Dentistry 3000

Vol 14, No 2 (2026)
ISSN 2167-8677 (online)
DOI 10.5195/d3000/2026.1465

Effectiveness of Manuka Honey in the Management of Oral Halitosis

Ali A. Shaheed[1], Shaymaa Abdulkareem Nori[2], Maha Mohammed Abd Ali[2], Batool Hassan Al-Ghurabi[3]
[1]*College of Dentistry, University of Kut, Iraq*
[2]*College of Dentistry, Al-Hadi University, Iraq*
[3]*College of Dentistry, University of Baghdad, Iraq*

Abstract

The objective of the present research was to assess and compare the effectiveness of tongue scraping, Manuka honey, and a combination of both interventions in reducing oral halitosis. This pilot case-series study included three adolescents aged 13–16 years with clinically diagnosed halitosis. Participants received either tongue scraping, Manuka honey, or combination therapy. Halitosis severity was assessed using the Rosenberg organoleptic scale and the Winkel Tongue-Coating Index. Tongue dorsum samples were collected at baseline, immediately after treatment, one week and two weeks after treatment. The bacterial load of *Solobacterium moorei* was determined using quantitative real-time polymerase chain reaction. All treatment modalities produced immediate reductions in bacterial load, organoleptic scores, and Winkel Tongue-Coating Index scores. Manuka honey demonstrated the greatest immediate reduction in bacterial load (97.75%). However, the combination treatment showed the most sustained effect, maintaining a 91.59% reduction in bacterial load after two weeks. Organoleptic scores were reduced by 80% at two weeks in the combination group, compared with 60% in the Manuka honey group and 0% in the tongue scraping group. Similarly, the combination treatment maintained a 66.67% reduction in Winkel Tongue-Coating Index scores throughout the follow-up period, whereas reductions observed in the Manuka honey and tongue scraping groups declined over time. All three interventions reduced halitosis immediately after treatment. However, the combination of tongue scraping and Manuka honey demonstrated the most sustained improvement in bacterial load, organoleptic scores, and tongue-coating scores over the two-week follow-up period, suggesting that combining mechanical and antimicrobial approaches may offer superior control of oral halitosis.

Open Access
Citation: Shaheed AA et al. (2026) Effectiveness of manuka Honey in the Management of Oral Halitosis. Dentistry 3000. 1:a001 doi:10.5195/d3000.2026.1465
Received: June 21, 2026
Accepted: June 24, 2026
Published: July 27, 2026

Email: shaymaa.a.nori@huc.edu.iq

Introduction

Halitosis is defined as a persistent and unpleasant odor originating from the oral cavity. It is a common condition that can negatively affect an individual's social interactions, self-esteem, and overall quality of life. The diagnosis of halitosis requires a comprehensive oral examination to identify local etiological factors and underlying causes. Assessment methods include both organoleptic evaluation and instrumental measurements, which are widely used to determine the severity of oral malodor and monitor treatment outcomes [1]. The development of oral malodor is primarily associated with the putrefactive activity of oral microorganisms on endogenous and exogenous proteins and peptides. These metabolic processes result in the production of volatile sulfur compounds (VSCs), which are largely responsible for the characteristic unpleasant odor associated with halitosis [2]. Reduced oxygen availability within dental plaque, saliva, and oral biofilms further promotes the growth of anaerobic bacteria involved in VSC production. In addition, decreased salivary flow contributes to increased bacterial accumulation and exacerbates oral malodor [3]. Among the microorganisms implicated in halitosis, *Solobacterium moorei* (*S. moorei*) has emerged as a key indicator species. Previous studies have reported the presence of *S. moorei* in all subjects with halitosis, whereas it was absent in healthy controls [4]. The dorsum of the tongue serves as an ideal ecological niche for this bacterium due to the low oxygen tension within the deep

Vol 14, No 2 (2026) DOI 10.5195/d3000/2026.1465

crypts of the tongue surface. Furthermore, the tongue dorsum provides a rich source of proteases that facilitate the degradation of proteins and peptides, thereby enhancing VSC production [5]. Consequently, elevated levels of *S. moorei* have been consistently detected in the tongue coating and saliva of individuals suffering from halitosis [4]. Effective management of halitosis is primarily based on the elimination of etiological factors and improvement of oral hygiene [6]. Current treatment approaches include mechanical and chemical reduction of oral microorganisms, neutralization of volatile sulfur compounds, and the use of odor-masking agents [7]. Mechanical tongue cleaning is considered one of the most effective methods for reducing oral malodor, as the tongue dorsum represents the principal reservoir of microorganisms responsible for halitosis. Van der Sleen et al. demonstrated that tongue scraping significantly reduces tongue coating, thereby decreasing the microbial load associated with malodor production [8].

Recently, increasing attention has been directed toward natural antimicrobial agents as alternative approaches for halitosis management [9]. Manuka honey (MH), derived from *Leptospermum scoparium*, possesses potent antimicrobial properties and has demonstrated inhibitory activity against a broad spectrum of microorganisms [10]. The antibacterial efficacy of MH is mostly ascribed to its methylglyoxal (MGO) concentration, represented by the Unique Manuka Factor (UMF), as well as various polyphenolic compounds. These bioactive constituents disrupt bacterial cell structures and metabolic pathways, resulting in dose-dependent antimicrobial effects, particularly against Gram-negative bacteria. Moreover, honey has been reported to reduce odor formation by promoting bacterial metabolism toward lactic acid production rather than the generation of malodorous gases [11].

The therapeutic potential of MH in odor control has been demonstrated in several clinical settings [9]. MH effectively reduced odor and inflammation in wounds associated with oral squamous cell carcinoma, while honey was reported to be superior to chlorhexidine in reducing halitosis among post-stroke patients [9,12-15]. Despite the documented antimicrobial effects of MH and the established benefits of tongue scraping, limited information is available regarding their combined use in the management of oral halitosis. Therefore, the present study aimed to evaluate and compare the effectiveness of tongue scraping, topical application of MH, and a combination of both interventions in reducing halitosis.

Materials and Methodos

The present pilot case-series investigation was executed to evaluate the effectiveness of three different treatment modalities for the management of oral halitosis: tongue scraping, topical application of MH, and a combination of tongue scraping and MH. The effectiveness of each intervention was assessed through clinical and microbiological parameters measured at predetermined follow-up periods.

For *S. moorie* analysis, a bacterial deoxyribonucleic acid (DNA) isolation kit (Presto™ Mini gDNA Bacteria Kit, Geneaid Biotech Ltd/Taiwan) was used, primers for *S. moorie* (Macrogen™ /South Korea), and quantitative real-time polymerase chain reaction Master Mix (Luna® Universal/New England Biolabs/USA)

Three adolescents aged 13–16 years with clinically diagnosed oral halitosis (organoleptic examination score ≥ 3 and Winkle test score ≥ 3) and visible tongue coating were enrolled in this pilot study. Participants were assigned to one of three treatment modalities: tongue scraping (S), topical application of MH to the dorsal surface of the tongue (M), or a combination therapy consisting of tongue scraping followed by topical application of MH (C). Clinical examinations and tongue dorsum samples were taken for each participant at four time points:

1-Baseline (before treatment): M0, S0, C0
2-Immediately after treatment: M1, S1, C1
3-One week after treatment: M2, S2, C2
4-Two weeks after treatment: M3, S3, C3

The study was conducted in accordance with the ethical principles of the Declaration of Helsinki and was approved by the Ethics Committee of Al Hadi University, College of Dentistry, Iraq (number HD140626, 14-6-2026).

All clinical examinations and microbiological sample collections were conducted in the morning under standardized conditions.

Participants were directed to abstain from consuming food, beverages, and performing oral hygiene procedures, including tooth brushing, prior to each assessment visit.

Halitosis severity was assessed using the organoleptic examination, which is considered the clinical gold standard for the evaluation of oral malodor. Participants were instructed to inhale deeply through the nose, hold their breath for a few seconds, and then exhale slowly through a disposable pipette. The examiner evaluated the exhaled breath by smelling it from a standardized distance of 20 cm. Odor intensity was scored according to the Rosenberg organoleptic scale, ranging from 0 to 5, where 0 indicates no odor, 1 signifies a barely perceptible odor, 2 denotes a minor but distinctly noticeable odor, 3 represents a moderate odor, 4 corresponds to a strong odor, and 5 reflects an intense offensive odor [16]. Assessments were performed at baseline, immediately after treatment, one week after treatment, and two weeks after treatment.

Winkel Tongue-Coating Index (WTCI) was utilized to evaluate tongue coating. The tongue dorsal surface was segmented into six sextants, comprising three posterior and three anterior regions. Each sextant was visually examined and scored according to the extent of tongue coating as follows: 0 indicates no coating, 1 indicates moderate coating, and 2 indicates heavy coating. The individual sextant scores were summed to obtain the total WTCI score, yielding a possible score ranging from 0 to 12, where elevated scores signify increased tongue coating [17,18]. Assessments were performed at baseline, immediately after treatment, one week after treatment, and two weeks after treatment.

Participant assigned to the tongue scraping group underwent mechanical cleaning of the dorsal surface of the tongue using a tongue scraper. The procedure was performed according to standard oral hygiene recommendations, ensuring thorough removal of tongue coating from the posterior to the anterior region of the tongue.

Participant assigned to the MH group received 5ml MH (methylglyoxal concentration 514+mg/kg and Unique Manuka Factor 15+) once a day for one month. The honey was applied to the dorsal surface of the tongue and evenly distributed over the tongue coating area to maximize contact with the microbial biofilm, keeping the honey for at least 60 seconds before swallowing.

Participant assigned to the combination group first underwent tongue scraping, followed immediately by topical application of MH to the cleaned dorsal tongue surface.

Microbiological samples were collected from the dorsum of the tongue by gentle scraping of the tongue surface using the curette head of a stainless steel dental cumine, placed immediately in Eppendorf tubes containing 0.5 ml Tris EDTA buffer and stored at (-40°C) [19].

Quantitative real-time polymerase chain reaction (qRT-PCR) was used to quantify the bacterial load of *Solobacterium moorei* in tongue dorsum samples collected from each participant. Genomic DNA was extracted and species-specific primers for *S. moorei* were used for DNA amplification. Fluorescence was monitored in real time throughout the amplification process, and the cycle threshold value for each sample was recorded. The bacterial load was determined by comparing the cycle threshold values with a standard curve generated from serial dilutions of known DNA concentrations [20].

Statistical analysis was conducted utilizing IBM SPSS Statistics (Version 27; IBM Corp, Armonk, N, USA). Due to the pilot nature of the study

Vol 14, No 2 (2026) DOI 10.5195/d3000/2026.1465

and the limited sample size, data were analyzed descriptively. Bacterial load, organoleptic examination scores, and WTCI scores were recorded at baseline, immediately after treatment, one week after treatment, and two weeks after treatment. Treatment effectiveness was evaluated by calculating the percentage reduction from baseline for each outcome measure. Percentage reductions were calculated for bacterial load, organoleptic examination scores, and WITCI test scores at each follow-up interval. The results were presented in tables and line graphs to illustrate changes over time and to compare the effects of tongue scraping, MH application, and combination therapy. No inferential statistical tests were performed because the study included only one participant per treatment modality, preventing meaningful statistical comparison between groups.

Results

The bacterial load decreased immediately after treatment in all three treatment modalities. The greatest immediate reduction was observed in the MH group, where the bacterial load decreased from 1.067 at baseline to 0.024, corresponding to a 97.75% reduction. The combination treatment reduced the bacterial load from 2.580 to 0.210 (91.86% reduction), while tongue scraping alone reduced the bacterial load from 5.274 to 0.962 (81.76% reduction) (Table 1).

At the one-week follow-up, both the MH and combination groups maintained substantial reductions in bacterial load, with percentage reductions of 97.19% and 93.37%, respectively. In contrast, the tongue scraping group demonstrated a lower reduction of 79.6%.

At two weeks, the combination treatment showed the most sustained antimicrobial effect, maintaining a 91.59% reduction in bacterial load. The MH group exhibited a reduction of 59.98%, whereas the tongue scraping group demonstrated the lowest long-term reduction (46.36%) (Table 2).

Table 1. Bacterial load measurements over time.

Treatment	Before	Immediate	Week 1	Week 2
MH	1.067	0.024	0.03	0.427
Combination	2.58	0.21	0.171	0.217
Tongue Scraping	5.274	0.962	1.076	2.829

Table 2. Percentage reduction in bacterial load.

Treatment	Immediate (%)	Week 1 (%)	Week 2 (%)
MH	97.75	97.19	59.98
Combination	91.86	93.37	91.59
Tongue Scraping	81.76	79.6	46.36

All treatment modalities resulted in a complete reduction of organoleptic scores immediately after treatment, with scores decreasing from 5 at baseline to 0 (Table 3).

At the one-week follow-up, both the MH and combination groups maintained low organoleptic scores (score = 1), corresponding to an 80% reduction from baseline. In contrast, the tongue scraping group demonstrated a score of 4, representing only a 20% reduction.

At two weeks, the combination treatment maintained the lowest organoleptic score (score = 1) and an 80% reduction from baseline. The MH group showed a score of 2 (60% reduction), while the tongue scraping group returned to its baseline value (score = 5), indicating complete loss of the treatment effect.

Table 3. Organoleptic examination scores over time.

Treatment	Before	Immediate	Week 1	Week 2
MH	5	0	1	2
Combination	5	0	1	1
Tongue Scraping	5	0	4	5

A reduction in WITCI scores was observed in all groups immediately after treatment (Table 4). The combination group showed the greatest immediate reduction, decreasing from 9 at baseline to 3, corresponding to a 66.67% reduction. The MH group decreased from 7 to 3 (57.14% reduction), while the tongue scraping group decreased from 9 to 4 (55.56% reduction).

At the one-week follow-up, the combination group maintained a 66.67% reduction, whereas the MH and tongue scraping groups showed reductions of 57.14% and 33.33%, respectively.

At two weeks, the combination treatment continued to maintain the greatest reduction in tongue-coating scores (66.67%), while reductions in the MH and tongue scraping groups declined to 28.57% and 11.11%, respectively.

Table 4. Winkel Tongue-Coating Index scores over time.

Treatment	Before	Immediate	Week 1	Week 2
MH	7	3	3	5
Combination	9	3	3	3
Tongue Scraping	9	4	6	8

Discussion

The present pilot study evaluated the effectiveness of tongue scraping, topical application of MH, and a combination of both interventions in reducing halitosis. Treatment outcomes were assessed using bacterial load measurements, organoleptic examination scores, and WTCI scores at baseline, immediately after treatment, one week after treatment, and two weeks after treatment. Overall, all treatment modalities produced an immediate improvement in halitosis-related parameters; however, the combination of tongue scraping and MH demonstrated the most sustained effect throughout the follow-up period.

The reduction in bacterial load observed in all treatment groups supports the role of the tongue dorsum as a major reservoir of microorganisms associated with oral malodor. The deep crypts and papillary structure of the dorsal tongue surface provide favorable conditions for bacterial colonization and the production of volatile sulfur compounds (VSCs), which are considered the primary cause of halitosis. In the present study, MH achieved the greatest immediate reduction in bacterial load (97.75%), suggesting a rapid antimicrobial effect. This finding is consistent with previous studies demonstrating the broad-spectrum antibacterial activity of MH against both Gram-positive and Gram-negative microorganisms [11,14,15,21]. The antimicrobial properties of MH have been largely attributed to its methylglyoxal (MGO) content and various polyphenolic compounds, which disrupt bacterial cell structures and metabolic processes.

Although MH produced the highest immediate reduction in bacterial load, the combination treatment demonstrated the most sustained antimicrobial effect, maintaining a 91.59% reduction after two weeks. To the authors' knowledge, no previous studies have specifically investigated the combined use of tongue scraping and MH for the management of halitosis. Therefore, direct comparison with the existing literature is limited.

Nevertheless, the present findings may be explained by the established mechanisms of the two interventions. Previous studies have shown that tongue scraping effectively reduces tongue coating and oral malodor by mechanically removing microorganisms, debris, and desquamated epithelial cells from the dorsum of the tongue, which is recognized as a major reservoir of halitosis-associated bacteria. Van der Sleen reported significant reductions in tongue coating following mechanical tongue cleaning, highlighting its importance in halitosis management [8].

Similarly, several studies have demonstrated the antimicrobial and odor-reducing properties of MH. The antibacterial activity of MH has been attributed to its methylglyoxal content and polyphenolic compounds, which inhibit bacterial growth and metabolism [11,22,23]. Furthermore, honey has been reported to reduce malodor in various clinical settings, including oral wounds and post-stroke halitosis [12].

Vol 14, No 2 (2026) DOI 10.5195/d3000/2026.1465

The sustained reduction observed in the combination group in the present study may therefore be attributed to the complementary actions of the two interventions. Mechanical tongue scraping may reduce the existing microbial biofilm and tongue coating, while subsequent application of MH may suppress bacterial recolonization and inhibit the re-establishment of malodor-producing microorganisms.

The organoleptic examination results further support the superiority of the combination treatment. All three interventions achieved complete elimination of detectable malodor immediately after treatment. This finding is consistent with many other previous studies which braced the role of MH and tongue scrubbing in reducing halitosis [9,24,25].

However, differences became evident during follow-up. While the combination treatment maintained an 80% reduction in organoleptic scores at two weeks, the reduction observed with MH alone decreased to 60%, and tongue scraping alone returned to baseline values. These findings indicate that mechanical tongue cleaning alone may provide only temporary relief from halitosis unless accompanied by additional antimicrobial measures.

The results obtained from the WITCI Tongue-Coating Index also demonstrated a clear advantage for the combination treatment. The WTCI score remained reduced by 66.67% throughout the two-week observation period in the combination group, whereas the effectiveness of MH alone and tongue scraping alone gradually diminished. Since tongue coating serves as a major habitat for halitosis-associated bacteria, the sustained reduction in WTCI scores observed in the combination group may explain the corresponding improvements in bacterial load and organoleptic scores.

The findings of the present study align with previously published reports emphasizing the importance of tongue hygiene in halitosis management. Kadu reported that the dorsum of the tongue serves as an ideal reservoir for anaerobic microorganisms due to its papillary surface architecture, allowing retention of food debris, desquamated epithelial cells, and bacterial biofilm, all of which contribute to volatile sulfur compound production and subsequent oral malodor. Therefore, interventions targeting tongue biofilm removal remain clinically relevant in the management of intraoral halitosis. [26]. Similarly, studies investigating the therapeutic applications of honey have demonstrated its effectiveness in reducing odor in various clinical conditions. Makmuriana et al. reported that honey was superior to chlorhexidine in reducing halitosis among post-stroke patients [12], while Drain and Fleming demonstrated the ability of MH to reduce odor and inflammation in oral wounds [13]. The present study extends these observations by suggesting that the combination of tongue scraping and MH may provide greater and more sustained benefits than either intervention alone. Several mechanisms may explain the effectiveness of MH in reducing halitosis. In addition to its direct antibacterial activity, honey may alter bacterial metabolism by promoting the production of lactic acid rather than malodorous sulfur-containing compounds. Furthermore, the inhibitory effects of MH on bacterial growth may be particularly relevant for microorganisms associated with halitosis, including *S. moorei*, which has been identified as a key species in the development of oral malodor. By reducing the microbial burden on the tongue dorsum, MH may indirectly decrease VSC production and improve breath odor.

It is important to note that the current study has significant limitations. With only one subject allocated to each treatment method, the sample size is quite small, which is the most significant drawback. Consequently, the findings should be regarded as preliminary observations rather than conclusive evidence of therapeutic efficacy.

In addition, the follow-up period was limited to two weeks, preventing assessment of long-term treatment outcomes. The absence of a control group and the inability to perform inferential statistical analyses further limit the generalizability of the results.

Despite these limitations, the study provides valuable preliminary evidence regarding the potential benefits of combining tongue scraping with MH for the management of halitosis. Future studies involving larger sample sizes, randomized controlled designs, and longer follow-up periods are necessary to confirm these findings and further investigate the mechanisms underlying the observed effects.

Conclusion

All three treatment modalities reduced halitosis immediately after treatment; however, the combination of tongue scraping and MH demonstrated the most sustained improvement in bacterial load, organoleptic examination scores, and WITCI scores over the two-week follow-up period. These findings suggest that combining mechanical and antimicrobial approaches may represent a promising strategy for the management of oral halitosis.

Conflicts of interest

The authors declare no competing interest.

Funding

This study was self-funded by the authors.

References

1.Greenman J, Duffield J, Spencer P, Rosenberg M, Corry D, Saad S, Lenton P, Majerus G, Nachnani S, El-Maaytah M. Study on the organoleptic intensity scale for measuring oral malodor. Journal of Dental Research. 2004 Jan;83(1):81-5.

2.Hampelska K, Jaworska MM, Babalska ZŁ, Karpiński TM. The role of oral microbiota in intra-oral halitosis. Journal of Clinical Medicine. 2020 Aug 2;9(8):2484.

3.Bicak DA. A current approach to halitosis and oral malodor-a mini review. The Open Dentistry Journal. 2018 Apr 30;12:322.

4.Barrak I, Stájer A, Gajdács M, Urbán E. Small, but smelly: the importance of Solobacterium moorei in halitosis and other human infections. Heliyon. 2020 Oct 1;6(10).

5.Mugita N, Nambu T, Takahashi K, Wang PL, Komasa Y. Proteases, actinidin, papain and trypsin reduce oral biofilm on the tongue in elderly subjects and in vitro. Archives of Oral Biology. 2017 Oct 1;82:233-40.

6.Ahmad ZH. Halitosis: a review of the etiologic factors and association with systemic conditions and its management. The Journal of Contemporary Dental Practice. 2015 May 1;15(6):806-11.

7.Khounganian RM, Alasmari ON, Aldosari MM, Alghanemi NM, Alasmari ON, Alghanemi Jr NM. Causes and management of halitosis: A narrative review. Cureus. 2023 Aug 19;15(8).

8.Van der Sleen MI, Slot DE, Van Trijffel E, Winkel EG, Van der Weijden GA. Effectiveness of mechanical tongue cleaning on breath odour and tongue coating: a systematic review. International Journal of Dental Hygiene. 2010 Nov;8(4):258-68.

9.Demel K, Talaska J, Dziedzic M, Król J, Szatkowska Z, Odrzywolska O, Niemczyk W, Zawilska A. Use of honey in dentistry-literature review. Wiadomości Lekarskie. 2025 Jan 31;2025(1):156-61.

10.Samarghandian S, Farkhondeh T, Samini F. Honey and Health: A Review of Recent Clinical Research. Pharmacognosy Res. 2017 Apr-Jun;9(2):121-127. doi: 10.4103/0974-8490.204647.

11.Johnston M, McBride M, Dahiya D, Owusu-Apenten R, Nigam PS. Antibacterial activity of Manuka honey and its components: An overview. AIMS Microbiol. 2018 Nov 27;4(4):655-664. doi: 10.3934/microbiol.2018.4.655.

12.Makmuriana L, Lestari L, Usman U, Surtikanti S, Pradika J, Ramadhaniyati R, Haryanto H. Chlorhexidine and honey: Mouthwash liquids in reducing halitosis of stroke patients. Enfermería Clínica. 2021 Dec 1;31:S677-81.

13.Drain J, Fleming MO. Palliative management of malodorous squamous cell carcinoma of the oral cavity with Manuka honey. Journal

Vol 14, No 2 (2026) DOI 10.5195/d3000/2026.1465

of Wound Ostomy & Continence Nursing. 2015 Mar 1;42(2):190-2.
14.Al-Kubaisi MW, Al-Ghurabi BH, Alkubaisy W, Abdullah NN. Anti-inflammatory effects of Manuka honey on salivary cytokines (clinical study). Journal of Baghdad College of Dentistry. 2023a Mar 15;35(1):10-9.
15.Al-Kubaisi MW, Al-Ghurabi BH. Evaluation of manuka honey effects on dental plaque and bacterial load (Clinical study). J. Med. Chem. Sci. 2023b Jan 1;6(2):365-75.
16.Rosenberg M, Gelernter I, Barki M, Bar-Ness R. Day-long reduction of oral malodor by a two-phase oil: water mouthrinse as compared to chlorhexidine and placebo rinses. Journal of Periodontology. 1992 Jan;63(1):39-43.
17.Winkel EG, Roldan S, Van Winkelhoff AJ, Herrera D, Sanz M. Clinical effects of a new mouthrinse containing chlorhexidine, cetylpyridinium chloride and zinc-lactate on oral halitosis: A dual-center, double-blind placebo-controlled study. Journal of Clinical Periodontology. 2003 Apr;30(4):300-6.
18.Izidoro C, Botelho J, Machado V, Reis AM, Proença L, Alves R, Mendes JJ. Intra-oral halitosis in periodontitis: the role of tongue coating—a cross-sectional study. In: Medical Sciences Forum 2023 Aug 8 (Vol. 22, No. 1, p. 1). MDPI.
19.Faveri M, Feres M, Shibli JA, Hayacibara RF, Hayacibara MM, De Figueiredo LC. Microbiota of the dorsum of the tongue after plaque accumulation: an experimental study in humans. Journal of Periodontology. 2006 Sep;77(9):1539-46.
20.Vancauwenberghe F, Dadamio J, Laleman I, Van Tornout M, Teughels W, Coucke W, Quirynen M. The role of Solobacterium moorei in oral malodour. Journal of Breath Research. 2013 Dec 1;7(4):046006.
21.Ogwu MC, Izah SC. Honey as a Natural Antimicrobial. Antibiotics (Basel). 2025 Mar 1;14(3):255. doi: 10.3390/antibiotics14030255.
22.Roberts AE, Brown HL, Jenkins RE. On the antibacterial effects of Manuka honey: mechanistic insights. Research and Reports in Biology. 2015 Oct 29:215-24.
23.Halwani M. Enhanced Antibacterial Activity of Manuka honey with Higher Methylglyoxal Concentration Against Staphylococcus aureus: in vitro Study. Journal of Contemporary Medical Sciences. 2024 Jul 1;10(4).
24.Chandran S, Venkatachalam K. Effect of Manuka honey and Licorice Root Extract on the Growth of Porphyromonas gingivalis: An In Vitro Study. J. Emerg. Investig. 2018;10:17-085.
25.Gurpinar B, Yildirim G, Kumral TL, Akgun MF, Sari H, Tutar B, Uyar Y. A simple method to reduce halitosis; tongue scraping with probiotics. Journal of Breath Research. 2020 Jan 1;14(1):016008.
26.Kadu N, Deshpande U, Qureshi U, Sardar M, Prabhu O. Effect of Winkel Tongue Coating Index-guided tongue cleaning and oral hygiene instructions on halitosis: a prospective clinical study. IOSR J Dent Med Sci. 2026;25(6):32-38. doi:10.9790/0853-2506023238.