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The Chemical Constituents Used in Toothpaste Formulations and Their Adverse Effects on Systemic Health- A Review

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ABSTRACT:

The quality of life is greatly impacted by oral health.Therefore, there has been a strong emphasis on the need for affordable, secure, and effective oral hygiene practices. Brushing your teeth and using the right toothpaste is the best way to remove biofilms from your teeth, reduce your risk of gingivitis, and improve your oral health. Reducing dental plaque generation is the most efficient strategy to stop dental disease from developing. A thin, soft film called plaque builds up on the gums, teeth, and any dental equipment. It is created by microorganisms. Dietary sugars—sucrose in particular—increase the pace and thickness of plaque development and have a role in its production. Maintaining a healthy mouth requires regular clearance of plaque from the teeth and surrounding tissues.1

INTRODUCTION

The quality of life is greatly impacted by oral health. Therefore, there has been a strong emphasis on the need for affordable, secure, and effective oral hygiene practices. Brushing your teeth and using the right toothpaste is the best way to remove biofilms from your teeth, reduce your risk of gingivitis, and improve your oral health. Reducing dental plaque generation is the most efficient strategy to stop dental disease from developing. A thin, soft film called plaque builds up on the gums, teeth, and any dental equipment. It is created by microorganisms. Dietary sugars—sucrose in particular—increase the pace and thickness of plaque development and have a role in its production. Maintaining a healthy mouth requires regular clearance of plaque from the teeth and surrounding tissues.[1]

Since toothpaste was first used thousands of years ago, formulas have changed significantly. From simple ashes or egg shell suspensions to intricate mixtures that sometimes contain more than 20 components, formulas have undergone significant development. Compounds that treat dental caries, gum disease, oral malodor, calculus, erosion, and dentin hypersensitivity may be among them. In addition, toothpastes have scents to refresh breath, colors for improved aesthetic appeal, and abrasives to clean and whiten teeth. Toothpaste that is designed to maximize the bioavailability of its active ingredients is considered effective.[2,3]

It is commonly acknowledged that Paracelsus said, "Is there anything that is not toxic?" Everything has poison, and nothing would live without it. The sole factor determining whether a drug is harmful is its dose.[4] likewise many chemical ingredients that are used for the formulation of toothpastes are found to be harmful for your health. These toxic chemicals can cause health related problems both systemically and locally. They can

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enter the bloodstream through sores and abrasions in the oral mucosa, or they can enter by ingestion, absorption into the skin and mouth mucosa, or both. Adverse effects include nausea, vomiting, diarrhea, seizures, disorientation, intestinal ulcers, irritability, pain and discomfort in the abdomen, intestinal cancer, heart attack, stroke, multiple organ failure, and so on. Local side effects include fluorosis, aphthous ulcers, xerostomia, taste loss, tooth abrasions etc.[5,,6,7,8,9,10] This review article discusses the various chemical ingredients used in toothpaste and their adverse effects on human body.

DISCUSSION

Drugs are more easily absorbed in the oral cavity of humans. The harmful compounds included in toothpaste additions are something that humans are exposed to on a regular basis. Using commercial toothpastes can lead to hazardous difficulties for the user, and this is a concern that is sadly not well-known. The following list includes the chemical ingredients added to toothpastes that have been shown to have adverse effects on systemic health.

Flouride

Fluoride is praised for its ability to prevent cavities and tooth decay. The Food and Drug Administration (FDA) warns against the acute toxicity of fluoride, despite the fact that a little amount of fluoride can promote stronger and healthier teeth and gums. It is also well known that fluoride helps to remineralize teeth; however, conventional toothpaste does not contain nearly as much fluoride as necessary for consumers to genuinely benefit from remineralization. Fluorosis, or discolored patches on teeth, can result from using fluoride more often. On the other hand, it may also result in several grave side effects, such as endocrine and neurological dysfunction Fluoride poisoning's acute toxic consequences might be harmful. Acute consequences include vomiting and nausea, hypocalcemia, tetany in the hands and feet, hypersalivation, hypotension, respiratory and renal failure, as well as potentially fatal coma and convulsions. Chronic consequences include cancer, birth abnormalities, inadequate renal system, skeletal and dental fluorosis, stomach discomfort, numbness, and muscle spasms.[11]

Fluoride poisoning can cause headaches, nausea, vomiting, and other gastrointestinal symptoms, and for this reason, should be avoided. Researchers from China Medical University and Harvard School of Public Health discovered a compelling link in 2012 suggesting fluoride may have a deleterious effect on children's cognitive development[12].Fluorosis, or discolored patches on teeth, can result from using fluoride more often. Furthermore, evidence that fluoride impacts normal endocrine function was discovered in a 2006 research conducted by the US National Research Council of the National Academies[13]

Triclosan

In 2017, toothpaste, hand soap, and body washes were all effectively prohibited from containing triclosan. Toothpaste contains this antibiotic and antifungal because it effectively lowers plaque and the inflammation of the gums that is prone for gingivitis. The Food and Drug Administration (FDA) reports that some thyroid hormones have decreased as a result increased ingestion of Triclosan. Triclosan promotes cancer, messes with thyroid hormones, and helps inhabiting microbes resistant to antibiotics.[14]

Sodium Lauryl Sulphate (SLS)

Sodium Lauryl Sulphate is used as a foaming agent in toothpastes. Sodium Lauryl Sulphate has the potential to worsen aphthous ulcers as well as induce skin irritation .Patients who used a paste containing SLS for three months saw a substantial increase in ulcers following the trial, according to a preliminary study conducted by the Department of Oral Surgery and Oral Medicine Conversely, there was a significant decrease in the quantity of ulcers when the patients moved to an SLS-free paste. SLS may be included in your dental care products under a dubious alias. A13-00356, Akyposal SDS, Aquarex methyl, Monododecyl ester, Monododecyl ester sodium salt sulfuric acid, sodium dodecyl sulfate (SDS), sodium salt, sulfuric acid, monododecyl ester sodium salt, and sulfuric acid are some common alternate names to look for.[15,16]

Propylene Glycol

Synthetic propylene glycol is use as an emulsifier, foaming agent, and detergent in toothpastes. Glycol at high doses, may cause harm to the heart, liver, and central nervous system. These effects may be more severe in those with renal or liver problems since the breakdown process may not be as easy[17,18].

Diethanolamine (DEA)

Toothpaste is formulated with the hormone disrupting ingredient diethanolamine (DEA) to enhance foaming.

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Antifreeze and brake fluid both include diethanolamine (DEA).. Animal cancer has been connected to the topical use of DEA in a 1998 research .It was discovered in the same investigation that DEA caused hepatic choline insufficiency, or liver deficiency[19,20].

Parabens

Parabens are used to increase the shelf life of toothpastes.Because parabens resemble estrogen, they can cause disruptions to hormone function. Parabens may occasionally cause breast cancer[21].

Carrageenan

It is used as a thickening agent. Inflammatory skin disorders including acne, gastrointestinal problems, colon ulcers, and cancer can all be brought on by carrageenan. It is preferable to avoid carrageenan in both your food and dental care products, even if there are two types of the material: one that is food-grade and the other that is deteriorated and known to cause cancer.[22,23]

Aspartame

Toothpaste gains taste from the artificial sweetener aspartame. On the other hand, the carcinogenicity of this sweetener has drawn criticism. When the compounds in aspartame are consumed, some of them decompose into the alcohol methanol. Our bodies overcompensate by turning this molecule into formaldehyde since they are unable to digest it. Formaldehyde can lead to a host of other problems, including headaches, nausea, weakness, dizziness, and memory loss.[24]

Titanium Dioxide (TiO2

Because it contributes to toothpaste's distinctive white tint, titanium dioxide (TiO2) is an inorganic chemical component that is frequently utilized in toothpaste. Only when titanium dioxide is not absorbed is it safe. The membranes within our mouths may very easily absorb amounts of titanium dioxide, even if we don't swallow toothpaste and so don't ingest titanium dioxide. Titanium dioxide may be carcinogenic and show non-reproductive organ system toxicity, which implies it adversely affects the body's nonreproductive organs, according to the Environmental Working Group (EWG).[25,26]

Artificial sweeteners

Xylitol, saccharin, and sorbitol are the artificial sweeteners commoly used in toothpastes. Humans may safely consume xylitol, however sorbitol and saccharin are regarded as potentially harmful substances.While saccharin is linked to brain tumors, lymphomas, and bladder cancer, sorbitol is a liquid artificial sweetener that prevents toothpaste from drying out and becoming crusty. However, it also acts as a laxative and can cause diarrhea in kids who consume it.[27,28]

Hydrogen Peroxide

While hydrogen peroxide has been shown to be a successful teeth-whitening agent, several studies also indicate that the chemical penetrates a tooth's enamel deeply. Your tooth's surface may be harmed by this whitening, weakening it. A compromised tooth surface may lead to mineral loss and increased sensitivity to noticeable abrasions in the compromised enamel.[29,30]

Nanoparticles

Toothpaste contains nanoparticles for several purposes, such as preventing dental decay, remineralizing the tooth enamel, reducing hypersensitivity, whitening the teeth, and having antimicrobial properties. Gum Arabic Silver nanoparticles, titanium dioxide nanoparticles, sodium hexametaphosphate nanoparticles, calcium carbonate nanoparticles, calcium phosphate nanoparticles, and other nanoparticles are used in toothpastes. The International Agency for Research on Cancer (IARC) designated TiO2 as "possibly carcinogenic to humans" in 2006. In instance, autophagy—a cellular disposal system that is typically started when a cell is stressed—is induced by titanium dioxide nanoparticles..[31]It has been discovered that nano hydroxyappetite particles are cytotoxic and genotoxic; they can induce carcinogenesis, fibrosis, epithelial hyperplasia, and pulmonary inflammation[32]. Particles of calcium phosphate dissolve entirely in the stomach at a pH of 1-2 after being ingested.In very acidic environments, the tiny calcium phosphate particles become unstable[33]. Oral administration of CuO, ZnO, and Ag NPs might cause inflammation in your body and can harm your organs if taken repeatedly. Organs such as the brain, lungs, liver, kidneys, and testes collect CuO, ZnO, and Ag NPs[34] Children's livers exposed to NPs experience apoptosis and oxidative stress[35]. The oral administration of CuO and Ag NPs has resulted in impairment of microvilli, which has produced disturbances in the small intestinal lining's functionality. CuO, ZnO, and Ag NPs cause hepatocytes to expand and change the structure of liver tissue. Additionally, they result in the accumulation of fluid around blood vessels, which ultimately cause cell death. When incubated with human gum cells, it has been

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found that NPs may penetrate both the cell membrane and the mitochondria, resulting in cell damage and death[36,37,38]

CONCLUSION

Maintaining good dental health requires a balanced diet, regular brushing, and flossing. The article states the harmful effects of toothpastes and advise that they have to be used with high caution. Many of the toothpastes on the market now contain additives including fluoride, saccharin, SLS, abrasives, carrageenan, parabens, triclosan, and artificial sweeteners. But it is seen that their adverse effects outweigh their benefits. The commercial toothpaste can best be avoided and oral health can be maintained with simple cooking ingredients such as coconut oil which inhibits acid-producing oral bacteria. The safest teeth cleanser for regular use may be made using bentonite clay, salt, baking soda, stevia, essential oils and coconut oil. When it comes to the availability and ease of use, most people rely on commercial toothpastes. So the individual has to be very cautious while selecting the right toothpastes with the least amount of chemicals.

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