

REVIEW ARTICLE

*Role of coffee in periodontitis: A review*Vaibhav Tandon,¹ Diya Kumari,² Ravishankar TL,³ Amit Tirth,⁴**Abstract**

Coffee is one of the most consumed beverages in the world and is commonly consumed in India on an everyday basis as it is considered to be psychoactive, mood elevator and provides relief from cold and headache. Components of coffee that have been found to have such effects include caffeine, caffeic acid, and chlorogenic acid. Caffeine, a component of coffee, exerts antioxidant and anti-inflammatory effects. Caffeine suppresses human lymphocyte function as indicated by reduced T-cell proliferation and impaired production of Th1 (interleukin [IL]-2 and interferon [IFN]-gamma), Th2 (IL-4, IL-5) and Th3 (IL-10) cytokines.

Periodontal diseases are highly prevalent, affecting approximately 538 million people worldwide. It is a chronic inflammatory disease, aggravated by microorganisms in the periodontal pocket, tooth surface, and periodontium.¹ Subgingival microorganisms that adhere to and grow in the periodontal pocket, along with excessive and aggressive immune response against these microorganisms, are considered to cause periodontitis and produce cytokines, such as IL-1 and IL-6. These factors activate osteoclasts, which destroy the alveolar bone, and inhibit bone forming osteoblasts.^{2,3}

These inflammatory diseases could be worsened by multiple factors such as systemic disease, nutrients, social factors, obesity, and genetic factors. Nowadays, several nutrients and foods are of interest in the prevention of dental diseases.

Coffee holds an essential place in everyday diets across the globe and considered to be one of the most consumed beverage all over the world. It is “the largest source of dietary antioxidants in industrialized nations Reported by International Coffee Organization, the world consumption of coffee increased by 1% from 2017 to 2021, with the highest increase found in Africa and the largest consumption reported in Europe.⁴

In the general population, the main contributors to the total caffeine intake were coffee for adults, and a cup of coffee is usually regarded to contain 70 to 100 mg/cup. According to European Food Safety Authority (EFSA), a cup of filter coffee (200 ml) contained 86 mg of caffeine. Coffee is composed of caffeine, chlorogenic acid, trigonelline, diterpenoids, cafestol, and kahweol. Unfiltered coffee is a significant source of cafestol and kahweol, which are diterpenes that have been implicated in the cholesterol-raising effects of coffee.⁵ Caffeine has antioxidant and anti-inflammatory effects by reducing reactive oxygen species and serum pro-inflammatory cytokines, respectively and it is a xanthine alkaloid found in tea leaves and coffee seeds contain carbohydrates, nitrogenous compounds, vitamins, minerals, phenolic compounds along with anti-cariogenic, chemo protective compounds. It is considered to be a psychoactive stimulant thus known to increase alertness, elevate mood, reduce fatigue, treat migraine, cluster headaches and is most widely used ever since Stone Age.^{6,7} Long-term caffeine intake denotes one of the risk factors in the advancement of periodontitis pathology.

There are several pharmacological and cellular activities of caffeine on bone metabolism related to osteoblast proliferation and calcium metabolism. It is known to be able to inhibit the osteoblasts like cells proliferation, also have negative impacts towards the viability of osteoblast, leading to the increase of apoptosis rate of the cells. The major polyphenol in coffee is chlorogenic acid. Chlorogenic acid is one of the major strong antioxidant compounds in coffee.⁸ The antioxidant activity of coffee depends on the chemical composition. Chlorogenic acid from coffee demonstrated a direct inhibitory effect on *Porphyromonas gingivalis*, a major pathogen key-player of periodontitis and can indirectly affect the bioavailability of other nutrients and thereby modulate periodontal disease prevalence.⁹ The US Department of Veterans Affairs Dental Study included 1,231 participants and reported no harmful but rather a beneficial effect of coffee on periodontal health.¹⁰ A Korean population-based study reported higher tooth loss in

1. Reader

2. Post graduate student

3. Professor & Head

4. Professor

Department of Public Health Dentistry

***Correspondence Address**

Dr Diya Kumari

Department of Public Health Dentistry

Kothiwal dental college and research centre,
Moradabad.

participants with daily coffee intake, compared with those only drinking coffee less than once a month. Horrigan et al. reviewed the evidence for the immunomodulatory effects of caffeine, finding that it modulates both innate and adaptive immune responses and reported that caffeine can suppress human neutrophil and monocyte chemotaxis, and also suppress production of the pro-inflammatory cytokine tumor necrosis factor (TNF)-alpha." Caffeine was also found to "suppress human lymphocyte function as indicated by reduced T-cell proliferation and impaired production of Th1 (interleukin [IL]-2 and interferon [IFN]-gamma), Th2 (IL-4, IL-5) and Th3 (IL-10) cytokines" and may be associated with an increased risk of osteoporosis.¹¹ However, the epidemiologic evidence associating high caffeine intake from various sources with low bone density is inconsistent, and caffeine has yet to be shown to be an important risk factor for osteoporosis. Caffeine is also shown to increase bone loss and reduce bone healing after tooth extraction. According to Han et al. (2016), the consumption of two or more cups of coffee each day may be considered as risk factor for periodontitis.¹² Meanwhile, Hong et al. (2021) reported no statistically significant association between coffee and periodontitis¹³ and according to Angel Mary who consumed more than four cups of coffee on an everyday basis had gingivitis, of which 57.1% had the moderate form and 13% had the mild form. Moreover, all the subjects had periodontitis of which 72.7% subjects had the moderate form and 12.5% subjects had mild periodontitis. This could be thus attributed to the caffeine content in the coffee, because in general, one cup of coffee contains 70 to 100 mg of caffeine, and considering the deleterious effects of caffeine on bone metabolism and its risk factors associated with periodontitis, the findings of the present study could be consistent.¹⁴ A previous report showed that 76% of the Korean subjects were habitual coffee drinkers, most of whom consumed instant coffee mix containing sugar and powder creamer. Drinking coffee with sugar can be tooth-damaging, and the worst tooth loss occurred among the women who drank coffee sweetened with sugar or syrup. The groups using sugar, other sweetening agents, or neither of these, mainly in coffee, differed significantly and the nonusers of sugar had lowest periodontal treatment time.^{15, 16, 17} The instant coffee mix that contains nondairy creamer and/or sugar may have offset the potential benefit of coffee. The contradictory effects of daily coffee intake are also found in oral health fields.

Although coffee consumption is so common, the literature is still reporting both protective and destructive mechanisms to preserve/degrade periodontal tissue. The antioxidant and anti-inflammatory effects of caffeine contained in coffee might lead to beneficial results for periodontal diseases. In contrary, a study indicated that the daily coffee consumption may delay the bone repair after tooth extraction. Whether caffeine consumption enhances or decreases the activity of osteoclasts and the subsequent alveolar bone loss connected with periodontitis is not definite. More studies would be necessary to further evaluate caffeine's impacts.

REFERENCES

1. L. Nibali, A. Di Iorio, Y.-K. Tu, and A. R. Vieira, "Host genetics role in the pathogenesis of periodontal disease and caries," *Journal of Clinical Periodontology*, vol. 44, Supplement 18, pp. S52–S78, 2017
2. Schwartz Z, Goultschin J, Dean DD, Boyan BD. Mechanisms of alveolar bone destruction in periodontitis. *Periodontol* 2000. 1997;14(1):158–172. doi: 10.1111/j.1600-0757.1997.tb00196.x.
3. Usui M, Onizuka S, Sato T, Kokabu S, Ariyoshi W, Nakashima K. Mechanism of alveolar bone destruction in periodontitis—periodontal bacteria and inflammation. *Jpn Dental Sci Rev*. 2021;57:201–208. doi: 10.1016/j.jdsr.2021.09.005.
4. Bramantoro T, Zulfiana A, Amir MS et al. The contradictory effects of coffee intake on periodontal health: a systematic review [version 1; peer review: 1 approved] *F1000Research* 2022, 11:924 <https://doi.org/10.12688/f1000research.124547.1>
5. Brown, L., Poudyal, H. & Panchal, S. K. Functional foods as potential therapeutic options for metabolic syndrome. *Obes Rev* 16,914–941 (2015).
6. Parvathy S, Luiz A and Varkey JT. "Chemical analysis of caffeine content in tea and coffee samples." *AJSAT*. 2014;3:1-4.
7. Ogah CO and Obebe OT. "Caffeine content of cocoa and coffee beverages in Lagos, Nigeria". *IJRSE*. 2012;3(1): 404-411.
8. Sato Y, Itagaki S, Kurokawa T, Ogura J, Kobayashi M, Hirano T, et al. In vitro and in vivo antioxidant properties of chlorogenic acid and caffeic acid. *Int J Pharm* 2011;403:136–8.6
9. Tsou SH, Hu SW, Yang JJ, Yan M and Lin YY (2019) Potential oral health care agent from coffee against virulence factor of periodontitis. *Nutrients* 11 <https://doi.org/10.3390/nu11092235>
10. Ng N, Kaye EK, Garcia RI (2014) Coffee consumption and periodontal disease in males. *J Periodontol* 85:1042–1049. <https://doi.org/10.1902/jop.2013.130179>
11. Horrigan LA, Kelly JP, Connor TJ. Immunomodulatory effects of caffeine: Friend or foe? *Pharmacol Ther* 2006;111:877-892.
12. Han K, Hwang E, Park J-B. Association between consumption of coffee and the prevalence of periodontitis: The 2008–2010 Korea National Health and Nutrition Examination Survey. *PLoS ONE*. 2016;11(7):e0158845. doi: 10.1371/journal.pone.0158845.
13. Hong SJ, Kwon B, Yang BE, Choi HG, Byun SH. Evaluation of the relationship between drink intake and periodontitis using KoGES data. *BioMed Res Int*. 2021, 2021.
14. Angel Mary, Pragathi R Bhat, Anirudh B Acharya, Vijay A Trasad. Association of coffee with severity of periodontal disease - A comparative cross-sectional clinical study.

15. Bernabe E, Vehkalahti MM, Sheiham A, Aromaa A, Suominen AL (2014) Sugar-sweetened beverages and dental caries in adults: a 4-year prospective study. *J Dent* 42: 952–958. doi: 10.1016/j.jdent.2014.04.011 PMID: 24813370
16. Koyama Y, Kuriyama S, Aida J, Sone T, Nakaya N, et al. (2010) Association between green tea consumption and tooth loss: cross-sectional results from the Ohsaki Cohort 2006 Study. *Prev Med* 50:173–179.
17. Markkanen H (1978) Periodontal treatment need in a Finnish industrial population. *Community Dent Oral Epidemiol* 6: 240–244. PMID: 28128