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Research paper

Treatment of halitosis antibiotics or probiotics

Ilma Robo [1] *, Saimir Heta [2], Vera Ostreni [2], Joana Hysi [3], Iriana Balla [3], Nevila Alliu [2]

[1] *University of Medicine, Faculty of Dental Medicine, Tiranë, Albania*
[2] *University of Medicine, Faculty of Medicine,Tiranë, Albania*
[3] *Albanian University, Tirane, Albania*
**Corresponding author E-mail: ilmarobo@yahoo.com*

Abstract

Background: Halitosis as the primary causative source is thought to be the oral cavity, including here not only pathologies of dental origin such as caries or periodontitis, but also including the effect of a diet rich or not in nitrite products, which is reflected in the produced saliva, with the effect of in the oral cavity. Halitosis originates from pathologies of different systems, mainly mentioning the gatointestinal one. If these pathologies have a new treatment trend such as the application of probiotics, the question is whether or not they can be used for halitosis treatment. Collecting data from published literature sources about the possibility of treating halitosis with probiotics is another goal of this study.
Main body of the abstract: The study is of the review type with the aim of knowing the data published in the literature on the possibility of treating halitosis through the application of probiotics. Probiotics are seen as the newest possibility for the treatment of periodontal pathologies and not only but also carious processes. Based on the literature data, the initial source of halitosis is exactly periodontal pathologies and carious processes, to continue further with problems related to pathologies of different systems of the body. The time of selection for the articles included in this study was 5 years of publications, so the purpose is the analysis of the data published in the literature on the Pubmed page on this topic, in the last 5 years, considering the trend of scientific research on this topic. Based on these key word combinations and based on the application of search filters, 15 articles were selected for further analysis on this topic.
Short conclusion: Studies about probiotics should be channeled into the "in vivo" type for real clinical results. Probiotics should come up with specific names of effective bacteria versus specific names of pathogenic bacteria of oral pathologies. The family of lactobacilli is effective against specifically p. gingivalis, but against S. mutans this data is missing. In about 7% of cases, halitosis is caused by gastrointestinal disorders, and as an oral cause of halitosis, there is no specific division from only caries or only periodontitis.

Keywords: *Probiotics; Periodontitis; Non-Surgical Treatment; Halitosis; Lactobacillus Reuteri; Antibiotics.*

1. Introduction

Halitosis or foetor ex oris, are clinical terms that explain quite well the presence of bad breath. Bad breath has several sources, which are initially thought to be all from pathologies of dental origin, and then from the systems, the main one is thought to be the gastrointestinal system. [1], [2] Probiotics as a new approach to gastrointestinal treatments can be considered as such even in the case of halitosis treatment. In 2020 [1], a review article was published on the effect of probiotics as adjuvant therapy for the treatment of halitosis, originating from dental caries and originating from periodontitis. In fact, probiotics are a therapeutic approach for the prevention of gastrointestinal diseases, which has been studied extensively and has already published results.
In fact, the oral and non-oral classification of bad breath is also applied, during the establishment of the respective diagnoses. In 2021 [3], a review article was published on the effect of probiotics in improving halitosis and on the protective effect on the oral cavity. Sulfur compounds are the main causative agents of halitosis, and depending on the source of these compounds, halitosis is classified into oral and non-oral types. The dietary effect also plays a role in the appearance of bad breath. The article published in 2022 [2] regarding the importance of nitrate reduction highlighted the effect of reducing this substance in improving oral health. A diet rich in nitrate products, meals with vegetables rich in nitrates, leads to increases in plasma nitrate levels and then salivary glands that have the ability to concentrate plasma nitrate pour it into the produced saliva.
Probiotics as bacteria that cure bacterial infections is a concept already known and supported in literature publications.[4] This study highlights the fact that probiotics are live bacteria with different treatment effects against human infectious diseases. The fact is the wide range of products - probiotics produced and facing this wide range of products that put into question which one and how you should use it for the specific pathology you are interested in. Izidoro C et al. in 2020 [5] published the article regarding the reanalysis and techniques and newer therapeutic approaches for the treatment of halitosis. In this study, the social impact on human relationships that halitosis has in itself is emphasized once again. Social interaction, communication and quality of life are among the consequences of halitosis, described as a pathology that in unusual cases can be non-oral and non-communicative. The term halitosis was mentioned in 1874 for the first time, a symptom that was noticed much more during the times of the Covid-19 pandemic, where the majority of the population used masks as a means of protection against the pandemic. [6] Halitosis is the third reason why patients visit the dentist, after caries and periodontal diseases. [6].

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2. Main text

The study is of the review type with the aim of knowing the data published in the literature on the possibility of treating halitosis through the application of probiotics. Probiotics are seen as the newest possibility for the treatment of periodontal pathologies and not only but also carious processes. Based on the literature data, the initial source of halitosis is exactly periodontal pathologies and carious processes, to continue further with problems related to pathologies of different systems of the body. Zhang J et al in 2022 [13] published the article on the discovery of L. plantarum as a new probiotic agent for the treatment of oral pathologies. This study aimed to find the probiotic active against S.mutans. The study is of the in vitro type aiming to prevent the inhibition of pathogen colonization on the surface of gingival epithelial cells. Higuchi T et al. in 2019 [15] they published an article about the effects of L.salivarius of the nation with catechins originating from green tea on the appearance of dental caries, periodontitis and the elimination of halitosis. There are two pathogens where the probiotic acts: S. mutas and P. gingivalis, an in vitro study. L.salivarius affects the reduction of methyl mercaptan and the inhibition of P.Gingivalis.

Probiotics, being live bacteria, affect the existing symbiosis of the oral flora, and it is even thought that they can transmit or take from the existing oral flora the bacterial resistance already created. The selection of the articles on which this review was developed was based on the combination of the key words halitosis and general periodontal and probiotic. The time of selection for the articles included in this study was 5 years of publications, so the purpose is the analysis of the data published in the literature on the Pubmed page on this topic, in the last 5 years, considering the trend of scientific research on this topic. Based on these key word combinations and based on the application of search filters, 15 articles were selected for further analysis on this topic. [1-15].

3. Results

The processing of the data from the selected articles is presented in the following tables. Table 1 shows the trend of local studies and classified according to the type of study and method of analysis, how the effect of probiotics for the treatment of halitosis was evaluated.

Table 1: Distribution of Articles Based on the Type of Study and Year of Publication of the Article

Years of publication Type of article	2018-2020 No. - %	2021-2023 N0. - %	Total No. - %
Review	2 – 13%	7 – 47%	9 – 60%
In vitro	2 – 13%	2 – 13%	4 – 26%
In vivo	2 – 13%	2 – 13%	2 – 13%
Total - %	6 – 39%	9 – 60%	15 – 100%

Regarding the oral pathology causing halitosis in table 2, the studies are divided depending on the method of analysis or the type of study and the oral pathology from which the halitosis originates.

Table 2: In this Table, the Division of Articles Depends on the Type of Study and the Type of Oral Pathology Causing Halitosis

Cause Type of article	Caries	Periodontitis	Caries-periodontitis	Others	Total
Review	1 – 7%	2 – 13%	5 – 33%	1 – 7%	9 – 60%
In vitro			4 – 26%		4 – 26%
In vivo		2 – 13%			2 – 13%
Total	1 – 7%	4 – 26%	8 – 50%	1 – 7%	15 – 100%

In table no. 3, there are specific names of the families of probiotic bacteria and the specific bacteria against which they act, bacteria that are the cause of either caries or periodontal pathologies.

Table 3: This Table Shows Results on the Families of Probiotic Bacteria and the Specific Names of the Oral Pathogenic Bacteria Against Which They Act

Pathogenic bacteria Probiotics	S.mutans	P.gingivalis	Total - %
Lactobacillus	4 – % [7], [9], [13], [15]	5 – 26% [4], [9], [10], [13], [15]	6 – 40%
Streptococcus	1 – 7% [11]	1 – 7% [11]	1 – 7%
Bifidobacterium	2 – 13% [7], [9]	1 – 7% [9]	2 – 13%
Total - %	5 – 33%	6 – 40%	9 – 60%

Table 4 shows the articles with not very concrete, evasive conclusions of the studies included in the review.

Table 4: Data on the Studies Included in the Analysis

Study	Conclusion Concretely	Evasive
Bustamante M et al 2020 [1]	Halitosis is treated with coherent treatment of periodontitis in the oral cavity	More concrete studies both in vitro and in vivo with a high number of volunteers involved are required
Rosier BT et al 2022 [2]	Nitric acid has antimicrobial ability in inhibiting periodontitis-causing anaerobes. Nitrates increase resilience to salivary acidification.	Data from in vivo studies are limited
Izidoro C et al. [5]	Treatment of halitosis is multidisciplinary.	The high clinical success of the treatment comes as a result of the good knowledge of the etiology of halitosis.
Froum SJ et al. 2022 [6]	Halitosis is the third reason why the patient comes to the dentist.	The diagnosis of halitosis requires a rigorous anamnesis, clinical examination and specific measurements, followed by treatments with different methodologies.
Tagg JR et al.2023(11)	Probiotic S.salivarius shows good results in improving oral health.	What is becoming increasingly clear is that in the future the application of oral probiotics will extend significantly beyond the limits marked against effects against oral pathogens.
Total	5 studies – 33%	

Table 5 shows the articles with very concrete conclusions of the studies included in this review.

Table 5: Concrete Data on the Studies Included in this Analysis

Studies	Conclusion Concretely	Concretely
Karbalaei M et al 2021 [3]	Lactobacillus, Streptococcus, Weissella are effective probiotics against halitosis.	It is not seen as a symptom of oral pathologies, only of caries and periodontitis, but also as a systemic symptom, and halitosis should be treated as such.
Mishra et al. 2020 [4]	Probiotics effective against oral pathologies, but in this study they also come with a legal basis for the production and marketing of these products.	Halitosis is an oral pathology just like caries and periodontitis.
Homayoni Rad A et al. 2023 [7]	The oral cavity as part of the gastrointestinal system should react equally with positive effects to probiotics.	There are numerous studies on the positive effect of probiotics on the occurrence of caries and consequently also on the reduction of halothosis.
Inchongolo F et al. 2018 [8]	Oral bacteria degrade sulfur-containing amino acids to produce sulfur products that cause halothosis.	The positive effect of probiotics against pathogenic oral bacteria reduces the production of sulfur products.
Gonczi NN et al.2021 [9]	In vitro investigation of commercially available probiotic products against pathogenic oral bacteria to obtain concrete results on the effectiveness of probiotics.	The results indicate successful bacteriocin production against pathogenic bacteria in at least 5 types of strains.
Soares LG et al.2019 [10]	Lactobacillus significantly reduces the depth of periodontal pockets and significantly reduces the bleeding index.	Lactobacillus by healing periodontal diseases, significantly reduces halitosis caused by periodontal diseases.
Cantore S et al.2018(12)	Probiotics are used as a substitute for antibiotic treatments of oral pathologies.	Probiotics not only have an antimicrobial effect, but also have an inhibitory effect on the reappearance of oral pathogenic bacteria.
Zhang J et al 2022 [13]	Lactobacilli show positive effects against P.gingivalis, a.actinomycetemcomitans and F.nucleatum.	After 2 hours of co-cultivation of lactobacillus with periodontal bacteria a significant reduction of adhesin on gingival epithelial cells was observed.
Gennai S et al.2023 [14]	Probiotics were after antiseptics and before antibiotics for positive results in the treatment of peri-implant mucositis.	Periodontal diseases cannot be definitively cured, but their treatment with non-surgical periodontal therapy and probiotics has good clinical results.
Higuchi et al.2018 [15]	Lactobacillus is effective against periodontitis and caries, eliminating halitosis caused by these pathologies.	The effect of the probiotic is enhanced if it is combined with green tea catechins.
Total	10 studies – 67%	

4. Discussions

Notice from the data of table no. 1 the years 2018-2020 before the Covid-19 pandemic, despite the smaller number of articles published about 40%, they have almost the same distribution regarding the type of study conducted, review, in vitro or in vivo, contrary to the years after the pandemic, where the tendency to see and study the effects of probiotics remains only against the review type of studies in almost 47% of cases. Regardless of the years of publication, it is noted that the review type of articles exceeds 60%, occupying the main place and 26% of the in vitro type and only 13% of the cases are in vivo type studies. The moment has come for more investments in "in vivo" studies about the effect of probiotics against the elimination or reduction of halitosis, or rather the reflection of the results of review studies in in vitro analysis and then the application "in vivo" to reach conclusions based on fictitious results and to avoid the expression that should be analyzed further, or should probiotics be applied in larger samples of patients with the typology of the selected oral pathology.

The data in table 2 shows the division of the causes of halitosis into intraoral elements and systemic or extraoral elements. In only 7% of cases, halitosis is seen as a symptom originating beyond the oral cavity and mainly from gastrointestinal pathology or disorders. This element that is supported in the literature and is presented with a value of about 5%. [5] While in 92% of cases it comes as a result of oral carious or periodontal diseases. If we look at the last values, it can be seen that periodontal pathologies are more analyzed as the cause of halitosis in almost 33% of cases and pathologies from caries in almost 7% of cases, while the caries-periodontitis combination is expressed in 50% of cases. What stands out is the tendency to see both pathologies together as the cause of halitosis is much higher, but can't a probiotic be effective for both caries and periodontal pathologies? So if halitosis is seen as having a common origin, then there must be a probiotic that acts on both S.mutans and P.gingivalis. Something which is highlighted in only 1 article [13] and the agent is Lactiplantibacillus plantarum. Another data from table 2 is the fact that the "in vivo" studies are almost all oriented around the effect of probiotics on periodontal diseases and therefore on the reduction of halitosis as a consequence of the healing of periodontal diseases, while the "in vitro" studies are oriented about caries-periodontal analysis. Only the reduction of halitosis as a result of caries treatment is mentioned in an article of the review type [7] where the aim of the application of probiotics is to reduce dental caries and thus the reduction of halitosis. This logic comes from the fact that probiotics have the primary effect in regulating the gastrointestinal flora and the flow even in S. mutans as the flora of a part of the gastrointestinal system. A somewhat truncated logic, but which derives a minimalist branch for the analysis of probiotics divided depending on which oral pathology we are treating, and consequently from which pathology halitosis is coming.

From the data of table no. 3 only in 60% of cases concrete results related to the name of the probiotic and the effect on the specific oral pathogenic bacteria are mentioned. In this 60% of cases, the distribution for the family of lactobacilli is in 40%, for the family of streptococcus in 7% and bifidobacterium in 13% of cases. Probiotics specifically act on S.mutans in 33% and in 40% of cases on P.gingivalis. The distribution is almost the same for both oral pathologies with the difference that the positive effect against P.gingival is significantly higher with the lactobacilli family, while for s.mutans there is still no specific probiotic. For carious lesions, we are still at the stage where all probiotics work equally without concrete results. In table no. 3, only the articles that present the specific data as required in the table are included. References are also placed on the sides of the expressed percentage and their numbering is done without counting them twice. The results of table 4 and table 5 are distinct and understandable in which study supports the concrete results of probiotics against the treatment of the pathology of halitosis. It is worth mentioning that 67% of the articles support positively and with concrete results the treatment of halitosis with probiotics, as opposed to 33% of the articles where the conclusions are ambiguous.

5. Conclusions

Studies about probiotics should be channeled into the "in vivo" type for real clinical results. Probiotics should come up with specific names of effective bacteria versus specific names of pathogenic bacteria of oral pathologies. The family of lactobacilli is effective against specifically P.gingivalis, but against S.mutans this data is missing. In about 7% of cases, halitosis is caused by gastrointestinal disorders, and as an oral cause of halitosis, there is no specific division from only caries or only periodontitis.

6. List of abbreviation

Not Applicable.

7. Declarations ethics approval and consent to participate

Not Applicable. This study not require an ethical approval since individual patients data is not included in any form.

8. Consent for publication

Not Applicable.

9. Availability of data and materials

The datasets analyzed during the current study are available from the corresponding author.

10. Competing interests

The authors declare that they have no competing interests.

11. Funding

No funding was obtained for this study.

12. Authors' Contributions

IR, JH and IB collected the scientific data and wrote the manuscript. SH and NA revised and edited the manuscript. Literature research was conducted by IR and NA. SH and VO collected the scientific data. All authors read and approved the final manuscript.

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