Journal Homepage: - www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI: 10.21474/IJAR01/21646
DOI URL: http://dx.doi.org/10.21474/IJAR01/21646

RESEARCH ARTICLE

TONGUE COATING AND ITS RELATIONSHIP WITH PERIODONTITIS

Dheeraj V, Shashikanth Hegde, Rajesh K.S and Vinita Boloor

Manuscript Info

Manuscript History
Received: 18 June 2025
Final Accepted: 20 July 2025
Published: August 2025

Abstract

Tongue coating is a natural biofilm consisting of microbes, saliva, and desquamated epithelial cells that accumulate on the tongue's filiform papillae. Its thickness increases with age, diminished salivary flow, soft diets, smoking, coffee intake, and specific medications. It hosts bacteria such as Porphyromonas, Fusobacterium, and Odontomycesviscosus, which generate volatile sulfur compounds linked to halitosis and periodontal disease. Regular tongue scraping decreases bacterial load, volatile sulfur levels, and plaque recolonization, supporting better oral hygiene and overall oral health.

"© 2025 by the Author(s). Published by IJAR under CC BY 4.0. Unrestricted use allowed with credit to the author."

Introduction:-

The tongue covers nearly one-third of the oral cavity surface. Its dorsal surface, with numerous papillae, provides a large area that readily traps debris and microorganisms. As a result, the dorsum of the tongue acts as a reservoir for oral bacteria, which accumulate along with desquamated epithelial cells, food remnants, and salivary or serum components to form what is referred to as tongue coating (TC) [1,2]. TC development is considered a physiological process in health, with the posterior third of the tongue showing the greatest accumulation [3].

Given the tongue's microbial density, its influence on the oral ecosystem is significant. For example, the microbial profile of chewing-stimulated saliva is closely similar to that of the tongue dorsum [4], and variations in oral pH have been linked to tongue appearance [5]. Evidence indicates that TC is more pronounced in periodontal disease [3,6], and the bacterial populations in tongue coating closely resemble those found in dental plaque [7,8]. This supports the idea that tongue bacteria act as a reservoir, continuously supplying bacteria to dental biofilms via saliva [9].

TC occurs more frequently than other tongue-related changes, such as fissured tongue (associated with conditions like hyposalivation, candidiasis, diabetes mellitus, vitamin B deficiency, lichen planus, or Sjögren's syndrome) and depapillated tongue (linked to trauma, candidiasis, xerostomia, or nutritional deficiencies) [10]. The tongue is often described as a "mirror of systemic health," offering diagnostic clues to systemic disorders [11]. For example, in HIV, early signs such as corrugated white plaques or hairy leukoplakia on the tongue margins can aid diagnosis [12]. Despite its clinical relevance, TC remains underexplored in scientific literature, and healthcare professionals generally have limited awareness of its significance[12].

The aim of this narrative review is to summarize current knowledge on tongue coating and its association with periodontitis.

Corresponding Author:- Dheeraj V

Formation of tongue coating:-

The exact mechanisms underlying TC formation remain unclear, but it is known to consist of desquamated epithelial cells, oral bacteria, salivary proteins, gingival exudates, postnasal secretions, and blood metabolites [1]. The filiform papillae on the tongue dorsum play a major role in TC development. Microscopic studies, including light and transmission electron microscopy, have revealed bacterial colonies intermixed with degenerated keratinized epithelium shed from these papillae [13]. Retention of food debris, bacteria, and saliva between the filiform papillae further promotes coating formation [11].

The tongue's surface is composed of both keratinized and non-keratinized epithelium, and TC thickness depends on the balance between epithelial shedding and clearance [11]. Ultrastructural analysis of the tongue has shown a relationship between epithelial cell proliferation, membrane-coating granule formation, and TC accumulation [12]. Thus, TC results from a combination of epithelial turnover, microbial colonization, and retention of salivary and dietary components [10,11,14].

Characteristics of tongue coating:-

Accurate evaluation of TC requires attention to examination conditions such as patient position and lighting, as these factors may alter its perceived color and appearance [16]. A thin, whitish, moist coating is considered normal in healthy individuals [3], though variations in color, moisture, thickness, and distribution often reflect systemic or oral health status [16].

Studies indicate wide variability in TC thickness and extent depending on periodontal health and individual oral hygiene (IOH). For instance, even among patients with clinically healthy periodontium, those with poor IOH were observed to have thicker coatings [17]. Individuals with periodontitis show significantly greater TC accumulation, with wet weight measurements revealing up to four times more coating compared to healthy controls [1]. This is attributed to an increased presence of leukocytes from periodontal pockets entering saliva and subsequently depositing onto the tongue surface [10].

Measurement of tongue coating:-

Numerous techniques have been developed to quantify TC, though none are considered a universal standard. Yaegaki and Sanada [1] proposed a direct method: TC is removed using a spoon-shaped tongue scraper from the terminal sulcus to the apex, followed by cleaning with saline-soaked cotton pellets, and its wet weight (mg) is then measured.

Other approaches rely on scoring systems. Gross et al. [20] introduced a 0–3 scale (no coating to severe coating), though it lacked photographic guidance. Bosy et al. [19] categorized TC visually as heavy, medium, light, or absent, while Miyazaki et al. [20] graded coverage based on surface area:

- **Score 0:** No visible coating
- **Score 1:** < one-third of the dorsum covered
- **Score 2:** < two-thirds covered
- **Score 3:** > two-thirds covered

Chen [21] classified TC by color (white, yellow, grey, black) and by surface quality (dry, slippery, rough, prickly, partially or completely furred). Winkel et al. [22] divided the tongue into six sections (anterior and posterior thirds), scoring coating and discoloration separately:

- **Coating:** 0 = none, 1 = light, 2 = heavy
- **Discoloration:** 0 = none, 1 = light, 2 = severe

More recently, Gómez et al. [3] refined Miyazaki's method by dividing the tongue into nine sections, scoring thickness (0 = none, 1 = light, 2 = heavy) and color (0 = pink, 1 = white, 3 = brown, 4 = black). Intraexaminer agreement was approximately 70%, while interexaminer agreement was lower, with ~50% concordance for discoloration and ~58% for coating thickness.

Fig 1. Discoloration of the tongue: score 0, pink; score 1, yellow/light brown; score 3, brown; score 4:, black.
Fig 1. Discoloration of the tongue: score 0, pink; score 1, yellow/light brown; score 3, brown; score 4:, black.

Factors affecting tongue coating:

Influence of Age:

Age plays a key role in determining the thickness and appearance of tongue coating (TC) [3]. In older individuals, TC tends to be both thicker and more discolored than in younger populations. These age-associated changes can be linked to several factors, such as reduced ability to perform thorough oral hygiene, a preference for softer diets, and decreased natural tongue cleansing by saliva. Alterations in salivary composition or reduced flow with aging may also contribute [23]. Moreover, studies have reported that the number of filiform papillae increases with age, while fungiform papillae decrease, further influencing TC formation [14].

Impact of Diet on Tongue Coating:

Dietary habits strongly affect both the thickness and color of TC. Depending on food intake, TC may appear as a clear, watery layer or a thicker, pigmented, and mucous-like deposit. High-fat foods are known to promote TC formation [24]. Discoloration of TC is commonly observed following consumption of pigmented foods (e.g., chocolate, watermelon), beverages (e.g., coffee, red wine), certain mouth rinses (e.g., chlorhexidine), smoking, and some medications [25,27]. Coffee consumption and smoking may also create a false impression of heavier coating than is actually present. In everyday life, tongue movements during chewing and swallowing, adequate salivary flow, and fibrous diets contribute to natural cleaning of the tongue, maintaining a thin, healthy coating. Conversely, soft diets—often consumed during illness—reduce tongue movement and saliva stimulation, leading to thicker TC [11].

Oral Hygiene:

Oral hygiene practices are a major determinant of TC accumulation [25]. While the tongue has natural self-cleansing mechanisms, they are often insufficient to remove heavy coatings. Mechanical cleaning, such as tongue scraping or brushing, can help eliminate debris, but tongue cleaning is not yet widely recognized or practiced as part of routine oral care [24].

Tongue coating and malodour:

Oral malodour has numerous causes, but the most frequent type arises from microbial breakdown of proteins, peptides, and amino acids on the tongue and teeth [2]. Patients with periodontal disease typically exhibit higher levels of volatile sulfur compounds (VSCs), such as hydrogen sulfide (H_2S) and methyl mercaptan, primarily on the dorsal tongue surface [1,2,20]. The bacteria colonizing both periodontal pockets and the tongue are key contributors to VSC production in health and disease [1,2,20].

Research has identified up to 82 oral bacterial species capable of producing fatty acids, H_2S, and methyl mercaptan from amino acids like cysteine and methionine, though no single organism has been established as the main source of malodour [28]. In individuals with excellent oral hygiene, a healthy periodontium, and intact dentition, the dorsum of the tongue—especially its posterior section—is often the primary source of bad breath, whereas the anterior tongue plays a lesser role.Malodour causing bacteria such as Porphyromonasgingivalis, Fusobacterium spec ies, Prevotella intermedia, and Capnocytophaga species are frequently isolated from this area [19,29].

In elderly patients, a shift in the microbial population occurs: Odontomycesviscosus becomes predominant in the filiform papillae around age 70, replacing Streptococcus viridans. This organism contributes to a viscous, malodorous tongue coating [23,30].

Tongue brushing:-

Historical Overview:

The practice of tongue cleaning dates back centuries and is still common among indigenous populations in Africa, Arabia, India, and South America [32]. Many ancient religious traditions emphasized comprehensive oral care, including cleaning the tongue. In India, daily oral hygiene rituals included tooth cleaning, tongue scraping, and rinsing with herbal preparations made from betel leaves, cardamom, camphor, or other natural ingredients. Despite this longstanding tradition, tongue scraping and brushing remain underused and undervalued in Western countries. Historically, tongue scrapers have been crafted from diverse materials, such as wood, ivory, metals, tortoiseshell, whalebone, and more recently, plastic [32].

Tongue Brushing and Dental Plaque:

Some studies indicate that tongue brushing, when combined with other oral hygiene measures, reduces plaque accumulation [32,33]. However, Badersten et al. [34] reported no significant differences in plaque levels after four days of tongue brushing compared to four days without any oral hygiene. Similarly, no significant difference was observed when comparing one week of toothbrushing alone with combined tooth and tongue brushing. The authors suggested that plaque-forming bacteria may not primarily originate from the tongue, and that challenges in cleaning the posterior tongue due to limited access and discomfort may reduce the effectiveness of tongue brushing [34].

Tongue Brushing and Gingival Inflammation:

Jacobson et al. [32] investigated the effect of tongue and palate brushing on gingival inflammation in combination with standard oral hygiene. While no significant improvement in gingival inflammation was observed, there was a slight trend towards reduced gingival index scores over time. The authors attributed this trend to the frequent professional prophylaxis given to participants, which may have obscured any independent benefits of tongue brushing.

Tongue Brushing and Taste Sensitivity:

A review has highlighted that tongue cleaning is particularly beneficial for improving taste perception in elderly individuals with prostheses, especially those with dry mouth [35]. However, only one study has directly evaluated changes in taste thresholds after tongue brushing [36].

In this study, participants underwent several sessions to assess sensitivity to sucrose, sodium chloride (NaCl), citric acid, and caffeine. In one session, the tongue was brushed with a toothbrush alone, and in another, it was brushed with both toothbrush and dentifrice. Among younger participants, dentifrice use was associated with reduced sensitivity to sucrose, while both methods lowered sensitivity to citric acid. Tongue brushing alone decreased caffeine detection thresholds but raised NaCl thresholds. Similar effects were observed in older subjects, with dentifrice significantly influencing caffeine thresholds. The study concluded that tongue brushing, with or without dentifrice, affects taste-perception thresholds.

Fig 2. Different types of Tongue scrappers

The tongue microbiota:-

The oral microbiome comprises complex microbial communities that inhabit various oral surfaces, including the tongue, cheeks, palate, and tonsils, as well as the biofilm on teeth [37]. At birth, the oral cavity is sterile, but microbial colonization begins almost immediately after delivery [38]. Early investigations into oral microbes primarily relied on standardized culture techniques using solid media.

However, the field advanced significantly with the development of molecular approaches, such as DNA hybridization, polymerase chain reaction (PCR), and Sanger sequencing of the 16S rRNA gene. These techniques have since been complemented by high-throughput sequencing methods, including pyrosequencing and metagenomic analysis, allowing for a more comprehensive understanding of oral microbial diversity. Collectively, these advancements led to the establishment of the Human Oral Microbiome Database (HOMD) and the CORE database, which catalog the bacterial species present in the oral cavity [37].

Conclusion:-

Tongue coating plays a crucial role in shaping the oral microbial ecosystem and has a direct impact on oral health. The accumulation of desquamated epithelial cells, microorganisms, and debris on the dorsum of the tongue provides an ideal environment for the proliferation of pathogenic bacteria, which can contribute to inflammatory conditions such as gingivitis and periodontitis. Additionally, this dysbiosis is strongly associated with halitosis, as anaerobic bacteria produce volatile sulfur compounds (VSCs) that are primarily responsible for malodour.

Routine tongue cleaning or mechanical debridement is an effective measure for reducing coating thickness, decreasing bacterial load, and restoring microbial balance. Incorporating tongue hygiene into daily oral care can lead to improvements in periodontal health, a lower risk of halitosis, and enhanced overall oral hygiene. Therefore, tongue coating management should be considered a vital component of preventive and therapeutic strategies for maintaining optimal oral health.

References:-

1. Yaegaki K, Sanada K. Biochemical and clinical factors influencing oral malodor in periodontal patients. J Periodontol. 1992;63(9):783-789.
2. Quirynen M, Mongardini C, Van Steenberghe D. The effect of a 1-stage full-mouth disinfection on oral malodor and microbial colonization of the tongue in periodontitis. A pilot study. J Periodontol. 1998;69(3):374-382
3. Mantilla Gómez SM, Danser MM, Sipos PM, Rowshani B, Van Der Velden U, Van Der Weijden GA. Tongue coating and salivary bacterial counts in healthy/gingivitis subjects and periodontitis patients. J ClinPeriodontol. 2001;28:970-978.
4. Simón-Soro A, Tomás I, Cabrera-Rubio R, Catalan MD, Nyvad B, Mira A. Microbial geography of the oral cavity. J ClinPeriodontol. 2013;92(7):616-621.
5. Chen ZL, Hu QF. Recent development in research on tongue inspection.Chin Med J. 1986;99(6):444-456.
6. Yaegaki K, Sanada K. Volatile sulfur compounds in mouth air from clinically healthy subjects and patients with periodontal disease. J Periodontal Res. 1992;27(4 Pt 1):233-238.
7. Van derVelden U, Van Winkelhoff AJ, Abbas F, De Graaf J. The habitat of periodontopathic micro-organisms. J ClinPeriodontol. 1986;13(3):243-248.
8. Kishi M, Ohara-Nemoto Y, Takahashi M, et al. Prediction of periodontopathic bacteria in dental plaque of periodontal healthy subjects by measurement of volatile sulfur compounds in mouth air. Arch Oral Biol. 2013;58(3):324-330.
9. Matsui M, Chosa N, Shimoyama Y, Minami K, Kimura S, Kishi M. Effects of tongue cleaning on bacterial flora in tongue coating and dental plaque: a crossover study. BMC Oral Health. 2014;14:4.
10. Patil S, Kaswan S, Rahman F, Doni B. Prevalence of tongue lesions in the Indian population. Journal of clinical and experimental dentistry. 2013 Jul 1;5(3):e128.
11. Blumenreich MS, Walker HK, Hall WD, Hurst JW. Clinical methods: the history, physical, and laboratory examinations. Third ed1990. 1990 Feb 2.
12. Greenspan D, Greenspan JS. HIV-related oral disease. The Lancet. 1996 Sep 14;348(9029):729-33.
13. Watanabe HI. Observation of the ultrastructure of the tongue coating. KokubyoGakkaizasshi. The Journal of the Stomatological Society, Japan. 2006 Mar 1;73(1):26-39.
14. Danser MM, Gómez SM, Van derWeijden GA. Tongue coating and tongue brushing: a literature review. International journal of dental hygiene. 2003 Aug;1(3):151-8.
15. Ye J, Cai X, Cao P. Problems and prospects of current studies on the microecology of tongue coating. Chinese medicine. 2014 Mar 5;9(1):9.
16. Anastasi JK, Currie LM, Kim GH. Understanding diagnostic reasoning in TCM practice: tongue diagnosis. AlternTher Health Med. 2009 May 1;15(3):18-28.
17. Haraszthy VI, Zambon JJ, Sreenivasan PK, Zambon MM, Gerber D, Rego R, Parker C. Identification of oral bacterial species associated with halitosis. The Journal of the American Dental Association. 2007 Aug 1;138(8):1113-20.
18. Gross A, Barnes GP, Lyon TC. Effects of tongue brushing on tonguecoating and dental plaque scores. J Dent Res 1975; 54: 1236–7.
19. BosyA,KulkarniGV,RosenbergM,McCullochCAG.Relationshipof oral malodor to periodontitis: evidence of independence in discrete subpopulations. J Periodontol 1994; 65: 37–46.
20. Miyazaki H, Sakao S, Katoh Y, Takehara T. Correlation between volatile sulphur compounds and certain oral health measurements in the general population. J Periodontol 1995; 66: 679–84.
21. Chen Z. Brief history of tongue inspection. Chinese Med J 1987; 100:38–44.
22. Winkel EG, Roldan S, Van Winkelhoff AJ, Herrera D, Sanz M. The clinical effects of a new mouthrinse containing chlorhexidinecetylpyridinium chloride and zinc-lactate on oral halitosis. A dual- center, double-blind placebo-controlled study. J ClinPeriodontol 2003; 30: 300–7.
23. Ralph W J 1988 Oral hygiene—why neglect the tongue? Aust. Dent. J. 33 224–5
24. Christensen G J 1998 Why clean your tongue? J. Am. Dent.Assoc 129-1605-7
25. Van Tornout M, Dedamio J, Coucke W and Quirynen M 2013 Tongue coating: related factors J. Clin. Periodontol. 40 180–5
26. GürganCA,ZaimE,BakirsoyIandSoykanE2006Short-term side effects of 0.2% alcohol-free chlorhexidinemouthrinse used as an adjunct to non-surgical periodontal treatment: a double-blind clinical study J. Periodontol. 77 370–84
27. AmirKA,BobbaRK,ClarkeB,Nagy-AgrenS,ArsuraEL, Balogun S A and Evans J M 2006 Tongue discoloration in an elderly kidney transplant recipient: treatment-related adverse event? Am. J. Geriatr. Pharmacother. 4 2603

28. Tonzetich J. Production and origin of oral malodor: a review of the mechanisms and methods of analysis. J Periodontol 1977; 48: 13–20.
29. De Boever EH, De Uzeda M, Loesche WJ. Relationship between volatile sulfur compounds, BANA-hydrolizing bacteria and gingival health in patients with and without complaints of oral malodor. J Clin Dentistry 1994; 4: 114–9.
30. Massler M. Geriatric dentistry: root caries in the elderly. J Prosth Dentistry 1980; 44: 147–9.
31. Griffen AL, Becker MR, Lyons SR, Moeschberger ML, Leys EJ. Prevalence of Porphyromonasgingivalis and periodontal health status. J ClinMicrobiol 1998; 36: 3239–42.
32. Jacobson SE, Crawford JJ, McFall WR. Oral physiotherapy of the tongue and palate: relationship to plaque control. J Am Dent Assoc 1973; 87: 134–9.
33. Gilmore E, Bhaskar S. Effect of tongue brushing on bacteria andplaque formed in vitro. J Periodontol 1972; 43: 418–22.
34. Badersten A, Egelberg J, Jonson G, Kroneng M. Effect of tongue brushing on formation of dental plaque. J Periodontol 1975; 46: 625–7.
35. Winkler S, Garg A, Mekayarajjananonth T, Bakaeen L, Khan E.Depressed taste and smell in geriatric patients. J Am Dent Assoc 1999; 130: 1759–65.
36. Hyde RJ, Feller RP, Sharon IM. Tongue brushing, dentifrice and ageeffects on taste and smell. J Dent Res 1981; 60: 1730–4.
37. Morita M, Wang H-L. Association between oral malodor and adult periodontitis. J ClinPeriodontol 2001; 28: 813–9.
38. Christen A, Swanson B. Oral hygiene. a history of tongue scraping and brushing. J Am Dent Assoc 1978; 96: 215–9