



**Oral-Microbiome**

**Sample Report**

*Health begins in the mouth.*

**MEDsan**<sup>®</sup>  
biological health solutions

Sample-ID  
Sample receipt

Summary of your results	3
What do the bacteria in my mouth do?	4
Diversity of the oral microbiome	5
Dysbiosis of the oral microbiome	6
Are there bacteria in my mouth that could harm me?	7 - 9
• Periodontitis	7
• Caries	8
• Bad Breath	9
Which bacteria positively contribute to my saliva production?	10
What impact do the bacteria in my oral cavity have on cardiovascular diseases?	11
What impact do the bacteria in my oral cavity have on my gastrointestinal tract?	12
Recommendations for oral hygiene	13
How can I support my oral microbiome?	14
What can I do about bad breath?	15
What should I do if I suspect harmful bacteria?	15
How can I promote my heart health with the help of my microbiome?	16
How can I support the function of my gastrointestinal tract through oral hygiene?	17
The influence of smoking on oral health	17
Additional recommendations	18
Literature	19
Notes	20
Miscellaneous	20

### Microbial Composition

Diversity of the Microbiome (Shannon index)



Balance of the Microbiome (Dysbiosis index)



### Oral Health

Periodontitis



Caries



Bad Breath



Saliva Production



### Overall Health

Heart Health



Stomach Health



## What do the bacteria in my mouth do?

Our body is inhabited by a community of bacteria, fungi, and viruses collectively known as the microbiome. These microorganisms can be found in various parts of our body, particularly on the skin, in our mouth, and in the intestines <sup>[1][2]</sup>. Among them, bacteria constitute the largest group in the human microbiome.

Although microorganisms are ubiquitous and coexist with humans for mutual benefit, they often go unnoticed in our daily lives. Many of them perform important functions in the mouth, such as aiding in food processing and maintaining a healthy oral flora. However, some microorganisms can contribute to health problems such as caries and periodontitis <sup>[1][3]</sup>.

In recent years, it has become increasingly clear that alterations in the composition of the microbiome can pose potential risks to our health <sup>[1][2][4]</sup>. Some bacteria permanently reside in the oral cavity, while others may enter the mouth through external influences and disrupt the balance of the microbiome. There are microorganisms that have a protective effect by inhibiting the growth of harmful bacteria, while others produce acid that attacks tooth enamel and promotes caries <sup>[5]</sup>.

The microbiome is unique to each individual and can vary depending on diet and overall health <sup>[1][2][4]</sup>. The oral microbiome plays a crucial role in maintaining oral health and preventing conditions such as caries, bad breath, and gum diseases, especially periodontitis <sup>[4-12]</sup>. Changes in the microbiome have been associated not only with dental diseases but also with various health problems like diabetes and cardiovascular diseases <sup>[13-21]</sup>. In the following report, we provide you with an insight into the balance of your oral microbiome, compared to a reference population of average healthy adults, and information about bacteria present in your oral cavity that may potentially contribute to health issues. Over 1800 groups of bacteria in your microbiome will be analysed.



## Diversity of the oral microbiome

An important indicator of the stability of your oral microbiome is its diversity, as a microbiome with higher diversity tends to be more stable than one with lower diversity <sup>[3][28]</sup>. Therefore, increased diversity is often associated with a healthy microbiome. This is because a greater variety of bacteria can help maintain the balance of the microbiome and restrict the growth of harmful bacteria. However, under certain circumstances, diversity can also be relatively high due to an increase in harmful bacteria.

A stable microbiome has the ability to recover and restore itself after short-term disturbances. However, if the microbiome is increasingly disrupted, for example, due to the use of antibiotics, it may lose its stability and promote the development of oral diseases <sup>[25-28]</sup>.

The Shannon index is used to assess diversity and provides information about the bacterial variety in your mouth <sup>[15]</sup>. A low value indicates reduced diversity or variety in the microbiome, leaving room for disease-causing bacteria <sup>[27]</sup>. High values indicate greater bacterial diversity, which in turn suggests a good balance of the oral microbiome (with a low presence of disease-causing bacteria).

### Your Result:



Your Shannon Index with 2.3 is in a range that is classified as normal, indicating a normal diversity of your microbiome. This means that your microbiome is not susceptible to the proliferation of "bad" bacteria.

## Dysbiosis of the oral microbiome

However, common oral diseases such as periodontitis and caries often do not reflect reduced bacterial diversity, but rather the presence of harmful bacteria. Therefore, diversity alone is not sufficient to make conclusions about the health status <sup>[5-11,22-24]</sup>. Therefore, in addition to diversity, the dysbiosis index is usually determined.

Dysbiosis of the oral microbiome refers to an imbalanced composition of bacterial groups in the mouth. The dysbiosis index is another way to assess the balance of the oral microbiome <sup>[25, 27]</sup>. Your oral microbiome is compared to the average composition of the microbiome of healthy individuals.

A low value in the dysbiosis index indicates a balanced microbiome, while high values are associated with dysbiosis and higher amounts of harmful bacteria.

### Your Result:



Your dysbiosis index with 5.17 is in a range that is classified as normal, indicating no disturbance in the balance of your microbiome.

## Are there bacteria in my mouth that could harm me?

Pathogenic bacteria in the mouth can cause health problems in the oral cavity. These include dental caries, periodontitis, and halitosis, among others. The use of antibiotics can also promote the proliferation of disease-causing bacteria by disrupting the balance in the microbiome. Below you will find an overview of the bacteria that can potentially trigger these respective conditions.

### Periodontitis

In addition to a general dysbiosis index, a specific dysbiosis index can be determined for periodontitis. This index assesses the distribution of bacteria in the mouth and possible imbalances related to gum inflammation. Bacteria associated with periodontitis and bacteria that have a protective effect on oral health are compared to the average microbial composition of healthy individuals <sup>[29]</sup>. Bacteria such as *Treponema denticola* and *Tannerella forsythia* have been linked to periodontitis <sup>[30]</sup>. A low value in the dysbiosis index indicates a balanced microbiome, while high values are associated with dysbiosis and higher quantities of harmful bacteria.

### Your Result:



Your dysbiosis index for periodontitis is within a range that is classified as normal, indicating no tendency for gum inflammation in your mouth.

## Are there bacteria in my mouth that could harm me?

### Caries

Caries is a complex disease of the oral cavity in which a variety of bacteria produce acid that attacks the tooth enamel. While bacteria such as *Streptococcus mutans* are often mentioned as the main causative agents of caries, current knowledge indicates that no single species of bacteria alone is responsible for the development of caries. Instead, an imbalance in the oral microbiome plays an important role, promoting the growth of harmful bacteria <sup>[7]</sup>.

Previously, increased amounts of various *Proteobacteria* and *Streptococcus mutans*, as well as a decreased presence of *Fusobacteria*, have been associated with caries. This information aims to provide insight into your individual caries risk <sup>[8]</sup>. In the following, we will evaluate the number of caries-causing bacteria and the number of protective bacterial groups in your oral microbiome.

### Your Result:



No elevated levels of cariogenic bacteria have been found in your oral microbiome. The amount of caries-protective bacteria is comparable to that of average reference individuals. This means that there is no tendency for dental caries in your teeth.





## Are there bacteria in my mouth that could harm me?

### Bad Breath

Bad breath, also known as halitosis, is a common problem that affects many people. It can be unpleasant and have social as well as personal consequences. Bad breath can occur for various reasons, both extraoral (outside the mouth) and intraoral (inside the mouth) <sup>[12]</sup>.

Extraoral bad breath does not originate from the mouth but is caused by other factors. Certain foods such as garlic, onions, spices, or alcoholic beverages can temporarily leave an unpleasant odour in the mouth. Additionally, conditions like gastrointestinal problems, respiratory infections, or diabetes can lead to persistent bad breath that emanates from the breath.

Intraoral bad breath is primarily caused by bacteria that reside in the oral cavity. These bacteria can settle on the tongue, in periodontal pockets, or other areas in the mouth and break down food debris, dental plaque, and dead cells. In the process, they produce volatile sulphur compounds that cause the unpleasant odour. Poor oral hygiene, gum disease, and caries can contribute to intraoral bad breath.

Below, we provide an overview of bacteria that cause bad breath. These bacteria include *Porphyromonas gingivalis* and *Solobacterium moorei* <sup>[31]</sup>.

### Your Result:



No increased amounts of bacteria contributing to bad breath have been found in your oral microbiome. This suggests that you are likely not suffering from bad breath or it is less likely to develop in you.

## Which bacteria positively contribute to my saliva production?

Nitrate are chemical compounds that are found in various vegetables such as spinach, arugula, and cabbage. When we consume these foods, nitrates enter our bodies and are then converted to nitrites by specific bacteria naturally present in the oral cavity. Nitrites are believed to have positive effects on oral health as they have a protective effect and inhibit the growth of harmful bacteria.

Adequate saliva production is important for tooth protection and maintaining a healthy oral cavity. Nitrites can also stimulate saliva production, which helps clean the mouth and neutralise acid production by bacteria that cause caries in the oral cavity. These bacteria include Actinomyces and Schaalia.

### Your Result:



Average amounts of bacteria converting nitrate to nitrite in your oral microbiome have been found. This means that your saliva production and its protective effect against caries and periodontitis are likely not impaired.

## What impact do the bacteria in my oral cavity have on cardiovascular diseases?

In addition to the protective effect of nitrite in the mouth (as described in the previous chapter), nitrite can also have positive effects on heart health, particularly in relation to high blood pressure <sup>[32][33]</sup>. Unlike most digestive processes that occur in the gut, nitrate is predominantly converted to nitrite by bacteria in the mouth and later transformed into nitric oxide in the body (in the stomach and blood vessels).

High blood pressure, also known as hypertension, is a condition characterised by chronically elevated blood pressure that can lead to health problems. Nitric oxide is a substance that dilates blood vessels, thereby improving blood flow <sup>[34]</sup>. This can help lower blood pressure as the heart requires less force to pump blood. Maintaining a low blood pressure is beneficial for heart health as it can reduce the risk of cardiovascular diseases such as a heart attack and/or a stroke. Good blood circulation and appropriate dilation of blood vessels are crucial for healthy heart function <sup>[33][35]</sup>.

The effects of bacteria in the mouth on heart health and blood pressure are complex and depend on various factors, such as obesity. Nitrate-converting bacteria include *Actinomyces* and *Schaalia* <sup>[35][36]</sup>.

### Your Result:



Average levels of bacteria associated with the conversion of nitrate to nitrite in the oral microbiome have been found. This suggests that your oral microbiome does not indicate health issues related to the cardiovascular system.

## What impact do the bacteria in my oral cavity have on my gastrointestinal tract?

In addition to hypertension and cardiovascular diseases, the same nitrate-converting bacteria in the mouth also play a significant role in inflammation regulation. Nitrite is converted not only in blood vessels but also in the stomach and partially in the intestine to nitric oxide, where it also exhibits a protective effect. Furthermore, nitric oxide is believed to be important for the nourishment and maintenance of the gastric mucosa. Therefore, the increased intake of nitrate-rich foods and the bacteria responsible for its conversion are thought to be important for defending against harmful bacteria in the gut. Reduced levels of bacteria that convert nitrate in the mouth have been shown to promote inflammation in the stomach and partially in the small intestine. These bacteria include *Actinomyces* and *Schaalia*, among others.

In the following, we will assess the amount of nitrite-producing bacteria in your oral flora and the resulting implications for the gastrointestinal tract.

### Your Result:



Average levels of bacteria associated with the conversion of nitrate to nitrite in the oral microbiome have been found. This suggests that your oral microbiome does not indicate any health issues related to the stomach.

## Recommendations for oral hygiene

Gently brushing your teeth and cleaning the interdental spaces with interdental brushes or dental floss twice a day supports oral health. It is important to avoid cleaning the teeth immediately after consuming food, especially acidic foods like fruits, to prevent potential enamel erosion <sup>[44]</sup>. Additionally, it is advisable not to apply excessive force or clean the teeth more frequently than twice a day without consulting a dentist, as prolonged exposure may lead to enamel abrasion <sup>[51]</sup>.

To protect the tooth enamel, it is recommended to choose a toothpaste with a low RDA value. The RDA value measures the abrasiveness of toothpaste on tooth enamel. It is believed that higher values result in stronger enamel abrasion during brushing. Toothpastes with an RDA value above 60 often have more abrasive properties on tooth enamel, while values below 40 minimally affect the enamel. High RDA values are commonly found in toothpaste that promise teeth whitening effects <sup>[52]</sup>.



## How can I support my oral microbiome?

A balanced oral microbiome not only contributes to the long-term preservation of teeth but is also important for overall health, as microorganisms in the oral cavity have an impact on the entire body.

### **Microbial Composition:**

For high diversity and a good balance of the oral microbiome, a varied diet rich in fibre is crucial. Fibre is a complex, long-chain carbohydrate that serves as an important food source for bacteria. Plant-based foods such as fruits, vegetables, whole grains, legumes, and nuts are abundant in fibre, while processed and animal-based foods contain little to no significant amounts of fibre.

### **Nutrition:**

In addition to a fibre-rich diet, a tooth-friendly diet should also include adequate intake of vitamin C, vitamin D3, and omega-3 fatty acids <sup>[37]</sup>. Furthermore, it is advisable to minimise the consumption of sugary foods, as bacteria utilise sugar to produce acid, which promotes tooth enamel breakdown. If sugary foods are consumed, it is important to avoid prolonged exposure (e.g., drinking sugary beverages over several hours or continuous snacking) to allow for enamel remineralisation. By consuming probiotic-rich foods such as apple cider vinegar, pickles, yogurt, kimchi, kombucha, miso, tempeh, and sauerkraut, which contain many „good“ bacteria through fermentation, healthy eating habits can strengthen the microbiome <sup>[38][39]</sup>.

Alternatively, these beneficial bacteria can also be introduced to the body in the form of probiotics. Specifically formulated probiotics for the oral cavity are believed to be helpful against caries, periodontitis, and bad breath <sup>[37]</sup>. Additionally, it is important to ensure adequate water intake, as dehydration leads to reduced saliva production <sup>[40][41]</sup>. Since saliva has protective properties, this helps combat bad breath and promotes oral balance. Chewing food thoroughly also supports saliva production.

## What can I do about bad breath?

If you suffer from bad breath and have no oral cavity diseases, you should consult a general practitioner to investigate other possible causes. Besides certain bacteria in the mouth, other potential causes of bad breath include gastritis, which is inflammation of the stomach lining. Bacteria in the stomach produce sulphur compounds that are emitted through the breath. Additionally, a developing or poorly controlled diabetes condition can also be a cause of bad breath <sup>[45]</sup>.

## What should I do if I suspect harmful bacteria?

If there are increased amounts of bacteria in your oral microbiome that are associated with caries and periodontitis, it is advisable to consult a dentist (our analysis does not replace a diagnosis by a health-care professional!). Additionally, for the prevention of oral cavity diseases, it is recommended to establish a tooth-friendly diet with sufficient fluid intake, avoid smoking, and maintain good oral hygiene in the long term.

A positive finding of disease-causing bacteria in our report does not imply the presence of an actual disease, as individual susceptibility varies. Furthermore, the oral microbiome is influenced by various external factors, such as diet, which means that harmful bacteria might be overrepresented in a snapshot analysis.

## How can I promote my heart health with the help of my microbiome?

In addition to avoiding general risk factors for cardiovascular diseases such as smoking and obesity, a balanced diet supports the maintenance of a healthy oral microbiome. In terms of heart health, it is particularly beneficial to increase the consumption of foods rich in nitrate (leafy greens like lettuce, lamb's lettuce, arugula, and spinach; cruciferous vegetables like kale, cabbage, and savoy cabbage; root vegetables like beetroot, radishes, and radishes) to promote the production of nitric oxide <sup>[46][47]</sup>.

Furthermore, regular cleaning of the teeth and interdental spaces should be emphasised to control the proliferation of harmful bacteria. Unlike tooth cleaning, there is evidence suggesting that the use of antimicrobial mouthwashes can have a negative impact on the balance of the oral flora, especially bacteria involved in nitrate metabolism. It has been shown that regardless of other risk factors, the risk of hypertension increases with frequent use of mouthwashes, as most commercial mouthwashes reduce nitrate-reducing bacteria in the oral cavity. Therefore, it is important to weigh the pros and cons of mouthwash use, as well as the frequency of use, based on existing conditions, in consultation with a dentist.

Moreover, in some studies, bacteria associated with periodontitis have been found in the deposits within blood vessels of patients with atherosclerosis. Therefore, the treatment and prevention of periodontitis are also important for supporting heart health <sup>[18][20][21]</sup>.





## How can I support the function of my gastrointestinal tract through oral hygiene?

The nitrate consumed through food is converted to nitrite in the stomach and further converted to nitric oxide, which supports the gastric and intestinal mucosa. Therefore, to prevent and especially when experiencing symptoms such as nausea, stomach pain, and heartburn, it is important to ensure an adequate intake of nitrate-rich foods and consult a doctor if necessary <sup>[34]</sup>.

To support the mucous membranes in the gastrointestinal tract, it is also important that bacteria involved in nitrate metabolism do not disappear from the oral cavity due to dysbiosis or excessive use of mouthwashes. It is essential to weigh the benefits and potential harm of antimicrobial mouthwashes, as they not only kill harmful bacteria but also beneficial bacteria in the mouth, leading to an imbalance in the oral microbiome [48]. Unless there are known bacterial oral conditions and a doctor confirms the need for mouthwash, a tooth-friendly diet and regular oral hygiene should be prioritised over the frequent use of mouthwashes.

## The influence of smoking on oral health

It is known that smoking promotes the growth of harmful bacteria in the oral cavity and, consequently, dysbiosis <sup>[42][43]</sup>. Often, neither smokers nor patients with caries or periodontitis show a reduced overall diversity, but rather an increase and more varied composition of harmful bacteria. Therefore, high diversity is not necessarily synonymous with a healthy oral microbiome and should be considered together with other results. Furthermore, smoking not only increases the likelihood of dental diseases but has also been shown to make the treatment of periodontitis and caries more challenging. Therefore, it is advisable to quit smoking in the long term to reduce the spread of harmful bacteria in the mouth and prevent the resulting consequences.

## Additional recommendations

If you experience oral discomfort and receive corresponding results from the microbiome analysis, it is advisable to consult a doctor to investigate possible causes. Implementing a tooth-friendly diet should be accompanied by regular check-ups with the dentist.

Additionally, analysing the gut microbiome can provide insights into personal dietary patterns and their influence on the health of the gut, brain, skin, heart, joints, and liver. This can help adjust nutrient intake, identify potential vitamin deficiencies, and optimise fibre consumption, if necessary.

Keep in mind that the analysis of your oral microbiome is a snapshot and can be immediately influenced by antibiotics, certain foods, the use of mouthwashes, etc. If necessary, the analysis should be repeated several times to obtain reliable information and make accurate statements about the stability of your oral microbiome.

- [1] Deo, Priya Nimish, and Revati Deshmukh. „Oral microbiome: Unveiling the fundamentals." *Journal of oral and maxillofacial pathology: JOMFP* 23.1 (2019): 122.
- [2] Morowitz, Michael J., Erica M. Carlisle, and John C. Alverdy. „Contributions of intestinal bacteria to nutrition and metabolism in the critically ill." *Surgical Clinics* 91.4 (2011): 771-785.
- [3] Dagli, Namrata, et al. „Oral microbial shift: factors affecting the microbiome and prevention of oral disease." *J Contemp Dent Pract* 17.1 (2016): 90-96.
- [4] Dekaboruah, Elakshi, et al. „Human microbiome: an academic update on human body site specific surveillance and its possible role." *Archives of microbiology* 202 (2020): 2147-2167.
- [5] Strużyccka, Izabela. „The oral microbiome in dental caries." *Polish journal of microbiology* 63.2 (2014): 127.
- [6] Takahashi, Nobuhiro, and Bente Nyvad. „The role of bacteria in the caries process: ecological perspectives." *Journal of dental research* 90.3 (2011): 294-303.
- [7] Hurley, Eimear, et al. „Comparison of the salivary and dentinal microbiome of children with severe-early childhood caries to the salivary microbiome of caries-free children." *BMC oral health* 19 (2019): 1-14.
- [8] Jiang, Shan, et al. „Salivary microbiome diversity in caries-free and caries-affected children." *International journal of molecular sciences* 17.12 (2016): 1978.
- [9] Pang, Liangyue, et al. „Metagenomic analysis of dental plaque on pit and fissure sites with and without caries among adolescents." *Frontiers in Cellular and Infection Microbiology* (2021): 986.
- [10] Kalpana, Balakrishnan, et al. „Bacterial diversity and functional analysis of severe early childhood caries and recurrence in India." *Scientific reports* 10.1 (2020): 21248.
- [11] Jiang, Qian, et al. „The oral microbiome in the elderly with dental caries and health." *Frontiers in cellular and infection microbiology* 8 (2019): 442.
- [12] Hampelska, Katarzyna, et al. „The role of oral microbiota in intra-oral halitosis." *Journal of clinical medicine* 9.8 (2020): 2484.
- [13] Mealey, Brian L., and Thomas W. Oates. „Diabetes mellitus and periodontal diseases." *Journal of periodontology* 77.8 (2006): 1289-1303.
- [14] Long, Jirong, et al. „Association of oral microbiome with type 2 diabetes risk." *Journal of periodontal research* 52.3 (2017): 636-643.
- [15] Preshaw, P. M., et al. „Periodontitis and diabetes: a two-way relationship." *Diabetologia* 55 (2012): 21-31.
- [16] Thorstensson, H., G. Dahlen, and Anders Hugoson. „Some suspected periodontopathogens and serum antibody response in adult long duration insulin dependent diabetics." *Journal of Clinical Periodontology* 22.6 (1995): 449-458.
- [17] Takahashi, K., et al. „Subgingival microflora and antibody responses against periodontal bacteria of young Japanese patients with type 1 diabetes mellitus." *Journal of the International Academy of Periodontology* 3.4 (2001): 104-111.
- [18] Chistiakov, Dimitry A., Alexander N. Orekhov, and Yuri V. Bobryshev. „Links between atherosclerotic and periodontal disease." *Experimental and molecular pathology* 100.1 (2016): 220-235.
- [19] Li, Yiwen, et al. „The oral microbiota and cardiometabolic health: A comprehensive review and emerging insights." *Frontiers in Immunology* 13 (2022).
- [20] Chhibber-Goel, Jyoti, et al. „Linkages between oral commensal bacteria and atherosclerotic plaques in coronary artery disease patients." *NPJ biofilms and microbiomes* 2.1 (2016): 7.
- [21] Koren, Omry, et al. „Human oral, gut, and plaque microbiota in patients with atherosclerosis." *Proceedings of the National Academy of Sciences* 108.supplement\_1 (2011): 4592-4598.
- [22] Liu, Bo, et al. „Deep sequencing of the oral microbiome reveals signatures of periodontal disease." *PLoS one* 7.6 (2012): e37919.
- [23] Griffen, Ann L., et al. „Distinct and complex bacterial profiles in human periodontitis and health revealed by 16S pyrosequencing." *The ISME journal* 6.6 (2012): 1176-1185.
- [24] Li, Yan, et al. „Phylogenetic and functional gene structure shifts of the oral microbiomes in periodontitis patients." *The ISME journal* 8.9 (2014): 1879-1891.
- [25] Dewhirst, Floyd E., et al. „The human oral microbiome." *Journal of bacteriology* 192.19 (2010): 5002-5017.
- [26] Zaura, Egija, et al. „Defining the healthy" core microbiome" of oral microbial communities." *BMC microbiology* 9.1 (2009): 1-12.
- [27] Kriss, Michael, et al. „Low diversity gut microbiota dysbiosis: drivers, functional implications and recovery." *Current opinion in microbiology* 44 (2018): 34-40.
- [28] Mosca, Alexis, Marion Leclerc, and Jean P. Hugot. „Gut microbiota diversity and human diseases: should we reintroduce key predators in our ecosystem?." *Frontiers in microbiology* 7 (2016): 455.
- [29] Najmanova, Lucie, et al. „R/G Value—A Numeric Index of Individual Periodontal Health and Oral Microbiome Dynamics." *Frontiers in Cellular and Infection Microbiology* 11 (2021): 602643.
- [30] Site-Specific Development of Periodontal Disease Is Associated With Increased Levels of *Porphyromonas gingivalis*, *Treponema denticola*, and *Tannerella forsythia* in Subgingival Plaque
- [31] Karbalaei, Mohsen, et al. „Alleviation of halitosis by use of probiotics and their protective mechanisms in the oral cavity." *New microbes and New infections* 42 (2021): 100887.
- [32] Sato-Suzuki, Yuria, et al. „Nitrite-producing oral microbiome in adults and children." *Scientific reports* 10.1 (2020): 16652.
- [33] Kapil, Vikas, et al. „Dietary nitrate provides sustained blood pressure lowering in hypertensive patients: a randomized, phase 2, double-blind, placebo-controlled study." *Hypertension* 65.2 (2015): 320-327.
- [34] González-Soltero, Rocio, et al. „Role of oral and gut microbiota in dietary nitrate metabolism and its impact on sports performance." *Nutrients* 12.12 (2020): 3611.
- [35] Ahluwalia, Amrita, et al. „Dietary nitrate and the epidemiology of cardiovascular disease: report from a National Heart, Lung, and Blood Institute Workshop." *Journal of the American Heart Association* 5.7 (2016): e003402.
- [36] Björne, Håkan, et al. „Nitrite in saliva increases gastric mucosal blood flow and mucus thickness." *The Journal of clinical investigation* 113.1 (2004): 106-114.
- [37] Tennert, Christian, et al. „An oral health optimized diet reduces the load of potential cariogenic and periodontal bacterial species in the supragingival oral plaque: A randomized controlled pilot study." *Microbiologyopen* 9.8 (2020): e1056.
- [38] Zhang, Josie Shizhen, Chun-Hung Chu, and Ollie Yiru Yu. „Oral microbiome and dental caries development." *Dentistry Journal* 10.10 (2022): 184.
- [39] Bustamante, Mariela, et al. „Probiotics as an adjunct therapy for the treatment of halitosis, dental caries and periodontitis." *Probiotics and antimicrobial proteins* 12 (2020): 325-334.
- [40] Van der Sluijs, E., et al. „The effect of water on morning bad breath: a randomized clinical trial." *International journal of dental hygiene* 14.2 (2016): 124-134.
- [41] Déadach na hÉireann, Iris Cumainn. „The oral health benefits of chewing gum." *Journal of the Irish Dental Association* 58.5 (2012): 253-261.
- [42] Jiang, Yaling, et al. „The impact of smoking on subgingival microflora: from periodontal health to disease." *Frontiers in microbiology* 11 (2020): 66.
- [43] Albandar, Jasim M., et al. „Cigar, pipe, and cigarette smoking as risk factors for periodontal disease and tooth loss." *Journal of periodontology* 71.12 (2000): 1874-1881.
- [44] Carvalho, Thiago Saads, and Adrian Lussi. „Acidic beverages and foods associated with dental erosion and erosive tooth wear." *The impact of nutrition and diet on oral health* 28 (2020): 91-98.
- [45] Hajifattahi, Farnaz, et al. „Relationship of halitosis with gastric helicobacter pylori infection." *Journal of dentistry (Tehran, Iran)* 12.3 (2015): 200.
- [46] Joshipura, Kaumudi, et al. „Over-the-counter mouthwash use, nitric oxide and hypertension risk." *Blood pressure* (2019).
- [47] Blot, Stijn. „Antiseptic mouthwash, the nitrate–nitrite–nitric oxide pathway, and hospital mortality: a hypothesis generating review." *Intensive Care Medicine* 47.1 (2021): 28-38.
- [48] Bescos, Raul, et al. „Effects of Chlorhexidine mouthwash on the oral microbiome." *Scientific reports* 10.1 (2020): 5254.
- [49] Li, Hong, et al. „Salivary nitrate—an ecological factor in reducing oral acidity." *Oral microbiology and immunology* 22.1 (2007): 67-71.
- [50] Rosier, B. T., et al. „Nitrate as a potential prebiotic for the oral microbiome." *Scientific reports* 10.1 (2020): 12895.
- [51] Wiegand, Annette, and Nadine Schlueter. „The role of oral hygiene: does tooth-brushing harm?." *Erosive Tooth Wear* 25 (2014): 215-219.
- [52] Enax, Joachim, et al. „Toothpaste Abrasion and Abrasive Particle Content: Correlating High-Resolution Profilometric Analysis with Relative Dentin Abrasivity (RDA)." *Dentistry Journal* 11.3 (2023): 79.

[WHO, Healthy diet, 29.04.2020]  
<https://www.who.int/news-room/fact-sheets/detail/healthy-diet>; Zugriff am 24.05.2023





*Health begins in the mouth.*

**MEDsan<sup>®</sup>**  
biological health solutions

<https://medsaninc.com>