

Sulfate reducing bacteria in oral cavity

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Review Article

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Prevalence of sulfate reducing bacteria in oral cavity: a narrative review

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Abstract:

Sulphate is used as terminal electron acceptor for the respiration of sulphate reducing bacteria (SRB) forming a specialized group of microbes. SRB have been known to cause microbiologically induced corrosion by forming metallic sulfides and oxides in the process of their dissimilatory respiration. Since oral cavity provides a conducive environment for corrosion, presence of SRB in oral cavity and their corrosive potential needs to be assessed. This article provides a narrative review of the available literature with the primary objective of evaluating the presence of SRB in oral cavity of patients.

Keywords: SRB; corrosion, oral cavity, patients

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Prévalence des bactéries sulfato-réductrices dans la cavité buccale: bilan narratif

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Abstrait:

Le sulfate est utilisé comme accepteur d'électrons terminal pour la respiration des bactéries réductrices de sulfate (SRB) formant un groupe spécialisé de microbes. On sait que le SRB provoque une corrosion induite par la microbiologie en formant des sulfures et des oxydes métalliques au cours du processus de respiration dissimilatoire. Étant donné que la cavité buccale crée un environnement propice à la corrosion, la présence de SRB dans la cavité buccale et leur potentiel corrosif doivent être évalués. Cet article fournit une revue narrative de la littérature disponible avec l'objectif principal d'évaluer la présence de SRB dans la cavité buccale des patients

Mots-clés: SRB; corrosion, cavité buccale, patients

Introduction:

Microorganisms play an important part in sulphur transformations. Sulphur which occurs in nature as pyrite, gypsum or sulphate is either taken up as a nutrient for metabolic energy such as sulphide oxidation by chemolithotropic sulphur bacteria and dissimilatory sulphate reduction by sulphate-reducing bacteria (SRB) or for producing sulphur containing amino acids or enzymes. SRB have been known to cause microbiologically induced corrosion by forming metallic sulfides and oxides in the process of their dissimilation (1, 2, 3). In accordance with this, the role of SRB in causing metal corrosion is of important concern in oral cavity where a lot of metallic components are used.

Assessing the prevalence of SRB in oral cavity is of utmost importance with reference to the same. This article provides a narrative review of the available literature with the primary objective of evaluating the presence of SRB in oral cavity of patients.

Materials and methods:

We searched PubMed and Embase databases. The search covered the period 1980 to March 2018. The main terminologies used for search were; "sulfate reducing bacteria and oral or dental or periodontal or saliva" AND "presence or prevalence of SRB and oral or dental or periodontal or saliva". We identified 123 articles in PubMed and 26 in Embase with these key words. Of these, 78 articles were selected after eliminating duplications. These 78 articles were screened and 68 articles were eliminated

based on relevancy. The remaining 10 articles were further scrutinized and the article by Costinar et al., (4) was eliminated since it was related to dogs' oral cavity. The remaining 9 articles were included in the review (Fig 1).

Results:

Description of studies

Nine articles were finally selected for inclusion in the review. There were two major population groups studied, one involved healthy oral cavity and the other periodontally compromised. One article by Paster et al., (7) included samples from refractory periodontitis, acute necrotizing ulcerative gingivitis (ANUG) and HIV patients in addition to healthy and periodontitis patients. The sample size varied from 5 to 118. The details of the study representing the sample size, sampling sites and percentage of prevalence are given in Table 1.

Sampling sites and methods

The sampling sites were dorsum of tongue both anterior and posterior, palate, buccal mucosa, vestibular mucosa, supra and subgingival plaque for healthy patients. For periodontitis cases, the samples were taken from the deepest pocket. In the studies by Heggendorf et al., (5, 6), sampling was done on saliva in one study and from tooth fragment in another study. The samples were placed in reduced medium to facilitate the survival and growth of anaerobic bacteria in all of the studies with Postgate medium E being the most being the most common choice

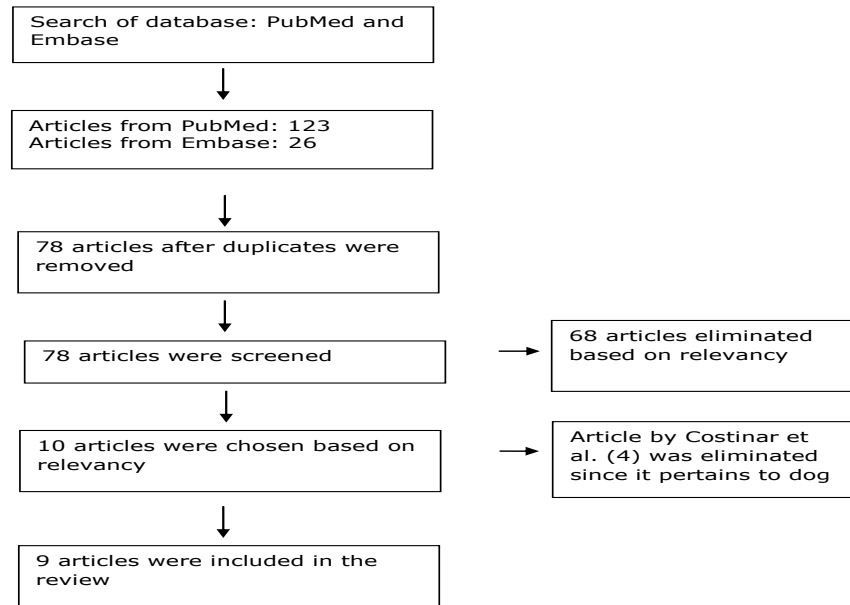


Fig 1: Flowchart for search and selection process

Table 1: List of articles selected for review

Study	Sample size	Groups	Sampling sites	Prevalence rate
Paster et al., 2001	31	Healthy (5) Periodontitis (9) Refractory periodontitis (11) ANUG(4) HIV (2)	Subgingival plaque from four most diseased or deepest site	Percentage not given but positive in periodontitis, refractory periodontitis and ANUG cases
Heggendorn et al., 2013	118	Healthy and periodontitis with other subgroups of gastritis, diabetes	Saliva	29.66%
Heggendorn et al., 2014	8	Healthy and periodontitis	Tooth fragment ,healthy tooth extracted tooth for orthodontic purpose	37.5%
Langendijk et al., 1999	41	Healthy and periodontitis	Pooled sample from posterior anterior palate, vestibular mucosa, dorsum of tongue, supragingival area, around the opening of parotid duct, gingival sulci deep pockets	Site wise: 10% in mucosa of healthy and periodontitis, 22% for tongue and supragingival, 86% for periodontal pockets
Langendijk et al., 2001	168	Periodontal SRB compared with other spirochetes	Subgingival plaque	SRB and <i>Porphyromonas</i> co-existed in 32% cases
van der Hoeven et al., 1995	43	Periodontitis	Subgingival plaque	58% had SRB
Langendijk et al., 2001	83	Periodontitis	Deepest area of the pocket	49% patients had SRB
Willis et al., 1995	12	Healthy	Posterior and anterior tongue, mid buccal mucosa, vestibular mucosa, supra and subgingival plaque	83%
Vianna et al., 2008	102	Healthy and periodontitis	Subgingival plaque	41.2% in periodontitis patients, insignificant presence in healthy

Description of outcome

Of the nine studies, seven gave the percentage prevalence of SRB in healthy and periodontitis patients, while the study by Paster et al., (7) reported the prevalence of SRB in association with periodontitis, refractory periodontitis, ANUG and HIV patients. The study by Langendijk et al., (8) assessed the co-existence of SRB and *Porphyromonas gingivalis* in periodontitis patients.

Saliva: One study did the sampling on saliva (5). Of 118 saliva samples collected, 35 were positive for the presence of SRB. Three positive samples were randomly chosen to identify the species of SRB by PCR and sequencing. The three selected samples were identified as *Desulfovibrio fairfieldensis*, *Desulfovibrio desulfuricans* and *Raoultella ornithinolytica*.

Pooled sample: Two of the studies (9, 10) did a pooled sampling from posterior and anterior tongue, mid buccal mucosa, vestibular mucosa, supra and subgingival plaques. The study by Langendijk et al., (9) reported site-wise prevalence of 10% in mucosa of healthy and periodontitis, 22% for tongue and supragingival, and 86% for periodontal pockets.

Subgingival: The study by Langendijk et al., (8) reported a prevalence percentage of 32% along with co-existence with *Porphyromonas gingivalis*. Van der Hoeven et al., (11) reported 58% for subgingival plaque. Vianna et al., (12) reported a prevalence of 41.2% in periodontitis patients while insignificant presence in healthy persons.

Deep pockets: Langendijk (13) reported a prevalence of 49% for deep pockets.

Discussion

In this narrative review, we included nine articles describing the presence of SRB in oral cavity of healthy and periodontitis individuals. Almost all the articles have reported positively on the existence of SRB in oral cavity. Though the presence is more in periodontitis patients, healthy individuals also had presence of SRB. This has an important relevance since SRB has been associated with biological corrosion (1,2,3).

SRB are anaerobic microorganisms that are widespread in anoxic habitats, where they use sulphate as a terminal electron acceptor for the degradation of organic compounds, resulting in the production of sulphide (10). The sulphate ion acts as an oxidizing agent for the dissimilation of organic matter in sulphate reduction process like oxygen in conventional respiration. Under anaerobic conditions, a metal surface acts as the anode in an electrochemical reaction and is oxidized, yielding Me^{2+} ions. Bacteria produce S^{2-} ions, which enter into a reaction with Me^{2+} ions, resulting in the formation of metal sulfide. In the cathode area, H^+ ions are produced and they react with hydroxyl groups. As a result, oxygen from sulfates is consumed for oxidizing metals which leads to the formation of metal oxides thereby corroding metals.

It has been documented that SRBs are capable of corroding metals like stainless steel and titanium intraorally (14, 15). There are very few literatures assessing the prevalence of SRB in oral cavity. More studies with larger sample size and randomized controlled trials (RCTs) are needed to have a clear understanding of the prevalence of SRB in oral cavity whether in healthy or periodontitis patients. With SRB being associated with microbiologically induced corrosion, it becomes even more relevant due to the use of metallic implants and other metallic materials in the oral cavity.

Conclusion

SRB is present in the oral cavity of both healthy and periodontitis patients but more commonly in periodontitis patients compared to healthy persons. The prevalence rates varied with studies. With the current knowledge on the prevalence of SRB in oral cavity, more quality studies, preferably RCTs with large sample size are needed in the future to evaluate the corrosive potentials of SRB on the metallic materials used intraorally.

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