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Phytochemical Analysis of Mango Leaves (Mangifera Indica L.)

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Abstract

Mangifera indica L. (mango) is a tropical plant widely recognized for its nutritional, medicinal, and industrial value. In recent years, increasing attention has been directed toward the phytochemical composition of mango leaves due to the presence of bioactive secondary metabolites with potential pharmacological and industrial applications. This study aimed to determine the phytochemical constituents present in the crude extract of mango leaves through qualitative phytochemical screening. Fresh leaves of Mangifera indica were collected, cleaned, dried, and subjected to methanolic extraction using a percolation method. The extract was then concentrated through rotary evaporation and analyzed using standard phytochemical screening procedures to detect major classes of secondary metabolites. The qualitative tests included Mayer's and Wagner's tests for alkaloids, Molisch's test for carbohydrates, ferric chloride test for tannins and phenolic compounds, Millon's test for proteins, foam test for saponins, spot test for fixed oils and fats, and the ninhydrin test for amino acids. The results of the phytochemical analysis revealed the presence of several important secondary metabolites including alkaloids, carbohydrates, fixed oils and fats, tannins, proteins, and saponins, while amino acids were not detected. These findings confirm that mango leaves contain a diverse range of phytochemicals that may contribute to their biological and functional properties. The presence of these bioactive compounds supports the potential use of mango leaves as a natural source of phytochemicals for pharmaceutical, nutraceutical, and industrial applications. Further studies involving quantitative phytochemical analysis and isolation of individual compounds are recommended to better understand the bioactive potential of Mangifera indica leaves.

Keywords: Mangifera indica, mango leaves, phytochemical screening, secondary metabolites, plant extract.

1. Introduction

Plants are an abundant source of biologically active compounds that possess diverse chemical structures and biological activities. These compounds, often referred to as phytochemicals or secondary metabolites, play significant roles in plant defense and have been widely investigated for their pharmacological, antioxidant, antimicrobial, and industrial applications. The exploration of phytochemical constituents in plant species has therefore become an important aspect of natural product chemistry and medicinal plant research.

Mangifera indica L., commonly known as mango, is a tropical fruit-bearing tree belonging to the family Anacardiaceae. The plant is widely cultivated in many tropical countries, including the Philippines, India, and other parts of Southeast Asia. Beyond its economic value as a fruit crop, different parts of the mango plant—including leaves, bark, fruit peel, and seed kernels—have been reported to contain numerous

bioactive compounds such as polyphenols, flavonoids, tannins, alkaloids, and saponins. These compounds contribute to the plant's antioxidant, antimicrobial, and anti-inflammatory properties (Masibo & He, 2008).

Mango leaves in particular have been studied for their rich phytochemical composition. They contain a variety of secondary metabolites including phenolic compounds, mangiferin (a xanthone glycoside), flavonoids, terpenoids, and tannins that contribute to their medicinal potential (Imran et al., 2017). Phytochemical screening of plant extracts is therefore an essential preliminary step in identifying these bioactive compounds, which may subsequently be utilized in pharmaceutical, nutraceutical, or industrial applications.

The present study focuses on the phytochemical analysis of mango (Mangifera indica L.) leaves. The aim is to determine the presence of major classes of secondary metabolites through qualitative phytochemical screening. According to the experimental data contained in the uploaded research document, the crude extract of mango leaves showed the presence of several phytochemical constituents including alkaloids, carbohydrates, fixed oils and fats, tannins, proteins, and saponins, while amino acids were not detected. Understanding these phytochemical components provides important insight into the biological and chemical potential of mango leaves.

2. Methodology

Research Design

The study employed a quantitative experimental approach involving extraction and qualitative phytochemical screening of mango leaves. The procedures aimed to identify the presence of major secondary metabolites in the crude extract of Mangifera indica leaves.

Sample Collection and Preparation

Fresh mango leaves were collected in Cabanatuan City, Philippines. After collection, the plant materials were transported to the laboratory for processing. The leaves were washed, sorted, chopped into smaller pieces, and dried to remove moisture prior to extraction. These preparatory steps ensured the removal of impurities and improved the efficiency of solvent extraction.

Extraction Procedure

The dried mango leaves were subjected to solvent extraction through percolation. Approximately four liters of 95% methanol were used to extract the phytochemical compounds from the plant material over a 24-hour period. Methanol is commonly used in phytochemical extraction because it efficiently dissolves a wide range of polar and moderately non-polar compounds (Azmir et al., 2013).

After extraction, the mixture was filtered to separate the plant residues from the solvent extract. The filtrate was then concentrated using rotary evaporation to remove the solvent. The rotary evaporator operates under reduced pressure, allowing solvent removal at lower temperatures to preserve thermolabile compounds. The resulting crude extract of mango leaves was collected for further phytochemical analysis.

Phytochemical Screening

Qualitative phytochemical tests were conducted using standard laboratory procedures to detect the presence of different classes of bioactive compounds in the crude extract. The tests performed included the following:

1. **Alkaloids (Mayer's and Wagner's Tests):** Plant extract samples were treated with Mayer's reagent and Wagner's reagent. The formation of a white or reddish-brown precipitate indicated the presence of alkaloids.

2. **Amino Acids (Ninhydrin Test):** The extract was reacted with ninhydrin solution. The development of a purple coloration would indicate the presence of amino acids.
3. **Carbohydrates (Molisch's Test):** A few drops of α-naphthol followed by concentrated sulfuric acid were added to the extract. The appearance of a violet ring indicated the presence of carbohydrates.
4. **Fixed Oils and Fats (Spot Test):** A small amount of extract was pressed between filter papers. The appearance of an oil stain indicated the presence of lipids.
5. **Phenolic Compounds and Tannins (Ferric Chloride Test):** The extract was treated with ferric chloride solution. The development of a dark green coloration confirmed the presence of tannins or phenolic compounds.
6. **Proteins (Millon's Test):** Addition of Millon's reagent to the extract produced a white precipitate, indicating the presence of proteins.
7. **Saponins (Foam Test):** The extract was shaken with distilled water. The formation of a persistent foam layer indicated the presence of saponins.

These qualitative phytochemical screening procedures are widely used in plant chemistry studies to identify major classes of secondary metabolites present in plant extracts (Harborne, 1998).

3. Results and Discussion

Phytochemical Screening Results

The qualitative phytochemical screening of mango leaf extract revealed the presence of several important secondary metabolites. These metabolites represent biologically active compounds naturally synthesized by plants and are widely recognized for their roles in plant defense, ecological adaptation, and pharmacological activity. The results are summarized below:

Phytochemical Test	Result	Interpretation
Alkaloids (Mayer's test)	Positive	Alkaloids present
Amino acids (Ninhydrin test)	Negative	Amino acids absent
Carbohydrates (Molisch's test)	Positive	Carbohydrates present
Fixed oils and fats (Spot test)	Positive	Lipids present
Tannins (Ferric chloride test)	Positive	Tannins present
Proteins (Millon's test)	Positive	Proteins present
Saponins (Foam test)	Positive	Saponins present

The crude extract of Mangifera indica leaves therefore contained multiple bioactive phytochemicals, including alkaloids, carbohydrates, fixed oils, tannins, proteins, and saponins, while amino acids were not detected in the qualitative test.

Discussion of Phytochemical Constituents

The presence of alkaloids in mango leaves suggests potential pharmacological properties. Alkaloids are nitrogen-containing compounds known for their diverse biological activities, including antimicrobial, analgesic, and antimalarial effects (Cushnie et al., 2014).

The detection of tannins and phenolic compounds is consistent with previous research indicating that mango leaves contain high levels of polyphenols. These compounds contribute significantly to antioxidant

activity and protective effects against oxidative stress (Masibo & He, 2008). Polyphenols also play a role in plant defense mechanisms against pathogens and herbivores.

Saponins, which were also detected in the extract, are glycosidic compounds known for their surfactant properties and biological activities such as antimicrobial, anti-inflammatory, and cholesterol-lowering effects. Their presence in mango leaves has been reported in several phytochemical investigations of medicinal plants.

The presence of carbohydrates and proteins reflects the nutritional components of the plant material, although these compounds are generally not the primary contributors to medicinal properties. However, they may participate in biochemical interactions that support plant metabolism.

Additionally, the detection of fixed oils and fats suggests the presence of lipid-soluble compounds that may contribute to the extraction of other phytochemicals and influence the physicochemical properties of the crude extract. Furthermore, the presence of these phytochemicals indicates that mango leaves may serve as an important natural source of bioactive compounds. Phenolic compounds and tannins contribute significantly to antioxidant activity, alkaloids may provide pharmacological effects, and saponins may enhance antimicrobial properties. The combination of these compounds highlights the chemical diversity of mango leaves and their potential relevance in natural product research.

Previous studies confirm that mango leaves are rich in diverse bioactive constituents. For example, Imran et al. (2017) reported that mango leaves contain mangiferin, quercetin, catechins, and other flavonoids that contribute to their antioxidant and therapeutic potential. Similarly, Pattarin, Vilasinee, and Sumet reported the presence of flavonoids, tannins, alkaloids, terpenoids, and saponins in mango leaf extracts.

Overall, the results of the phytochemical analysis confirm that mango leaves are a rich source of secondary metabolites. These compounds may contribute to various biological activities and support the potential application of mango leaf extracts in pharmaceutical, nutraceutical, and industrial fields.

4. Conclusion

The phytochemical analysis of Mangifera indica leaves revealed the presence of several important secondary metabolites, including alkaloids, carbohydrates, fixed oils and fats, tannins, proteins, and saponins, while amino acids were not detected. These phytochemicals are known to possess diverse biological and chemical properties that contribute to the medicinal and functional value of plant materials.

The results indicate that mango leaves contain a variety of bioactive compounds that may have potential applications in pharmacology, natural product chemistry, and industrial processes. The presence of phenolic compounds, alkaloids, and saponins particularly highlights the therapeutic potential of mango leaves.

Further studies involving quantitative phytochemical analysis, isolation of individual compounds, and biological activity testing are recommended to better understand the functional properties and potential applications of these phytochemicals.

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