ABSTRAK

Karies gigi adalah masalah serius yang telah berdampak pada lebih dari dua miliar penduduk dunia. Karies gigi membutuhkan perawatan endodontik, tetapi kegagalan perawatan sering terjadi karena bakteri yang persisten. *Enterococcus faecalis* adalah bakteri yang paling banyak ditemukan dan memiliki prevalensi yang tinggi dalam kegagalan perawatan endodontik. Bakteri ini memiliki dinding sel peptidoglikan yang menyebabkan *Enterococcus faecalis* mampu bertahan hidup di lingkungan hipotonik dan kurang menguntungkan. Penghambatan *Enterococcus faecalis* agar tidak lagi persisten dalam saluran akar dapat dilakukan dengan cara menghambat muramidase A yang merupakan enzim penting dalam sintesis peptidoglikan. Penelitian terhadap bahan yang mampu menghambat enzim muramidase A dengan efek samping yang minim penting untuk dilakukan. Penelitian ini mengkaji potensi bahan herbal *Piper betle* Linn. yang selama ini diketahui memiliki aktivitas antibakteri. Penelitian difokuskan pada fraksi n-heksana karena sifatnya yang kurang toksik dibandingkan dengan jenis pelarut non polar lainnya. Tujuan penelitian adalah menganalisis aktivitas antibakteri fraksi n-heksana *Piper betle* Linn. terhadap *Enterococcus faecalis* dan menganalisis interaksi senyawa terpeniol dan α-terpinene *Piper betle* Linn. terhadap enzim muramidase A *Enterococcus faecalis*. Metode penelitian adalah penelitian *in vitro* untuk melihat zona hambat, Konsentrasi Hambat Minimum (KHM), dan Konsentrasi Bunuh Minimum (KBM), serta penelitian *in silico* untuk melihat interaksi terpeniol dan α-terpinene terhadap muramidase A *Enterococcus faecalis*. Hasil penelitian menunjukkan bahwa fraksi n-heksana *Piper betle* Linn. memiliki aktivitas antibakteri terhadap *Enterococcus faecalis* secara *in vitro*, yakni memiliki diameter daya hambat sebesar 13,5 mm pada konsentrasi 10% dengan kategori kuat, Konsentrasi Hambat Minimum (KHM) sebesar 10.000 ppm, dan Konsentrasi Bunuh Minimum (KBM) sebesar 20.000 ppm. Interaksi senyawa terpeniol dan α-terpinene *Piper betle* Linn. terhadap enzim muramidase A *Enterococcus faecalis* secara *in silico* menghasilkan *binding affinity* masing-masing sebesar -5,59 kcal/mol dan -4,94 kcal/mol, serta konstanta inhibisi masing-masing sebesar 80,34 µM dan 238,57 µM. Terpeniol memiliki kinerja yang lebih baik daripada α-terpinene untuk menghambat enzim muramidase A *Enterococcus faecalis.*

Kata Kunci: ***Enterococcus faecalis*, fraksi n-heksana, *in vitro, in silico*, *Piper betle* Linn.**

ABSTRACT

Dental caries is a serious problem that has affected over 2 billion people worldwide. Dental caries requires endodontic treatment, but treatment failure often occurs due to persistent bacteria. Enterococcus faecalis is the most commonly found bacterium and has a high prevalence in endodontic treatment failure. This bacterium has a cell wall composed of peptidoglycan, which enables Enterococcus faecalis to survive in a hypotonic and unfavorable environment. Inhibiting Enterococcus faecalis from persisting in the root canal can be achieved by inhibiting muramidase A, an important enzyme in peptidoglycan synthesis. Research on substances that can inhibit muramidase A with minimal side effects is important. This study examines the potential of Piper betle Linn.*, a herbal material known for its antibacterial activity. The research focuses on the n-hexane fraction due to its less toxic properties compared to other nonpolar solvents. The objectives of this study are to analyze the antibacterial activity of the n-hexane fraction of Piper betle* Linn. *against Enterococcus faecalis and to analyze the interactions of terpeniol and α-terpinene compounds from Piper betle* Linn. *with muramidase A enzyme from Enterococcus faecalis. The research methods included in vitro research to observe the inhibition zone, Minimum Inhibitory Concentration (MIC), and Minimum Bactericidal Concentration (MBC), as well as in silico research to observe the interactions of terpeniol and α-terpinene with muramidase A from Enterococcus faecalis. The results of the study showed that the n-hexane fraction of Piper betle* Linn. *has antibacterial activity against Enterococcus faecalis in vitro, with an inhibition zone diameter of 13.5 mm at a concentration of 10% with a strong category, Minimum Inhibitory Concentration (MIC) of 10,000 ppm, and Minimum Bactericidal Concentration (MBC) of 20,000 ppm. The in silico interactions of terpeniol and α-terpinene compounds from Piper betle* Linn. *with muramidase A from Enterococcus faecalis resulted in binding affinities of -5.59 kcal/mol and -4.94 kcal/mol, and inhibition constants of 80.34 μM and 238.57 μM, respectively. Terpeniol performed better than α-terpinene in inhibiting muramidase A from Enterococcus faecalis.*

***Keywords: Enterococcus faecalis, in vitro, in silico, n-hexane fraction, Piper betle* Linn.**