

# Clinical and morphological features of dental hard tissue and oral mucosa under the influence of caffeine-containing beverages

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**Abstract:** Caffeine-containing beverages, such as coffee, tea, and energy drinks, are widely consumed worldwide. Their impact on oral health has been a topic of interest in recent dental research. This paper explores the clinical and morphological effects of these beverages on dental hard tissues and the oral mucosa. The study discusses enamel erosion, dentin hypersensitivity, discoloration, and mucosal irritation. Additionally, it examines the chemical interactions between caffeine, acids, and sugars in these beverages and their role in the progression of oral diseases. Understanding these effects is crucial for developing preventive strategies and improving dental health awareness among consumers.

**Keywords:** Caffeine, enamel erosion, dentin hypersensitivity, oral mucosa, staining, dental health.

**Introduction:** Caffeine is a widely consumed psychoactive substance found in various beverages, including coffee, tea, and energy drinks. While moderate caffeine consumption has been associated with certain health benefits, its impact on oral health remains a concern [1.2.4]. Dental hard tissues and the oral mucosa are constantly exposed to the chemical composition of these beverages, leading to potential structural and functional changes. This article aims to analyze the clinical and morphological alterations caused by caffeine-containing beverages on teeth and oral tissues, focusing on their implications for oral health [3.4].

The widespread consumption of caffeine-based drinks necessitates an in-depth understanding of their effects on dental structures. Coffee and tea, which are commonly consumed daily, have been associated with significant oral health concerns. Moreover, the rising popularity of energy drinks among younger populations has led to increased cases of dental erosion and hypersensitivity [5.6]. Understanding how these

beverages interact with oral tissues can aid in developing effective preventive and treatment strategies.

## Chemical Composition of Caffeine-Containing Beverages

Caffeine-containing drinks typically include acidic compounds, tannins, sugars, and colorants, which contribute to dental erosion and staining. The pH of these beverages often falls below 5.5, the critical threshold for enamel demineralization. Additionally, high sugar content in energy drinks exacerbates the risk of caries formation.

The chemical composition of these beverages varies significantly. Coffee, for instance, contains chlorogenic acids, which contribute to its acidity, while tea contains polyphenols and catechins that can influence dental health. Energy drinks, on the other hand, are loaded with citric and phosphoric acid, making them highly erosive. The combination of low pH, sugar content, and caffeine can create a detrimental environment for teeth, leading to increased risk of caries and erosion.

(table-1)

**Table-1**

<b>Beverage Type</b>	<b>pH Level</b>	<b>Sugar Content (per 100ml)</b>	<b>Impact on Teeth</b>
<b>Coffee</b>	4.85 – 5.10	Minimal	Staining, mild erosion
<b>Black Tea</b>	4.9 – 5.5	Minimal	Staining, plaque buildup
<b>Green Tea</b>	6.0 – 7.0	Minimal	Antioxidant benefits, less staining
<b>Energy Drinks</b>	2.5 – 3.5	High	Severe erosion, caries risk

**Effects on Dental Hard Tissue****Enamel Erosion**

Frequent exposure to acidic caffeine-containing beverages weakens enamel, leading to demineralization. Over time, enamel loss increases dentin exposure, causing hypersensitivity and structural weakness. The process of erosion begins with the dissolution of hydroxyapatite crystals in the enamel, making it more susceptible to mechanical wear. Energy drinks, due to their extreme acidity, have been found to cause three times more enamel loss compared to coffee or tea [8.9].

**Dentin Hypersensitivity**

With enamel loss, dentinal tubules become exposed, making teeth more sensitive to thermal and chemical stimuli. This sensitivity can lead to discomfort and affect daily oral functions. Studies indicate that prolonged exposure to acidic caffeine beverages increases the permeability of dentin, allowing irritants to reach the pulp more easily. This can result in chronic pain and the need for restorative treatments such as dental bonding or fluoride application.

**Staining and Discoloration**

Tannins present in coffee and tea contribute to surface staining by binding to the protein pellicle of enamel. Regular consumption results in extrinsic discoloration, which may require professional dental cleaning. In addition to surface stains, caffeine beverages can also cause intrinsic discoloration, particularly if consumed at high temperatures. Hot beverages cause enamel porosity to expand, allowing pigments to penetrate deeper into the tooth structure.

**Effects on Oral Mucosa****Mucosal Irritation**

Caffeine can cause dehydration of oral tissues, leading to dryness and irritation. Acidic beverages, especially energy drinks, can disrupt the natural pH balance, making the mucosa more susceptible to inflammation. Additionally, caffeine acts as a vasoconstrictor, reducing blood flow to oral tissues, which may impair their ability to heal from minor injuries [7.10].

**Increased Risk of Ulcers**

Prolonged consumption of acidic beverages can lead to the erosion of oral mucosal cells, potentially increasing the likelihood of ulcer formation and discomfort. Individuals with pre-existing conditions such as gastroesophageal reflux disease (GERD) may experience aggravated symptoms, as caffeine stimulates acid production in the stomach, potentially leading to further irritation of oral tissues.

**Preventive Strategies**

To minimize the negative effects of caffeine-containing beverages on oral health, individuals can adopt the following preventive measures:

**Use a straw:** Reduces direct contact of acidic beverages with teeth, thereby minimizing enamel erosion. This method is particularly useful for high-acidity drinks like energy drinks and black coffee.

**Rinse with water:** Helps neutralize acids and wash away staining compounds. Rinsing immediately after consumption prevents prolonged acid exposure, reducing the risk of demineralization and discoloration.

**Wait before brushing:** Brushing immediately after

consumption can worsen enamel erosion; waiting at least 30 minutes allows saliva to neutralize acids and strengthen the enamel. This step is especially crucial for individuals who frequently consume acidic or sugary beverages.

**Increase fluoride exposure:** Fluoride strengthens enamel and helps counteract demineralization by forming a protective layer on teeth. Using fluoride-containing toothpaste or mouth rinses can aid in remineralization.

**Consume dairy products:** Dairy products such as milk or cheese can help neutralize acidic effects by increasing saliva production and delivering calcium and phosphate essential for enamel health.

**Drink caffeine-containing beverages in moderation:** Reducing the frequency and quantity of acidic beverage intake can prevent severe oral health issues. Limiting consumption to one or two servings per day can significantly lower the risk of dental erosion and hypersensitivity.

**Use sugar-free alternatives:** Opting for unsweetened coffee or tea can minimize sugar-related caries risk, as sugar is a primary contributor to bacterial growth and acid production in the oral cavity.

**Chew sugar-free gum:** Stimulates saliva production, which helps neutralize acids and protect enamel from erosion. Xylitol-containing gums can also reduce bacterial activity in the mouth.

## CONCLUSION

Caffeine-containing beverages, while popular, pose significant risks to dental hard tissues and oral mucosa due to their acidic nature and chemical components. Enamel erosion, dentin hypersensitivity, and mucosal irritation are some of the common clinical manifestations that arise from prolonged exposure to these beverages.

Understanding these effects allows for better preventive strategies, ensuring improved oral health for regular consumers. Implementing simple yet effective preventive measures, such as reducing consumption, increasing fluoride exposure, and following proper oral hygiene practices, can mitigate these risks.

Additionally, consumers should be aware of the long-term consequences of excessive caffeine intake on oral health, including its contribution to dry mouth conditions and increased susceptibility to infections. Dental professionals should emphasize patient education on the impact of acidic beverages and encourage regular dental check-ups for early detection of potential problems.

Further research is necessary to explore the long-term

implications of caffeine-containing beverages on oral health, particularly their effects on various demographics and their role in the development of systemic conditions. Advancements in dental treatment and remineralization technologies could provide better protective solutions against the adverse effects of these beverages, ensuring a more comprehensive approach to oral health maintenance.

By fostering greater awareness and adopting proactive dental care practices, individuals can enjoy their favorite caffeine-containing beverages while minimizing their negative impact on oral health.

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