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Review Article

Pharmacology study of peperomia pellucida : A scoping review

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ABSTRACT

People have long used various plants for traditional medicine. One of the medicinal plants used by local communities is suruhan or Chinese betel (Peperomia pellucida). Peperomia pellucida has various local names, such as suruhan, Chinese betel, worm grass, earth betel, pansit-pansitan, glass grass, and Chinese siheah daing. in this study we will examine the pharmacological effects of the Chinese betel plant. suruhan plants are used in traditional medicine in various ways, depending on the type of disease. the method to be used in this study is marseration extraction using 96% ethanol. The most widely used part of the plant is the leaves.with test animals namely mus muculus. Chinese betel contains various bioactive compounds, such as alkaloids, flavonoids, sterols, tannins, saponins, triterpenoids, carbohydrates, phenols, azulenes, carotenoids, and quinones. Chinese betel is very potential to be developed as an herbal medicinal material, including antibacterial, anticancer, and antifungal. in further research, it is necessary to develop better dosage formulations to improve stability, bioavailability, and ease of use of Chinese betel-based products.

Keywords:
peperomia pellucida, anti-cancer, anti-bacterial, anti-inflammatory, anti-fungal

INTRODUCTION

Indonesia is an archipelago that has a diversity of plants and biological resources from tropical forests. These various biological resources are the nation's assets that can be used for the development of herbal medicines based on medicinal plants in an effort to be independent in the health sector. compounds that have been proven as active compounds are secondary metabolite groups such as coumarins, flavonoids, terpenoids, alkaloids (Abriyani, 2018).

Chinese betel (*Peperomia pellucida L.*) has traditionally been used by the community in treating several diseases. The ability of Chinese betel (*Peperomia pellucida L.*) as a medicinal plant is thought to be related to the antioxidant content in the plant. From the results of the phytochemical screening conducted by Angelina et al (2015), the Chinese betel plant (*Peperomia pellucida L.*) contains alkaloid compounds, flavonoids, saponins, tannins and triterpenoids. With the compounds contained in Chinese betel plants (*Peperomia pellucida L.*) it can be assumed that this plant can inhibit bacterial growth (Karomah, 2019).

Chinese betel (*Peperomia pellucida L.*) is a herbaceous plant that belongs to the family of Piperaceae. It grows in areas that are not so dry. Generally in areas that are not so buried, for example on rocks, damp walls, in fields and yards and even on the edges of ditches. Chinese betel plants (*Peperomia pellucida L.*) have traditionally been used by the community in treating several diseases. The ability of Chinese betel (*Peperomia pellucida L.*) as a medicinal plant is thought to be related to the antioxidant content of the plant. From the results of several studies that have been conducted, it shows that Chinese betel leaf plants have potential as anti-inflammatory, have antipyretic, antimicrobial and anti-cancer effects, it is known that Chinese betel leaf plants contain chemical compounds of the

glycoside, flavanoid, tannin and steroid / tripernoid groups (Yuliani et al., 2022).

The use of suruhan leaves for medicinal purposes is empirically used by the community as a medicine for gout, heart disease, cancer, antidiabetes and is used in fresh form (fresh vegetables), infusion and decoction. The form of infusion and decoction of suruhan leaves and stems is used for the treatment of gout, arthritis, inflammation, lowering cholesterol levels in the blood, as cancer, diabetes, kidney disease, and burns. The bioactive compounds contained in the suruhan plant are alkaloids, flavanoids, saponins, triterpenoids and tannins (Angelina et al., 2015; Imbar et al., 2019; Mutee et al., 2010; Pratiwi et al., 2021).

Acne is a common skin problem that occurs in adolescents to college students, and the use of cosmetic products with natural ingredients is increasingly in demand by the public. The use of Chinese betel leaf (*Peperomia pellucida L.*) as a raw material in the manufacture of beauty serum to treat acne problems. The Chinese Betel has flavonoid content which has the ability as an antibiotic against the growth of bacteria that cause acne and antioxidants to neutralise free radicals, eliminate fine lines or wrinkles on the skin so as to suppress the aging process. Chinese Betel Plant (Peperomia Pellucida) is widely spread in various places including in the house yard and is considered as a Moisturizer or facial moisturiser is a very popular skin care by all ages from teenagers to adults. In this case, Mopellucida (Moisturizer Peperomia Pellucida) is a product that is still new and no one has sold it. Based on this, we made Mopellucida products. This product is rich in helping neutralise free radicals to overcome thin skin, dry skin and help eliminate fine lines or wrinkles on adult skin (Yasmin et al., 2024).

The Chinese betel has been a beauty and health secret since ancient times. ranging from maintaining healthy skin to helping with digestive problems. Its high antioxidant and antibacterial content makes Chinese betel a prima donna in the world of alternative medicine. chinese betel plant classification as followsKingdom: Plantae, Division: Magnoliophyta, Class: Magnoliopsida (Dicotyledona), Subclass: Magnoliidae, Order: Piperales, Family: Piperaceae, Genus: Peperomia Ruiz & Pav, Species: pellucida. This study also indicates that Chinese betel can be used to overcome various health problems, in accordance with the content or pharmacological effects of Chinese sish, namely as anti-cancer, anti-bacterial, anti-inflammatory, anti-fungal, analgesic.

Literature review research on Chinese betel nut plants makes a significant contribution to the development of natural medicines in the pharmaceutical field. By summarising various previous studies, this literature review helps research determine the development of drug formulations and product development of the Chinese betel plant. thus opening up opportunities to make new medicinal drugs made from Chinese betel. this study aims to determine the pharmacological effects of Chinese betel leaves (*peperomia pellucida L*). provide recommendations for further research to support the development and optimal use of Chinese betel, and can open up new opportunities for its use in the pharmaceutical and medical fields.

METHODS

A systematic search was conducted using the google scholar database, which yielded a total of 3,676 articles and another database of 3,415 articles published between 2015 and 2024. To ensure comprehensive coverage, a combination of keywords was used: 'anti-bacterial', 'anti-cancer', 'anti-microbial', 'anti-inflammatory', and 'anti-fungal.' In addition, the search was limited to articles within the focal areas of pharmaceutical sciences, biology, and cosmetics fields. The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework was adopted to guide the article selection process. The process involved three main stages such as identification, screening, eligibility, and inclusion. Relevant keywords were identified by consulting previous studies and expert recommendations. This initial search resulted in a total of 3,466 articles. Based on the established inclusion and exclusion criteria detailed in Table 2, a total of 879 articles were deemed eligible for further review. These criteria related to literature type (journal) and field of study (pharmaceutical & biological sciences, cosmetic field). Full text access was obtained for 879 potentially relevant articles. After a rigorous review process informed by inclusion and exclusion criteria, 29 articles were identified as suitable for further in-depth analysis.

Table 1. Inclusion and Exclusion Criteria

Criteria	Feasibility	Exceptions
Year	Articles published at least in the year 2015	< 2015
Jurnal type	Journal article	Journal article review, books, book series
Fields in google scholar	Pharmacy science, biology science, and the field of cosmetics	Field of economics, Business, Psychology, Energy, Arts & Humanities

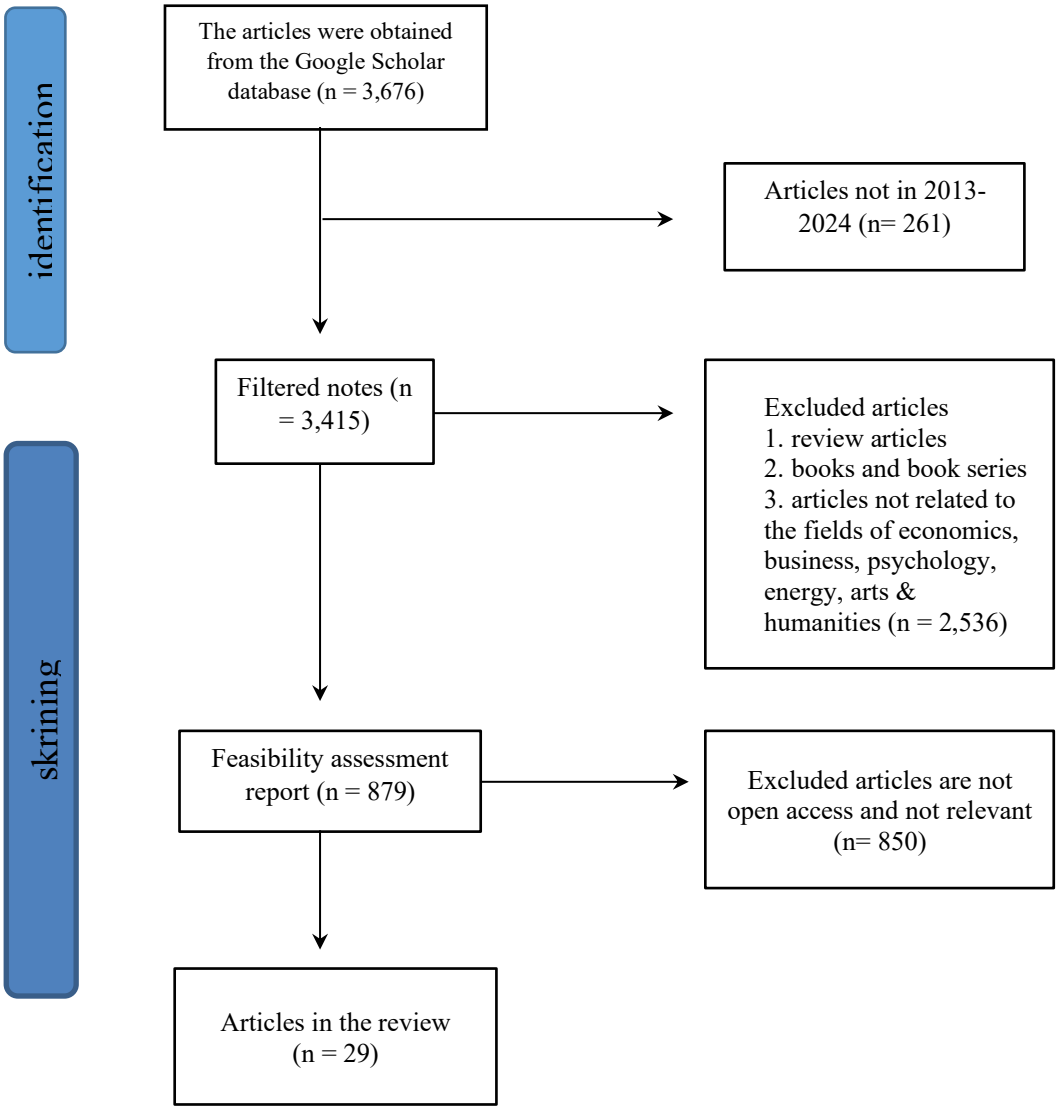

Figure 1. Data selection and extraction

RESULTS AND DISCUSSION

This section presents analyses of 29 selected articles, focusing on the themes, pharmaceutical sciences, biological sciences, and cosmetics fields, and project outcomes (summarised in Table 2).

Table 2. Selected Study Analyses

No	Author	Solvent	Sample section	Test animals/microbes	Extraction method	Pharmacological effects
1	(Abdullah et al., 2021)	70% ethanol	Leaf	Mus musculus	Not specific	Anti-microbial
2	(Teoh et al., 2021)	Metanol and etanol	Not specific	Staphylococcus aureus, salmonella typhi, e. Koli, and p. Aeruginosa	Not specific	Antibacterial
3	(Kartika et al., 2022)	N-heksana, etil asetat, 96% etanol	Not specific	Mus muculus	Maceration	Antibacterial
4	(Saputri et al., 2021)	Etanol dan aquadest, n-heksana, diklorometana, and etil asetat	Not specific	Mus musculus	Maceration	Anti-inflammatory
5	(Kartika et al., 2020)	Etil asetat, n-heksana and metanol and petroleum eter	Not specific	Not specific	Maceration	Not specific
6	(Shaffie et al., 2023)	Aquadest and etil asetat	Leaf	Not specific	Solid-liquid	Antibacterial
7	(Hidayati, 2021)	Etanol and n-heksana	Not specific	Mus muculus	Maceration	Not specific
8	(Putra et al., 2024)	Aquadest	Not specific	Mus muculus	Maceration	Analgesic and anti-inflammatory
9	(V. S. Putri et al., 2023)	Not specific	Leaf	Mus muculus	Maceration	Analgesic and antidiabetic
10	(Imansyah & Hamdayani, 2022)	Etanol and aquadest	Leaf	Propionibacterium acnes.	Maceration	Antibacterial
11	(Putu et al., 2024)	Not specific	Leaf	Staphylococcus saprophticus	Maceration	Antibacterial
12	(N. P. Putri et al., 2023)	Etanol 96%, aquadest,hcl	Leaf	Not specific	Maceration	Antioxidant
13	(Karomah, 2019)	Etanol 70%	Leaf	Staphylococcus aureus and staphylococcus	Maceration	Antibacterial
14	(Togelang et al., 2023)	Etanol 96%	Leaf	Artemia salina l.	Maceration	Anti cancer
15	(Kurniadi et al., 2024)	Etanol 96 and aquadest	Not specific	Propionibacterium acnes	Maceration	Anti-inflammatory
16	(Sari, 2023)	Etanol 96 and amonia	Stem	Rattus norvegicus	Maceration	Depridemen
17	(Yuliani et al., 2022)	96% etanol	Leaf	Propionibacterium acnes	Maceration	Antioxidant
18	(Fauziah & Arianti, 2023)	Not specific	Leaf	Not specific	Maceration	Anti-acne
19	(Yekti Rahayu & Tyas Asih Surya Mentari, 2024)	Sodium lauryl sulfate	Leaf	Not specific	Maceration	Antibacterial, anti-fungal
20	(Andriani et al.,	70% etanol	Leaf	Not specific	Maceration	Antimikrobial

No	Author	Solvent	Sample section	Test animals/microbes	Extraction method	Pharmacological effects
	2022)					
21	(Endriyatno & Puspitasari, 2023)	96% etanol	Leaf	Not specific	Not specific	Antibacterial
22	(Hasanah et al., 2020)	Aquades	Leaf	Escherichia coli	Not specific	Antibacterial
23	(D. Putri et al., 2023)	Etanol	Leaf	Not specific	Not specific	Antibacterial
24	(Ninsih et al., 2022)	Etanol	Leaf	Staphylococcus aureus	Not specific	Antibacterial
25	(Faizah et al., 2022)	Etanol	Not specific	Mus muculus	Maceration	Imunomodulator
26	(Abadi & Eulis, 2023)	Etanol 96%	Leaf	Not specific	Maceration	Antibacterial
27	(Angelina et al., 2015)	Etanol 96%	Leaves, stems, flowers, fruits	Propionibacterium acnes	Maceration	Not specific
28	(Trianingsih et al., 2021)	Etanol 96%	Not specific	Propionibacterium acnes	Maceration	Antibacterial
29	(Widjayanti & Setiawan, 2022)	Metanol	Leaf	Staphylococcus aureus	Maceration	Antibacterial

Solvents Used

This section presents diagrams of 29 selected articles, focusing on the solvents used (summarised in figure 2).

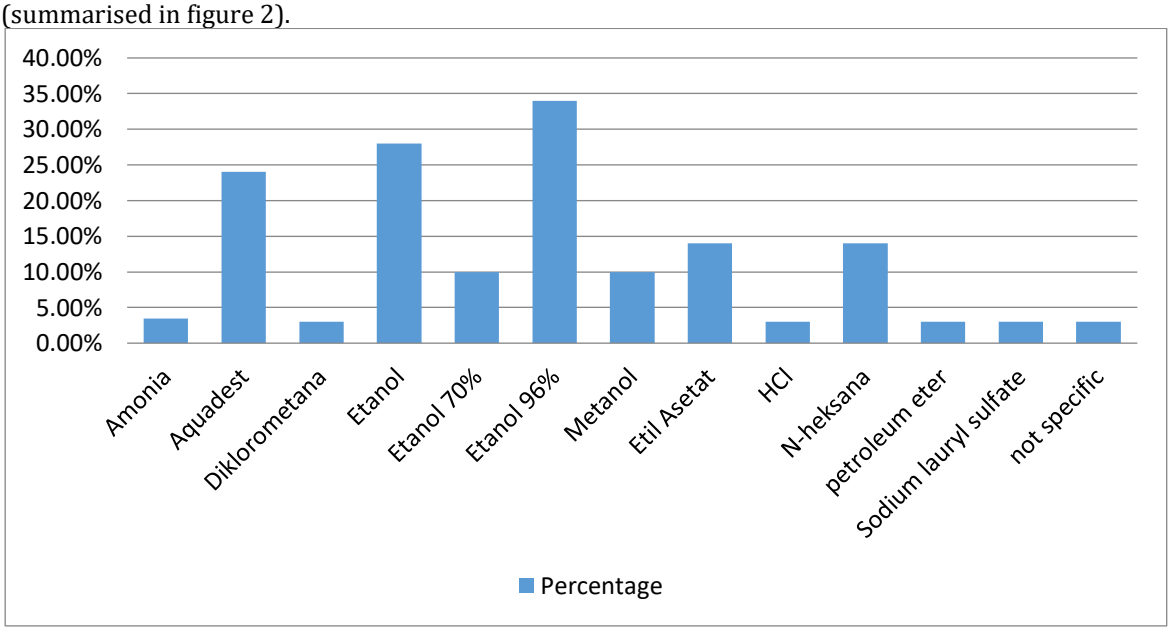

Figure 2. Diagram of Solvents Used

This bar chart provides an overview of the frequency of use of various types of solvents in the study. Based on the diagram, 96% ethanol was the most widely used solvent with 34% usage. The next widely used solvent was ethanol without a specific concentration, accounting for 28% usage. The next widely used solvent is aquadest with 24%. Then ethyl acetate and N-hexane with 14% usage. Followed by 70% ethanol and methanol with 10% usage. And solvents such as ammonia, dichloromethane, HCL,

petroleum ether, and sodium lauryl sulfate with the least use of about 3.45% to 3%. There are also solvents with an unspecified category of 3%.

It can be seen that ethanol is widely used in research or experiments, because ethanol has polar properties, where the molecule has positively and negatively charged parts. This polar property allows ethanol to dissolve various types of compounds, including polar compounds such as flavonoids, tannins, and alkaloids which are found in Chinese betel. The advantages of ethanol solvents are easy to find, universal, and cheap (Candra et al., 2021). Furthermore, distilled water, distilled water is widely used in Chinese betel research to extract polar compounds. Ethyl acetate is a semi-polar solvent and will dissolve semi-polar compounds, n- hexanes are non-polar solvents that will dissolve non-polar compounds (Kartikawati et al., 2023). Methanol can be used as a solvent for Chinese betel extract, because methanol is a polar solvent that can dissolve the active compounds of Chinese betel. Solvents such as ammonia, dichloromethane, HCL, petroleum ether, and sodium lauryl sulfate are only slightly used, because these solvents have limitations in their use for the extraction of active compounds from betel nut, such as ammonia, dichloromethane, and HCL have corrosive properties. Then there is the "unspecific" category, which refers to a mixture of solvents such as ethanol and water that are often used to extract compounds (Saputri et al., 2021).

Based on the results of the solvent diagram analysis, it can be concluded that ethanol is the most commonly used solvent in the extraction of active compounds from Chinese betel nut. Ethanol has moderate polarity, so it is able to dissolve various types of compounds, both polar and non-polar. Although ethanol is effective in extracting various compounds from betel nut, other solvents can also be used for the same purpose. Like distilled water, distilled water also has polarity, lower extraction efficiency than organic solvents. And there is also the solvent methanol, methanol is similar to ethanol and is also often used for initial extraction and its toxicity is higher than ethanol.

The concentration of ethanol greatly affects the results of the extract obtained. The use of ethanol as a solvent can be combined with water which is expressed in units of percent (%) and can also be used as a parameter in the extraction process. The ethanol-water combination produces differences in the polarity concentration of the extraction solvent. The concentration of ethanol determines the hydrophobic strength in the dissolution process and the strength of hydrogen bonds or van der Waals forces of the target component in the dissolution and extraction process of the target component. Referring to the theory of similarity and intermixability, the more similar the polarity of the solvent to the solute, the faster the dissolution of the solute from plant cells. When the ethanol concentration is greater than 70%, the extraction rate of the target component decreases slightly, possibly because protein denaturation increases diffusion resistance at higher ethanol concentrations (Fan et al., 2020; Thoo et al., 2013).

Types of Sample Sections Used

This section presents diagrams of 29 selected articles, focusing on the types of sample sections used (summarised in figure 3).

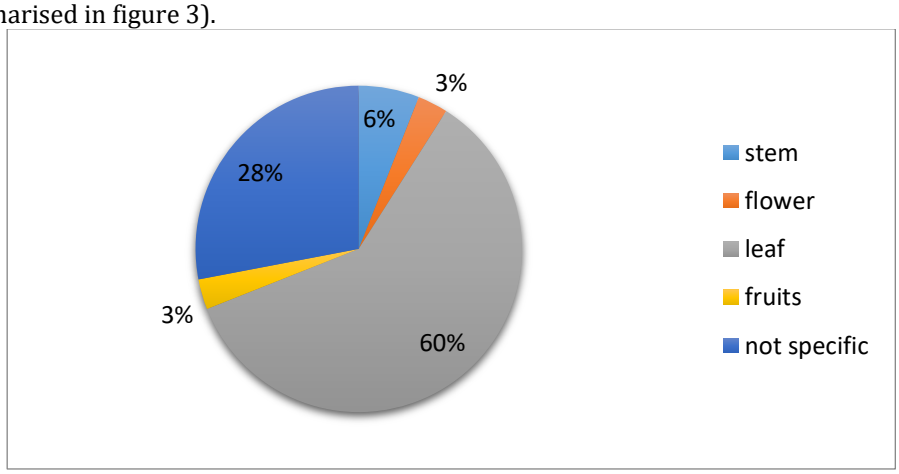

Figure 3. Diagram of the Sample Parts Used

The red betel plant parts used as samples in this study were 60% of the samples used were the leaves. Then as much as 28% of the unspecified parts used from Chinese betel plants. The remaining 6% of the stem, 3% of the fruit, and 3% of the flower.

The large number of leaves as samples indicates that Chinese betel leaves contain bioactive compounds that are widely studied and have significant pharmacological potential. As many as 28% of the samples used did not have clear specifications of plant parts (Teoh et al., 2021), this could be due to the sample being a mixture of various plant parts such as pieces of stems or leaves. Then the stem as the third widely used sample part, the active compounds in the stem (such as alkaloids and saponins) which are different from the leaves make additional information about the pharmacological potential of Chinese betel. The use of fruit and flower parts as samples is less than leaves and stems, it can be due to the content of active compounds lower than other parts.

It can be seen from the 29 articles obtained that the leaf part of Chinese betel is the most widely used part because it contains a much higher concentration of bioactive compounds than other parts of Chinese betel, such as flavonoids, phenols, and alkaloids. These compounds have a variety of interesting pharmacological activities, such as antioxidant, anti-inflammatory, and antimicrobial.

A good wound healing process is characterised by the quality of granulation tissue formation. The thicker the granulation tissue, the shorter the wound healing process. The increase in granulation tissue formed is thought to be due to the effect of active compounds such as saponins, tannins, flavonoids, phenols, and essential oils. The content of active compounds in Chinese betel leaves can help the wound healing process with different cellular mechanisms, namely as anti-inflammatory, antimicrobial, and antioxidant (Mutiarawati et al., 2022).

Test Animals or Microbes Used

This section presents diagrams of 29 selected articles, focusing on the animals or microbes used (summarised in figure 4).

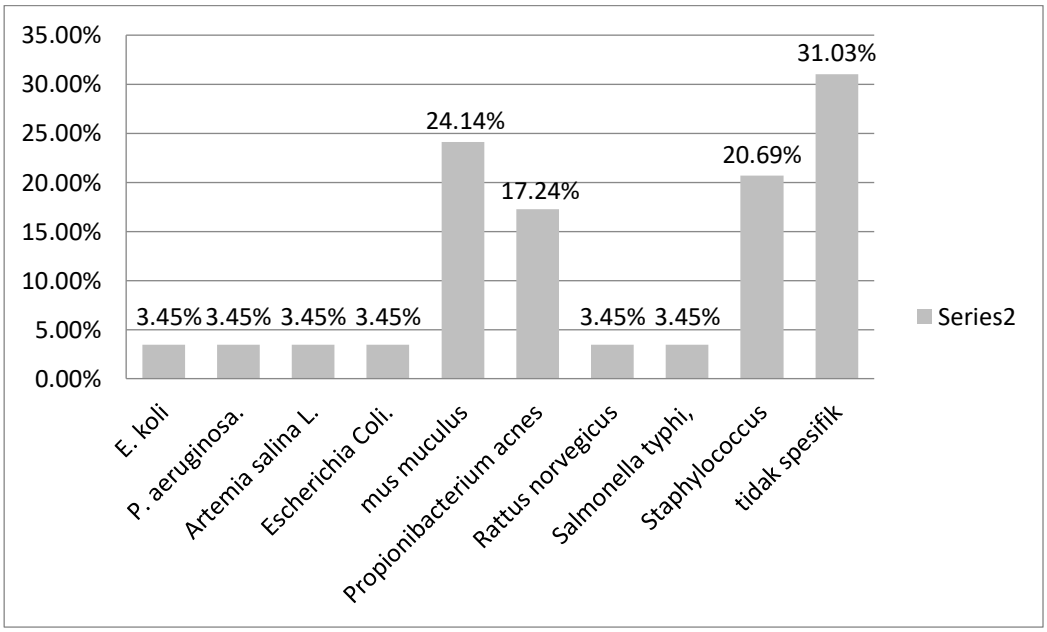

Figure 4. Diagram of Test Animals or Microbes Used

This research test involves various types of animals or microbes. From the diagram, it can be seen that the unspecified category has the highest percentage of use at 31.03%. Mus musculus with a percentage of 24.14%. Staphylococcus with a percentage of 20.69% was the third most used. Then Propionibacterium acnes with a percentage of 17.24%. And the rest are E. coli, P. aeruginosa, artemia salina L, Escherichia coli, rattus norvegicus, and salmonella typhi with the same percentage of 3.45%.

The existence of an unspecific category could be due to the fact that information about the organisms used was not recorded completely or in detail in the research data obtained or because the research focused more on the effect of a treatment on organisms in general, rather than on a particular

species. Mus musculus is widely used in research because the use of Mus musculus as a test animal has many advantages including relatively easy handling, low price, large number of breeds, small size, and has physiological similarities with humans. Research on the biological activity of Chinese betel focuses on its antimicrobial potential, especially against bacteria, P. aeruginosa, artemia salina L, Escherichia coli, rattus norvegicus, and salmonella typhi. The use of various types of pathogenic and non-pathogenic bacteria indicates an attempt to map the broad spectrum of antibacterial activity of Chinese betel extract.

Mice (Mus musculus) are one of the rodents most commonly used as animal models in various biomedical studies. Mice share significant genetic similarities with humans. Many genes found in mice are also found in humans, allowing researchers to study various human diseases, such as cancer and diabetes.

In this study, the experimental animals used were mice (Musmusculus L). Mice (Mus musculus L) are one of the experimental animals that are often used in laboratories commonly referred to as white mice. Mice have characteristics: Red eyes, pigmented skin, body weight varies, but generally at the age of four weeks the body weight reaches 18-20 grams. Adult mice can reach 30-40 grams at the age of six months or more. Now have a variety of fur colours that arise and a variety of strains (Smith and Mangkoewidjojo, 1988).

Extraction Methods

This section presents diagrams of 29 selected articles, focusing on the extraction methods used (summarised in figure 5).

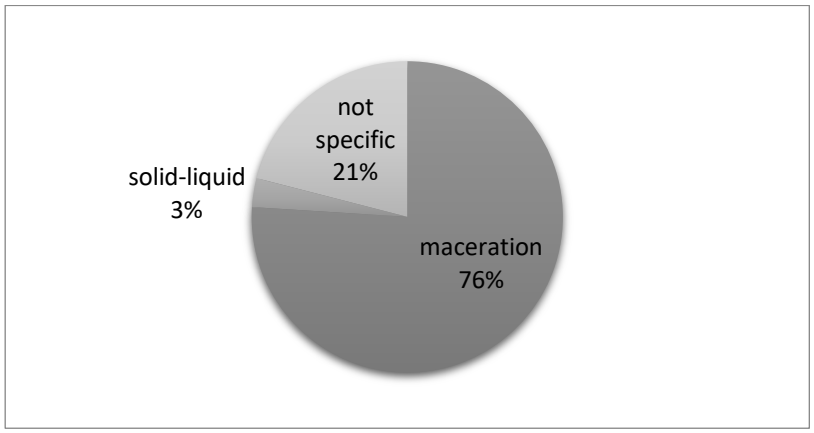

Figure 5. Extraction Method Diagram

This pie chart provides an overview of the extraction methods used in a study. In the circle diagram, the highest percentage category is the maceration method, the percentage is 76%. Furthermore, in the second order is the non-specific method with a percentage of 21%. Then the last is solid-liquid with a percentage of 3%.

The diagram in Figure 5 provides an overview of the extraction methods used in a study. There are three main categories of extraction methods used, namely the most common extraction method used in this study. Maceration is the process of immersing plant material in a solvent for a specified time with periodic shaking. This method is simple and often used to extract active compounds from natural materials. The solid-liquid extraction method involves direct contact between solid materials e.g. plants and liquid solvents. This method is usually used for the extraction of more polar compounds compared to maceration. An example of a solid-liquid method is percolation. Then the unspecified category, this category includes various other extraction methods that do not fall into the above two categories. Most likely, this category includes methods that are more modern or specific to certain types of samples.

Maceration is the process of filtering simplisia by immersion using a solvent with stirring at room temperature. Maceration which is carried out by continuous stirring is called kinetic maceration while the repetition of solvent addition after filtering the first macerate and so on is called remaseration. In this research, the method used is the maceration method because this method is

simpler. This method can attract compounds that are resistant to heating and those that are not resistant to heating (RI, 2000).

Chinese betel leaf extract (Peperomia pellucida) was extracted at Yarsi University Herbal Laboratory. The extraction was carried out using the maceration method with 96% ethanol solvent. This is because the maceration extraction method uses simple procedures and equipment and is not heated so that natural ingredients do not become decomposed, and the use of solvents is in accordance with Puspitasari's 2017 research, namely the maceration method using 96% ethanol solvent (Puspitasari & Syam, 2017).

From the diagram in Figure 5, it can be concluded that maceration is the method most often chosen by researchers in this study, due to the simplicity and effectiveness of this method to extract active compounds from natural materials. Although maceration dominated, solid-liquid extraction and other methods were also used, albeit in smaller proportions. This shows that researchers do not rely on just one method, but choose the method that best suits the type of sample and the purpose of the study. The 'unspecific' category shows that there is considerable variation in the extraction methods used. This could be due to differences in sample type, the nature of the compounds to be extracted, or limitations of the equipment available.

Pharmacological Effects

This section presents diagrams of 29 selected articles, focusing on the pharmacological effects of Chinese betel (summarised in figure 6).

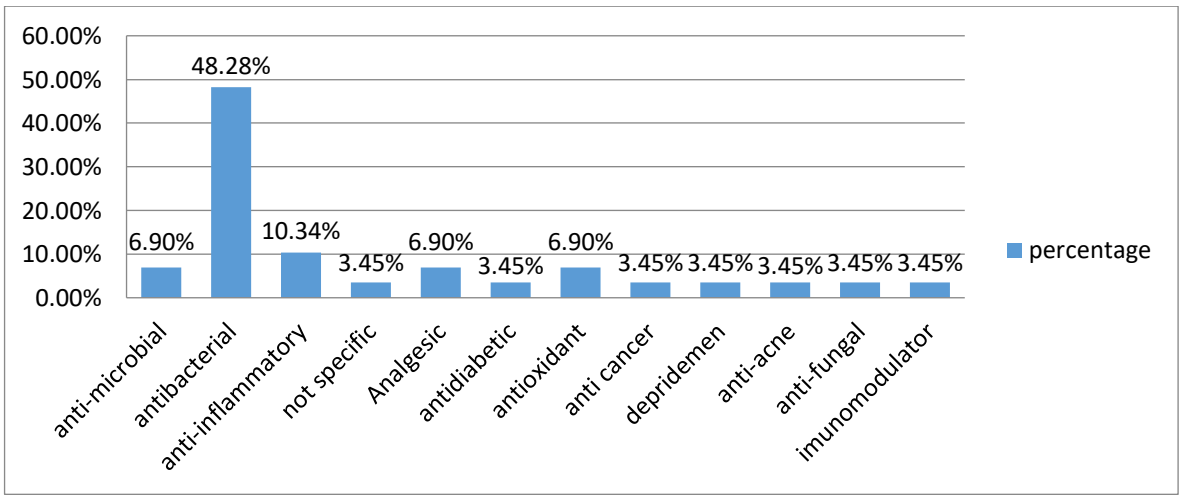

Figure 6. Diagram of Pharmacological Effects

This research test uses phytochemical screening. From Figure 6, it has the highest percentage, namely with an anti-bacterial percentage of 48.28%, in second place there are two equal percentages, namely anti-inflammatory and unspecific with a percentage of 10.34%, third place there are three equal percentages, namely analgesic, anti-microbial, and oxidant with a percentage of 6.90%, the next percentage there are six equal percentages consisting of anti-diabetic, anti-fungal, anti-acne, anti-cancer, depridemen, and immunomodulator with a percentage of 3.45%.

It appears that Chinese betel leaf has a significant antibacterial effect. This means that the active compounds in Chinese betel leaf are able to inhibit the growth or even kill certain bacteria. Anti-inflammation is the body's natural response to injury or infection. Although it is an important defence mechanism, prolonged inflammation can lead to various health problems, such as autoimmune diseases and degenerative diseases. The existence of this 'unspecified' category indicates that the pharmacological potential of Chinese betel leaf is still not fully revealed. An analgesic effect is the ability of a substance or compound to reduce or eliminate pain. Pain is the body's natural mechanism for signalling damage or threat to tissues. The analgesic effect of Chinese betel leaf comes from the content of active compounds such as: flavonoids, phenols, and alkaloids. These anti-microbial properties mean that Chinese betel leaf has the ability to inhibit the growth or even kill microorganisms such as bacteria, fungi, and viruses.

Anti-oxidants are compounds that can prevent or inhibit oxidation, oxidation is a chemical process that involves the transfer of electrons from one substance to another, and often produces free radicals, these free radicals are highly reactive and can damage body cells, causing various diseases such as cancer, heart disease, and premature aging. Chinese betel leaf (Peperomia pellucida) has long been used in traditional medicine for a variety of ailments, including diabetes, several studies have shown that Chinese betel leaf has potential as a natural remedy to help control blood sugar levels. anti-fungal has a content of active compounds in it making it effective in inhibiting the growth and development of various types of fungi.

Chinese betel leaf has long been used as a traditional remedy for various skin problems, including acne. Its antibacterial and anti-inflammatory properties are very effective in treating acne. Chinese betel leaf has potential in anti-cancer pharmacological effects, some of the anti-cancer mechanisms of action of Chinese betel leaf that have been identified include: strong anti-oxidants, induction of apoptosis, inhibiting angiogenesis, modulating the immune system. Research on the pharmacological effects of anti-depriments on Chinese betel is still not significant. Immunomodulators have active compounds in them, such as flavonoids and phenols, which play an important role in improving immune system function. Chinese betel leaves are rich in bioactive compounds such as flavonoids, phenols, and alkaloids. These compounds have strong antioxidant, anti-inflammatory, and antimicrobial properties. It is these properties that form the basis of the claim that Chinese betel leaf can boost immune system function.

The combination of flavonoids and tannin substances in Chinese betel leaves provides potential for a variety of health applications, including in the area of extra effectiveness of Chinese betel leaves against bacteria. Flavonoids have a tendency to bind to proteins so that they can interfere with the metabolic processes of bacteria. At low concentrations, tannins function as bacteriostatic, while at high concentrations, tannins function as antimicrobials by coagulating bacterial protoplasm so that stable bonds are formed with bacterial proteins. Some factors that influence the presence of inhibition zones depend on the diffusion ability of antibacterial ingredients into the media and their interaction with the bacteria tested.

The growth rate of the tested bacteria and the sensitivity of the bacteria to the tested antibacterial agent. At 25% and 50% concentrations of Chinese betel leaf extract, there was no inhibition zone. The 75% concentration of Chinese betel leaf extract obtained an inhibition zone of 10 mm, at a concentration of 100% Chinese betel leaf extract obtained an inhibition zone of 11.17 mm. The positive control inhibition zone is using erythromycin antibiotics obtained by 49.04 mm, in negative control using sterile aquadest there is no visible inhibition zone. The results of the test of the meaningfulness of Chinese betel leaf extract (Peperomia pellucida) from the results of Greenwood's classification in the Post hoc test, the difference between concentrations obtained a value of $P < 0.05$ is declared meaningful at each concentration except 25% and 50% (Nadya, 2024). According to Davis & Stout, (1971) the inhibition zone category of antibacterial activity is divided into: weak (<5 mm), medium (5-10 mm), strong (10-20 mm), and very strong (>20 mm).

CONCLUSIONS

Intensive research has shown that Chinese pepper leaf (*Peperomia pellucida L*) has a very promising potential in the fields of pharmacy and medicine. Its diverse bioactive compound content, including flavonoids, tannins, alkaloids, and terpenoids, has proven effective against various types of microorganisms, as an anti-inflammatory, and as an anti-cancer agent. In addition, Chinese pepper leaf also has potential as an analgesic and anti-diabetic. However, Chinese pepper leaf opens up wide opportunities for the development of natural products, ranging from medicines to cosmetic and functional food products. To realize this potential, further in-depth research is needed, especially in terms of identifying the main active compounds, understanding their mechanisms of action, and conducting clinical trials to prove their safety and effectiveness in humans.

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