

Chemical Analysis, Nutraceuticals, and Infra-Red Characterization of Cassia alata Leaves

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Research Article

Keywords: Pharmaceutical, Drugs, Infra-Red, Spectroscopy, Cassia Alata

Posted Date: November 21st, 2023

DOI: <https://doi.org/10.21203/rs.3.rs-3627069/v1>

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Abstract

This *Cassia alata* leaf is an important medicinal leaf used in folk medicine in the treatment of various skin infections such as ringworm and other fungal infections of the skin. The study was carried out to assess the proximate compositions (%) ash contains (8.998), moisture (2.615), crude fat (10.557), crude fiber (14.443), protein (12.023), and carbohydrate contents (51.364), mineral elements (mg/kg): magnesium (115.000), potassium (86.900), calcium (72.800), sodium (25.000), iron (9.000), zinc (3.900) and copper (0.860), vitamins (mg/kg): vitamin C (1.904), vitamin B1, (0.527) and vitamin B2, (0.312), phytochemical: Total phenol (20.804), saponins (1.357), alkaloids (14.542), glycosides (9.174) and tannins (2.018) using various analytical standard techniques. The study appraised the impact of the functional groups of the sample using Perkin infra-red spectroscopy to distinct fingerprint regions such as (3408.00 cm^{-1}) phenol, (2925.83 and 2365.00 cm^{-1}) phosphine, (1648.35 cm^{-1}) carbonyl, alkene, and aromatic ring, (1407.30 cm^{-1}) phosphate compound, (1252.47 cm^{-1}) arylethers and (1063.00 cm^{-1}) thiocarbonyl. The study revealed the leaves to be a potential source of nutrition, minerals, and confirmations of secondary metabolites likewise the presence of functional groups which is a source of information about the leaves in the formulation of pharmaceutical drugs.

I. INTRODUCTION

From the world go, medicinal plants have been a tremendous source of herbal medicine which pre-date the practice of medicine. In a million times, plants synthesize chemical compounds. Uncountable higher metabolites of well-laid-down biological effects have been brought to the book. As a lot of secondary metabolites can be derived from a single plant, hence, medicine should be derived bit by bit. According to (Ahn, 2017) pharmacological effects can be derived from secondary metabolites. The cost and scarcity of modern medicines have given room for the widest acceptability of medicinal plants in the non-civilized areas of society. In the submission (Ahn, 2017), changes in climatic conditions coupled with excessive demand for medicinal plants have constituted a great challenge to these medicinal plants. The use of medicinal plants is not limited to human beings alone, domestic and wild animals are not left behind including insects, since sickness and diseases are not only limited to humans alone. For this reason, both human beings and non-human beings alike need sound health. In this light, *Cassia alata* leaves are part of the medicinal plant that can be found anywhere but Mexico has it in large quantities (Nicolson, 1991; Hirt et al., 2008). This medicinal plant has been given different names by different people. Some call it the candelabra bush, while others call it empress candle plants or ringworm tree or candle tree etc (Hirt et al., 2008). The flowers are admirable and attractive to the eyes. Their average is almost 1200, most especially in the tropic areas. Their height normally ranges from 3m to 4m as the case may be and their leaves from 50cm to 80cm. It looks like a yellow candle. The fruit is about 25cm in length and the agent of dispersion can be water or animals. The length and breadth of the seeds are 15cm and 15mm respectively and the colour is black-like. The leaves constantly respond to the stimuli. The benefits of the tree cannot be overemphasized. These benefits range from healing of the skin

diseases of any kind to curing any form of ailment. Almost every part of the tree is useful including the flowers (Rao et al., 1975).

The objective of this study is to draw our attention to the phytochemical constituent, Infra-red and chemical composition of this plant. This is to provide useful information for the effective utilization of this plant. It is also to bring into focus the scientific rationale behind the usage of this plant in traditional medicine. In addition, it is also to know the other of usefulness of the plant in the physical sciences apart from its medicinal benefits.

II. MATERIALS AND METHODS

A. Collection and preparation of plant materials

The Cassia alata leaves were obtained at Abbe farmland in Egbedore Local Government area of Osun State, Nigeria. Identification of the plant was carried out by the experts in the Department of Science Laboratory Technology, Osun State Polytechnic, Iree. The Leaves were air-dried at room temperature for about two weeks. After which was ground with mortar and pestle into a fine powder and sieved with a 1.5mm plastic sieve. It was kept in an air-tight container for subsequent uses.

III. METHODS

A. Phytochemical screening

Phytochemical screening was performed on the Cassia alata Leaves to confirm the presence of total phenol, saponins, alkaloids, glycosides, and tannins with the methods described by Harborne (1998); and Trease and Evans (2002).

B. Minerals composition analysis

The Cassia alata Leaves was analyzed for sodium, potassium, calcium, magnesium, iron, zinc and copper according to the method described by Gideon et al., (2018).

C. Biochemical composition of analysis

The Cassia Leaves was analyzed for ash, moisture, crude fat, crude fibre, protein, carbohydrate and energy value following the standard methods described by Association of Official Analytical Chemist (AOAC, 2012).

D. Instrumental analysis

The Leaves sample was subjected to Infrared analyses. This involves the use of Fourier Transform Infra-Red (FT-IR) spectroscopy Perkin-Elmer tutorial library model to determine the active spectrum and also to determine the functional compounds in the sample. (Perkins, 1986).

E. Other parameters

Parameters such as vitamin C. B1 and B2 were analyzed according to the method (AOAC, 2012).

C. Minerals composition analysis

The Cassia alata Leaves were analyzed for sodium, potassium, calcium, magnesium, iron, zinc, and copper according to the method described by Gideon et al., (2018).

IV. RESULTS AND DISCUSSIONS

Table 1
Proximate analysis of Cassia alata leaves

Parameters	Compositions
Ash content	8.998 ± 0. 2
Moisture content	2.615 ± 0. 1
Crude fat content	10.557 ± 0. 2
Crude fibre content	14.443 ± 1.0
Protein content	12.023 ± 0. 2
Carbohydrate content	51.364 ± 0. 1

Results are expressed as mean ± SD of triplicate determinations

Table 2
Minerals analysis of Cassia alata
leaves (mg/kg)

Parameters	Compositions
Sodium	25.000 ± 0. 20
Potassium	86.900 ± 0. 10
Calcium	72.800 ± 0. 10
Magnesium	115.000 ± 0. 20
Iron	9.000 ± 0. 10
Zinc	3.900 ± 0. 2
Copper	0.860 ± 0. 10

Results are expressed as mean ± SD of triplicate determinations

Table 3
Vitamins analysis of Cassia
alata leaves (mg/g)

Parameters	Compositions
Vitamin C	1.904 ± 0. 10
Vitamin B1	0.527 ± 0. 20
Vitamin B2	0.312 ± 0. 2 0

Results are expressed as mean ± SD of triplicate determinations

Table 4
Qualitative phytochemical analysis of Cassia alata leaves

Parameters	Constituents
Tannins	+ve
Phenols	+ve
Alkaloids	+ve
Flavonoids	-ve
Saponins	+ve
Glycosides	+ve
+ve = presence of constituents, -ve = absence of constituent	

Table 5
Quantitative phytochemical analysis of
Cassia alata leaves

Parameters	Compositions
Total phenols (%)	20.804 ± 0. 30
Saponins (%)	1.357 ± 0. 10
Alkaloids (%)	14.542 ± 0. 20
Glycosides (mg/Kg)	9.174 ± 0. 10
Tannins (mg/g)	2.018 ± 0. 2 0

Results are expressed as mean ± SD of triplicate determinations

Table 6
Infra-red spectrum table of Cassia alata Leaves

Regions	Wavelengths cm-1	Functional groups
Functional group	3408.00	Phenol
	2925.83	C-H, RCH = CH ₂ ,CH ₃ ,CH ₂ &CH having 2/3bands
	2365.00	P-H (phosphine)
	1648.35	C = O (carbonyl)
		C = C (alkene aromatic rings)
Fingerprint	1407.30	N-H stretch (phosphate compound) CH ₃ , CH ₂ P = O
	1252.47	O-H (usually bond C-O Arylethers)
	1063.00	C = S (thiocarbonyl)

V. DISCUSSIONS

The chemical analysis (%) of Cassia alata leaves is given in Table I. The results reveal that ash contains (8.998), moisture (2.615), crude fat (10.557), crude fiber (14.443), protein (12.023), and carbohydrate contents (51.364).

Carbohydrate has the highest value, while the value for moisture is the least. The low moisture content of the leaves would prevent the development of micro-organisms and shelf life would be prolonged (Uzama et al., 2012). The value is lower when compared to the value obtained for Securinega virosa leaf (10.88%) as reported by (Uzama et al., 2012). As observed in the present study, the ash content of (8.998) was obtained for the sample analyzed. The value obtained is higher compared to (1.80%) reported in sweet potato leaves as reported (Asibey-Berko and Tayle, 1999). This shows that the leaves are rich in mineral elements. The leaves contained (10.557) crude fat, but higher when compared to Chaya leaves (0.4%)

and (1.60%) in *Amaranthus hybridus* leaves (Nwaogu et al., 2000). Fat is the source of energy (Anita et al., 2006). Protein contributes to the growth and repair of worn-out tissues (Ayoola et al., 2012) and can thereby improve the nutrition of both humans and animals just as revealed in the fiber content (14.443), fiber can lower serum cholesterol level, and risk of coronary heart diseases as reported by Rao and Newmark; 1998; Ishida et al., 2000).

Carbohydrate is known to supply energy to cells which include the brain, muscle, and blood likewise it aids in the contribution of fat metabolism and excess protein as an energy source (Alinnor and Oze, 2011). The present study revealed that the samples are rich sources of mineral elements (mg/kg) as shown in ascending order in (Table 2). Sodium and potassium are the main cations in extracellular fluids magnesium (115.000), potassium (86.900), calcium (72.800), sodium (25.000), iron (9.000), zinc (3.900), and copper (0.860) that helps to regulate plasma volume and acid-base balance involved in the functioning of osmotic pressure of the body fluids system (Hays and Swenson, 1985). Calcium is essential for growth, teeth formation, and muscle development as well as in keeping and maintenance of bones in the body (Turan et al., 2003). Magnesium is an important component of many enzyme systems in the body, it is essential because it is an activator for the phosphate-transferring enzyme myokinase (Murray et al., 2000). Iron is needed in the body as an essential constituent of succinate dehydrogenase as well as a part of the haemo of the hemoglobin (Galan et al., 2005). Zinc aids in cell reproduction and gene expression of amino and nucleic metabolism (Murray, 2000).

Copper is an important micronutrient element for the haematologic and neurologic systems. It is important for the formation of myelin sheaths in the nervous system, growth and formation of bone as well as ascorbic acid (Murray et al., 2000 and Hassan et al., 2005). The present study confirmed that *Cassia alata* leaves contained a significant amount of vitamins (mg/g) which include vitamin C (1.904), vitamin B1, (0.527), and vitamin B2, (0.312) as stated in Table 3.

Ascorbic acid which is known as vitamin C is a good antioxidant that accelerates sound teeth and gums. It aids the body system to imbibe iron which helps in blood formation and affirm tissue. Likewise, it is important for the fast healing of wounds. Riboflavin in collaboration with another vitamin especially the B vitamin is essential for body development and the manufacture of red blood cells in the body system. Vitamin B1 called thiamine assists the body cell to convert carbohydrates into energy. Likewise, it is important for heart function and healthy nerve cells. (Jenkins et al., 2018). Tables 4 and 5 indicate the qualitative and quantitative phytochemical analysis of the present study. It reveals the presence of total phenol (20.804%), saponins (1.357%), alkaloids (14.542%), glycosides (9.174mg/g), and tannins (2.018mg/g) in their quantities. Saponins have been ascribed as anti-microbial and anti-fungal remedies (Foerster and Hartmut, 2006). Likewise, Tannins have been unveiled to have anti-viral, anti-bacterial, and anti-parasitic properties (Kolodziej and Kiderien, 2005). This was observed in the study, phenolic as an analgesic, antipyretic, and anti-inflammatory has been named for this phytochemical and has induced its effectiveness in folk medicine (Michael, 2008).

Table 6 shows the infrared spectra of *Cassia alata* leaves. The infrared spectrum of the *Cassia alata* leaves showed distinct, functional group and fingerprint regions. The functional group region consists of relatively few peaks associated with the stretching vibrations.

The usual C-H absorption bands appear around 2925.83cm^{-1} . The absorption band at 3408cm^{-1} is sharp due to the OH group of an alcohol or phenol (Li et al., 2010). However, the absorption around 1648.35cm^{-1} is due to the presence of a C-H double bond indicating the level of unsaturation in the sample. The active functional compound in the sample is absorbed around 2365cm^{-1} indicating the presence of phosphine compound (P-H). Absorptions at wave number 1648.55cm^{-1} are assigned for C = O stretching; a carbonyl compound and conjugated carbonyl bonds of aromatic rings from flavonoids which commonly appear in the region (Villena et al., 2000; Adiana and Mazura, 2011). The presence of C = C bonds at 1648.35cm^{-1} indicates the presence of alkenes functional groups which shows the level of conjugation in the sample investigated (Mitra et al., 2016).

The brain tissue would have been reinforced with mystery. No wonder, phosphorus was assigned as a brain food and is used in body metabolism. Indeed, coca-cola was initially marketed as a brain tonic, due to its phosphoric acid content (Dronsfield et al., 2004).

However, the presence of the aryl ethers in the leaves sample impacts the medicinal value of the said plant. Arylethers are structural components of natural products and have been used as an intermediate in the production of potent pharmaceuticals (DrugBank, 2013). Research has shown that the synthesis of Arylether can be used in inhibiting the resistant *Bacillus anthracis* via nucleophilic aromatic substitution reactions (Suresh et al., 2008)

VI. CONCLUSION

The presence of some important macro and micro minerals element, phytochemicals, nutritional composition as well as the spectroscopy determination of the leaf under investigation revealed some biochemical basis for the ethno- pharmaceutical uses of the leaves. The study showed that the *casia alata* leaf contained potential sources of nutritional value, presence of secondary metabolites as well as the presence of medicinal functional components that are good in the potential drug formulation.

Declarations

The authors declare no competing interests.

Acknowledgements

The authors acknowledge the funding support of the Tertiary Education Trust Fund (TETFund) under the Institution-based Research Grant (IBR). This support has significantly contributed to the successful completion of this work.

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Figures

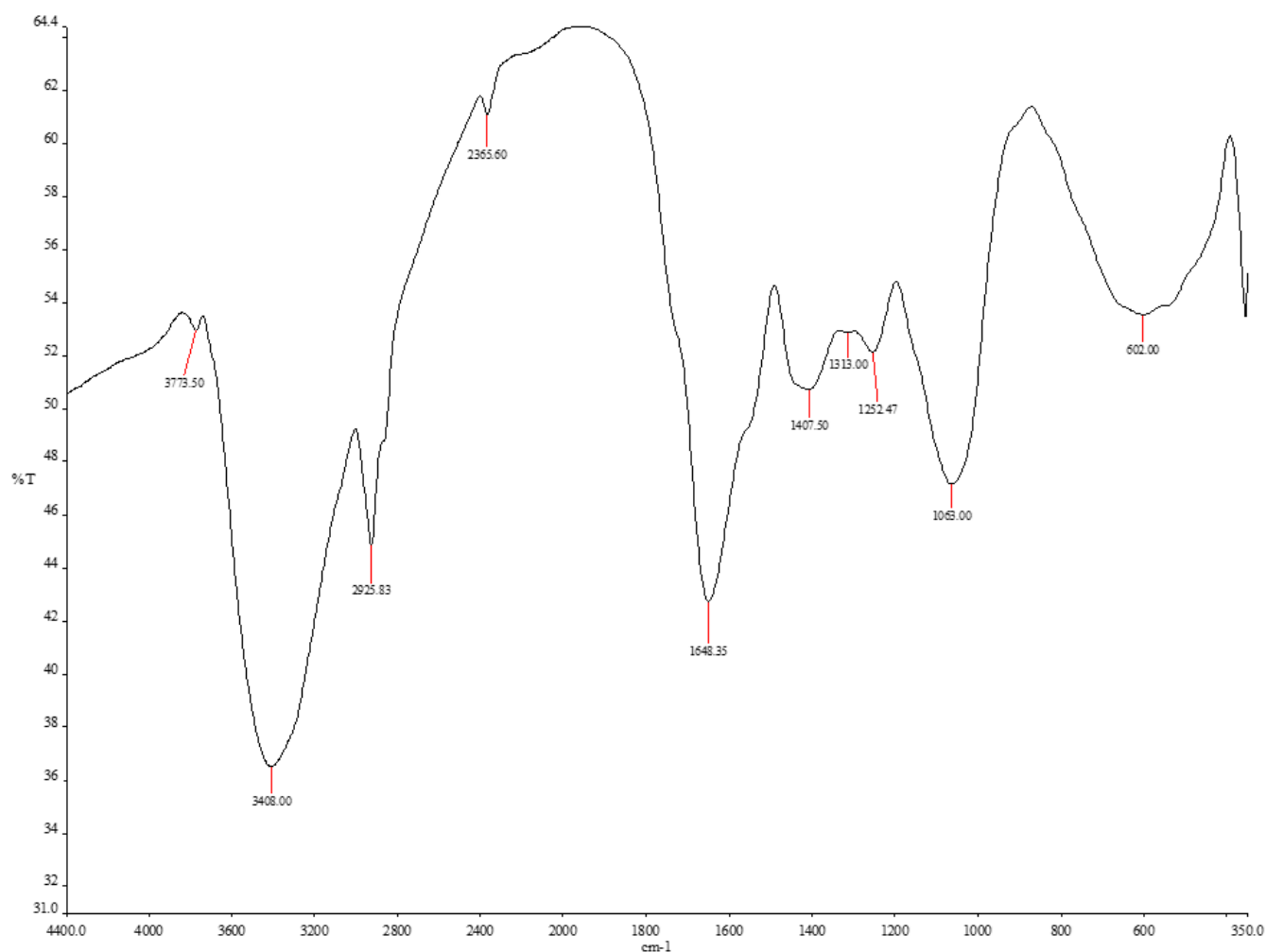


Figure 1

Cassia alata leaves spectrum