

IN THE NAME OF GOD

Oral microbiota

By

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Introduction

About **700** kinds of microorganisms exist in the human mouth

It is one of the **most complex** microbial communities in the human body
oral microbiota in oral diseases such as caries , **periodontal disease**, and **oral cancer**

Oral microbiota is also **closely related to systemic diseases**, including RA, adverse pregnancy outcomes, and cardiovascular disease

Notably, a large number of oral microorganisms enter the down-stream digestive tract from the oral cavity through saliva, and they present a particularly **close relationship with digestive diseases**

Oral microbiota can be used as **targets to treat** oral and systemic diseases

Oral microbiota

The oral cavity is a **complex** environment

Numerous microorganisms exist in the mouth, among which are bacteria, fungi, and viruses

Bacteria are the main inhabitants of the mouth; they primarily comprise bacteria of the Firmicutes, Bacillus, Proteobacteria, and Actinomycetes

Diet and the **environment** have a great **impact** on gut microbiota but exert minimal effect on the composition of oral bacteria

Healthy people from **different countries** have similar **compositions of oral microbiota**

In the human mouth, **85 species of fungi** can be found. Among these fungi, the most important one is Candida

Candida is **neutral** when the oral microbiota is normal; however, when the oral microbiota balance is broken, Candida will seek the **opportunity** to attack oral tissue

Viruses, mainly **phages**, are also part of the oral microbiota, The **type of phage** in the mouth is constant during all stages of life

Viruses may also appear in the mouth when certain diseases exist in the human body. The most common is the **mumps** virus and **HIV**

Oral bacteria are the main components of the oral microbiota

Common oral bacteria include Streptococcus mutans, Porphyromonas gingivalis, Staphylococcus, and Lactobacillus

S. mutans is the main component of the oral microbiota, and it is one of the main components of **dental plaque**

It is also the main pathogen of caries, which is a **bacterial infectious disease** that has the **highest incidence** among oral diseases

Subgingival plaque

- *Streptococcus*
- *Fusobacterium*
- *Capnocytophaga*
- *Prevotella*
- *Corynebacterium*
- *Uncl. Pasteurellaceae*

- *Streptococcus*
- *Capnocytophaga*
- *Corynebacterium*
- *Uncl. Pasteurellaceae*
- *Uncl. Neisseriaceae*
- *Fusobacterium*

Keratinized gingiva

- *Streptococcus*
- *Uncl. Pasteurellaceae*

Hard palate

- *Streptococcus*
- *Uncl. Pasteurellaceae*
- *Veillonella*
- *Prevotella*
- *Uncl. Lactobacillales*
- *Gemella*

Buccal mucosa

- *Streptococcus*
- *Uncl. Pasteurellaceae*
- *Gemella*

Throat

- *Streptococcus*
- *Veillonella*
- *Prevotella*
- *Uncl. Pasteurellaceae*
- *Actinomyces*
- *Fusobacterium*
- *Uncl. Lachnospiraceae*

Tongue dorsum

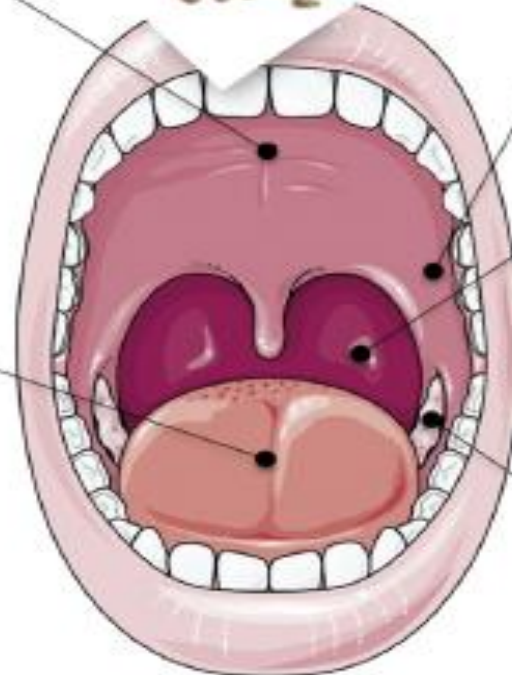
- *Streptococcus*
- *Veillonella*
- *Prevotella*
- *Uncl. Pasteurellaceae*
- *Actinomyces*
- *Fusobacterium*
- *Uncl. Lactobacillales*
- *Neisseria*

Palatine tonsils

- *Streptococcus*
- *Veillonella*
- *Prevotella*
- *Fusobacterium*
- *Uncl. Pasteurellaceae*

Saliva

- *Prevotella*
- *Streptococcus*
- *Veillonella*
- *Uncl. Pasteurellaceae*
- *Prevotella*
- *Streptococcus*
- *Veillonella*



FACTORS AFFECTING THE GROWTH OF MICROORGANISMS IN THE ORAL CAVITY

- Temperature
- pH
- Nutrients
- Adherence and agglutination
- Anti-microbial agents.
- Host defence
- Host genetics

Specific and non-specific host defence factors of the mouth

Defence factor	Main function
Non-specific:	
Saliva flow	Physical removal of microorganisms
Mucin/agglutinins	Physical removal of microorganisms
Lysozyme-protease-anion	Cell lysis
Lactoferrin	Iron sequestration
Apo-lactoferrin	Cell killing
Sialoperoxidase system	Hypothiocyanite production (neutral pH) Hypocyanous acid production (low pH)
Histatins	Antifungal with some antibacterial activity
Defensins (α - & β -)	Antimicrobial & immunomodulatory activity
Cystatins, SLPI & TIMP	Cysteine, serine & metallo-protease inhibitors
Chitinase & chromogranin	Antifungal
Cathelicidin	Antimicrobial
Calprotectin	Antimicrobial
Specific:	
Intra-epithelial lymphocytes & Langerhans cells	Cellular barrier to penetrating bacteria and/or antigens
sIgA	Prevents microbial adhesion & metabolism
IgG, IgA, IgM	Prevent microbial adhesion; opsonins; complement activators
Complement	Activates neutrophils
Neutrophils/macrophages	Phagocytosis

Infancy & Early Childhood

- ❧ The infant comes into contact with an ever-increasing range of microorganisms and some become established as part of commensal flora.
- ❧ The eruption of deciduous teeth provides a new attachment surface and turns **Streptococcus sanguis and mutans** as regular inhabitants of oral cavity.
- ❧ Anaerobes are few in number due to absence of deep gingival crevice.
- ❧ **Actinomyces** , **Lactobacilli** are found regularly.

Adolescence

- ❧ The greatest number of organisms in mouth occur when permanent teeth erupt.
- ❧ These teeth have deep fissures, larger inter proximal spaces and deeper gingival crevice, allowing a great increase in anaerobes.

Infant's oral microbiota

The process of permanent colonization of the oral cavity begins in the **postpartum period**

At this stage, the most frequent colonizers of the oral cavity are **Streptococcus**

Around 5 months of age, the infant's oral microbiota differs from maternal microbiota and consists mostly of bacteria belonging to Firmicutes, Proteobacteria, Actinobacteria, Bacteroidetes, Fusobacteria, Streptococcus, Haemophilus, Neisseria, and Veillonella

The eruption of the first teeth and the development of gingival crevices allows **anaerobic microorganisms** to become part of the healthy oral ecology

At this phase, infants present a **greater microbial diversity** but a **lower microbial load** than their parents

From the deciduous to the permanent dentition, as well as by **food ingestion**, **contact** with other adults and children, interaction with **domestic animals**, **hygiene habits**

It is thought that after the establishment of the **permanent dentition**, a more **stable microbiome** is acquired and that persists into adulthood

Several factors may, however, affect this oral microbiome such as **behavioral changes**, **systemic health disturbances**, and **oral biomaterials**

A study of 120 individuals from 12 worldwide locations found no significant geographical differences between their **salivary microbiota**,



suggesting that local **diet** and **environment** do not significantly influence the composition of the oral microbiome

Direct effects

- Cell mediated immunity wanes
- Change in salivary antibodies
- Hormonal changes
- Altered physiology of oral mucosa

Oral microflora

Indirect effects

- Denture wearing
- Medication
- Cancer therapy
- Dietary changes

Direct and indirect effects of ageing on the oral microflora.

Oral microbiota impacts body health by digesting food

Oral microbiota can influence body health through digesting certain types of food

Diet pattern

Diet pattern is an important factor that influences oral microbiota

Abundance ratios of core species are significantly correlated with diet pattern

Food extract

Many types of food can improve oral health, such as **mushrooms** and celery

Many reports have shown that the consumption of **green tea** can prevent **oral cancers**

Researchers measured the oral microbiota of tobacco smokers before and after drinking green tea, and these smokers were at high risk for oral cancer

Oral microbiota and oral diseases

Dental caries

- ✓ Dental caries is the **most common chronic infectious diseases** in the oral cavity
- ✓ Dental caries has a **higher incidence** in children than in adults, and it is closely related to oral microbiota
- ✓ A previous study found that a high frequency of **eating sweets** before going to bed is a risk factor for dental caries among children
- ✓ Compared with healthy individuals, the oral microbiota on the surface of dental caries presents increased **complexity** and decreased **diversity**, possibly due to the **acidic environment**
- ✓ When people do not eat, the bacteria obtain nutrients from our saliva and **gingival crevicular fluid**, which are rich in glycoproteins

Periodontitis

- ✓ Chronic periodontitis is a common type of chronic periodontal disease with a wide age range
- ✓ **Dental plaque** bacteria are the main factors of periodontal disease
- ✓ The **interactions** between host and microbiota determine the **manner**, **severity**, and **rate** of progression of the disease



Therefore, the **pathogen characteristics** and **microbiota distribution** of periodontal disease are critical

- ✓ Periodontal disease causes destruction of periodontal tissues and constitutes a potential risk factor for certain systemic diseases

Oral cancer

Oral cancer is a general term for **malignant tumors** that occur in the mouth, and most of them belong to **squamous cell carcinoma**

Oral cancer is one of the most common malignant tumors of the head and neck

Genetic background, bacteria, and living habits all affect the development of oral cancer

Recent research indicated a **correlation** between oral microbiota and oral cancer

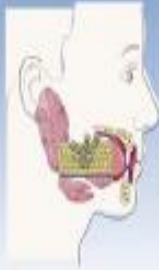
Specific microorganisms exist on the surface of oral cancer and in cancer tissues, and their **composition** is significantly different from that of normal mucosal microorganisms

Gingival **carbon dioxide phagocytic bacteria, prednisone, and S.mutans** in the saliva of patients with oral SCC significantly increase

These three bacteria have potential value as **diagnostic indicators** for oral SCC

Caries (b)

Oral Cancer (a)



↑ Carbachia, Clostridium, Porphyromonas, Helicobacter, Actinomyces, Eugenia, Tannella, Hurdella, Micromonas, and Streptococcus pneumoniae (b)-1

↓ Neisseria, Corynebacterium, Carbonophilic genus, actinomyces (b)-2

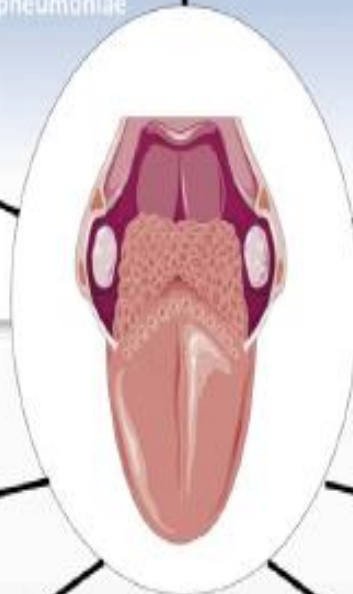
Periodontitis (c)



↑ Prevotella spp., Lactobacillus spp, Dialister spp, Filifactor spp, S. acidophilus (c)

Oral diseases

↑ Gingival carbon dioxide phagocytic bacteria, prednisone and streptococcus mutants (Both in saliva and tissues near tumors) (a)



Systematic diseases

↑ Plasmodium, S. genus, and Streptococcus mutants
↓ Haemophilus, Corynebacterium, Carbonophilic phage and Staphylococcus (d)

↑ Fusobacterium nucleatum: Transfer from mouth to gut (h)



Obesity (d)

↑ Streptococcus, Actinomyces, Neisseria
↓ Bifidobacterium, Eubacterium (e)



Diabetes (e)

↑ Clostridium, Oribacterium, Ciliate, Actinomyces and Campylobacter (f)-1

↓ Haemophilus, Streptococcus and Pseudomonas (f)-2

Liver diseases (f)

↑ Helicobacter pylori and P. gingivalis Actinobacillus actinomyces (g)



Pancreatic Cancer (g)



Colon Cancer (h)

Thanks for your attention

