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Analysis of the Mineral Nutritional and Phytochemical Composition of Mistletoe Leaves (*Loranthaceae*)

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Abstract
Medicinal plant extracts have been used in different cultures, for treating ailments and managing health issues like inflammatory conditions, hypertension, diabetes mellitus, arthritis, epilepsy, etc. Extracts of mistletoe leaves were studied for their mineral, nutritional and phytochemical composition. The proximate analysis results reveal high fibre content (11.1%) and low fat (3.2%) content, making it a good cholesterol-lowering agent. The mineral composition revealed that mistletoe leaves are nutritionally beneficial as they contain relatively high levels of iron, calcium, potassium, manganese and magnesium, which all play important physiological and metabolic roles in the body. The Na/K and Ca/P ratios of 0.623 and 3.931 respectively are considered favourable, making the leaves nutritionally and physiologically important. The presence of tannins, saponins, flavonoids, steroids, resins and alkaloids could be responsible for their use in traditional medicine. These findings therefore reveal that mistletoe leaves can be utilized as medicinal/curative agents in ameliorating health-related issues such as hypertension, cancer, arthritis and fertility-related ailments; as well as being nutritionally beneficial, if properly harnessed.

Keywords: Mistletoe leaves, Mineral, Phytochemical, Nutritional, Proximate.

Introduction

Mistletoe plants (*Loranthaceae*), a semi-parasite, are usually found growing on orange, mango, cocoa, kola-nut and other trees. With the aid of adhesives, it can stick firmly to the branches of the trees, absorbing water and nutrients from the trees for their steady growth. It is used by tradomedical practitioners when dried and ground as a tea by patients to control blood pressure ailments, hypertension, fertility-related ailments, cancer, arthritis and diuretics (Adesina et al., 2013). It is known for its nutritional and/or nutritive content in animal and plant health. Essential oils (e.g. n-hexa-decanoic acid) are present in mistletoe leaves with anti-inflammatory properties. Medically, economically, and ornamentally, they are regarded as epiphytic plants, and little is known about their chemistry and host/plant relationship. Some pharmacological studies (Atewolara-Odule & Oladosu, 2016; Adesina et al., 2013) have revealed crude alcoholic purified extracts to possess anti-oxidative, antimicrobial, anti-inflammatory and hypoglycemic effects that were non-toxic in animal and plant at their used doses. Mistletoes are generally regarded as devastating parasites which indicates economic losses to farmers. They are usually dispersed by birds through regurgitation (Weston et al., 2012) and cause salt imbalance in the host plant (Dibong et al., 2010), this explains the reduction in the quality of fruits in the host plant due to the parasitism of mistletoe plants.

The most distinctive components of mistletoes are carbohydrates, proteins, lectin, flavonoids and phenylpropanoids, which contribute to the anti-oxidative properties of its extract, as well as other smaller molecular weight like tannins, flavonoids and alkaloids, which are also present. Their isolate administered on rats showed it caused a reduction in plasma levels of inorganic phosphate, haemoglobin, muscle glycogen and blood sugar. The results of different feeding experiments and tests of toxicity revealed mistletoe leaf extract to be non-toxic in laboratory animals. Other studies showed it to be a source of nutrients that are essential in nutritional challenges (Ohikhena et al., 2017). The leaves are important to man due to flavonoids and tannins in modifying body reactions to carcinogens and viruses (Tabe et al., 2019).

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This study was conducted to determine the chemical components of mistletoe by evaluating their nutritional, phytochemical constituents, mineral contents and sodium/potassium (Na/K) and calcium-phosphorus (Ca/P) ratios.

Materials and Methods

Samples of mistletoe leaves were collected from mango trees in Agbarho, Ughelli North local Government Area of Delta State. Samples were divided into two, one for oil and moisture extraction, and the other for proximate, mineral and phytochemical composition of the leaves. A portion was dried for four hours in a Techchem oven. It was crushed with mortar and pestle to powder and stored until analysis. The fresh leaves were used for oil extraction and moisture analysis. The experiment was carried out in the Chemical Sciences Laboratory at the University of Delta, Agbor, Delta State, Nigeria.

Solvent Extraction: Solvent extraction was done using the method described by (Allinor, 2007). About 75 g of dried powdered mistletoes leaves were placed in a Soxhlet extractor with ethanol as the solvent. It was refluxed for 3 hours and evaporated to get a slurry form at 60℃. This procedure was repeated with toluene and petroleum ether, using 75 g of ground leaves sample for each extraction. Extracts were cooled and stored in a refrigerator.

Oil Extraction: Mistletoe leaves (fresh) were placed in a round bottom flask and placed in the Soxhlet extractor, with 150 ml of distilled water. To prevent bumping, anti-bumping was introduced into the flask which was placed in a hot plate for 12 hrs. The extraction process was terminated when a clear extract was noticed. The separating funnel top was open, and the water layer was separated from the oil on top.

Proximate Analysis: Proximate analysis, which involves the quantitative determination of the percentage composition of moisture, ash, crude protein, crude fibre, carbohydrates, total protein and fats (total lipids), was done using the Association of Official Analytical Chemists (AOAC) standard methods (AOAC, 2005).

Mineral Content: The mineral content of the extracts was determined using the HACH 2010 spectrophotometer (phosphorus), corning 600 flame photometer (sodium and potassium) and spectral 10 Atomic Absorption Spectrophotometer (calcium, magnesium, iron, copper and zinc), according to APHA standard protocols (APHA, 2005).

*Phytochemical Screening***:** The mistletoe leaf extracts were qualitatively evaluated for the presence of flavonoids, steroids, tannins, saponins, alkaloids, and resins, using modifications of previously published standard protocols as follows: flavonoids (Alqethami & Aldhebiani, 2020), steroids (Gupta et al., 2022), tannins, saponins and alkaloids, (Sherma et al., 20200) and resins (Odeja et al., 2016).

Results

The proximate composition of the mistletoe leaf extracts is presented in Figure 1.

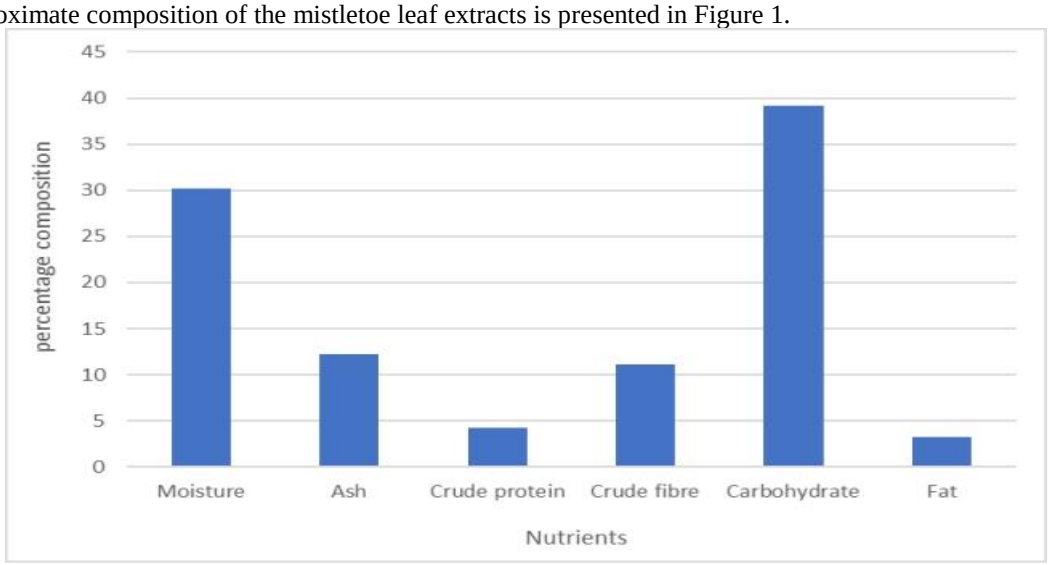

Figure 1: Percentage proximate composition of mistletoe leaf extract

Figure 1 shows the proximate constituents of mistletoe leaves to contain moisture, ash, crude protein, fibre, carbohydrate and fat in varying concentrations as presented.

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The mineral composition of leaf extracts of mistletoe is presented in Table 1.

Table 1: Mineral composition of mistletoe leaves.

Mineral element	Quantity (mg/100g)
Potassium	20.01 ± 0.30
Sodium	13.10 ± 0.32
Calcium	59.00 ± 0.10
Magnesium	360.32 ± 0.01
Phosphorus	15.01 ± 0.32
Manganese	240.00 ± 0.01
Iron	240.00 ± 0.01
Copper	13.03 ± 0.10
Zinc	1.30 ± 0.40
Sodium/potassium (Na/K) ratio	0.623
Calcium/phosphorus (Ca/P) ratio	3.931

The result obtained from the determination of the mineral composition of the mistletoe leaf extracts reveals magnesium (360.32 ± 0.01) to be the mineral with the highest concentration, followed by iron and manganese (240.0 ± 0.01mg/100mg), calcium (59.00 ± 0.10) and potassium (20.01 ± 0.3). The Na/K and Ca/P ratios yielded 0.623 and 3.931 respectively.

Table 2 shows the result of the percentage yield of mistletoe leaf extract using different solvents (ethanol, petroleum ether and toluene).

Table 2: Percentage yield extract of mistletoe leaves.

Extract	Weight of powdered sample	Weight of yield	Percentage of yield
Ethanol	75	5.30	7.01
Petroleum ether	75	3.20	4.27
Toluene	75	4.20	5.60

The use of different solvents in the extraction of mistletoe leaves revealed that ethanol produced the highest yield of 5.30, representing 7.01% yield, while petroleum ether and toluene yielded 3.20 (representing 4.27% yield) and 4.20 (representing 5.10% yield) respectively.

The phytochemical composition of the mistletoe leaf extracts using different extraction solvents is presented in Table 3.

Table 3: Phytochemical composition of mistletoe leaf extracts using different extraction solvents

Extract	Tannins	Saponins	Flavonoids	Steroids	Alkaloids	Resins
Ethanol	+	+	+	+	+	+
Petroleum ether	+	+	+	+	+	+
Toluene	+	+	+	+	+	+

The result of the phytochemical analysis shown in Table 3, revealed that mistletoe leaf extracts contain tannins, saponins, flavonoids, steroids, alkaloids and resins.

Discussion

Proximate Analysis: The leaves were found to contain relatively high moisture, ash, fibre and carbohydrate contents. The high fibre content and low fat content, make it nutritionally beneficial, as they help in lowering serum cholesterol levels, as well as lowering the risks of blood cancer and heart diseases (Ishiwu et al., 2013). The high ash content is indicative of the presence of some minerals (Ohikhena et al., 2017).

*Mineral Composition***:** Mistletoe leaves used for this study contained high concentrations of iron, manganese, calcium and potassium. This is consistent with previous studies (Ohikhena et al., 2017) that have reported mistletoe leaves as sources of iron, potassium and calcium due to their high concentrations. Magnesium was also present in relatively large quantities, and as opined by Groenendijk et al. (2022), magnesium assists calcium in bone formation and prevention of diseases associated with poor circulation of blood, thus making mistletoe leaves highly beneficial health-wise. The combination of zinc and magnesium in adequate levels makes up the prosthetic groups of enzymes in body metabolism and its deficiency can result in retarded growth.

Na/K ratios less than 1 have been reported to control high blood pressure in humans and reduce the risk of cardiovascular diseases (Iwahori et al., 2017). In this study, the Na/K ratio of the extract was less than 1, which is

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makes mistletoe leaves a favourable therapeutic agent. According to Yu et al. (2023), Ca/P ratios greater than 1 are considered favourable. The Ca/P ratio observed for this study is greater than 1, it is making mistletoe leaves favourable curative agents. Since both ratios (Na/K and Ca/P) obtained from this study are considered favourable, it is a pointer that mistletoe leaves are a good nutrient source and an important curative/therapeutic agent. *Percentage Yield of Extract:* Of the three solvents used for extraction (ethanol, petroleum ether and toluene), ethanol produced the highest yield. This is an indication that ethanol is the ideal solvent for the extraction of mistletoe leaves, in comparison with the other solvents used.

Phytochemical Composition: The use of plant leaves by traditional herbalists in the treatment of illnesses is not surprising, as they contain phytochemicals which are known for their curative activities. The phytochemicals screened (tannins, saponins, flavonoids, steroids, alkaloids and resins) were present in the different extracts. The presence of tannins in the leaves of extract of mistletoes is responsible for its use in the treatment of wounds and bruises, as suggested by Jing et al. (2022). Flavonoids in plants are used as antioxidants, stress management agents, UV-light-induced damage repair agents, male fertility promoters and agents for the improvement of visual signals (Petrussa et al., 2013). Flavonoids are also used for diuretics and possess antibacterial and anti-cancer activities. Saponins function as defence compounds in plants and medicinally for humans as an anti-inflammatory (Miranda et al., 2022), anti-diabetic and anti-hypertensive agents (Lim & Park, 2023). Alkaloids in plants are used in the treatment of excessive salivation in Parkinson's disease and motion sickness, as an anaesthetic agent. Steroids present in mistletoe leaves can boost sexual function, and regulate physiological processes related to growth, development and reproduction. Resins, also present, have anti-tumoral properties and improve cognitive function; they also help in wound healing, and in the treatment of cough, ulceration and genitourinary disorders (Gangasani et al., 2022).

Conclusion

This investigation shows that the leaves of mistletoe are a good source of carbohydrates, fibre and minerals. They are rich in magnesium, needed for bone formation, as well as in manganese, iron, calcium and potassium, which play important biological, physiological and metabolic roles in humans. The presence of saponins, alkaloids, flavonoids, steroids and resins is responsible for its reported use in traditional medicines in the treatment, management and ameliorative of diverse health challenges.

Recommendations

The use of mistletoe leaves as a good source of nutrients, as well as in the treatment, management and amelioration of health challenges is suggested and recommended. However, there is a need to conduct further studies on the antimicrobial activity of the leaves, as well as toxicity tests, dose-response tests, clinical trials and isolation of the active compounds, all of which are highly recommended, considering their potential curative properties and nutritional benefits.

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