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Review Article

Lactobacillus Probiotics and their Impact on Periodontal Diseases

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Abstract: The alteration of the eubiosis of the oral microenvironment, together with other risk factors, promotes the development of the most common chronic inflammatory diseases in the oral cavity, gingivitis, and periodontitis; they are characterized by the destruction of the gingiva and underlying tissues that support and house the teeth. Because of this, a patient without timely and adequate treatment can lose teeth. The elimination of supragingival plaque, scaling, and root planing, combined with antibiotics in some cases are the treatments for these diseases and are focused on controlling the growth of microorganisms considered pathogenic periodontal. This study reviews the literature on the use and effect of probiotics as a treatment alternative for periodontal diseases in various types of trials. In recent decades, bacterial resistance has increased over the years and has motivated the search for alternative methods such as probiotics, among which are bacterial species of the genus *Lactobacillus*. They have even been shown to be effective in periodontal diseases by controlling the growth of etiological agents and reducing the inflammation of the tissues affected by periodontal diseases.

Keywords: *Lactobacillus*, probiotics, periodontal diseases, *Porphyromonas gingivalis*, treatment.

INTRODUCTION

Periodontal Diseases

Periodontal diseases (PDs) are a public health problem (Vos T *et al., 2017*). They are the most frequent diseases in the oral cavity, after caries, and their prevalence has increased by almost 10% in the last 30 years (Chen M X *et al.,* 2019).

During the onset and progression of PDs, the protective and insertion tissues of the teeth are affected as a result of dysbiosis in the oral microenvironment; and by the formation of dental plaque or biofilm; in addition to host-associated and behavioral factors. Although dental plaque is very diverse and complex, the microorganisms commonly associated with PDs are *Porphyromonas gingivalis (P. gingivalis), Treponema denticola, Aggregatibacter actinomycetemcomitans, Tannerella forsythia (*Socransky S S *et al.*, 1998), *Prevotella intermedia, and Fusobacterium nucleatum* (Hajishengallis G *et al.*, 2012). The presence of these microorganisms considered periodontopathogens promotes inflammatory diseases (Listgarten, M. A. 1987); initiate as gingivitis that can be reversible if treated in time. However, chronic periodontitis can lead to tooth loss if left untreated by a specialist (Riep B *et al.*, 2009) impacting various environments of the individual, affecting their quality of life.

Probiotics

Probiotics are microorganisms that generally live in complexes consisting of bacteria and yeasts. According to World Health Organization (WHO) and the Food and Agriculture Organization of the United States (FAO) in 2002 probiotics are "live microorganisms which when administered in adequate amounts confer a health benefit on the host" (FAO/WHO, 2002), (FAO/WHO. 2001). Some species of the genera *Bifidobacterium* and *Lactobacillus* are the most consumed probiotics and therefore the most studied. (Kandwal A *et al.*, 2011). On the other hand, it is important to mention that so far there are few exclusions for their consumption (Shahrokhi M *et al.*, 2023) because they are considered Generally Recognized as Safe (GRAS) foods (Salminen S 1998). In addition, evidence about the consumption of lactic fermented foods with probiotics dates to 3000 to 2000_{BC} in different civilizations (Gasbarrini G *et al.*, 2016).

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Also, probiotic foods include water or milk kefir, sauerkraut, kimchi, olives, beer, sourdough, among others.

In recent years, probiotics have been used to prevent, reduce, or treat various diseases or conditions, such as: allergies (Lee N-K *et al.*, 2014), respiratory diseases, cancer, psychiatric diseases (Slyepchenko A *et al.*, 2015), urinary tract infections, diabetes, hypertension, autoimmune diseases (Lye, H. S *et al*, 2016) and diseases of the oral cavity among which can be mentioned caries, gingivitis, periodontitis, and candidiasis. (Stavropoulou E *et al*, 2020). In addition, probiotic strains possess an antimicrobial effect (Slattery C *et al.*, 2019).

Lactobacillus and its effect in the treatment of periodontal diseases.

Conventional treatment of periodontal diseases involves surgical and non-surgical treatments (Goodson, J. M *et al.*, 2012) for the purpose of removal or control of dental plaque by mechanical or chemical means using systemic antibiotics. However, treatment alternatives for PDs have been sought to avoid bacterial resistance (Mahasneh S *et al.*, 2017), avoidance of allergies, as well as alterations of the oral and intestinal microbiota when using antibiotics (Mishra S *et al.*, 2020).

Clearly, probiotics have aroused interest in various areas of health and the field of dentistry has been no exception (Pelekos, G *et al.*, 2019). For example, different species of the genus *Lactobacillus* have been used to treat PDs; among those we can mention are *Lactobacillus salivarius*, *Lactobacillus brevis*, *Lactobacillus plantarum*, *Lactobacillus rhamnosus*, *Lactobacillus gasseri* (Zhang *Y et al.*, 2022).

Due to the above, several *in vitro* and *in vivo* studies and some clinical trials have been carried out to demonstrate the role of probiotics in periodontal diseases. *In vitro* assays have established that several Lactobacillus strains have an antimicrobial effect *on P gingivalis* due to the metabolites they produce such as bacteriocins, hydrogen peroxide, fatty acids (Cheng, Y *et al*., 2022), (Homayouni Rad A *et al.*, 2023), and (Cornacchione, L P *et al.*, 2029); *in vivo* trials, the published results refer mainly to the ability of probiotic strains of *Lactobacillus* to decrease gingival inflammatory processes pocket depth, as well as to reduce alveolar bone loss (Nguyen T *et al.*, 2021). Finally, in clinical trials, decreased inflammation of the protective periodontium (Riccia D N D *et al.*, 2007) and reduction periodontal pocket depth, as well as a lower bacterial load has been observed (Gheisary Z *et al.*, 2022) (Table 1). In contrast to the above, one study reported that no changes occurred when probiotics were used. However, in this study, probiotics were not applied directly to the affected areas, as tablets were used (Pelekos G *et al.*, 2019).

Table 1: Probiotics of the genus Lactobacillus analyzed to treat periodontal diseases

Type of trial	Probiotic species	Effect	Reference
in vitro	*Lactobacillus plantarum* 44048 and NC8 strains	Bacteriocin-mediated growth of *P. gingivalis* inhibited.	(Khalaf, H *et al.*, 2016)
In vitro	*Lactobacillus helveticus* SBT2171	Decreases the number of *P. gingivalis*	(Kobatake E *et al*., 2019)
in vitro	*Lactobacillus reuteri* AN417	Antimicrobial activity against *P. gingivalis*	(Yang, K. *et al.*, 2021)
in vitro	*Limosilactobacillus (Lactobacillus) fermentum* ALAL020	Presents antibacterial activity against *P. gingivalis* and *P. intermedia*. No tissue toxicity.	(Kawai, T *et al.*, 2022)
in vivo mice	*Lactobacillus brevis* (CD2)	Reduces gingival inflammation.	(Maekawa T *et al*., 2014)
in vivo mice	*Lactobacillus gasseri* SBT2055 (LG2055)	Decreased alveolar bone loss, periodontal ligament detachment and *P. gingivalis* colonization.	(Kobayashi R *et al*, 2017)
in vivo mice	*Lactobacillus reuteri*	Reduces inflammation and improves the repair of affected tissues.	(Garcia V G *et al.*, 2022)
in vivo mice	*Lactobacillus curvatus* SMFM2016-NK	Decreases periodontal inflammation	(Choi Y *et al.*, 2021)
Clinical trial	*Lactobacillus salivarius* SGL03	It reduces the depth of the periodontal pocket regardless of the bacterial load.	(Nędzi-Góra, M *et al*, 2020)
Clinical trial	*Lactobacillus rhamnosus* L8020	Decreases the risk of periodontal disease in patients with intellectual disabilities.	(Yuki O D A *et al.*, 2019)
Clinical trial	*Lactobacillus brevis* CD2	Decreases gingival index.	(Shah M *et al*, 2018)
Clinical trial	L*actobacillus* reuteri	No evidence of improvement when combined with non-surgical periodontal therapy.	(Pelekos, G *et al.*, 2019)
Clinical trial	*Lactobacillus reuteri*	Improve clinical periodontal parameters. Improve inflammation.	(Ikram, S *et al*., 2019)
Clinical trial	*Lactobacillus reuteri*	Improved outcomes in chronic periodontitis	(El-bagoory G M *et al.*,

		when using the probiotic with scaling and root planing compared to non-surgical therapy alone.	2021)

CONCLUSION

Periodontal diseases frequently affect oral health, probiotics have been reported as an adjuvant alternative in the treatment of such diseases. This is due to the antibacterial capacity and anti-inflammatory efficacy of Lactobacillus probiotics. However, some studies have shown contradictory results; therefore, more controlled clinical trials are required to support the relevance of the use of probiotics for periodontal diseases.

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