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Scardovia wiggsiae as Recent Player in Caries Process: a Review

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Abstract

Aims: Oral cavity is attacked by many infectious agents that invade tooth, periodontium and tongue. Dental caries which is the most common oral disease, can caused by the reaction between tooth structure, oral bacteria and fermentable carbohydrates. Most of caries microbial researches considered *Streptococcus mutans* and lactobacilli as majors caries-associated players. The discovery of *Scardovia wiggsiae* in 2011 had highlighted the possible occurrence of dental decay in absence of both *Streptococcus mutans* and lactobacilli in addition to other oral diseases. This review focused on taxonomy, acidogenicity, normal habitat and the important roles of newly *S.wiggsiae* as the pioneer bacteria for initiation and progression of caries process.

Methods: The database was focused on articles published till 2022 for the topics oral diseases, dental caries, *Scardovia wiggsiae* and microbiology of dental caries

Conclusions: *Scardovia wiggsiae* can to be considered as a potential risk indicator for caries prediction in a given population.

Keywords: *Scardovia wiggsiae*, oral diseases, dental caries, microbiology of dental caries.

Introductio

Human kind faced oral infections since the human existence[1].Bacteria can play an important role in the initiation and later development of oral diseases[2]. Dental caries which is a common global problem[3] , has complex infectious process with different causes[4] .It has major three risk factors; cariogenic bacteria, susceptible teeth, and the frequent dietary carbohydrates intake[5]. As the mouth has one of most larger and most diverse microbiology[6],understanding of diverse microbiota of dental caries is necessary because it is not simple process caused by single bacteria but by complicated tooth-bacterial interaction[7].

Many researches had claimed that mutans streptococci is the primary major pathogen to initiate caries[8] while others found these bacteria on dental surfaces; however, with no participating role in the development of caries lesion[9].

Although *Streptococcus mutans* and lactobacilli are identified as caries associated bacteria. It was noticed that other bacteria can cause dental caries in absence of the above bacteria, opening the door for discovering a new cariogenic bacteria[10]. The aim of this review was to identify the role of Scardovia wiggsiae in dental caries.

Methods

The Medline database was focused for English-language articles, published up to 2022 for the topics oral diseases ,dental caries , *Scardovia wiggsiae* and microbiology of dental caries. Manual searching was additionally done from the citations of the updated identified reports. The literature search intent was done to highlight and review the analytic reports of the emerging and pioneer role of *Scardovia wiggsiae* in many oral diseases and aspects include all peer-reviewed epidemiological and supporting human scientific articles.

Exclusion criteria: Studies that were reported in languages other than English were excluded due to practical difficulty of translation. In addition, articles that dealt with systemic effects, presence and diseases of *Scardovia wiggsiae* other than oral cavity were excluded .

Results and discussion

Tanner *et al* in 2011 applied updating molecular techniques to identified a new causative agent of dental caries in absence of known previous agents (e.g. *S. mutans*). This new agent was known as *Scardovia wiggsiae.* It should be noted that Scardovia was derived from the name of Italian microbiologist Vittorio Scardovi while wiggsiae was derived from American microbiologist Lois Wiggs [11,12].

Scardovia belongs to Bifidobacteriaceae family that have seven genera, and due to presence of great alterations in genome sequence , Scardovia became out of the genus Bifidobacterium[13]. The systemic classification of *Scardovia wiggsiae* is

"Domain: Bacteria
Phylum:Actinobacteria
Class: Actinobacteridae
Order:Bifidobacteriales
Family: Bifidobacteriaceae
Genus:Scardovia
Species: wiggsiae [14,15] ,,

Morphologically, *S.wiggsiae* is Gram positive anaerobic bacillus, non-spore forming, non-motile with dimensions of about 0.65 μm width and 1.6 to 4 μm length. It´s shape can be pleomorphic, tend to curved slightly with club-shaped arrangement.It can be found singularly ,in pairs or in short chains[16].

In biochemical caries formation, one of the most important factors to initiate caries is capacity of cariogenic bacteria to build up a biofilm[17] nevertheless, not all the oral bacteria can take part with the same pattern in the caries process[18]. The high metabolic rate, self protection from saliva and oral environments and ability to form organic acid that demineralize the hard tooth structure are important factors for cariogenic bacteria to grow within a biofilm[19].

Recarding to these points, *S.wiggsiae* was presented as important caries associated bacteria due to it´s ability to build up and acidification of the oral plaque [20,21].It is hetero-fermentative bacteria that can use different carbohydrates forming lactate and acetic acids as fermentation final end products[22].

Accordingly, *S.wiggsiae* can be considered as high acidogenic and aciduric bacteria as *S.mutans*[23], however with different metabolic pathway (called fructose-6-phosphate) from that of *S.mutans* glycolytic metabolic pathway[24].This enables *S.wiggsiae* to be to more acid tolerant and a high ecological competitive in low pH environments[23]. Furthermore, it has a saccharolytic hydrolyzing ability by producing a lot amounts of acetic acids and little-moderate of lactic and formic acids from breaking sugar molecules e.g.sucrose, glucose, fructose and so on[16,23].These large amounts of acetic acids have great chance to invade and decalcify enamel more than lactic acids[25]. As result of it´s advance acidurcity and acidogencity which can decrease the environmental pH up to 3.5[23] , *S.wiggsiae* can be considered as important pathogen in caries process together with other cariogenic players[10].

The normal habitat of the Bifidobacteriaceae family to which *S. wiggsiae* belongs, is present primarily in human and animals gastro-intestinal tracts[26]. Orally, *S.wiggsiae* is present in the saliva of children with early childhood caries and extensive early childhood caries[10] . A study done by Streiff *et al* 2017, insured the presence of *S.wiggsiae* DNA in the saliva of about 20 %of adults and 25% of pediatric patients[26]. Regarding counting *S.wiggsiae in oral cavity*, Zhou J *et al* 2016 found it in less than 0.1% of the oral microbiota; however, it can seriously influenced oral community leading to dysbiosis[27]. Nevertheless, Isaac R D *et al* 2022, noticed that *S.wiggsiae* can be one of the predominant bacteria in caries process comparing to mutans streptococci and lactobacilli[28]. Periodontaly,*S.wiggsiae* can be found in gingival cervices, gingival crevicular fluids [29],supragingival plaque sites as in the buccal region to upper molar area and lingually to lower incisor ,but to lower extent on ventral surface to the tongue [30].

Pathologically, Streiff BJ *et al* 2015 believed that the cause of moderate childhood gingivitis and adults periodontal pockets was due to the presence of *S.wiggsiae*[26]. Nevertheless, Chakrapani *et al* 2019, showed a lower concentration of *S.wiggsiae* in subgingival biofilm in both healthy patients and in gingivitis and chronic periodontitis patients[31]. .

In dental caries, *S.wiggsiae* usually occurs in initial enamel caries[32] affecting about 30% of children in the United States of America [11] . In addition, it was found in active, deep and soft dentinal lesions of both dentitions, deciduous and permanent teeth, [15]and greatly in infected pulpal tissue of children[33], explaining the ability of this bacteria to be active player in dental caries alone . *S.wiggsiae* also was present in root carious lesions and can reach up to 6% of it´s total microbiom [34] .Nevertheless *S.wiggsiae* can be more in dentinal lesions than plaque samples[35]. The presence of extra carious risks factors as fixed orthodontics appliances, may increase the prevalence of *S.wiggsiae* as they increase plaque accumulation and interfere with normal salivary self-cleaning[36] .

S.wiggsiae can be found in higher rate in both adult[26] and pediatric patients using fixed orthodontic appliances [37]. According to Mc Daniel *et al* 2021, more than 44 % pediatric orthodontic patients have *S.wiggsiae* in their samples[29].

In relation to smoking, *S.wiggsiae* has the ability to form more biofilms necessary for caries lesions in smoker compared to non-smokers patients[38].This can be explained as nicotine can exaggerate the cariogenicity of *S.wiggsiae* . [39]

Isolation of *S.wiggsiae* needs an anaerobic culture conditions[40] with pH 7, 5.5 till 5 that can obtains on neutral to acidic environments[11]. Downes J. *et al* (2011) modified a new selective media with acid indicator to isolate *S.wiggsiae* effectively called *S.wiggsiae* selective medium(SWSM) [16]. Nevertheless, polymerase chain reaction (PCR) can be the cornerstone

for isolation of *S.wiggsiae* using the known primers[41] .

Conclusions:

There was an evidence that *S.wiggsiae* could be considered an efficient cariogenic, acidogenic and acidruic oral bacteria that has many criteria, enablingto be used as a potential risk indicator for caries prediction in a given population. This would provide a useful information for future development of new strategies of caries diagnosis,prevention and treatment.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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