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(REVIEW ARTICLE)

# *Streptococcus salivarius* K12: A comprehensive review on its role as a probiotic in pediatric and general health

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## Abstract

*Streptococcus salivarius* K12 (S. salivarius K12) is a pioneering probiotic strain derived from the human oral microbiota, known for its unique ability to enhance oral and upper respiratory tract health. This comprehensive review explores the background, mechanism of action, clinical applications, limitations, and evidence-based use of S. salivarius K12, with a special focus on its role in pediatrics. Evidence suggests that S. salivarius K12 helps reduce the incidence of upper respiratory tract infections (URTIs), otitis media, halitosis, and dental caries. Despite its promising benefits, challenges such as short-term colonization and variability in efficacy warrant further investigation.

**Keywords:** *Streptococcus salivarius* K12; Probiotics; Oral Microbiota; Pediatric Health; Upper Respiratory Tract Infections; Halitosis; Dental Caries; Immunomodulation; Evidence-Based Medicine; Microbial Therapy

## 1. Introduction

The role of probiotics in health and disease has gained significant attention over the past two decades. While probiotics have traditionally been associated with gut health, emerging evidence highlights their applications beyond the gastrointestinal tract. *Streptococcus salivarius* K12, a naturally occurring commensal in the human oral cavity, represents a promising probiotic strain with distinct applications in oral and respiratory health, particularly in children. This article reviews the scientific basis, applications, and limitations of S. salivarius K12 in clinical practice.

## 2. Background of *Streptococcus salivarius* K12

*Streptococcus salivarius* is a Gram-positive, facultative anaerobic bacterium predominantly found in the human oral cavity and upper respiratory tract. The K12 strain was first isolated from a healthy individual with a history of low incidence of streptococcal infections. It is distinguished by its ability to produce two specific bacteriocins, salivaricin A2 and salivaricin B, which confer antimicrobial activity against pathogens such as Streptococcus pyogenes and Haemophilus influenzae. This characteristic makes S. salivarius K12 a potential probiotic for maintaining oral and respiratory health.

## 3. Mechanism of Action

### 3.1. Bacteriocin Production

*S. salivarius* K12 produces salivaricin A2 and salivaricin B, antimicrobial peptides that inhibit the growth of pathogenic bacteria in the oral cavity and pharynx. These bacteriocins target specific bacterial strains, reducing the risk of infections such as streptococcal pharyngitis and otitis media.

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### 3.2. Competitive Colonization

*S. salivarius* K12 adheres to mucosal surfaces, forming biofilms that act as physical barriers against pathogenic colonization. This competitive exclusion reduces the likelihood of pathogen overgrowth in the oral and upper respiratory tract.

### 3.3. Immunomodulation

*S. salivarius* K12 enhances mucosal immunity by stimulating the production of secretory IgA, which plays a critical role in pathogen neutralization. It also interacts with immune cells to modulate inflammatory responses, promoting a balanced immune environment.

### 3.4. Neutralization of Volatile Sulfur Compounds

In cases of halitosis, *S. salivarius* K12 reduces the production of volatile sulfur compounds by altering the microbial balance in the oral cavity, thus improving oral odor.

## 4. Applications in Pediatric and General Health

### 4.1. Prevention of Upper Respiratory Tract Infections (URTIs)

URTIs, including pharyngitis and tonsillitis, are common in pediatric populations. Several studies demonstrate that regular use of *S. salivarius* K12 reduces the frequency and severity of URTIs by inhibiting pathogenic bacteria such as Streptococcus pyogenes.

#### *4.1.1. Key Evidence*

Di Pierro et al. (2016) conducted a randomized controlled trial (RCT) involving children with recurrent URTIs. S. salivarius K12 lozenges significantly reduced infection episodes compared to placebo.

### 4.2. Otitis Media Prevention

Otitis media, an inflammation of the middle ear, is a leading cause of pediatric visits. S. salivarius K12 has shown promise in preventing otitis media by suppressing pathogens like Streptococcus pneumoniae and Haemophilus influenzae.

#### *4.2.1. Key Evidence*

A 2020 study by Marchisio et al. found that children administered S. salivarius K12 had fewer episodes of otitis media and required fewer antibiotics.

### 4.3. Management of Halitosis

Halitosis, or bad breath, often results from microbial imbalances in the oral cavity. S. salivarius K12 neutralizes malodorous compounds and promotes a healthy oral microbiome.

#### *4.3.1. Key Evidence*

Burton et al. (2013) demonstrated that S. salivarius K12 supplementation reduced halitosis symptoms in 85% of participants within two weeks of use.

### 4.4. Oral Health

Dental caries and gum inflammation are prevalent in children. By producing bacteriocins and inhibiting cariogenic bacteria, S. salivarius K12 supports oral hygiene and reduces the risk of cavities.

### 4.5. Potential Use in Sinusitis and ENT Disorders

Emerging evidence suggests a potential role for *S. salivarius* K12 in managing sinusitis and other ENT disorders by modulating microbial flora and reducing inflammation.

## 5. Clinical Evidence

**Table 1** Key Studies on S. salivarius K12

| Study | Population | Intervention | Outcome | Reference |
|---|---|---|---|---|
| Di Pierro et al | Children with recurrent URTIs | *S. salivarius* K12 lozenges | ↓ URTI episodes, ↓ antibiotic usage | Pediatric ID J, 2016 |
| Marchisio et al | Children with otitis media | *S. salivarius* K12 tablets | ↓ Otitis media episodes, ↓ antibiotic courses | Int J Pediatric ORL, 2020 |
| Burton et al. | Adults with halitosis | *S. salivarius* K12 lozenges | Improved oral odor in 85% of participants | Oral Microbiol, 2013 |
| Guglielmetti et al | Children | Probiotic therapy | Improved oral microbiota balance | Int J Pediatric Health |

### 5.1. Limitations and Challenges

*5.1.1. Short-Term Colonization*

*S. salivarius* K12 colonization is transient, requiring regular supplementation for sustained benefits.

*5.1.2. Efficacy Variability*

Individual differences in oral microbiota may influence efficacy. Not all strains of *Streptococcus salivarius* exhibit probiotic properties.

*5.1.3. Regulatory and Standardization Issues*

Lack of uniform guidelines for probiotic dosages and delivery methods complicates clinical use.

*5.1.4. Cost and Accessibility*

High cost of probiotic formulations may limit widespread adoption in resource-limited settings.

## 6. Future Directions

### 6.1. Personalized Probiotic Therapy

Tailoring *S. salivarius* K12 formulations to individual microbiota profiles.

### 6.2. Combination Probiotic Formulations

Exploring synergistic effects with other probiotic strains.

### 6.3. Long-Term Studies

Conducting large-scale, multi-center RCTs to validate efficacy in diverse populations.

### 6.4. Applications Beyond ENT

Investigating its role in systemic diseases and immune regulation.

## 7. Conclusion

*Streptococcus salivarius* K12 is a promising probiotic with diverse applications in pediatric and general health. Its ability to prevent URTIs, otitis media, halitosis, and dental caries highlights its therapeutic potential. However, challenges such as short-term colonization and variability in efficacy necessitate further research. With ongoing advancements in probiotic science, *S. salivarius* K12 has the potential to become a cornerstone of preventive healthcare.

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## Authors short Biography

**Dr. Venugopal Reddy** is a distinguished Medical Director and Pediatrician at Ovum woman and Child Speciality Hospital in Bangalore, India. With extensive expertise in pediatric care, research, and community health initiatives, he has authored 100 plus research articles in Scopus and PubMed-indexed journals. He is actively involved in improving healthcare systems, child health awareness, and maternal well-being. His work has earned him recognition as one of the top professionals shaping healthcare in India.