Advances in Health Sciences Research, volume 32
Proceedings of the 1st Aceh International Dental Meeting (AIDEM 2019), Oral Health
International Conference On Art, Nature And Material Science Development 2019

Existence of Streptococcus Mutans and Streptococcus Sobrinus in Oral Cavity as Main Cariogenc Bacteria of Dental Caries

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ABSTRACT
Objective of this review is to give an overview about the role of *Streptococcus mutans* and *Streptococcus sobrinus* in dental caries pathogenicity. Both of these bacteria known as main agent of dental caries which has been succesfully isolated from patient with caries. We review current data on *Streptococcus mutans* and *Streptococcus sobrinus*based on open literature search of the topic.The causative agent for caries is called bacteriocaryogenic like mutan streptococci and lactobacilli sp. On reality, *Streptoccus mutans* and *Streptococcus sobrinus* are the most common caries related species isolated from human oral cavity. These bacteria form biofilm formation on tooth surface which is known as dental plaque. This formation help them to avoid immunity response in oral cavity. Moreover, existence both types of bacteria, because they have special characteristic which are not owned by other cariogenic bacteria that is acidophyllic. In general, dental caries remains a significant health problem worlwide, with a prevalence that is not yet decreasing in the developing countries like Indonesia. *Streptococcus mutans* and *Streptococcus sobrinus* are the bacterial species of mutan streptococci.

Keywords: *Streptococcusmutans, Streptococcus sobrinus, Dental caries, Dental biofilm*

1. INTRODUCTION

Dental caries is an infectious disease that is characterized by a progressive demineralization process in hard tooth tissue. The pathogenesis of this disease involves various interacting and synergizing factors, namely hosts (teeth and saliva), agents (microorganisms), substrate (diet containing sugar), and time. Saliva, substrate, and bacteriaform a layer of biofilm on the tooth surface which called dental plaque [1,2].

The role of the substrate in the pathogenesis of dental caries is very large because in the presence of the substrate, then the nutrients needed by bacteria to ferment through the process of glycolysis in which the byproducts in the form of acid are available. Acid produced from the fermentation process causes the plaque pH to drop below the critical point within 1-3 minutes. The decrease in pH over time will result in the dissolution of minerals in tooth enamel known as tooth demineralization. The process of demineralization that occurs continuously will result in the formation of white spots on the tooth surface which ultimately results in the formation of holes in the teeth. This condition is called dental caries [2,3].

Generally, children have a high caries risk. One factor that is directly related to the process of caries is dental and oral hygiene. Children tend to spend more time playing and pay less attention to the cleanliness of their teeth and mouth. In addition, children also usually like snacks and sweet drinks that have high sugar levels. This creates a very favorable environment for the microorganisms caused caries [4]. ***Streptococcal mutans*** *Streptococcal mutans* consist of several serotypes. The group of streptococcal mutants which associated with dental caries are *S. mutans* and *S. sobrinus*. Furthermore, these two types of bacteria are called *S. mutans* and are distinguished only from serotypes namely c and d. *S. mutans* taxonomy according to Bergey (1998), namely kingdom *Monera*; division*Firmicutes*;class *Bacilli*; order *Lactobacilalles*; family *Streptococcaceae*; genus *Streptococcus*; and species *Streptococcus mutans* (serotypes c, d, e, and f). *Streptococcus mutans* and *S.*

sobrinus are facultative anaerobic Gram-positive bacteria that grow as normal flora of the oral cavity and are known as the main causes of caries. In general these bacteria are round (coccus) shaped, form chains during their growth, are immovable (non-motile) and do not form spores with a diameter of 1-2 µm. These bacteria grow optimally at temperatures around 18-40 °C at a potential of Hydrogen (pH) 5.2-7 [5,6].

Streptococcus mutans hasacidogenic properties, which are properties of *S. mutans* which is able to produce acids from sugar/carbohydrate substrates. This bacterium can also metabolize sugars that produce acids such as lactic acid, formic acid, and acetic acid. Lactic acid is the strongest acid among the three. When the pH of dental plaque is below 5.5, the balance between enamel demineralization and remineralization is disturbed, which leads to dental caries. Sucrose is the sugar that causes dental caries because it can be fermented into lactic acid. Sucrose enters *S. mutans* cells and accumulates in the form of sucrose-6-phosphate which is hydrolyzed into glucose-6- phosphate and fructose which will be metabolized through the process of glycolysis. The process of glycolysis produces pyruvate which with the enzyme lactate dehydrogenase is converted to lactic acid. As much as 90% of the pyruvic acid produced will be converted to lactic acid [7,8].

Its aciduric nature allows these bacteria to survive in a low pH environment and increase their cariogenic potential. Unlike the majority of other oral cavity organisms, *S. mutans* can grow rapidly in an acidic environment. *S. mutans* metabolism increases at low pH because the proton motive system used to transport nutrients through its cell walls is modulated by increased hydrogen ions in an acidic environment. In this way, *S. mutans* can maintain the pH of the oral cavity at a low value, making conditions favorable for its metabolism. This low pH value causes demineralization and the formation of dental cavities that increase with increasing numbers of *S. Mutan* [9].

The acidogenic nature of *S. mutans* can cause ecological changes in the biofilm flora, such as the high composition of *S. mutans* and other acidogenic bacteria and acid-tolerant bacterial species. This will affect the virulence of *S. mutans* biofilms in causing dental caries. *Streptococcus mutans* has several virulence factors, namely *Glucosyltransferase* (Gtf), *Glucan-binding protein* (Gbp), and I/II antigen [10,11]. *Streptococcus mutans* produces the enzyme *glucosyltransferase* (Gtf). This enzyme acts as a catalyst in the formation of water soluble glucans (glucan glucose group bonds α (1-6)) and water insoluble glucans (glucan glucose group bonds α (1-3)) from the breakdown of sucrose. *Streptococcus mutans* produces at least three types of Gtf, namely Gtf B which synthesizes the most water-insoluble glucan polymers, Gtf C which synthesizes water-insoluble glucans and water-soluble glucans, and Gtf D synthesizes the water-soluble glucans. The glucan formed remains in the pellicle and provides attachment for *S. mutans* and contributes to plaque formation [11]. *Streptococcus mutans* has *glucan-binding protein* (Gbp), which is a receptor protein that has the ability to bind to glucans. *Glucan-binding protein* (Gbp) is different from Gtf. *Glucan-binding protein* (Gbp) has its own binding receptors and can also function as glucan receptors. This can increase *S. mutans* aggregation. There are four known types of Gbp: GbpA, GbpB, GbpC, and GbpD. These four types of proteins facilitate the adhesion of microorganisms and contribute to the formation of biofilms [12,14].

In addition, the *surface-associated protein* P1/SpaP, or so-called the I/II antigens, Pac, MSL-1, or B antigens, are genes associated with *S. mutans* attachment to the coated tooth surfaces by saliva. *Surface-associated protein* (SpaP) is a multifunctional adhesin that facilitates the binding of bacteria to the enamel component of the tooth enamel [13].

2. *STREPTOCOCCUS MUTANS* AS AN AGENT OF DENTAL CARRIES

The role of microorganisms is very important in the process of caries. The beginning of the caries process is an increase in the activity of microorganisms in the oral cavity. From several studies of bacteria in dental plaque, it turns out that *S. mutans* has a positive correlation with caries on the tooth surface [15].

Streptococcus mutans has certain properties that play an important role in the process of caries, namely *Streptococcus mutans*fermenting various types of carbohydrates into acids, resulting in a decrease in pH. In addition, *S. mutans* also has the property of forming and storing intracellular polysaccharides from various types of carbohydrates which can then be solved again by these bacteria so that they will produce acid continuously. Streptococcus mutans has the ability to form extracellular polysaccharides (dextran) which produce adhesive and cohesive properties of plaque on the tooth surface. *Streptococcus mutans* also has the ability to use glycoproteins from saliva on tooth surfaces [9,15].

The process of caries infection begins with the attachment of *S. mutans* to the tooth surface. This is because *S. mutans* has the glucosyltransferase (Gtf) enzymewhich can break down sucrose into glucans in large quantities. Glucose is a non-waterproof sticky solution that facilitates the aggregation of *S. mutans* and its attachment to the tooth surface. The presence of glucan binding protein (Gbp) facilitates the attachment of *S. mutans* to other microorganisms and contributes to plaque formation. Furthermore, *S. mutans* forms organic acids from sucrose. The metabolism of sucrose by *S. mutans* produces lactic

acid which is an acid that can cause demineralization of tooth structure [15,16].

Streptococcus mutans is able to metabolize carbohydrates to become acidic so that the pH of saliva and plaque pH decreases to below the critical point which can ultimately cause dissolution of enamel. There are several factors that cause *S. mutans* is considered to have an important role in the occurrence of dental caries, including its ability to make acid faster in sucrose with a lower pH than *Lactobacillus*. It is also capable of producing the optimum pH of 5,5 required for tooth demineralization. *Streptococcus mutans* is also acidogenic and aciduric, thus increasing cariogenic potential [17,18].

3. CONCLUSION

The attachment of *S. mutans* and *S. sobrinus* to the tooth surface which forms a biofilm is carried out by glucotransferase. Both bacteria have the ability to produce lactic acid as one the products produced from the carbohydrate fermentation process. This ability is known as acidogenic. In addition, the two bacteria also have the ability to adapt to an acidic environment called acidophilic. This characteristic is not shared by other cariogenic bacteria. So that *S. mutans* and *S. sobrinus* are known as the main bacteria for dental caries.

ACKNOWLEDGMENT

This is acknowledge that we received funding for research of Lektor Kepala from Universitas Syiah Kuala in cash for the implementation of the Project "Molecular Identification of *Streptococcus mutans* and S*treptococcus sobrinus* Isolated From Supragingival Dental Plaque of Patient With Various Level of Caries".

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