preventing the onset of dental caries and gingivitis. Additionally, some of these ingredients i.e. baking soda dolomite help in regulating the level of acidity within the oral cavity thus promoting efficient calcium absorption. This leads to development of strong dental enamel and jawbone. Others like hydrogen peroxide aid in reducing the occurrence of dental caries by eliminating oral biofilms and food stains. However, it is important to note that excessive intake of some of these ingredients might lead to severe health conditions. For instance, excessive consumption of fluoride can lead to dental fluorosis in young people. Therefore, only the toothpastes with the recommended quantities should be used.

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