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Phytochemical Screening and Chemical Compounds of Moringa Oleifera Leaf Hot Water Extract

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Abstract. In this study, the phytochemical composition and chemical compounds present in Moringa oleifera leaf hot water extract were investigated. The extraction process involved using hot water to retain a wide range of bioactive constituents. Qualitative and quantitative analyses were employed to characterize the extract's phytochemical profile. Fourier Transform Infrared Spectroscopy (FT-IR) was employed to identify and quantify specific chemical compounds. The phytochemical analysis revealed the presence of various classes of secondary metabolites, including alkaloids, flavonoids, tannins, saponins, terpenoids and phenolics. These bioactive compounds have been associated with antioxidant, anti-inflammatory, and antimicrobial properties. Additionally, the FTIR analysis unveiled a spectrum of chemical constituents, including phenol compounds, flavonoids and alkaloids compounds, known for their potential health benefits.

Keyword: Bioactive, Chemical Compounds, Hot Water Extract, Moringa Oleifera, And Phytochemicals

1 Introduction

Moringa oleifera, a remarkable plant species known by various names including the drumstick tree, horseradish tree, and ben oil tree, has captivated researchers and health enthusiasts alike due to its extraordinary phytochemical composition and potential therapeutic applications [1]. Originating from the Indian subcontinent, Moringa oleifera has a rich history of traditional use, and modern scientific investigations have unveiled its intricate phytochemistry, characterized by an array of functional groups that contribute to its antimicrobial properties [2]. This comprehensive review aims to delve into the intricate world of Moringa oleifera's phytochemistry, with a specific focus on its functional groups.

Phytochemical diversity lies at the heart of Moringa oleifera's reputation as a nutritional powerhouse and a source of numerous health benefits. The plant's leaves, seeds, pods, and roots encompass a spectrum of bioactive compounds, including flavonoids, alkaloids, polyphenols,

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and glucosinolates. These compounds not only contribute to the plant's color and flavor but also serve as potent antioxidants, capable of scavenging free radicals and preventing oxidative damage [3] The high concentration of polyphenols in Moringa results in strong antioxidant activity [4].urthermore, Moringa oleifera's remarkable nutritional profile, containing essential vitamins and minerals, has established it as a functional food with potential to address malnutrition and associated health issues [5].

Among the various extraction methods employed to harness the bioactive constituents from plant materials, hot water extraction stands out as a simple, cost-effective, and environmentally friendly approach. The use of hot water as an extraction solvent has been demonstrated to retain a broad spectrum of phytochemicals while minimizing the degradation of heat-sensitive compounds. This method has been widely utilized to explore the chemical composition and potential health-promoting properties of plant extracts [6]. Foods containing moringa leaf extract can be used as a source of folate. Folate is one of the water-soluble vitamins and is important to consume because folate plays an important role in various cellular metabolisms including oxidation and reduction. Folate deficiency can cause developmental disorders, especially in pregnant women [7].

A distinctive feature of Moringa oleifera's phytochemistry lies in its diverse functional groups. Phenolic compounds, for instance, showcase hydroxyl (-OH) groups that confer antioxidant capabilities, while alkaloids exhibit nitrogen-containing functional groups that contribute to their potential antimicrobial properties [8]. The presence of these functional groups lends Moringa oleifera its multifaceted biological activities, including anti-inflammatory, antidiabetic, and anticancer effects [9].

The present study delves into the comprehensive phytochemical profiling and chemical composition analysis of Moringa oleifera leaf hot water extract. By utilizing the hot water extraction technique, a broad spectrum of bioactive compounds can be captured, potentially enhancing the extract's therapeutic potential. The investigation of these compounds not only contributes to the scientific understanding of Moringa oleifera's chemical constituents but also offers insights into its potential applications in functional foods, nutraceuticals, and pharmaceuticals.

In this review, we aim to provide an in-depth analysis of Moringa oleifera's phytochemistry, with a specific focus on its functional groups. By unraveling the molecular intricacies of this exceptional plant, we strive to shed light on its therapeutic potential and inspire further research that could harness its functional groups for the development of innovative antimicrobial agents, contributing to the broader field of natural product-based drug discovery.

2 Material and Methods

Fresh Moringa oleifera leaves were harvested from a local organic farm. Leaves were selected based on their vibrant green color and absence of visible signs of disease or pest damage. The collected leaves were thoroughly washed, air-dried, and then ground into a fine powder using a mortar and pestle. A precise amount 10 grams of the powdered Moringa oleifera leaves was measured using an analytical balance, and distilled water was brought to a boil in a clean glass with 200 mL of water. Once the water reached boiling point, the powdered Moringa oleifera leaves were carefully added to the boiling water. The mixture was then gently stirred to ensure even dispersion of the plant material.

After boiling, the hot water extract was separated from the solid plant material. This was achieved by using a fine mesh strainer. The extract was collected in a separate container. The extracted liquid was allowed to cool to room temperature. It was important to avoid prolonged exposure to high temperatures to prevent degradation of heat-sensitive compounds. Then the hot water extract was transferred to a clean, airtight container and stored in a cool and dark place for further analysis.

2.1 Determination of Alkaloids

Moringa leaf extract is dripped on two drop plates. One part is tested with Mayer reagent and the second part is tested with Wagner reagent. If the extract that is dripped with Mayer reagent forms a white precipitate and is dripped with Dragendorf reagent to form a yellowish brown precipitate, the extract is positive for alkaloids.

2.2 Determination of Flavanoids

Magnesium powder, 1 ml of hydrochloric acid and 3 ml of alcohol were added to the tube containing moringa leaf extract were shaken vigorously and allowed to separate. If the results form red, yellow, orange color in the alcohol layer, it indicates the presence of flavonoids.

2.3 Determination of Saponnins

The test tube containing moringa leaf extract was shaken vertically for 10 seconds and then a stable foam. Next, the tube is left for 10 minutes and then 1 drop of 1% hydrochloric acid was added. If the foam formed does not disappear then the extract is positive for saponins.

2.4 Determination of Phenol/Tannin

A total of 5 mg of moringa leaf extract was dissolved with methanol in a volumetric flask. Furthermore 0.5 mL of test solution was added to 2.5 mL of distilled water; 2.5 mL of Folin-Ciocalteu reagent, then shaken and leave for 15 min. Then add 2 mL of 7.5% Na2CO3, homogenize and incubate again in the dark for 30 minutes.

2.5 Determination of Terpenoids

The terpenoid test was carried out by adding anhydrous acetate and concentrated sulfuric acid to a test tube containing moringa leaf extract. If a purplish red color is formed then the extract contains terpenoid compound group.

3 Results and Discussion

3.1 Phytochemical

After successfully obtaining a concentrated extract, our investigation progressed to a critical phase involving the characterization of the extract's chemical constituents. This crucial step was achieved through a comprehensive battery of phytochemical tests, targeting a diverse range of compound classes. Specifically, our study encompassed the assessment of alkaloids, flavonoids, tannins, saponins, terpenoids, and phenolics – each playing a distinctive role in the potential bioactivity of the Moringa oleifera leaf extract. The outcomes of these tests, conducted with rigorous attention to detail, are documented in Table 1.

Table 1. Phytochemical Compounds in Moringa Leaf Extract

No.	Compound	Result
1	Alkaloids	+
2	Flavonoids	+
3	Saponins	-
4	Tannin	+
5	Terpenoids	+

3.2 FT-IR Analysis

The spectral analysis presented in Figure has provided valuable insights into the chemical composition of the Moringa oleifera leaf extract obtained through our hot water extraction methodology. Through careful examination of the absorption peaks and bands, we have identified key absorption groups that strongly suggest the presence of

distinctive bioactive compounds, particularly phenol compounds, flavonoids, and alkaloids.

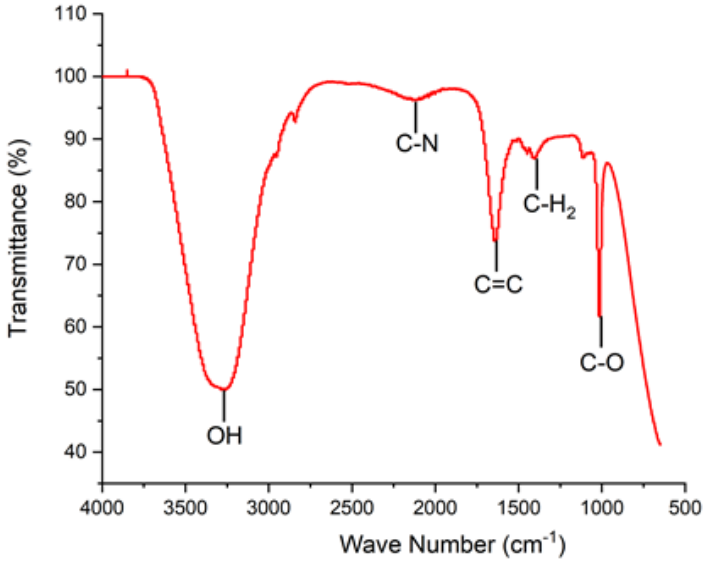

Figure 1. Spectrum of Moringa Oleifera Leaf Extract

One of the prominent features in the spectrum is the visible -OH vibrations observed at wave number 3265.69 cm-1. This characteristic absorption indicates the presence of hydroxyl groups, which are a defining feature of phenolic compounds. These phenolic compounds are widely recognized for their antioxidant potential and have been associated with a range of health benefits. Additionally, the broad band encompassing the range between 3500 and 3200 cm-1 is noteworthy. This range is indicative of the presence of phenolic and alcohol functionalities, often associated with hydrogen bonds involving -OH groups. The presence of such groups further strengthens the likelihood of the presence of phenolic compounds and reinforces their potential significance within the extract [10].

The appearance of absorption vibrations at wave number 1643.60 cm-1 points to the absorption of aromatic C=C bonds, characteristic of compounds such as flavonoids. Flavonoids, renowned for their various bioactivities, including antioxidant and anti-inflammatory effects, are crucial components that contribute to the overall health-promoting potential of the extract. Furthermore, the vibrational absorptions observed at wave number 2136 cm-1 and at wave number 1405.23 cm-1 are indicative of the presence of C-N compounds and the CH2 group from cyclohexane, respectively. These findings provide additional evidence of the intricate chemical makeup of the extract, underscoring its complexity and potential for diverse biological activities [11].

Lastly, the spectral feature at wave number 1014.23 cm-1, corresponding to the presence of C-O stretching groups, adds another layer of compositional information.

This observation further enriches our understanding of the chemical constituents that contribute to the distinct properties of the Moringa oleifera leaf extract.

4. Conclusion

In conclusion, our study provides a comprehensive insight into the phytochemical composition of Moringa oleifera leaf extract obtained through hot water extraction. The culmination of alkaloids, flavonoids, tannins, saponins, terpenoids, and phenolics, as evidenced by spectral analyses, showcases the richness of the extract's chemical compounds. This investigation paves the way for further research to elucidate the individual contributions of these compounds to the extract's potential biological activities and opens avenues for the development of novel natural products for health and wellness.

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