CHAPTER 1

INTRODUCTION

1.1 Introduction

Oral health and diseases investigation revealed that several types of oral bacteria have a worldwide distribution among individuals. Dental caries, gingivitis and chronic periodontitis are types of oral diseases (Sahril et al., 2014). Periodontal disease is an inflammatory chronic disease characterised by inflamed gingiva, bleeding on probing and attachment loss between the tooth and alveolar bone (Slots, 2017).

Periodontal disease is believed to affect at least one tooth in 80% of adults worldwide (Tsai et al., 2018). The inflammation was generally caused by an increase in the number of bacterial pathogens in the oral plaque (Zhang et al., 2016). Oral bacteria in humans interact with their surroundings by adhering to surfaces and forming mixed-species communities because it is easily accessible. Each bacteria cell that adheres creates a new surface on which more bacteria cells might attach.

Streptococci are early colonizers in establishing early dental plaque, including *Streptococcus gordonii* (*S. gordonii*). However, *Fusobacterium nucleatum* (*F. nucleatum*) is involved between early and late colonizers. The presence of *Porphyromonas gingivalis* (*P. gingivalis*) and *Treponema denticola* (*T. denticola*) are usually required for the late colonization of bacteria in the oral (Zhu et al., 2013).

According to Djais & Tope (2017), miswak or siwak is very popular and commonly used in Africa, South America, the Middle East and Asia as a medicinal

plant called *Salvadora persica* (*S. persica*). Miswak can protect the oral cavity, gastrointestinal tract, and heart from oral disease. Besides that, the sticks of *S. persica* were found to be more effective when compared with synthetic toothbrushes for oral hygiene and they can treat gum inflammation (El-Latif Hesham & Alrumman, 2016). Several studies have indicated that the sensitivity of oral pathogens to *S. persica* extracts is equivalent to or higher than antibiotics commonly used in the periodontal treatment (Mekhemar et al., 2021).

1.2 Background of the Study

Even though microbiota has been widely studied concerning periodontal health and disease, the discovery of microbial profiles that could identify various types of disease remains unclear. Bacterium and virus exposure is the main aetiological factor in most diseases (Thomson et al., 2012). Microorganisms that are most implicated in periodontal disease included *Aggregatibacter actinomycetemcomitans* (*A. actinomycetemcomitans*), *Porphyromonas gingivalis* (*P. gingivalis*), *Prevotella intermedia* (*P. intermedia*), *Tannerella forsythia* (*T. forsythia*), *Treponema denticola* (*T. denticola*), *Peptostreptococcus micros* (*P. micros*), *Fusobacterium nucleatum* (*F. nucleatum*), *Eikenella corrodens* (*E. corrodens*), *Campylobacter rectus* (*C. rectus*), *Eubacterium nodatum* (*E. nodatum*), and *Capnocytophaga* spp. (Martu et al., 2017). Many virulence factors can be produced by periodontopathogens, destroying periodontal tissues. In some pathogenic bacteria, biofilm formation regulates the formation of virulence factors, such as exopolysaccharide synthesis, biofilm formation, swarming motility, pigment creation, and antibiotic production (Noumi et al., 2017).

Bacteria in tooth plaque have been demonstrated to be capable of beginning the processes of destruction of periodontal tissues, and efficient control is the most effective way of preventing the development of periodontal disease (Slots, 2017). *Streptococcus mutans* (*S. mutans*) mainly exist in biofilms on tooth surfaces or known as dental plaques. The formation of biofilms will occur when there is an interaction of bacteria with each other (Contardo et al., 2011). Furthermore, the presence of *P. gingivalis* in periodontal pockets has been associated with the development of periodontal disease and is related to the pocket depth (Septiwidyati & Bachtiar, 2020).

Herbal medicine has long been used to treat dental plaque, control microorganisms, and maintain oral health. *S. persica* is a native plant from Iran and the Middle East that has historically been used for oral hygiene (Khan et al., 2020). When using *S. persica* as a chewing stick, it possesses cleansing efficacy, the ability to remove plaque, and the potential to reduce gingival bleeding. In addition, phosphorus, calcium, minerals, fluoride, polyphenolics, flavonoids, phenolic compounds, glycosides, terpenes, sterols, and alkaloids have been discovered that are biologically active in *S. persica* (Al-Judaibi, 2020).

In addition, certain products that contain fluoride with greater fluoride concentrations are effective in preventing dental caries (Khunkar et al., 2021). Studies have shown that ethanol extract of *S. persica* at 25 mg/mL, 50 mg/mL, and 100 mg/mL shows a significant growth inhibitory activity against *S. mutans*, *Streptococcus sanguinis* (*S. sanguinis*), and *Streptococcus salivarius* (*S. salivarius*) (Balto et al., 2017).

1.3 Statement of the Problem

Dental diseases may progress into severe complications, including dental caries and periodontitis. This is due to poor oral hygiene which can be pathogenic. Many researchers have conducted studies in identifying oral bacteria. However, there is still a lack of studies regarding the types of oral bacteria in the Malaysian population.

Antibiotics are one of the common drugs that are used to treat oral diseases. Most patients are given antibiotics that are effective against a vast variety of Gram-positive and Gram-negative bacteria, which influences on the oral microbiota. For example, beta-lactamase antibiotics, nitroimidazole, macrolides, lincosamide, fluoroquinolones and tetracycline. According to previous reports, amoxicillin is the most prescribed antibiotic in dental practice (Lang & Lindhe, 2015). Nevertheless, bacteria can develop antibiotic resistance to medicinal drugs over time. Nowadays, medicinal plants from natural products such as *S. persica* have known worldwide especially in Middle East countries because people believed herbal remedies are free from dangerous chemicals and adverse effects. Thus, the antibacterial activities of SPSE against selected oral bacteria from subgingival plaque were conducted in this study because oral bacteria strain from the Malaysian population has not been tested.

1.4 Objectives of the Study

The main objective of this study is to identify oral bacteria from subgingival plaque and determine the antibacterial activities of SPSE against selected oral bacteria.

1.4.1 Specific Objectives

1. To identify the type of oral bacteria in subgingival plaque using 16S rRNA sequencing.

2. To determine the antibacterial activities of SPSE against selected oral bacteria.

3. To investigate the phytochemistry compositions of SPSE using Gas Chromatography-Mass Spectrometry (GCMS).

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