CODEN [USA]: IAJPBB ISSN: 2349-7750

INDO AMERICAN JOURNAL OF
PHARMACEUTICAL SCIENCES
SJIF Impact Factor: 7.187

Available online at: http://www.iajps.com Review Article

REVIEW ON PROPERTIES OF *STREPTOCOCCUS SALIVARIUS*

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Abstract:

Streptococcus salivarius is present in the oral cavity of healthy people within a few hours of birth, which is an opportunistic pathogen that can infect people with impaired immune systems. At the same time, S. salivarius also secretes antimicrobial peptides, which can be employed as a probiotic to promote dental health. This review mainly focuses on the properties of S. salivarius, which is widely recognized for its probiotic and anti-inflammatory properties. However, S. salivarius also can cause some diseases, such as meningitis, endocarditis, and neonatal sepsis. In conclusion, these bacteria have numerous beneficial characteristics, but they also have some functions in causing diseases, which need to be studied more thoroughly.

Keywords: *Streptococcus salivarius, probiotics, anti-inflammatory, antimicrobial peptides,Immune systems.*

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Please cite this article in press Xing Jiangwa et al., ***Review On Properties Of Streptococcus Salivarius****, 2024; 11 (02).*

INTRODUCTION:

Streptococcus Salivarius

Streptococcus salivarius is a gram-positive bacterium which is spherical, non-motile, non-sporing, and catalase-negative. It is a common member of the oral cavity in healthy individuals after a few hours of birth. *S. salivarius* is an opportunistic pathogen capable of infecting individuals with compromised immune systems. Studies showed Streptococcus salivarius secretes antimicrobial peptides, which can be used as a probiotic to improve oral health [1]. Electively anaerobic microorganisms that are found in the oral cavity have been studied for their probiotic properties and antimicrobial activity in the oral cavity and upper respiratory tract of humans [2].

S. salivarius K12 was the first strain used commercially to develop oral probiotics, and it helps to improve oral health and reduces halitosis, or bad breath [3][4]. *S. salivarius* is also present in the stomach and jejunum and plays an important role in digestive tract ecology [5]. The infection rate caused by *S. salivarius* is low in normal conditions; however, it may be higher in institutionalized persons, such as those staying in hospitals or long-term care institutions, immunocompromised patients, and those with poor dental hygiene or periodontal disease [23]. Biofilm formation by *S. salivarius* may also play a role in dental plaque formation and oral biofilm development, which can lead to dental caries and periodontal disease [25].

1.1 Properties of *S. Salivarius*

1.1.1 Anti-Inflammatory properties

Streptococcus salivarius is one of the first colonizers of the human oral cavity and gut after birth and therefore may contribute to establishing immune homeostasis and regulating host inflammatory responses. The anti-inflammatory potential of S. salivarius was first evaluated in vitro on human intestinal epithelial cells and human peripheral blood mononuclear cells[30].

Therefore they play a significant role in the tendency of the immune system to protect internal stability and also in regulating inflammation tendencies and responses [9,27]. Nowadays, as per the demand for health issues, discussion and research on the actions, reactions, and role of the microbiota are increasing [10].

When *S. salivarius* is segregated from the mouth or oral cavity, it shows inflammatory responses both in lab results and when applied to living organisms [11].

1.1.2 Probiotic

Probiotics are beneficial live bacteria that can improve our overall health when consumed in the right amount. It's essential to maintain a balance of these bacteria in our gut for a healthy digestive system[31].

They play a vital role in boosting the host's health. It is observed that *S. salivarius* secretes antimicrobial peptides that have rich probiotic properties [12,32].

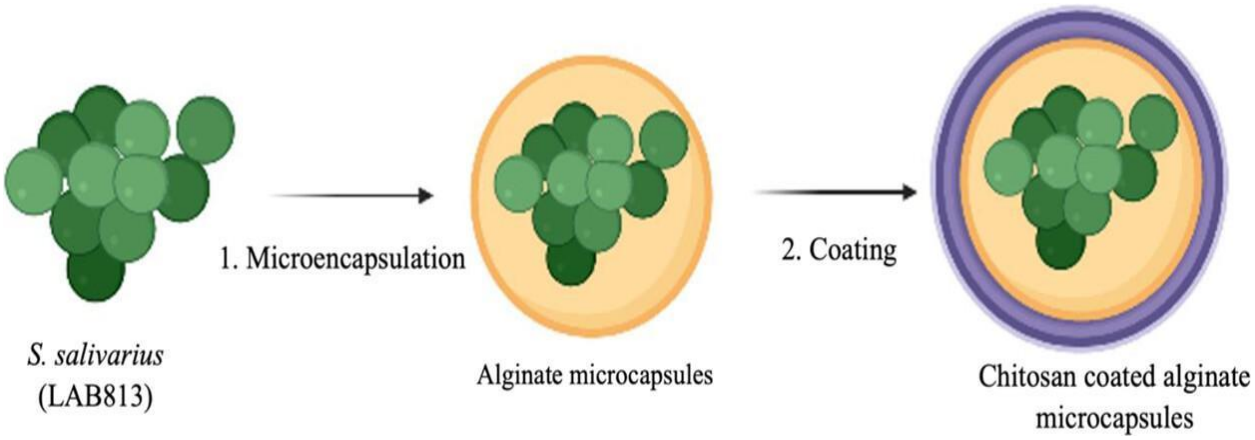

Fig. 1 : Microencapsulation of *S. salivarius* LAB813 [26].

The novel strain of Streptococcus salivarius was micro capsulated, as shown in [Fig. 1], which was first identified in the laboratory. These microcapsules enhance oral health due to their robust and prolonged inhibitory effects. *S. salivarius* generates bacteriocins to combat Streptococcus pyogenes. This production is highly influenced by the adhesive ability of bacteria on Kappa B (KB) cells. Few strains of *S. salivarius* produce bacteriocins, which can shield young children in school from pharyngeal infections. [13] M18 is a *S. salivarius* strain that was obtained from adult humans. It is extremely benign for humans since it does not possess any virulence factors or antibiotic resistance. [14] As per advanced research, there is another isolated strain called BIO5 that is also non-toxic and could be used as a probiotic therapy for different oral diseases like tonsils or sore throats. [15]

1.1.3 Antibiotic Resistance

Macrolides and tetracycline are the most widely used antibiotics for the treatment of infections caused by *Streptococci*. When some clinical, pathogenic, and commensal strains were isolated and analyzed using advanced techniques and methods like multilocus sequence typing (MLST), they exhibited astounding resistance to these antibiotics. Therefore, S. salivarius affects the oral and gastrointestinal dissemination of antibiotic-resistance genes[16].

When samples were collected from saliva and tissues around the tooth of the patient, its strains were analyzed using Active Pharmaceutical Ingredient (API) test systems to check their credibility against resistance to different drugs. E-tests and PCRs prove that *S. salivarius* is responsive to linezolid and meropenem. Surprisingly, *S. salivarius* also shows 23.5% resistance to penicillin, which is a notable figure. Other considerable resistances are to erythromycin, which is 47.9%; 44.4% to tetracycline; and last but not least, ofloxacin, which is 41%. It is of great importance to know how prone these organisms are to different antimicrobial drugs because they play a very vital role in the transmission of resistance determinants to more pathogenic and clinically relevant germs. [17]

Also, the above-mentioned resistance level is quite high in infants (2–8 months) and higher in 12- to 18-month-olds. There is a possibility that antibiotic-resistance genes are stored in the oral microbiome of healthy newborns by *S. salivarius*. That is why it is way more important to comprehend and track levels and their changes to resistance in this group of age. [18]

1.2 Role of *S. Salivarius* in Diseases

S. salivarius is part of the normal oral cavity and gastrointestinal tract microflora and an unusual cause of acute bacterial meningitis. Although this bacterium is usually nonpathogenic, in rare cases, it causes bacteremia, endocarditis, and meningitis. [19]

1.2.1 Meningitis

S. salivarius could be the originator of meningitis in some cases. [21] Though that is rare, reported cases of infection are spreading worldwide. Initial symptoms are the same as those of bacterial meningitis. These symptoms may include fever, pain in the neck, headaches, head spinning, etc. [20] Numerous investigations and case reports demonstrate that gastrointestinal cancer may be the source of the S. salivarius infection in cases of non-iatrogenic meningitis. The key cause of these phenomena is a disorder of the gastrointestinal mucosa [4].

Also, during different surgical procedures, vascular bleeding may occur. It sometimes allows peripheral blood to taint Cerebrospinal fluid(CSF). This contamination is one of the major causes of *S. salivarius* meningitis.

1.2.2 Endocarditis

The relationship between endocarditis and *S. salivarius* is quite certain [5]. It has been observed in a few cases that *S. salivarius* leads to endocarditis[29]. Owing to its hypoallergenic and nonirritating properties, this viridian species is a failure to catch. But it does not mean that it can be ignored, since *S. salivarius* can result in serious intricacy. It is observed in some cases that this bacterium may cause infective endocarditis, which in any case plays a role in originating mycotic aneurysms. So this peaceful bacterium that usually belongs to guts and oral issues must not be given the benefit of the doubt, but it should be diagnosed properly and seriously. [6] As reported in some cases, if cerebral mycotic aneurysms burst, it could be a lethal drawback of endocarditis. And it may also accompany a seriously deadly acute subarachnoid hemorrhage (SAH) [7].

1.2.3 Neonatal Sepsis

S. salivarius is typically located in the oral microbiota. Rarely and surprisingly, it may cause neonatal sepsis [22][23]. Neonatal sepsis is a kind of blood infection in infants younger than 90 days [8]. It could be a significant cause of death in neonates. It could be diagnosed by blood culture and saliva. The blood culture method is quite time-consuming and

expensive, whereas saliva is non-invasive, approachable, and easygoing [33].

Conclusion: *S. salivarius* is well-known for its probiotics and anti-inflammatory qualities. Besides, these bacteria have antibiotic resistance against some commonly used antibiotics. However, further research is required to fully understand the roles that these bacteria play in meningitis, endocarditis, and neonatal sepsis.

Declaration by Authors

Ethical Approval: Approved

Acknowledgment: None

Source of Funding: None

Conflict of Interest: The authors declare no conflict of interest.

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