

Microbiome Stability and Natural Approaches to Maintain Oral Microbiome Balance

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The oral microbiome is a complex community of microorganisms including bacteria, fungi, viruses, and others that live in different parts of the mouth like the teeth, tongue, gums, saliva, and cheeks (Deo & Deshmukh, 2019). In fact, the mouth is one of the most diverse microbial environments in the body, with more than 700 types of bacteria identified (Kilian et al., 2016). These microbes don't live independently they form organized communities called biofilms (like plaque), where they interact, share nutrients, and communicate with each other. These interactions play a big role in whether the mouth stays healthy or moves toward disease (Di Stefano et al., 2022). Because of this, oral health isn't about getting rid of all bacteria. Instead, it's about keeping a healthy balance. A stable oral microbiome means the body and its microbes are working together in harmony, even with constant changes from food, saliva, oxygen levels, and everyday activities like eating and brushing. Maintaining this balance is essential not just for oral health, but for overall health as well.

Ecological Structure of Oral Microbiome Stability

The stability of the oral microbiome varies depending on where you look in the mouth, because each area has its own unique environment. Different parts like the surface of the teeth, below the gumline, the tongue, saliva, and the inner cheeks have different levels of oxygen, nutrients, pH, and immune activity (Tian et al., 2024). These differences naturally influence which types of microbes are able to grow and thrive in each location. For example, bacteria like *Streptococcus* tend to be more common on the tooth surface where there is more oxygen, while other bacteria that prefer low-oxygen environments are more likely to be found below the gums. The structure of these areas also plays a role. Teeth don't shed like soft tissues do, which allows biofilms (plaque) to build up and mature over time. In contrast, the soft tissues in the mouth are constantly renewing themselves, making it harder for microbes to stay in one place for long (Deo & Deshmukh, 2019). Overall, each part of the mouth creates its own "mini environment," and the balance of microbes depends on the conditions within those spaces. Even though different areas of the mouth have different conditions, the oral microbiome is still very organized and generally stays in a stable balance when things are healthy. Certain groups of bacteria like *Streptococcus*, *Actinomyces*, *Veillonella*, *Neisseria*, *Rothia*, *Corynebacterium*, and *Haemophilus* are commonly found in a healthy mouth, although the exact mix can vary depending on the location and factors like age (Li et al., 2022).

These microbes don't just exist on their own they work together. They share nutrients, help control pH levels, and create protective communities (biofilms) that keep harmful bacteria from taking over. Research now shows that oral disease isn't usually caused by just one bad bacteria. Instead, it happens when the overall balance of the microbial community gets disrupted (Sedghi et al., 2021). Changes in the types of bacteria, their activity, and the environment in the mouth can all contribute to this imbalance, leading to disease. Because of this, the goal of oral health isn't to eliminate all bacteria, but to keep the microbial community balanced and healthy. Supporting this balance is key not just for oral health, but for overall well-being.

Biofilms, Saliva, and Host Regulation

Biofilms play a central role in both the maintenance of microbial stability and the progression of oral disease. Oral biofilms are highly structured, multicellular communities embedded within an extracellular matrix composed of polysaccharides, proteins, lipids, water, and extracellular DNA. This matrix facilitates surface adherence, enhances nutrient retention, enables intercellular communication, and provides protection against environmental stressors and host immune defenses (Di Stefano et al., 2022). Within these biofilms, microbes communicate with each other and work together, adjusting how they behave, compete, and respond to their environment. Because of this, oral health depends a lot on how these biofilms function whether they stay balanced and supportive of the surrounding tissues, or shift toward a state that produces more acid, causes irritation, and contributes to inflammation and disease.

Saliva plays a key role in keeping the mouth healthy and balanced. It helps keep the mouth moist, delivers important nutrients, and provides minerals that support and protect tooth enamel. It also contains natural defense components that help control harmful microbes, and it works to neutralize acids that can damage teeth and disrupt balance (Kilian et al., 2016). When saliva flow or quality is reduced, these protective effects are weakened. This can make it harder for the mouth to clear bacteria, control acid levels, and maintain a healthy environment (Tian et al., 2024). As a result, low saliva levels are often linked to issues like increased acid buildup, plaque and tartar formation, and microbial imbalance. Keeping saliva production at healthy levels is essential for maintaining a stable oral environment and plays an important role in preventing oral health problems and supporting overall health (Li et al., 2022).

How Dysbiosis Develops

Dysbiosis happens when ongoing stressors in the mouth shift the environment in a way that favors harmful bacteria. One of the biggest drivers of this is frequent consumption of sugars and other fermentable carbohydrates. When these foods are eaten often, they fuel bacteria that produce acid, lowering the pH in the mouth and allowing acid-tolerant microbes to thrive. Over time, this leads to enamel breakdown and the development of cavities (Zhang et al., 2022). Today, cavities are no longer seen as being caused by just one type of bacteria, but rather as the result of a broader shift in the entire microbial community toward acid production. This is why diet plays such a central role in oral health.

A similar imbalance occurs in gum disease, but the main driver here is chronic inflammation. Inflammation changes the environment around the gums, creating conditions that favor bacteria that thrive in low-oxygen, protein-rich settings. These bacteria including *Porphyromonas gingivalis* and others can further worsen inflammation and tissue damage (Di Stefano et al., 2022). Gum disease is now understood as a two-way process: microbes trigger inflammation, and that inflammation then creates an environment that supports more harmful microbes. This highlights how closely the immune system and the microbiome work together in both health and disease (Amato et al., 2022). Beyond these local factors, everyday lifestyle choices also play a major role in shaping the oral microbiome. Diet, smoking, stress, alcohol use, oral hygiene, hormonal changes, and aging can all influence the balance of microbes in the mouth (Kilian et al., 2016). While the microbiome is constantly adapting to these changes, repeated or long-term stress can overwhelm its ability to stay balanced. When that happens, the system loses stability, and dysbiosis begins to develop (Li et al., 2022).

Natural Approaches to Maintain Oral Microbiome Balance

A practical approach to supporting the oral microbiome focuses on keeping the system balanced, rather than trying to eliminate microbes altogether. This means using strategies that support a healthy environment in the mouth and reduce the factors that lead

to imbalance, instead of relying on vague “detox” claims or unsupported product promises. One of the most important factors is diet especially how often sugar and refined carbohydrates are consumed. Frequent sugar intake feeds acid-producing bacteria, lowers the pH in the mouth, and encourages the growth of microbes linked to cavities. On the other hand, reducing how often these foods are consumed helps maintain a more stable environment and reduces the risk of harmful shifts in the microbiome. Overall, what we eat plays a major role in shaping both the types of microbes in the mouth and how they behave. Another helpful strategy is supporting beneficial bacterial pathways, such as those involved in processing nitrates from foods like leafy greens and beets. These bacteria help produce compounds like nitric oxide, which can support both oral and overall health. This process may also help maintain a more balanced and stable oral environment.

Probiotics are also being explored for their ability to support balance in the oral microbiome. Some research suggests they may help regulate biofilms, reduce imbalance, and support the body’s inflammatory response. However, results are still mixed, and they should be seen as a supportive tool not a replacement for brushing, flossing, and other core habits. Xylitol is another well-supported option. Unlike sugar, it doesn’t feed harmful bacteria and may even help reduce their growth. It can also stimulate saliva, which plays an important role in keeping the mouth balanced. Because of this, xylitol is often recommended as a simple, effective addition to oral care routines. There are also other natural compounds like plant extracts, arginine, and certain dairy components that show promise in supporting oral health. While early research is encouraging, more studies are needed before they can be considered standard recommendations. Overall, the key takeaway is that oral health is best supported by maintaining balance. Instead of trying to eliminate all bacteria, the goal should be to create an environment where beneficial microbes can thrive, helping to support both oral and overall health.

Systemic Significance of Oral Microbiome Stability

The stability of the oral microbiome doesn’t just affect the mouth it can influence overall health throughout the body. Research shows that when the balance of microbes in the mouth is disrupted, it can impact other systems in several ways. This can include local damage to oral tissues, the movement of bacteria into the bloodstream, and the release of microbial byproducts and immune signals that affect other parts of the body (Tian et al., 2024). Because of this, the mouth acts as more than just a separate space it’s an important connection point between the outside world and the rest of the body. An imbalance in the oral microbiome has been linked to a number of chronic conditions, including heart disease, rheumatoid arthritis, Alzheimer’s disease, and metabolic issues (Li et al., 2022). These connections highlight how closely oral health and overall health are tied together. When the oral microbiome is balanced, it helps control acid levels, reduce ongoing inflammation, and prevent harmful bacteria from spreading. For this reason, maintaining a healthy oral microbiome isn’t just about protecting teeth and gums it’s an important part of supporting long-term, whole-body health.

Conclusion

The foundation of oral health is keeping the microbiome balanced. A healthy mouth is one where the microbes, saliva, biofilms (like plaque), and the body’s immune system are all working together in harmony. When this balance is maintained, it helps protect the teeth and gums, supports normal function, and keeps harmful bacteria from taking over. Problems begin when that balance is disrupted. Things like frequent sugar intake, low saliva flow, and ongoing inflammation can shift the environment in the mouth, allowing more harmful, acid-producing bacteria to grow. Over time, this imbalance can lead to issues like cavities and gum disease. Because of this, the best natural approaches are those that support balance rather than trying to wipe out all bacteria. This includes reducing how often sugar is consumed, keeping saliva production healthy, supporting beneficial bacterial pathways (like those linked to nitrate-rich foods), maintaining regular brushing and flossing to break up plaque, and using supportive tools like probiotics or xylitol. Ultimately, oral health isn’t about eliminating microbes it’s about maintaining a strong, balanced system. Supporting that balance not only helps the mouth stay healthy but also plays an important role in overall health.

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