POTENTIAL OF PIPER BETLE L. EXTRACT AGAINST Streptococcus mutans AS ANTIBACTERIA

(Systematic Review)

THESIS

Submitted to complete one of the conditions

Achieving a Bachelor's Degree in Dentistry

BY :

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DEPARTMENT OF CONSERVATIVE DENTISTRY

DENTAL EDUCATION STUDY PROGRAM

FACULTY OF DENTISTRY

HASANUDDIN UNIVERSITY

MAKASSAR

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APPROVAL SHEET

Title : **POTENTIAL OF BETEL LEAF (PIPER BETLE L.) EXTRACT AGAINST STREPTOCOCCUS MTANS AS ANTIBACTERIA (Systematic Review)**

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FOREWORD

Praise and gratitude the author prays to God Almighty for His blessings and faithfulness, so that the author can complete the preparation of the thesis in the form of a Systematic Review entitled : **POTENTIAL OF PIPER BETLE L. EXTRACT AGAINST Streptococcus mutans AS ANTIBACTERIA**

The writing of this Systematic Review was made as a requirement to achieve a Bachelor's degree in Dentistry at the Faculty of Dentistry, Hasanuddin University. During the process of preparing this Systematic Review, the author received a lot of support, moral and material advice, advice and guidance from many parties. Therefore, on this occasion and with all humility the author would like to express his gratitude to:

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ABSTRAK

POTENSI EKSTRAK DAUN SIRIH (PIPER BETLE L.) TERHADAP *Streptococcus mutans* SEBAGAI ANTIBAKTERI

(*Systematic Review*)

Latar Belakang: Kesehatan gigi dan mulut merupakan hal yang penting bagi kesehatan umum seseorang, karena mulut yang sehat memungkinkan seseorang untuk makan, berbicara dan bersosialisasi tanpa mengalami rasa sakit dan tidak nyaman. Streptococcus mutans merupakan bakteri utama penyebab karies yang ditandai dengan adanya demineralisasis pada gigi. Karies gigi terjadi karena adanya interaksi dari beberapa faktor yaitu host , bakteri, substrat , dan waktu, yang merusak jaringan keras pada gigi. Telah banyak dilakukan penulisan ilmiah yang memanfaatkan bahan alam dan bertujuan untuk menghasilkan obat-obatan. Salah satu bahan alam yang sedang dikembangkan saat ini adalah ekstrak daun sirih (piper betle L.) Ekstrak daun Sirih (Piper Betle L.) merupakan salah satu jenis tumbuhan terna memanjat yang termasuk famili Piperaceae. Ekstrak daun sirih mengandung minyak atsiri yang terdiri dari bethelphenol, kavinol, seskuiterpen, hidroksikavinol, cavibetol, estragol, eugenol, dan karvakrol. Beberapa penulisan ilmiah menyatakan bahwa ekstrak daun sirih juga mengandung enzim diastase, dan gula dan tanin . **Tujuan:** Untuk memberikan informasi tentang potensi ekstrak daun sirih (Piper Betle L.) terhadap *Streptococcus mutans* sebagai antibakteri. **Metode:** Desain penulisan ini adalah systematic review. Dilakukan pencarian artikel melalui mesin pencari database PubMed dan Google Scholar tahun 2012-2022. Kata kunci yang dimasukkan adalah: potensi ekstrak daun sirih (piper betle L.) terhadap *streptococcus mutans* sebagai antibakteri. Kriteria inklusi dan eksklusi ditentukan. **Hasil:** Berdasarkan pencarian diperoleh 296 artikel dan dilakukan skrining sehingga hanya memperoleh 5 artikel yang memenuhi. **Kesimpulan:** Didapatkan hasil yaitu pada konsetrasi 5%, 10%, 15%, 20%, dan 25% dapat menghambat pertumbuhan bakteri streptococcus mutans serta didapatkan juga hasil pada konsentrasi 80% memiliki aktivitas antibakteri terhadap bakteri streptococcus mutans karena mengandung senyawa alkaloid, tanin dan minyak atsiri yang berperan sebagai antibakteri terhadap bakteri streptococcus mutans.

Kata kunci: Karies, Streptococcus Mutans, Ekstrak daun sirih (*Piper Betle L.*)

ABSTRACT

POTENTIAL OF PIPER BETLE L. EXTRACT AGAINST STREPTOCOCCUS MUTANS AS ANTIBACTERIA

(Systematic Review)

Backgrounds: Dental and oral health is important for a person's general health, because a healthy mouth allows a person to eat, talk and socialize without experiencing pain and discomfort. Streptococcus mutans is the main bacteria that causes caries which is characterized by demineralization of the teeth. Dental caries occurs due to the interaction of several factors, namely the host, bacteria, substrate, and time, which damages the hard tissues of the teeth. There has been a lot of scientific writing that utilizes natural ingredients and aims to produce medicines. One of the natural ingredients currently being developed is betel leaf (piper betle L.). Betel leaf (Piper betle L.) is a type of climbing herb belonging to the Piperaceae family. Betel leaf contains essential oils consisting of bethelphenol, kavinol, sesquiterpenes, hydroxycavinol, cavibetol, estragol, eugenol, and carvakrol. Some scientific writings state that betel leaf also contains the enzyme diastase, and sugar and tannins. Purpose: To provide information about the content of betel leaf extract (Piper Betle L.) against Streptococcus mutans as an antibacterial. Methods: The design of this paper is a systematic review. Search articles through the PubMed and Google Scholar search engine databases for 2012-2022. The keywords included are: the potential of betel leaf extract against Streptococcus mutans as an antibacterial. The inclusion and exclusion criteria were specified. Results: Based on the search, 296 articles were obtained and carried out so that only 5 articles were met. Conclusion: The results obtained are that at concentrations of 5%, 10%, 15%, 20%, and 25% can inhibit the growth of streptococcus mutans bacteria and get results at a concentration of 80% have antibacterial activity against streptococcus mutans bacteria because they contain alkaloid compounds, tannins and oils. volatile which acts as an antibacterial against Streptococcus mutans bacteria.

Keywords: Caries, Streptococcus Mutans, Bethel leaf (Piper Betle L.)

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CHAPTER 1

PRELIMINARY

1.1 Background

Dental and oral health is important for a person's general health, because a healthy mouth allows a person to eat, talk and socialize without experiencing pain and discomfort. The oral cavity is the gateway for the entry of various kinds of microorganisms into the body, these microorganisms enter with the food and drinks consumed.[1] Under certain circumstances these bacteria can turn into pathogens due to a predisposing factor, namely the lack of oral hygiene. The bacteria usually found in the mouth is Streptococcus mutans.[1]

*Streptococcus mutans*is one of the gram-positive bacteria that are nonmotile and facultative anaerobes that can metabolize carbohydrates. Streptococcus mutans is the main bacteria that causes caries which is characterized by demineralization of the teeth. Streptococcus mutans bacteria play a role in the formation and increase in plaque accumulation. The glucosyl transferase enzyme produced by Streptococcus mutans can facilitate the formation of glucans, thereby helping the attachment and aggregation of other bacteria to form plaque biofilms. plaque thatnot cleaned regularly will experience maturation. The pathogenicity produced by the bacterial complex can cause caries.[2] Streptococcus mutans bacteria have acidogenic and aciduric (acid-resistant) properties, which are the cause ofmajor cause of dental caries.[3]

Dental caries or cavities is a disease of the hard tissues of the teeth, namely enamel, dentin and cementum caused by the activity of microorganisms present in fermented carbohydrates.[4] Substrate (diet), and time, which damage the hard tissues of the teeth.[5]

Now there has been a lot of scientific writing that uses natural ingredients and aims to produce medicines. The use of natural ingredients as medicine in Indonesia has recently increased, the use of traditional medicines is considered to have fewer side effects compared to drugs derived from chemicals, besides that the prices are more affordable. betel leaf (piper betle L.) The Indonesian people

themselves have known betel leaf extract as an ingredient for betel nut with the belief that betel leaf extract can strengthen teeth, heal small wounds in the mouth, stop bleeding gums and as a mouthwash.[5]

Betel leaf (Piper Betle L.) is a type of climbing herb belonging to the Piperaceae family, betel leaf extract contains tannin compounds which have strong antimicrobial and antifungal properties and can inhibit the growth of several types of bacteria including Streptococcus mutans.[3] Betel leaf extract has also been widely used because betel leaf extract is commonly found in Indonesia as a medicinal plant.[4] Betel leaf extract contains essential oils consisting of bethelphenol, kavinol, sesquiterpenes, hydroxycavinol, cavibetol, estragol, eugenol, and carvakrol. Some scientific writings state that betel leaf extract also contains the enzyme diastase, and sugar.[6]

Based on the description above, the authors are interested in knowing about the potential of betel leaf extract (Piper Betle L.) against Streptococcus mutans as an antibacterial through a literature review.

1.2 Formulation of the problem

The formulation of the problem from this systematic review is how the potency of betel leaf extract (Piper Betle L.) as an antibacterial against Streptococcus mutans.

1.3 Writing purpose

1.3.1 General purpose

Provide information about the content of betel leaf extract (Piper Bitle L.) against Streptococcus mutans as an antibacterial through a literature study from researchers which is used as a reference for making this literature review.

1.3.2 Special Purpose

1. Provide information about the potential of betel leaf extract (Piper Betle L.) as an antibacterial against Streptococcus mutans
2. Provide information about the content of betel leaf extract (Piper Betle L.)

3. Provide information about the content of betel leaf extract (Piper Betle L.) which has potential against Streptococcus mutans as an antibacterial

1.4 The benefits of writing

1.4.1 General Benefits

This writing is expected to provide information about the potential of betel leaf extract (Piper Betle L.) as an antibacterial against Streptococcus mutans.

1.4.2 Special Benefits

Obtain scientific information about the potential of betel leaf extract (Piper Betle L.) against Streptococcus mutans as an antibacterial and can be used and developed as an antibacterial to prevent caries.

CHAPTER II

LITERATURE REVIEW

2.1 Oral Cavity Microorganisms

The oral cavity is a complex environment and can be a habitat for a wide variety of microorganisms. In the oral cavity there are teeth, mucosa, palate and tongue that form a species-rich heterogeneous ecosystem. Because there are various nutrients and conditions that have high humidity, colonization of various species of microorganisms can occur in the oral cavity.[28]

The oral cavity is one of the most complex communities of microorganisms in the human body. There are about 700 types of microorganisms in the human oral cavity. Microorganisms found in the oral cavity, including bacteria, fungi, and viruses. Balanced interactions between microorganisms and the oral cavity and between microorganisms are the basis of a healthy oral cavity.[28] However, excessive growth of microorganisms can disrupt the balance of the oral cavity and cause various diseases.[8]

2.2 Streptococcus mutans

2.2.1 Classification of Streptococcus mutans

The classification of Streptococcus mutans can be seen below:[29]

- Kingdom : Bacteria
- Subkingdom : Posibacteria
- Divsi : Firmicutes
- Class : Bacilli
- Order : Lactobacillales
- Family : Streptococcaceae
- Genus : Streptococcus
- Species : Streptococcus mutans

2.2.2 Morphology of Streptococcus mutans

Streptococcus mutans bacteria are gram-positive organisms, spherical (coccus) to oval in shape with a diameter of 0.5 – 2.0 nm, non-motile, immobile, non-sporing, and facultatively anaerobic.[9] Arranged in chains, non-motile, and negative catalyst. Streptococcus mutans colony morphology is opaque, 0.5 – 1.0 nm in diameter, rough surface (only 7% is smooth and mucoid).[10]

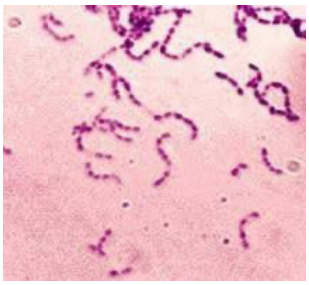

Figure 2.*1 Streptococcus mutans*

Source: Google Images

2.2.3 Overview of Streptococcus Mutans

*Streptococcus mutans*are Gram positive bacteria and are facultative anaerobes. Streptococcus mutans is a normal flora in the oral cavity and has multi-layered enveloped cells consisting of a cell wall and a cytoplasmic membrane. This cell wall consists of links between peptidoglycan, teichoic acid, polysaccharidesand proteins. This organism is mesophilic and can survive at temperatures ranging from 18-40oC.[11] The natural habitat of Streptococcus mutans is the human oral cavity, more specifically dental plaque, a biofilm that forms on the tooth surface.[12]

*Streptococcus mutans*is a commercial microorganism that has a number of characteristics that determine its pathogenesis under suitable environmental conditions. Most infections caused by these bacteria are a consequence of their proliferation in the human body.[13] Streptococcus mutans bacteria are the main cause of dental caries because: (1) its ability toto synthesize a large number of extracellular polymers from sucrose, which helps incolonization and development of extracellular polymer matrix in situ, (2) its ability to transport and metabolize various carbohydrates into organic acids (acidogenic), this ability is considered to

be able to change the local environment and create a favorable environment for other species to thrive, and (3) the ability of Streptococcus bacteria mutans to thrive in an unfavorable environment, especially at low pH (aciduric).[12]

2.3 Caries

Dental caries is an infection that attacks the oral cavity and is caused by bacterial destruction of the hard tissues of the teeth (email, dentin and cementum) caused by demineralization of enamel and dentin which is closely related to the consumption of cariogenic foods. teeth and saliva, bacteria in the oral cavity, and foods that are easily fermented.[14] Damage to the hard tissues of the teeth, if not treated immediately, will spread. If left untreated, cavities will cause toothache and pain, gum infection, tooth loss and even death.[15]

Figure 2.2 *An example of a dental caries visual. Source: Suratri L, Effects (pH) of saliva by Dental Caries occurrence in pre-School Children age.*

2.3.1 Caries Etiology

Dental caries is a multifactorial disease. Multifactorial factors, meaning that caries can occur when there are interrelated and supportive causal factors, namely the host (saliva and teeth), microorganisms, substrate and time.[16]

Microorganisms are a very important factor in the early caries process.The dominant microorganism in the formation and development of caries is Streptococcus mutans. The host (teeth) acts as a site for the interaction of these factors. Dietary carbohydrates can be a substrate for bacteria to form acids and synthesize exopolysaccharides. Time describes the duration of the interaction between the microorganism, the host (teeth), and the food. Plaque and dietary factors are interdependent in the spread of caries.[17]

In addition to the factors in the mouth that are directly related to caries, there are indirect factors called external Indonesian factors, which are predisposing factors and inhibiting factors for caries. External factors include age, gender, education level, economic level, environmental attitude, and behavior related to dental health.[18]

2.3.2 Caries Pathomechanism

Caries is the result of the interaction of several factors such as saliva, plaque, diet and oral hygiene, making it a multifactorial disease. These various factors do not stand alone. Plaque containing the bacteria Streptococcus mutans and Lactobacillus directly metabolizes sucrose to produce organic acids, especially lactic acid. As a result, plaque pH is below 5.5 and causes tooth surface demineralization. When plaque is continuously exposed to sucrose, the plaque pH will remain low and the demineralization process will continue. It takes about 20 minutes to 1 hour to return to normal pH after exposure to sucrose.[19]

At the demineralization stage, the enamel surface has not yet formed a cavity, but the enamel minerals have begun to dissolve, so that clinically the color change becomes whiter. Early carious lesions can return to normal by the process of remineralization. The fluorine ion remineralization process not only improves the enamel surface but also makes the enamel resistant to subsequent caries attacks and prevents the hydroxyapatite crystals from dissolving in the enamel. However, if local conditionschanges, that is, if the pH value is sufficientIf the height is >5.5, more hydroxyapatite, calcium and phosphate from saliva can be deposited on the tooth surface.[19]

When the demineralization of the inside of the enamel is so extensive, and the surface of the enamel does not receive sufficient support from the underlying tissue, a cavity will form. If a cavity has formed, then this condition can cause pain, discomfort, and if it spreads to the pulp, it can lead to infection and eventually sepsis and then tooth loss.[20]

2.3.3 Caries Prevention

The main objective of the prevention of dental caries is to reduce the number of cariogenic bacteria, and create conditions conducive to the remineralization process. In addition, prevention of dental caries also aims to improve living standards and prolong the usefulness of teeth in the mouth.[18] Plaque cleaning both mechanically and chemically to suppress the growth of Streptococcus mutans bacteria. Other prevention can be done by means of fluoridation, this makes the tooth surface more resistant to acid attack, and under certain conditions can stop the active caries process. Patients can also manage other risk factors such as a good diet, oral hygiene, use of mouthwash, dental care, and increase the consumption of foods that are healthy for teeth such as fruits and vegetables.[19]

2.4 Herbal Antibacterial

SourceNatural resources in the form of plants have provided many benefits in everyday life as well as food ingredients can also be used as traditional medicine.[21] The use of natural ingredients as medicine in Indonesia has recently increased, such as clove flowers, rosella flower petals and water. betel leaf extract. Even some natural materials have been manufactured on a large scale. The use of herbal medicines derived fromfrom nature can bealternative to reduce the side effects of synthetic drugs such as infection, hypersensitivity and discoloration of teeth.[22]

PThe use of traditional medicine is considered to have fewer side effects compared to drugs derived from chemicals, besides that the price is more affordable.4 Many herbal products have been shown to improve oral health by inhibiting the formation of biofilms, reducing the adhesion of pathogenic microorganisms to the tooth surface due to their antibacterial and antibacterial properties. antimicrobials.[23] Developments and scientific writings about alternative medicine using natural ingredients as inhibitors of bacterial growth are needed with the hope that treatment will be more effective, efficient and safe.[22]

2.5 Betel Leaf (Piper Betle L.)

*Piper Betle L.*Or better known as betel leaf is one of the climbing herbaceous plants belonging to the Piperraceae family. Betel leaf plants thrive throughout tropical Asia to East Africa, spreading in almost all regions in Indonesia, Malaysia, Thailand, Sri Lanka, India, to Madagascar.[6] Betel leaf extract is used as a plant to treat various diseases. Treatment with betel leaf extract has traditionally been proven to be able to cure diseases and increase body fitness.[4]

Figure 3. Betel Leaf Plant (Piper Betle L.)

Source: Novita W. Antibacterial Activity Test of Betel Leaf Fraction (Piper betle L.) Against Streptococcus mutans Bacterial Growth In Vitro.

2.5.1 Benefits of Betel Leaf (Piper Betle L.)

The benefits of betel leaf extract have been used for generations in Southeast Asia. Nyoya Kloppenburg Vesteegh, an expert on medicinal plants native to Indonesia, onthe 1930s recommended the use of betel leaf extract for gargling if the mouth is swollen, periodontal disease, halitosis control, and to stop blood and clean wounds when teeth are extracted.[6] The main components of Indonesian betel leaf extract have antiseptic, bactericidal, and antioxidant effects. . The chemical content is antiseptic because the betel leaf extract contains atsiri oil.[6]

2.5.2 Botanical Classification of Betel Leaf (Piper Betle L.)

The following is a Botanical classification of the Betel Leaf plant.[24]

- Kingdom :*Plantae*
- Subkingdom :*Tracheobionta*
- Super division :*Spermatophyta*
- Division :*Magnoliophyta*
- Class :*Magnoliopsida*
- Sub Class :*Magnoliidae*
- Order :*Piperales*
- Family :*Piperaceae*
- Genus :*Piper*
- Species :*Piper Betle*

2.5.3 Betel Leaf Content (Piper Betle L.)

Betel leaf extract contains tannins which have strong antimicrobial and antifungal properties and can inhibit the growth of several types of bacteria.[4] Betel leaf extract contains various ingredients consisting of bethelphenol, kavikol, sesquiterpenes, hydroxycavinol, cavibetol, estragol, eugnol, and carvakrol. Some scientific writings also state that betel leaf extract also contains diastase enzymes, sugars and tannins.[6] The chemical content is antiseptic because betel leaf extract contains essential oils. The antibacterial power of betel leaf extract essential oil is due to the content of phenolic compounds and their derivatives that can denature bacterial cell proteins.[6]

On green betel leaf extractcontains alkaloid compounds that differentiate between green betel leaf extract and red betel leaf extract. Alkaloids are one of the secondary metabolites that are commonly found in nature and have physiological activities. The ability of alkaloids as an antibacterial with a mechanism that interferes with the peptidoglycan constituent components in bacterial cells, so that the cell wall layer is not fully formed and causes cell death.[25]

Generally, alkaloids in plants are bound to organic acids to form salts. These salts are extracted with suitable organic solvents. Ethyl acetate and chloroform solvents have semipolar properties so that they can dissolve alkaloids well. Based on this description, researchers are interested in conducting research (Isolation, identification of alkaloid compounds and testing the effectiveness of the inhibition of betel leaf extract (Piper betle L.) against bacteria, with the dilution method to prove whether betel leaf extract can inhibit bacteria.[26]

2.5.4 Antibacterial Activity of Betel Leaf (Piper Betle L.)

Betel leaf extract has high antibacterial activity.[6] The antibacterial properties of betel leaf extract are phenolic compounds and their derivatives, especially tannins and flavonoids. The antibacterial mechanism of phenolic compounds in killing bacteria is by denaturing cell proteins. Phenol compounds will bind to proteins so that hydrogen bonds are formed which will cause the protein structure to be damaged. The toxicity of tannins can damage bacterial cell membranes through reactions with cell membranes, enzyme inactivation, and inactivation of genetic material functions, and the content of polar tannins makes it easier to penetrate the polar peptidoglycan layer on the bacterial cell wall and cause lysis.[6] also eugnol compounds which are bactericidal by increasing the permeability of bacterial membranes.[6]

2.6 Theoretical framework