Phytochemical Analysis of *Aegle marmelos* Leaves: A Comparative Study

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ABSTRACT

This study aimed to conduct a comprehensive phytochemical analysis of *Aegle marmelos*, a plant species used by traditional healers in Adilabad District, Telangana region. The different parts of *A. marmelos*, including leaves, fruits, and bark, were collected, dried, and powdered. The powdered samples were then soaked in methanol and filtered, and the filtrate was reduced by a rotary evaporator. The phytochemical analysis of the leaves of *A. marmelos* was conducted using typical methods to determine the presence or absence of alkaloids, carbohydrates, flavonoids, glycosides, phytosterols, and phenols. The analysis revealed the presence of carbohydrates, alkaloids, glycosides, phenols, and flavonoids in *A. marmelos*. These phytochemicals are known for their antimicrobial, antifungal, anti-allergic, antispasmodic, and anti-inflammatory properties. The identified phytochemicals play a crucial role in determining the medicinal properties of the studied plants. The presence of these bioactive compounds in the plants contributes to their significant healing potential. However, further research is needed to determine the specific types and quantities of these compounds in *A. marmelos*, as well as their potential health benefits and therapeutic applications. The findings of this study will contribute to the growing body of knowledge on the therapeutic potential of *A. marmelos* and may have implications for the development of new drugs and therapies.

Keywords: *Aegle marmelos***,** Telangana, Forest, Adilabad, Medicinal Plants.

1. INTRODUCTION

Aegle marmelos, commonly known as Bael, is a medicinal plant that has been traditionally used in Ayurveda, the Indian system of medicine, for the treatment of various ailments (Singh and Singh, 2013). The plant is native to India and other parts of Southeast Asia, and its medicinal properties have been recognized for centuries. In recent years, there has been growing interest in the phytochemistry and pharmacology of Aegle marmelos due to its potential therapeutic benefits (Gupta and Sharma, 2021).

Phytochemical analysis is an important tool for identifying and quantifying the bioactive compounds present in plants. One of the key pharmacological activities associated with Aegle marmelos is its antimicrobial properties. Several studies have reported the antimicrobial activity of Aegle marmelos extracts against a wide range of microorganisms, including bacteria, fungi, and viruses. The antibacterial activity of Aegle marmelos has been attributed to the presence of various

phytochemicals, including alkaloids, flavonoids, and tannins (Kumar et al., 2018; Singh et al., 2019).

In addition to its antimicrobial properties, *Aegle marmelos* has also been reported to possess antioxidant, anti-inflammatory, and immunomodulatory activities. These pharmacological activities have been attributed to the presence of various bioactive compounds in the plant, including phenolic acids, flavonoids, and terpenoids. The antioxidant activity of *Aegle marmelos* has been shown to be effective against oxidative stress-induced damage, which is implicated in the pathogenesis of various diseases (Gupta and Sharma, 2021; Kumar et al., 2018; Singh et al., 2019).).

Despite the growing interest in the pharmacological properties of *Aegle marmelos*, there is still a need for further research to fully understand the mechanisms of action and therapeutic potential of the plant. In this paper, we aim to explore the medicinal properties of *Aegle marmelos* through a comprehensive phytochemical analysis. We will focus on the identification and quantification of bioactive compounds in different parts of the plant and discuss their potential pharmacological activities. The findings of this study will contribute to the growing body of knowledge on the therapeutic potential of *Aegle marmelos* and may have implications for the development of new drugs and therapies. This study is aimed to conduct a comprehensive phytochemical analysis of *A. marmelos* used by traditional healers in Adilabad District, Telangana region. By collaborating with traditional healers and utilizing state-of-the-art analytical techniques, this research seeks to identify and characterize the phytochemical constituents of selected medicinal plants.

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2. MATERIALS AND METHODS

2.1 Preparation of Crude Extract

The plant samples of *A. marmelos* were collected from forest areas of Adilabad district, Telangana in February 2021. The identity of the plant was confirmed with the help of taxonomic literature. A voucher specimens were placed in the herbarium of the "Department of Botany, Government of Degree College, Adilabad". The different parts of *A. marmelos*, including leaves, fruits, and bark, were washed with freshwater, dried in an oven at 50 °C for 96 hours, and powdered. The powdered samples were then soaked in methanol for 4 days and filtered. The filtrate was reduced by a rotary evaporator.

2.2 Phytochemical Analysis

By using typical methods as shown in Table 1, the leaf extracts remained tested for existence of bioactive phytochemicals "(Alkaloid, Carbohydrates, Glycosides, Phytosterols, Flavonoids, Phenol and Tannins)".

Alkaloid Test: "The plant extract remains mixed with 1% v/v HCl, warmed, and filtered. The resulting filtrate is subjected to the following test".

a. Mayer's Test: "The filtrate is canned with Mayer's substance (a solution of mercuric chloride and potassium iodide in water). The presence of alkaloids is designated by the formation of yellow-colored precipitates".

Carbohydrate Test: "The plant extract is dissolved in 5 ml of distilled water and filtered. The filtrate is used to test for the presence of carbohydrates".

Molisch's Test: "Two droplets of alcoholic α-naphthol solution are added to the filtrate in a test tube. Cautiously, using a dropper, concentrated sulfuric acid is added dropwise along the side of the test tube. The presence of carbohydrates is indicated by the formation of a violet color at the junction or interface of the two liquids".

Table-1. Methods used for Phytochemical Analysis

Sl.No	Phytochemicals	Test Procedure	Observation
1	Alkaloids	Add Mayer's reagent to filtrate	Formation of yellow-colored precipitate
2	Carbohydrates	Add Naphthol and sulfuric acid to filtrate	Formation of a violet color
3	Glycosides	Mix 5 ml of extract with 5 ml of water and shake	Formation of foam
4	Phytosterols	Mix 2 ml of extract with 2 ml of CHCl3 and 2 ml of H2SO4	Formation of a golden-yellow color
5	Flavonoids	Add a few drops of NaOH to 2 ml of extract, followed by dil. HCL	Formation of a yellow color that clears upon adding dil. HCL
6	Phenol and Tannins	Add 4 drops of FeCl3 to the extract	Formation of a blue-black coloration

3. RESULTS AND DISCUSSION

The qualitative investigation of the leaves of chosen therapeutic plants aimed to determine the presence or absence of "alkaloids, carbohydrates, flavonoids, glycosides, phytosterols, and phenols". The findings of this investigation are presented in Table 2.

The analysis of the leaves of medicinal plants revealed the presence of carbohydrates, alkaloids, glycosides, phenols, and flavonoids in *A. marmelos*. On the other hand *A. marmelos* was found to contain carbohydrates, glycosides, flavonoids, and phenols. According to the literature, plants rich in tannins have been associated with anti-diarrheal, anti-inflammatory, and antioxidant activities. Saponins, phenols, and flavonoids were detected in all the plants under study. These phytochemicals are known for their antimicrobial, antifungal, anti-allergic, antispasmodic, and anti-inflammatory properties. Alkaloids were specifically identified in *A. marmelos*, and their presence suggests potential anti-microbial properties of

these plants. It can be concluded that the basis of these molecules like "flavonoids, carbohydrates, glycosides, alkaloids, and phenols are present in the selected medicinal plants which are used in Adilabad. Because of the presence of these secondary metabolites the selected medicinal plants have high healing potential". These phytochemicals extract the therapeutic values of the considered plants. The phytochemical analysis of medicinal plants plays a vital role in understanding their therapeutic potential and identifying the bioactive compounds responsible for their medicinal properties. In the case of the above-mentioned plant species, namely *A. marmelos*, the presence of various secondary metabolites was investigated and compared.

Table 2: Analysis of Phytochemicals in Methanolic Leaf Extracts of Selected Plant Species: Qualitative Results

S.Noo	Name of plants	Alkaloids	Carbohydrates	Glycosides	Phytosterols	Flavonoids	Phenols
1	*A. marmelos*	+	+	+	-	+	+
Note: + = The existence of phytochemical							

Flavonoids, carbohydrates, glycosides, alkaloids, phenols, and phytosterols are among the key secondary metabolites commonly found in medicinal plants (Harborne, 1998). The results of the analysis indicated that the selected plant extract contained a variety of these phytochemicals, although their composition varied to some extent. However, the specific composition and abundance of these phytochemicals vary among the plants, which may explain the differences in their traditional uses and reported therapeutic effects. The phytochemical analysis of the selected medicinal plants revealed the presence of various secondary metabolites, highlighting their potential therapeutic value. The presence of flavonoids, carbohydrates, glycosides, and phenols in these plants aligns with their reported medicinal properties and traditional uses. Further studies are warranted to explore the specific bioactive compounds responsible for the observed effects and to elucidate their mechanisms of action for the development of safe and effective herbal medicines.

Alkaloids and glycosides are known for their pharmacological effects and are commonly found in medicinal plants. Several studies have reported the presence of alkaloids and glycosides in A. *marmelos*, which suggests its potential as a source of natural medicines. For example, the alkaloid marmelosin, which is found in *A. marmelos*, has been shown to

possess antihyperglycemic and hypolipidemic activities in animal models (Gupta et al, 2010). Another alkaloid, skimmianine, has been reported to have antifungal and antibacterial properties (Mukherjee et al, 1997).

Flavonoids and phenols are known for their antioxidant and anti-inflammatory properties, which suggest that *A. marmelos* may have potential health benefits. Flavonoids have been shown to possess antioxidant, anti-inflammatory, and anticancer properties (Middleton et al, 2000). Phenols, on the other hand, have been reported to have antimicrobial, antioxidant, and anti-inflammatory activities (Sanchez et al, 2002). Several studies have reported the presence of flavonoids and phenols in *A. marmelos* (Sing et al, 2012; Kaur et al, 2012). The presence of carbohydrates in *A. marmelos* indicates the presence of nutrients and energy stores. Carbohydrates are essential for the proper functioning of the body and are the main source of energy for the body. A study has reported a high content of carbohydrates in *A. marmelos* pulp, which makes it a good source of energy (Ali et al, 2018).

Recent research has continued to explore the potential medicinal properties of Aegle marmelos. For example, Maheshwari et al. (2021) provided a comprehensive review of the phytochemical and pharmacological potential of *A. marmelos*, while Singh et al. (2020) reviewed its traditional uses, phytochemistry, and pharmacological activities. Ghosh et al. (2021) also provided a review of the phytochemical and pharmacological profile of A. marmelos. These studies highlight the growing interest in A. marmelos as a source of natural medicines.

In addition, recent studies have investigated the antimicrobial and antioxidant properties of *A. marmelos.* For example, Bhattarai et al. (2021) and Luthra et al., (2017) evaluated the antioxidant and antimicrobial activities of *A. marmelos* leaves extract, while Sahu et al. (2021) and Gujjeti et al., (2014) investigated the antioxidant and antibacterial potential of *A. marmelos* bark extracts. These studies suggest that *A. marmelos* may have potential applications in the development of natural antimicrobial and antioxidant agents.

However, further research is needed to determine the specific types and quantities of these compounds in *A. marmelos*, as well as their potential health benefits and therapeutic applications. Future studies could focus on isolating and characterizing the bioactive compounds in *A. marmelos* and evaluating their pharmacological activities. Clinical studies could also be conducted to evaluate the safety and efficacy of *A. marmelos* extracts or compounds in humans.

4. CONCLUSION

In conclusion, it can be inferred that the selected medicinal plant from Adilabad district, Telangana contain a diverse range of secondary metabolites, including flavonoids, carbohydrates, glycosides, alkaloids, and phenols. The presence of these bioactive compounds in the plants contributes to their significant healing potential. The identified phytochemicals play a crucial role in

determining the medicinal properties of the studied plants. However, further research is needed to determine the specific types and quantities of these compounds in *A. marmelos*, as well as their potential health benefits and therapeutic applications

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