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The Role of Streptococcus mutans in Tooth Decay

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Abstract

Streptococcus mutans is considered among the most important microbes that cause dental caries on its own and in its presence in association with types of Streptococcus bacteria, such as Streptococcus sobrinus, with which it produces acids that provide an acidic environment in the oral cavity and teeth. In our study (100 specimens) of dental caries were collected by swap into transport media (invasive sterile collection), from patients that they visit the Educational Clinics of the Dentistry Collage/ University of Babylon, during (April-2022). And they cultured by using modified (Mitis Salivarius Agar Base) (MSAB), with addition of bacitracin antibiotic and sucrose, the results were 36 positive samples, and 64 negative samples.

Keywords:

Streptococcus mutans, Tooth decay, Streptococcus sobrinus.

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Introduction

Streptococcus mutans is a Gram-positive facultative anaerobic bacterium, which is abundant in the human oral cavity and contributes significantly to dental caries [1, 2]. It is one of the genus "Streptococcus". The microbe was first described by James Killian Clark in 1924 [3]. S. mutans lives with and is closely related to Streptococcus sobrinus in the oral cavity, both of which contribute to oral disease. Tooth decay is the erosion that occurs to the teeth due to acids produced by bacteria due to some bad habits, such as excessively eating sweets, and not brushing the teeth regularly, which leads to the accumulation of bacterial waste, and thus decay occurs. Tooth decay may lead to the formation of yellow to black cavities. Symptoms associated with caries include pain and difficulty in eating and drinking [4].

Bacteria in the mouth convert glucose, fructose, and sucrose into acids such as lactic acid through a glycolysis process called fermentation [5, 6]. The acids that are formed cause demineralization, which leads to a dissolution of the tooth's mineral content. A good brushing of the teeth with fluoride toothpaste may help in re-mineralization.

As the process of demineralization continues over time, enough mineral content will be lost to decompose the soft organic matter, forming a cavity or hole in the tooth itself due to this process. The effect of sugars contributes to the progression of dental caries, especially sucrose, followed by glucose and fructose in the strength of the effect.

The use of Strep mutants for energy in the polysaccharide bond between the glucose and fructose units is sufficient to form a biofilm on the tooth, and it works to convert sucrose into a highly adhesive substance called dextran polysaccharide by the enzyme dextranscranase [7]. In many cases, even when you continue brushing your teeth, saliva contributes to the formation of a coating of bacteria, leading to the formation of (biofilm) because biofilms are constantly forming. The minerals in the hard tissues of the teeth are found in each of (enamel, dentin and cement).

Tooth decay may result quickly when the rate of demineralization of the teeth is faster than the rate of re-mineralization due to a net mineral loss that is more than the normal limit that can be compensated for. This process occurs due to the environmental transformations that occur within the biofilms of the teeth. The environment here is transformed from a balanced environment

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of a group of microorganisms to an acid-producing environment (acidic environment) [8].

Normally, bacteria live naturally in the human mouth, along with more than 25 other types of bacteria. The areas of the mouth differ in that they contain different numbers of bacteria, and each type of these bacteria has its own distinctive characteristics that make it colonize the place in which it is located. Mutant streptococci are the most prevalent among the holes and cracks of the teeth, as they constitute about 39% of the bacteria that reside in the human mouth, while a smaller number of them were found living on the surface, ranging between (2 – 9 %). *Strep. mutants* may be harmless (normal in the mouth), but under certain circumstances due to not cleaning the teeth well, or due to unhealthy food such as consuming excessive sugars, they can transform with some microbes from harmless bacteria to opportunistic and antagonistic bacteria causing many diseases [9].

Materials and Methods

Materials:

A Transport media, test tube, loop and glass, rack, flask, pipette, petri dish, spreader, injection water and distilled water.

B Mitis. Salivarius. Agar (M.S.A.), Brain Heart Agar (B.H.A.), Bacitracin, Incubator, Oven, Autoclave, Refrigerator, Gram-stain.

Methods:

Morphological examination of *S. mutans* was carried out using Gram-stain according to information documented in Burgess Manual of Bacteriology / 9th edition (1994) [10]. Distinctive colonial morphology on selective and non-selective agar, Gram staining, and distinct cell shape on light microscopy. Morphologically, isolated Gram-stained Streptococcus mutans were viewed by medical light microscopy at under 40x magnification. The observed colonies ranged in size for about (0.5 - 1 μm).

Results

The bacterial cells of *S. mutans* after cultured on modified (Mitis. Salivarius. Agar. Base.), resemble chains of cocci as beads in their arrangement, as shown in (Fig-1), and the morphological test of *S. mutans* isolates by using medical microscope, after (Gram-Stain).

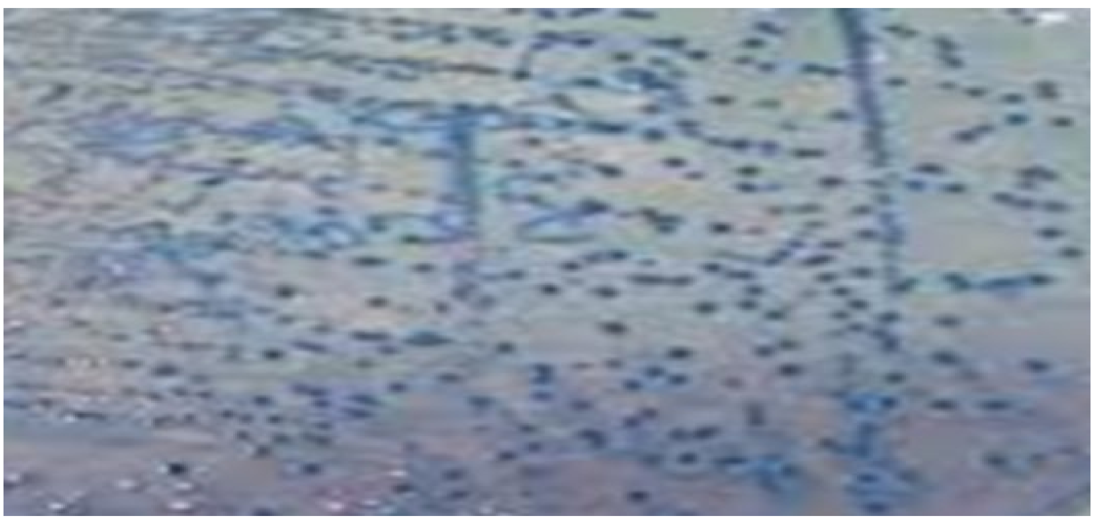

Figure (1): shown *S. mutans* colonies on modified (Mitis. Salivarius. Agar. Base.)

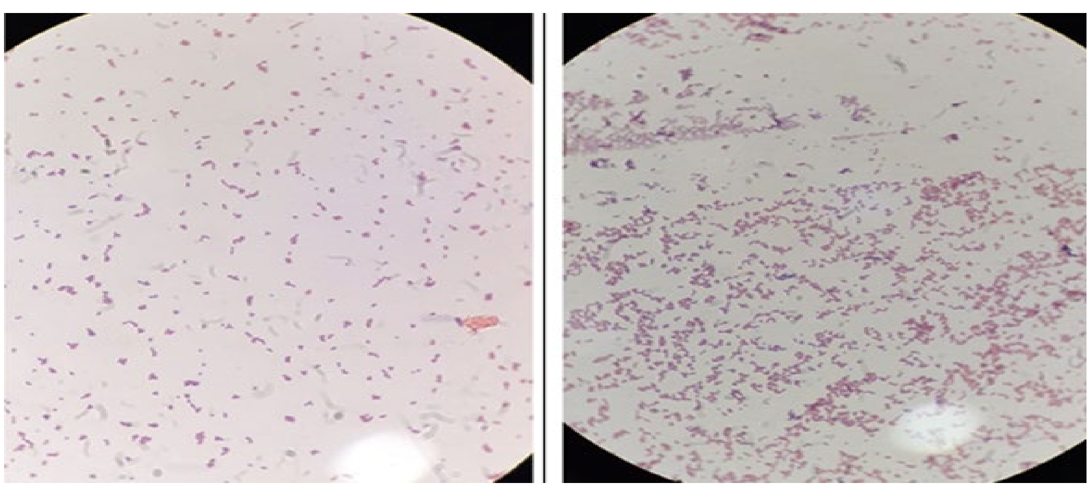

Figure (2): Morphological examination of isolates by using medical microscope, after (Gram Stain)

Discussion

S. mutans is the main bacteria contributing to tooth decay and enamel disintegration, and it is found naturally on most surfaces of teeth, especially in places that are difficult to clean such as pits and fissures. According to the method of Al-Mudallal et. al. [5], Naji [11], they proved that the Mitis-Salivarius Bacitracin Agar (MSB-agar) is a selective media [12], which used for cultivation of *S. mutans*. It was prepared by addition of selective agents bacitracin-antibiotic, potassium tolerate and sucrose [13]. The addition of the antibiotic bastracin is in order to kill the remaining microbes that may be present in dental caries samples [14], while the *S. mutans* is highly resistant to this type of antibiotic when it present with sucrose. Mitis-Salivarius Agar (M.S.A.) is the major component of this prepared modified media, which allows the growth of *S. mutans*. This media was prepared according to the manufacturer's instruction by dissolved (90gm) of M.S.A in (1000ml) distill-water. After the sterilizing by autoclave at (121 ºC, 1.5 bars\square inch) for 15minutes, and left to cool until (45ºC) [15, 16].

A bacitracin antibiotic stock-solution was prepared by dissolved (0.2661 gm) of bacitracin powder in (100ml) of deionized-water. After the sterilization of the Mitis-Salivarius Agar (M.S.A.), and left for cooling, (200gm/L) of sucrose was added for providing concentration. Sucrose solution was sterilized by Millipore-filter (0.4 µm). Sucrose can inhibit the growth of *S. sobrinus* and *S. cricetus* and enhance the growth of *S. mutans* [17, 18]. *S. mutans* is the second type of bacteria that works on creating early colonies in the teeth after *Neisseria* [19]. Its role begins in its ability to change the environmental conditions in the teeth, such as the pH, and the availability and accumulation of its constituent substances, which help the rest of the microbes more stable than continuing colonization after them[20, 21], thus forming plaques on the surface of the teeth [22]. *S. mutans* plays an important role in dental caries, as it exists along with *S. sobrinus*, where they both convert sucrose into lactic acid, using the enzyme glucan-sucrose [23]. The acidic environment developed by these two types of bacteria is the main factor in weakening tooth enamel and making it susceptible to erosion. Also, *S. mutans* is one of the few bacteria that possesses special receptors that improve its adhesion to the surface of the teeth [24]. It uses sucrose to produce a sticky sugary substance based on dextran, which allows it to bond and form dental plaque [25]. Sucrose is the only sugar that *S. mutants* use to form these sticky sugars. It can digest glucose, fructose, and lactose, and produce lactic acid as a final product of this digestion process, which leads to plaque and tooth decay. Due to the important role of *S. mutans* in the occurrence of dental caries, a number of health institutions have made a vaccine for this disease, but so far these vaccines have not been spread in the commercial markets. Recently, proteins used by *S. mutans* during caries have been used to produce antibodies. It is believed that *S. mutans* acquired the genes that enable it to produce biofilms that enable it to transfer genes with other types of bacteria that produce lactic acid [26].

Conclusion

In our study on the role of *S. mutans* in dental caries, we reviewed the most important factors with which *S. mutans* contributes to the occurrence of caries, as is the case when it is associated with *S. sobrinus*. It is the second most influential bacteria in caries, after Neisseria. Through our current study, the most important conditions in which bacteria grow vigorously were identified, and their role in producing acids that provide the appropriate environment for caries to occur. The most important types of antibiotics (Bacitracin) that *S. mutants* are resistant to are also highlighted.

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