AIJPS
Academic International Publishers
Academic International Journal of Pure Science
Volume 02, Issue 02

Normal Bacterial Flora of The Oral Cavity

Lames Husam Almanseekanaa[1], Esraa Ali Mohammed[2]

[1,2] College of Dentistry, University of Kerbala, Iraq

lames.h@uokerbala.edu.iq

(Received 7 June 2024, Revised 5 June 2024, Published 28 August 2024)

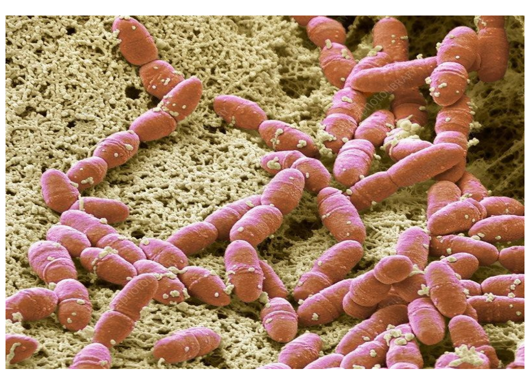
Abstract
The oral cavity is a biopolitical environment, very similar to the gastrointestinal microenvironment, which hosts billions of microorganisms known collectively as oral microbiota. These bacteria were shown to have important functions within the host oral ecosystem as they inhibit the attachment of pathogenic microorganisms and actively participate in the immune reaction of the host. Gingival crevices harbor various types of bacteria and are typically part of a balance; any disparity could result in oral disease such as dental caries, periodontal diseases, even systemic infections. This article systematically summarises the regular bacterial microbiota in the oral cavity, a description of its functions, and the aspects which precipitate the changes in bacterial flora.

Keywords: Bacterial Flora, oral cavity, Bacterial Biofilm, Streptococcus mutans, Actinomyces species, Prevotella intermedia

How to cite: Lames Husam Almanseekanaa, Esraa Ali Mohammed. Normal Bacterial Flora of The Oral Cavity. *Aca. Intl. J. P. Sci. 2024;02(2):26-31* https://doi.org/10.59675/P223

Composition of the Oral Biofilm
With reference to the current generation, the oral cavity is infested with well over 700 bacterial species which fall under different genera. Among the most predominant bacterial groups are:

1. Streptococcus species: These are the bacteria most often isolated in the oral cavity: Streptococcus mutans, Streptococcus sanguinis, Streptococcus salivarius, and Streptococcus mitis. It is noteworthy that S.



mutans is considered to be responsible for the formation of dental caries because of its ability to generate acid from fermentable carbohydrates that dissolve the enamel [1]

Figure 1 Streptococcus mutans

2 .Lactobacillus species: Though not as plentiful as streptococci, Lactobacillus bears some responsibility for the formation of caries; more notably, they are implicated with the progression of these caries once they have been initiated due to the fact that Lactobacillus is capable of thriving in an acidic environment.[2]

3 .Actinomyces species: These bacteria are most definitely present in the dental plaque and are related to root surface caries. Among the A derail family members, Actinomyces naeslundii seems to play a significant role in the formation of human plaque biofilm [3].

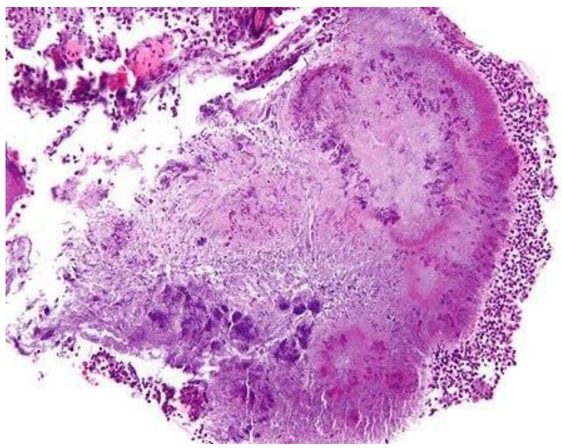


Figure 2 Actinomyces species

4 .Veillonella species: These Gram-negative anaerobes are routinely isolated from dental plaque. Unlike Streptococcus species, they do not directly initiate caries but ferment lactic acid synthesized by other microbes, which may help in the regulation of the levels of acidity in the oral environment.[4]

5 .Fusobacterium species: Periodontal diseases involve Fusobacterium nucleatum as an indexer. It plays a role in the development of diverse complicated biofilms and increases the chances for attachment of other pathogenic microorganisms in pockets of periodontal tissues.[5]

6 .Porphyromonas and Prevotella species: These anaerobic bacteria, among them Porphyromonas gingivalis and Prevotella intermedia, contribute to periodontal diseases. P. gingivalis is a pathogen in periodontitis which results in the degeneration of the gingiva and alveolar bone [6]

Aca. Intl. J. P. Sci. 2024;02(2):26-31. https://doi.org/10.59675/P223

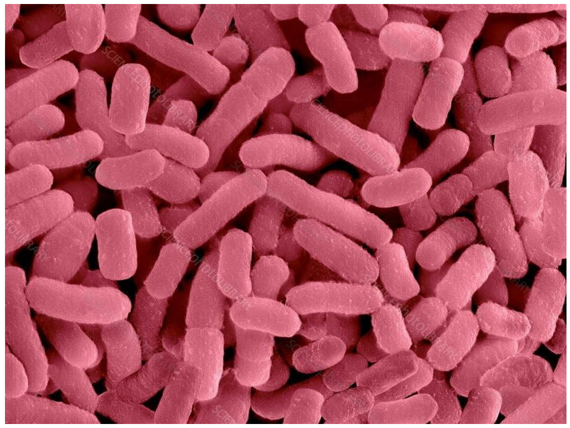


Figure 3Prevotella intermedia

7 .Treponema species: Other organisms, including Treponema denticola, are implicated in periodontal disease. It is involved in tissue destruction by synthesizing proteolytic enzymes and also by initiating inflammatory reactions.[7]

The Roles of Normal Oral Flora

The normal oral microbiota has several beneficial roles, including:

1 .Colonization resistance: In this way, the order resident bacteria defend the oral cavity from colonization by external pathogenic microorganisms. They manage to do so by outcompeting nutrients and binding sites, synthesis of bacteriocins, and keeping the environment (pH inclusive) unsuitable for pathogens .[8]

2 .Immune modulation: Oral flora is in constant direct contact with the host immune system, activating both the immediate and specific immune response. This interaction aids in the ability to sustain an immunologic state of non-recognition of commensal bacteria but, at the same time, maintain vigilance with respect to pathogenic organisms.[9]

3 .Nutrient metabolism: Some bacteria that are present in the oral cavity help in the digestion of food particles through the breakdown of the particles. Some of the species synthesize vitamins, including vitamin K, which is important for systemic human health.[10]

Factors Affecting the Oral Bacteria

Several factors influence the composition and balance of the oral microbiota, including:

1 .Diet: A diet high in sugars encourages the growth of acidogenic bacteria such as Streptococcus mutans and Lactobacillus, leading to a change towards cariogenic flora [11]. On the other hand, a low FODMAP diet seems to promote a healthier gut flora.

2 .Oral hygiene: Brushing and flossing wash away many of the bacteria found in the mouth, notably plaque-building microorganisms such as Actinomyces and Streptococcus species [12]. Lack of rigorous oral hygiene and good standards of oral cleanliness usually result in the formation of hard substances known as plaques and other pathogenic bacteria that cause caries and periodontal diseases.

3 .Saliva flow: These substances in saliva; rinse, lubricate, neutralize,3, It has some functions in the oral cavity which include cleaning off food debris and bacterial organisms, buffering agents, and providing

Aca. Intl. J. P. Sci. 2024;02(2):26-31. https://doi.org/10.59675/P223

antimicrobial agents such as lysozymes and immunoglobulins. Consequent diminished salivary flow (xerostomia) predisposes to the growth of cariogenic and pathogenic microorganisms.[13]

4 .Antibiotic use: Most antibiotics produce bacteriostatic effects on the dental microflora and eliminate not only the pathogenic bacterial strains but also the commensal salivary bacteria. This disruption can lead to opportunistic infections for example, oral candidiasis.[14]

5 .Smoking: Cigarette smoking affects the oral microbial community composition by favouring the development of P. gingivalis and reducing the count of non-pathogenic microbes. Patients with periodontal disease should be aware that smokers are more likely to develop this disease.[15]

Table No. 1 shows the most common diseases and how they alter the microbial flora,

Disease	How it Alters Microflora	Reference Number
Dental Caries	Overgrowth of acidogenic bacteria like *Streptococcus mutans* and *Lactobacillus*, leading to enamel demineralization	16
Periodontal Disease	Growth of pathogenic bacteria such as *Porphyromonas gingivalis*, *Tannerella forsythia*, and *Treponema denticola* causing tissue destruction	17
Clostridioides difficile Infection	Antibiotic use disrupts gut microbiota, leading to the overgrowth of *C. difficile* causing diarrhea and colitis	18
Inflammatory Bowel Disease (IBD)	Decrease in beneficial bacteria such as *Faecalibacterium prausnitzii* and increase in pro-inflammatory species	19
Irritable Bowel Syndrome (IBS)	Alterations in beneficial bacteria like *Bifidobacterium* and *Lactobacillus*	20, 30
Chronic Obstructive Pulmonary Disease (COPD)	Increased presence of pathogenic bacteria like *Pseudomonas aeruginosa*, *Haemophilus influenzae*, and *Streptococcus pneumoniae*	21
Asthma	Reduced microbial diversity and increased prevalence of *Proteobacteria*	22
Acne	Overgrowth of *Cutibacterium acnes* causing inflammation in sebaceous glands	23
Atopic Dermatitis	Reduced microbial diversity and overgrowth of *Staphylococcus aureus* leading to worsened inflammation	24
Obesity	Reduced microbial diversity and increased bacteria that extract more energy from food, contributing to weight gain	25
Diabetes	Changes in bacteria such as *Bacteroides*, *Firmicutes*, and *Proteobacteria*, influencing insulin resistance	26
HIV/AIDS	Decrease in beneficial bacteria and overgrowth of fungi like *Candida albicans* leading to oral candidiasis	27

Autoimmune Diseases	Dysbiosis in gut microbiota promoting inflammation, contributing to autoimmune response	28
Antibiotic-Associated Diarrhea	Broad-spectrum antibiotics reduce gut microbial diversity, allowing overgrowth of *Clostridioides difficile*	29

Conclusion

It is established that the oral cavity harbours a complex biofilm, and the microbial composition is diverse. It plays roles in the defence of pathogens, regulation of immune responses and metabolism of nutrients as a result of normal bacterial flora. But anything relating to diet, hygiene and or environmental conditions can interfere with this natural balance resulting in oral diseases. Knowledge of the types and roles of the normal oral flora is critical in order to design approaches that would contribute to the preservation of oral and general well-being.

References

1. Loesche WJ. Role of Streptococcus mutans in human dental decay. Microbiol Rev. 1986;50(4):353-380.
2. Badet C, Thebaud NB. Ecology of Lactobacilli in the oral cavity: a review of literature. Open Microbiol J. 2008;2:38-48.
3. Nyvad B, Kilian M. Microbiology of the early colonization of human enamel and root surfaces in vivo. Scand J Dent Res. 1987;95(5):369-380.
4. Kolenbrander PE. Oral microbial communities: biofilms, interactions, and genetic systems. Annu Rev Microbiol. 2000;54:413-437.
5. Bradshaw DJ, Marsh PD, Watson GK, Allison C. Role of Fusobacterium nucleatum and other plaque bacteria in the generation of volatile sulfur compounds in vitro. J Clin Periodontol. 1998;25(11 Pt 1):824-832.
6. Holt SC, Ebersole JL. Porphyromonas gingivalis, Treponema denticola, and Tannerella forsythia: the ‘red complex’, a prototype polybacterial pathogenic consortium in periodontitis. Periodontol 2000. 2005;38:72-122.
7. Simonson LG, Robinson PJ. Treponema denticola in periodontal disease. Adv Dent Res. 1992;6:106-112.
8. Tanner ACR, Izard J, Tanner JR. Role of oral microorganisms in health and disease. Clin Infect Dis. 1996;23(1):40-48.
9. Han YW, Wang X. Mobile microbiome: oral bacteria in extra-oral infections and inflammation. J Dent Res. 2013;92(6):485-491.
10. Ezaki T, Kawamura Y, Li N, Li ZY, Zhao L, Shu S. Proposal of the genera Actinomyces, Mobiluncus, and Gardnerella: a taxonomic study. J Bacteriol. 2001;183(2):383-390.
11. Touger-Decker R, van Loveren C. Sugars and dental caries. Am J Clin Nutr. 2003;78(4):881S-892S.
12. Marsh PD. Contemporary perspective on plaque control. Br Dent J. 2012;212(12):601-606.
13. Amerongen AVN, Veerman EC. Saliva--the defender of the oral cavity. Oral Dis. 2002;8(1):12-22.

14. Pihlstrom BL, Michalowicz BS, Johnson NW. Periodontal diseases. Lancet. 2005;366(9499):1809-1820.
15. Boström L, Linder LE, Bergström J. Smoking and cervicular fluid levels of IL-6 and TNF-alpha in periodontal disease. J Clin Periodontol. 1999;26(5):352-357.
16. Marsh PD. Dental plaque as a biofilm and a microbial community – implications for health and disease. BMC Oral Health. 2006;6(Suppl 1):S14.
17. Hajishengallis G. Immunomicrobial pathogenesis of periodontitis: Keystones, pathobionts, and the host response. Trends Immunol. 2014;35(1):3-11.
18. Leffler DA, Lamont JT. Clostridium difficile infection. N Engl J Med. 2015;372(16):1539-1548.
19. Manichanh C, Borruel N, Casellas F, Guarner F. The gut microbiota in IBD. Nat Rev Gastroenterol Hepatol. 2012;9(10):599-608.
20. Chong PP, Chin VK, Looi CY, Wong WF, Madhavan P, Yong VC. The microbiome and irritable bowel syndrome – a review on the pathophysiology, current research and future therapy. Front Microbiol. 2019;10:1136.
21. Wang Z, Bafadhel M, Haldar K, Spivak A, Mayhew D, Miller BE, et al. Lung microbiome dynamics in COPD exacerbations. Eur Respir J. 2016;47(4):1082-1092.
22. Durack J, Christian L, Nariya S, et al. Distinct associations of airway microbiota with asthma phenotypes and severity of disease. J Allergy Clin Immunol. 2017;139(1):60-68.
23. Dréno B. What is new in the pathophysiology of acne, an overview. J Eur Acad Dermatol Venereol. 2017;31(S5):8-12.
24. Kong HH, Oh J, Deming C, et al. Temporal shifts in the skin microbiome associated with disease flares and treatment in children with atopic dermatitis. Genome Res. 2012;22(5):850-859.
25. Turnbaugh PJ, Ley RE, Mahowald MA, Magrini V, Mardis ER, Gordon JI. An obesity-associated gut microbiome with increased capacity for energy harvest. Nature. 2006;444(7122):1027-1031.
26. Larsen N, Vogensen FK, van den Berg FW, et al. Gut microbiota in human adults with type 2 diabetes differs from non-diabetic adults. PLoS One. 2010;5(2):e9085.
27. Li D, Cai H, Wang X, et al. Oral microbiome diversity in human immunodeficiency virus-infected patients: A systematic review and meta-analysis. Open Forum Infect Dis. 2019;6(4):ofz132.
28. Zhang X, Zhang D, Jia H, et al. The oral and gut microbiomes are perturbed in rheumatoid arthritis and partly normalized after treatment. Nat Med. 2015;21(8):895-905.
29. Bartlett JG. Clinical practice. Antibiotic-associated diarrhea. N Engl J Med. 2002;346(5):334-339.
30. Nisreen Jawad Kadhim, Raed H. Ogaili, Asaad Abbas. Intestinal Bacterial Microbiota In Irritable Bowel Syndrome. Aca. Intl. J. P. Sci [Internet]. 2023 Jan. 1 [cited 2024 Oct. 24];1(1):1-6. Available from: https://aijps.aipublishers.org/index.php/aijps/article/view/P111

Aca. Intl. J. P. Sci. 2024;02(2):26-31. https://doi.org/10.59675/P223