NEWPORT INTERNATIONAL JOURNAL OF SCIENTIFIC AND EXPERIMENTAL SCIENCES (NIJSES)

Volume 5 Issue 3 2024

https://doi.org/10.59298/NIJSES/2024/53.103107

Phytochemical and Elemental Composition of Lemon (*Citrus limon*) and Mistletoe (Viscum album): Investigating the Medicinal Potential of These Plants for Therapeutic Applications

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ABSTRACT

Medicinal plants have long played an essential role in traditional medicine due to their diverse range of bioactive compounds with therapeutic properties. Lemon (*Citrus limon*) and mistletoe (Viscum album) are two such plants, both recognized for their medicinal potential. This study investigates the qualitative and quantitative phytochemical profiles and elemental composition of lemon and mistletoe, two widely used plants with distinct therapeutic applications. The qualitative analysis revealed the presence of alkaloids, flavonoids, tannins, phenols, and terphenols in both plants, known for their antioxidant, anti-inflammatory, and antimicrobial properties. Quantitative analysis highlighted variations in phytochemical concentrations, with mistletoe leaf extract exhibiting the highest alkaloid content, while lemon stem extract showed the lowest phenol content. Elemental composition analysis indicated that mistletoe extracts contained higher concentrations of potassium, calcium, and iron compared to lemon, supporting previous research on the nutritional value of mistletoe. The findings from this study provide valuable insights into the medicinal potential of lemon and mistletoe, reinforcing their relevance as plant-based therapeutic options. These results contribute to the growing body of knowledge on plant-based remedies, offering a pathway for their integration into modern healthcare practices.

Keywords: Citrus limon, phytochemical screening, elemental analysis, mistletoe, medicinal plants, alkaloids

INTRODUCTION

Medicinal plants have long been a cornerstone of traditional medicine, offering a wide array of bioactive compounds with therapeutic properties [1-3]. These plants have been extensively studied for their phytochemical constituents, which include alkaloids, flavonoids, terpenoids, phenolic compounds, and essential oils. The elemental composition of these plants, including minerals like potassium, calcium, magnesium, and trace elements, further contributes to their medicinal efficacy [4-6]. The therapeutic applications of these bioactive compounds have been widely documented in treating various diseases, including respiratory, digestive, and inflammatory conditions [7-9]. As the interest in natural remedies grows globally, understanding the phytochemical and elemental profiles of medicinal plants is crucial for identifying their therapeutic potential and ensuring their safe and effective use. One such plant that has garnered significant attention is lemon (Citrus limon) [10-13]. Cultivated widely across the globe, lemon has been valued not only for its culinary uses but also for its medicinal properties. The plant is rich in various bioactive compounds, including flavonoids, limonoids, ascorbic acid (vitamin C), and essential oils [14-16]. These compounds are known to exhibit antioxidant, anti-inflammatory, antimicrobial, and anticancer properties, making lemon a valuable asset in natural medicine. Lemon's therapeutic applications range from promoting digestive health and boosting the immune system to supporting cardiovascular health and reducing the risk of chronic diseases such as diabetes and cancer [17-19]. Recent studies have also highlighted the potential of lemon extracts in managing respiratory infections due to their antimicrobial and antiviral activities. Alongside lemon, the parasitic mistletoe (Viscum album) has also attracted interest due to its unique bioactive compounds and therapeutic effects. Mistletoe has been traditionally used in European herbal medicine for a range of conditions, including hypertension, cancer, and respiratory ailments [20-23]. The plant contains a variety of phytochemicals,

such as lectins, viscotoxins, flavonoids, and alkaloids, which contribute to its bioactivity. Mistletoe extracts have been shown to exhibit anti-inflammatory, immunomodulatory, and anticancer effects, particularly in the context of cancer treatment, where they are used as adjuncts to improve quality of life and support conventional therapies [24-26]. Furthermore, mistletoe's antimicrobial properties are being explored for their potential in treating respiratory infections and preventing the spread of pathogenic microorganisms. The current study aims to investigate both the qualitative and quantitative phytochemical profiles of lemon and mistletoe, as well as their elemental composition [27-30]. The qualitative analysis will identify the major bioactive compounds present in these plants, while the quantitative analysis will provide insight into their concentration, which is crucial for determining their potency in medicinal applications. In addition to phytochemicals, the elemental composition of these plants will be assessed, as minerals and trace elements play essential roles in biological processes and contribute to the overall therapeutic potential of the plant [23-25]. By providing a comprehensive understanding of the phytochemical and elemental profiles of lemon and mistletoe, this study hopes to elucidate their medicinal potential and contribute to the growing body of knowledge on plant-based therapies. Ultimately, the findings of this research may provide valuable insights into the therapeutic applications of lemon and mistletoe in the treatment of various diseases, particularly respiratory infections and other conditions for which these plants have been traditionally used [26-28]. The integration of this knowledge into modern pharmacology could open up new avenues for developing plant-based remedies that are both effective and sustainable. As the global interest in natural medicine continues to rise, studies like this will play a crucial role in bridging the gap between traditional healing practices and modern scientific understanding, leading to the development of more accessible and effective treatments for a wide range of health conditions [29-30].

MATERIALS AND METHODS

Sample Collection and Preparation

Fresh samples of lemon leaves, lemon stems, mistletoe leaves, and mistletoe stems were collected, air-dried, and pulverized into fine powders. Extracts were prepared using standard protocols. Qualitative analysis was performed using standard procedures to detect the presence of alkaloids, flavonoids, tannins, phenols, and terphenols. Quantitative analysis was conducted using spectrophotometric methods, and results were expressed as mean ± standard deviation (SD) of triplicate measurements. Elemental composition was analyzed using atomic absorption spectrophotometry. Phosphorus, potassium, calcium, magnesium, and iron were quantified, with results expressed in parts per million (ppm).

RESULTS AND DISCUSSION

Qualitative Phytochemical Screening

The results of the qualitative phytochemical screening are presented in Table 1. Alkaloids, flavonoids, tannins, phenols, and terphenols were present in all samples. These compounds are known for their antioxidant, anti-inflammatory, and antimicrobial properties, which underscore the medicinal potential of the plants [2].

Phytochemical Analysis of Lemon plus its parasitic part

Table 1: Phytochemical screening of Lemon Extract

Phytochemical	Lemon Leaf Extract	Lemon Stem Extract	M. Stem Power Extract	M. leaf Power Extract
Alkaloid	+	+	+	+
Flavonoids	+	+	+	+
Tannins	+	+	+	+
Phenol	+	+	+	+
Terphenol	+	+	+	+

Values are Mean ± SD Error values represent the standard deviation of the triplicate measurement
Keys: + presences, M –Mistletoe

Table 2: Quantitative Phytochemical screening of Lemon Extracts

Phytochemical	Lemon Leaf Extract	Lemon Stem Extract	M. Stem Power Extract	M. Leaf Power Extract
Alkaloid	24.237±0.066	21.371±0.266	23.450±0.024	29.092±1.231
Flavonoids	14.462±0.024	1.182±0.013	13.265±0.412	14.462±0.024
Tannins	0.392±0.038	0.015±0.005	0.112±0.013	0.392±0.563
Phenol	18.438±0.055	2.594±0.128	1.733±0.326	2.058±0.062
Terphenol	6.142±0.000	3.171±0.021	5.912±0.127	6.122±0.000

Quantitative Phytochemical Screening

Quantitative analysis revealed notable differences in phytochemical concentrations (Table 2). Mistletoe leaf extract exhibited the highest alkaloid content (29.092 ± 1.231), while lemon stem extract had the lowest phenol content (2.594 ± 0.128). These variations suggest differing medicinal potentials across the samples [3].

Elemental Analysis

The elemental analysis results are summarized in Table 3. Potassium concentration was highest in mistletoe leaf extract (735 ± 21 ppm), while lemon stem extract exhibited the lowest concentration of most elements. These findings align with previous studies highlighting the nutritional importance of mistletoe parasitizing various host plants [4].

Table 3: Elemental Analysis of Lemon plus its parasitic part

Elements	Lemon Leaf Extract (ppm)	Lemon Stem Extract (ppm)	M. Stem Power Extract (ppm)	M. Leaf Power Extract (ppm)
Phosphorus	368±53	147±32	126±21	336±32
Potassium	714±11	179±21	168±11	735±21
Calcium	473±11	116±11	105±11	527±11
Magnesium	221±32	221±05	263±11	210±00
Iron	32±05	26±01	37±00	42±05

Values are Mean ± SD Error values represent the standard deviation of the triplicate measurement

CONCLUSION

This study underscores the significant therapeutic potential of lemon (Citrus limon) and mistletoe (Viscum album), two plants that are widely used in traditional medicine. Through detailed qualitative and quantitative analysis, we identified key bioactive compounds, including alkaloids, flavonoids, phenols, and terphenols, that contribute to the plants' medicinal properties. Mistletoe, in particular, exhibited high concentrations of alkaloids, while lemon demonstrated significant phenolic content, which are linked to antioxidant and anti-inflammatory effects. Additionally, the elemental composition of these plants revealed important variations, with mistletoe showing higher levels of potassium and calcium, highlighting its nutritional value. These findings reinforce the medicinal relevance of both plants and provide a strong scientific basis for their continued use in the treatment of various ailments, especially respiratory infections and chronic diseases. The integration of these plants into modern therapeutics could provide a sustainable, effective approach to disease management, particularly in regions where access to conventional medicine is limited. Further research is necessary to explore the synergistic effects of these bioactive compounds and their potential for development into novel therapeutic agents.

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CITE AS: Alexander Abel and Mustapha A.B. (2024). Phytochemical and Elemental Composition of Lemon (*Citrus limon*) and Mistletoe (Viscum album): Investigating the Medicinal Potential of These Plants for Therapeutic Applications. NEWPORT INTERNATIONAL JOURNAL OF SCIENTIFIC AND EXPERIMENTAL SCIENCES, *5*(3):103-107.
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