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Cambodian Simplicia (*Plumeria sp.*) Phytochemical Screening Study: A Systematic Literature Review

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A B S T R A C T

Plumeria phytochemical screening is important to understand the chemical composition of this plant and its potential in the pharmaceutical and health fields. Through phytochemical analysis, researchers can determine the dominant compounds in plants, study their mechanism of action, and evaluate their biological activity. Phytochemical screening can be carried out using sophisticated analytical methods such as chromatography, spectroscopy, and biological assays to deeply understand the phytochemical profile of Plumeria. This study aimed to carry out a systematic review to explore the phytochemical screening of *Plumeria sp.* The literature search process was carried out on various databases (PubMed, Web of Sciences, EMBASE, Cochrane Libraries, and Google Scholar) regarding the evaluation of the phytochemical analysis of *Plumeria sp.* This study follows the preferred reporting items for systematic reviews and meta-Analysis (PRISMA) recommendations. The process of phytochemical screening was carried out qualitatively and quantitatively. *Plumeria sp* contains various alkaloids, flavonoids, terpenoids, and phenolic compounds.

1. Introduction

Plumeria sp, also known as the frangipani plant, is a popular plant because of the beauty of its fragrant flowers. Apart from its aesthetic and aromatic value, Plumeria also has interesting health potential because it contains various active compounds known as phytochemicals. Phytochemicals are natural compounds found in plants and have beneficial biological effects. Plumeria phytochemical screening study is an analytical process to identify, separate, and characterize the chemical compounds contained in this plant. Phytochemical screening involves various methods of extraction, separation, and chemical testing to identify the different phytochemicals present in a plant sample.[1-3]

Several groups of phytochemical compounds that have been identified in Plumeria include alkaloids, flavonoids, terpenoids, steroids, phenolics, and other compounds. Each group of these phytochemical compounds has different potential biological activities, such as antioxidant, anti-inflammatory, antimicrobial, anticancer, and other pharmacological properties. Plumeria phytochemical screening is important to understand the chemical composition of this plant and its potential in the pharmaceutical and health fields. Through phytochemical analysis, researchers can determine the dominant compounds in plants, study their mechanism of action, and evaluate their biological activity. The results of the Plumeria phytochemical screening study can provide a basis for

the development of new pharmaceutical products, food supplements, or other natural ingredients that are beneficial to human health. Phytochemical screening can be carried out using sophisticated analytical methods such as chromatography, spectroscopy, and biological assays to deeply understand the phytochemical profile of Plumeria.[4-6] This study aimed to carry out a systematic review to explore the phytochemical screening of *Plumeria sp*.

2. Methods

The literature search process was carried out on various databases (PubMed, Web of Sciences, EMBASE, Cochrane Libraries, and Google Scholar) regarding the evaluation phytochemical analysis of Plumeria sp. The search was performed using the terms: (1) "analysis" OR "phytochemical" OR "chemical" OR "*Plumeria sp*" AND (2) "metabolite analysis". The literature is limited to preclinical studies and published in English. The literature selection criteria are articles published in the form of original articles, an experimental study about evaluation phytochemical analysis of *Plumeria sp*, the control group only received liquid without therapeutic effect or no treatment, studies were conducted in a timeframe from 2000-2023, and the main outcome was phytochemical evaluation analysis of *Plumeria sp*. Meanwhile, the exclusion criteria were animal models that were not related to the evaluation phytochemical analysis of *Plumeria sp*, the absence of a control group, and duplication of publications. This study follows the preferred reporting items for systematic reviews and meta-analysis (PRISMA) recommendations.

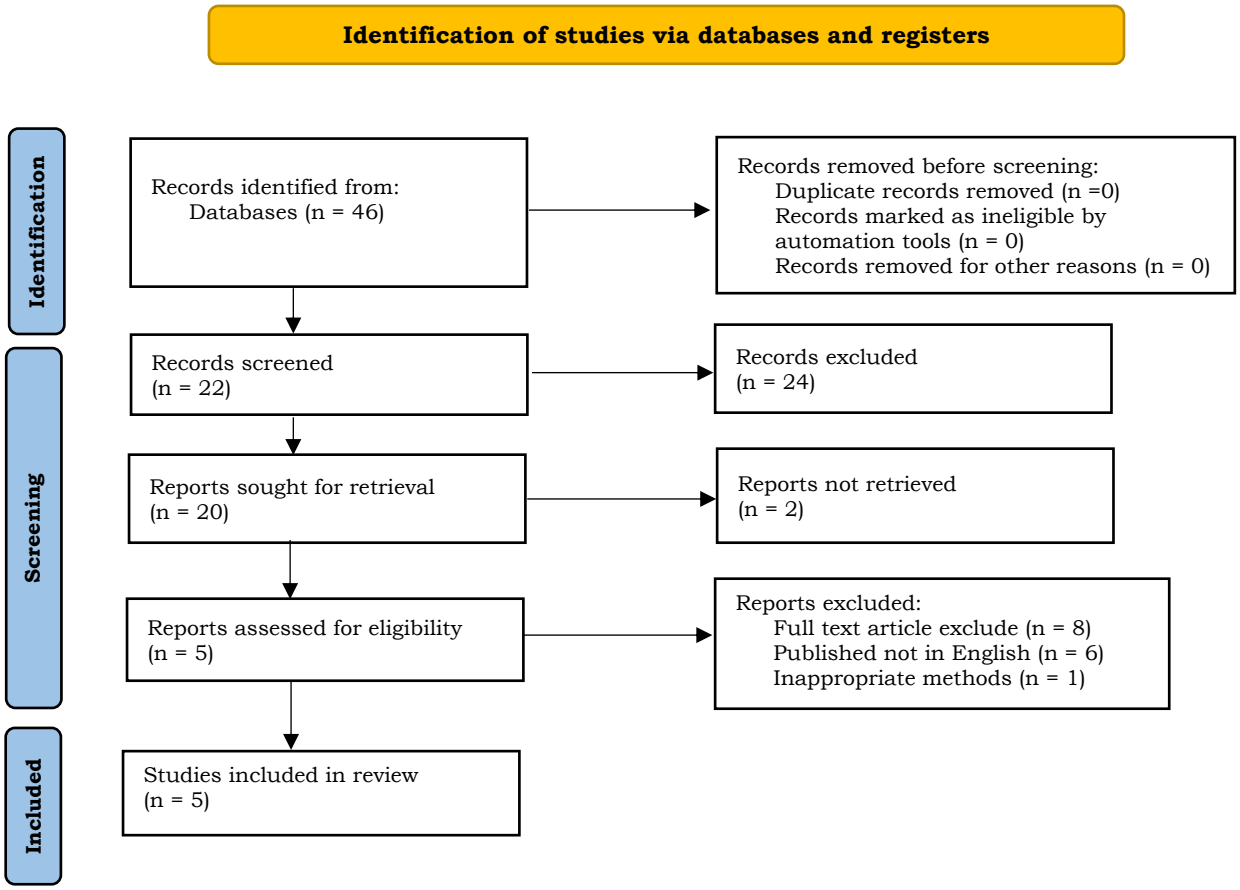

Figure 1. Research PRISMA diagram.

3. Results and Discussion

Qualitative phytochemical test

The simplicia phytochemical screening aims to identify the group of phytochemical compounds contained in the simplicia. The alkaloid test is used to detect the presence of alkaloids in the sample. Some of the tests commonly used include Mayer's test, Wagner's test, and Dragendorff's test. This test involves a chemical reaction between the alkaloids and certain reagents, which results in a characteristic precipitate or color change. Mayer's test involves the reaction of an alkaloid with Mayer's solution, which consists of potassium mercury-iodide in potassium iodide solution. If alkaloids are present, a white, red, or yellow precipitate will form depending on the type of alkaloid detected. The Wagner test also involves the reaction of alkaloids with Wagner's solution, which consists of iodine in potassium iodide. If alkaloids are present, a colored precipitate will form chocolate to purplish red. Dragendorff's test uses Dragendorff's solution, which consists of a solution of bismuth triiodide in acetic acid. If alkaloids are present, a pink to orange precipitate will form. These tests are based on chemical reactions between alkaloids and specific reagents. The reaction produces a characteristic color change or precipitate, which is used to indicate the presence of alkaloids in the sample. However, it is important to remember that this assay is qualitative in nature and only gives an indication of the presence of alkaloids without providing information about the type or concentration of alkaloids present.[7]

A flavonoid test is used to detect the presence of flavonoids in the sample. This test can be performed using a reagent such as Shinoda's reagent or cyanidin's reagent. Flavonoids will react with the reagent, producing an observable color change. Shinoda's reagent was used to detect flavonoids with free hydroxyl bases. This reagent consists of a mixture of sulfuric acid and Shinoda's reagent containing magnesium and a coloring agent such as fuchsine or eriochrome cyanine R. If a flavonoid is present, a reaction will occur between the flavonoid and Shinoda's reagent, resulting in a color change from pink to pink or purple. Cyanidin reagent is also used to detect flavonoids. This reagent consists of a solution of hydrochloric acid and cyanidin, which are coloring compounds. If flavonoids are present, a reaction will occur between the flavonoids and the cyanidin reagent, resulting in a color change from red to red-orange or orange. Flavonoids will interact with the appropriate reagent, causing the characteristic color change. This color change can be observed visually and is used as an indicator of the presence of flavonoids in the sample. A qualitative flavonoid test only provides information on the presence of flavonoids qualitatively and does not provide information on the specific type or concentration of the detected flavonoids.[8,9]

The tannin test is used to detect the presence of tannins in the sample. One of the commonly used tests is the ferric chloride (FeCl3) test. In this test, tannins will react with the FeCl3 reagent and produce a characteristic color change, usually blue or green. In the ferric chloride test, samples containing tannins were mixed with an FeCl3 solution. If tannins are present, then a reaction occurs between the tannins and FeCl3, which produces a tannin-FeCl3 complex. This complex has a visually observable blue or green color. The intensity of the color change can give an indication of the presence and concentration of tannins in the sample. It is important to note that the ferric chloride test only provides qualitative information about the presence of tannins in a sample and does not provide specific information about the type or concentration of tannins contained. This test can be the first step in phytochemical screening to indicate the presence of tannins in the sample.[10,11]

The saponin test is used to detect the presence of saponins in the sample. Foam tests or hemolysis tests are two common methods used. Saponins will produce persistent foam or hemolysis (destruction of red blood cells) when reacted with suitable reagents or suspensions. The foam test is a simple method that is carried out by mixing samples containing saponins with water and shaking or stirring the solution intensively. If saponins are present, a persistent and

stable foam will form, which can persist for a considerable period of time. This foam is due to the ability of saponins to reduce the surface tension of water. The hemolysis test is performed by using a suspension of red blood cells (usually human or animal red blood cells) and mixing it with a sample containing saponins. If saponins are present, hemolysis or destruction of red blood cells will occur, which can be seen from the color change or the release of hemoglobin pigment. Hemolysis occurs because saponins can damage the red blood cell membrane.[12]

Both of these methods provide an indication of the presence of saponins in the sample qualitatively. The foam test gives a positive result if the persistent and stable foam is formed, while the hemolysis test gives a positive result if there is destruction of red blood cells. However, it is important to note that this saponin test only provides information on the presence of saponins qualitatively and does not provide information on the specific type or concentration of saponins detected.[13]

The terpenoid/steroid test is used to detect the presence of terpenoids or steroids in the sample. Liebermann-Burchard test and the Salkowski test are two commonly used methods. These compounds will give a distinctive color change or precipitate when reacting with certain reagents. The Liebermann-Burchard test is used to detect the presence of terpenoids or steroids in the sample. In this test, the sample is mixed with concentrated acetic acid and concentrated sulfuric acid. If terpenoids or steroids are present, a reaction will occur, resulting in a color change from yellow to green or purplish-blue. This reaction is caused by the formation of a characteristic colored complex between terpenoids/steroids and sulfuric acid. The Salkowski test is also used to detect the presence of terpenoids or steroids in a sample. In this test, the sample is mixed with sulfuric acid and followed by the addition of an acetic acid reagent. If terpenoids or steroids are present, a reaction will occur, resulting in a color change from yellow to red or orange. This color change is caused by the formation of colored complexes between terpenoids/steroids and sulfuric acid. Both of these methods utilize chemical reactions between terpenoids/steroids and certain reagents, which produce a distinctive color change or precipitate. This color change can be observed visually and is used as an indicator of the presence of terpenoids or steroids in the sample. However, it should be noted that this test only provides qualitative information about the presence of terpenoids or steroids and does not provide specific information about the type or concentration of these compounds.[14]

The phenolic test is used to detect the presence of phenolic compounds in the sample. One of the commonly used tests is the dark ferric chloride (FeCl3) test. In this test, phenolic compounds will react with FeCl3 reagents and produce a distinctive color change or precipitate. In this test, samples containing phenolic compounds were mixed with FeCl3 solution. If phenolic compounds are present, a reaction occurs between the phenolic compounds and FeCl3, which produce a distinctive color change, such as a bluish, dark green, or purplish-red color change. This color change is caused by the formation of complex compounds between phenolic compounds and FeCl3. In addition to color changes, in some cases, reactions between phenolic compounds and FeCl3 can also produce colored precipitates that can be observed visually. The ferric chloride dark test gives an indication of the presence of phenolic compounds in the sample qualitatively. However, it is important to note that this test only provides information about the presence of phenolic compounds and does not provide specific information about the type or concentration of phenolic compounds contained.[15]

Quantitative phytochemical test

Quantitative phytochemical tests are used to quantitatively measure the amount or concentration of phytochemical compounds in a sample. This method provides more detailed information about the content of these compounds in the sample and is often used for more in-depth analyses. Chromatography: Chromatographic methods, such as high-performance liquid chromatography (HPLC) or thin-layer chromatography (TLC), can be used to separate and

measure the concentration of phytochemical compounds in samples. In this method, the sample is injected into the chromatography system, separated based on its chemical properties, and then detected and measured using a suitable detector. The UV-Vis spectroscopy method uses the absorption of electromagnetic radiation in the ultraviolet (UV) and visible (Vis) ranges to measure the concentration of phytochemical compounds in samples. This method is based on the ability of these compounds to absorb light at certain wavelengths, which can be used to generate calibration curves and calculate sample concentrations. The IR spectroscopy method is used to identify and measure phytochemical compounds based on their molecular vibration patterns. This method can provide information about the bonds and functional groups contained in the compound, and the concentration can be estimated using a calibration against a reference compound. The NMR spectroscopy method uses the magnetic resonance of atomic nuclei in compounds to identify and measure the concentrations of phytochemical compounds. This method can provide very detailed information on molecular structure and allows quantitative analysis using internal or external standards.[16]

Phytochemical test of *Plumeria sp*

Plumeria contains various types of alkaloids, including indole and isoquinoline alkaloids. Alkaloids are organic compounds that are commonly found in plants and have various biological activities. In Plumeria, the indole alkaloids that are commonly found are alkaloids related to indole compounds such as tryptamine and dimethyltryptamine (DMT). DMT is an indole alkaloid that is also found in several other plant psychedelic species. In addition, Plumeria is also known to contain isoquinoline alkaloids. Isoquinolines are a group of compounds that have a basic chemical structure called isoquinoline-1,3-dione which is found in *Plumeria sp.*[17]

Plumeria contains a variety of flavonoids, including rutin, quercetin, kaempferol, and apigenin. Flavonoids are polyphenolic compounds that are commonly found in plants and have a variety of biological activities and antioxidant properties. Rutin, also known as vitamin P, is a flavonoid that is found in many plants, including Plumeria. Rutin has strong antioxidant properties and is believed to have benefits for cardiovascular health. Quercetin is another flavonoid commonly found in many types of plants, including Plumeria. Quercetin has potential antioxidant, anti-inflammatory, and anticancer activities. Several studies have shown that quercetin can have positive effects on heart health, the immune system, and fighting oxidative stress. Kaempferol is also a flavonoid found in Plumeria. Kaempferol has been known to have anti-inflammatory, anticancer, and neuroprotective properties. Studies have also shown that kaempferol may benefit heart and blood vessel health. Apigenin is another flavonoid found in Plumeria. Apigenin has strong antioxidant and anti-inflammatory properties. Studies have shown that apigenin may have potential anticancer, antidiabetic, and neuroprotective effects.[18]

Plumeria contains terpenoid compounds, including triterpenoids and sesquiterpenoids. Terpenoids are a broad group of organic compounds that are commonly found in plants and have a variety of biological functions. Triterpenoids are one of the classes of terpenoids found in Plumeria. They consist of a basic unit called an isoprene unit and have a structure based on multiples of five isoprene units. Some of the triterpenoids that have been identified in Plumeria include lupeol, Betulin, and Ursolate. Triterpenoids have various biological activities, including anti-inflammatory, anticancer, and hepatoprotective. Sesquiterpenoids are another type of terpenoid found in Plumeria. They consist of 15 isoprene units and often have a ring structure. Some of the sesquiterpenoids found in Plumeria are farnesol and germacrene. Sesquiterpenoids also have a variety of biological activities, including anti-inflammatory, antimicrobial, and antitumor.[19]

Phenolic compounds have been isolated from Plumeria, including caffeic acid, chlorogenic acid, and p-coumaric acid. Phenolic compounds are a group of

organic compounds found in plants and generally have antioxidant activity and other properties that are beneficial to health. Caffeic acid is one of the phenolic compounds found in Plumeria. It is a hydroxycinnamic acid with strong antioxidant activity. Chlorogenic acid, also known as chlorogenic acid, is a phenolic compound that is present in many plants, including Plumeria. Chlorogenic acid has antioxidant, anti-inflammatory properties and may have benefits for heart health. P-coumaric acid is another phenolic compound isolated from Plumeria. It is a type of hydroxybenzoic acid found in various plants. P-coumaric acid also has antioxidant activity and the potential for various pharmacological uses.[20]

4. Conclusion

The process of phytochemical screening was carried out qualitatively and quantitatively. *Plumeria sp* contains various alkaloids, flavonoids, terpenoids, and phenolic compounds.

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