Phytochemical Composition and Antivenom Potential of Uvaria chamae: A Comparative Study of Leaves and Roots for Medicinal Applications in Traditional Medicine"

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Abstract

Objectives: This study investigates the phytochemical composition and antivenom potential of Uvaria chamae, focusing on a comparative analysis of the leaves and roots for their use in traditional medicine. The aim is to evaluate and compare the phytochemical profiles of the leaves and roots of Uvaria chamae and assess their potential efficacy as antivenom agents.

Design & Methods:A comprehensive phytochemical analysis was conducted on the leaves and roots of Uvaria chamae to identify and quantify bioactive compounds, including tannins, flavonoids, alkaloids, saponins, phytates, cardiac glycosides, and oxalates. Standard analytical techniques was applied to assess the medicinal properties and evaluate the therapeutic potential of these plant parts for treating snakebite envenomation.

Results: The phytochemical analysis demonstrated that both leaves and roots contain significant bioactive compounds, with leaves generally showing higher concentrations. Notably, flavonoid content measured at 8.30% in leaves and 3.90% in roots, while cardiac glycosides were present at 9.00% in leaves and 4.00% in roots. These compounds, particularly flavonoids and alkaloids, are recognized for their antioxidant and anti-inflammatory properties, which may contribute to antivenom effects. The presence of low levels of toxic compounds, such as oxalates (0.054% in both leaves and roots), supports the plant's safety for medicinal use.

Conclusions: The findings suggest that Uvaria chamae holds promise for use in antivenom formulations within traditional medicine, with the leaves showing greater medicinal potential than the roots due to higher concentrations of key bioactive compounds. This study supports further research and utilization of Uvaria chamae as a natural antivenom agent, offering a valuable resource for developing safe and effective treatments in resource-limited settings.

Introduction

Uvaria chamae, a small shrub native to tropical Africa, is extensively used in traditional medicine for its broad therapeutic applications. The leaves and roots are utilized to treat various ailments, including malaria, infections, and snakebites. This dependence on Uvaria chamae in indigenous healing practices is largely due to its rich phytochemical profile, which contains alkaloids, flavonoids, tannins, and saponins, all recognized for their pharmacological benefits (Akinmoladun *et al.,* 2019).

Snake envenomation remains a significant public health concern, particularly in rural regions where access to modern medical treatments is limited. Traditional medicine, including the use of herbal remedies, continues to serve as an accessible and affordable alternative for managing snakebites. Uvaria chamae has shown promise in this area due to its potential antivenom activity (Onyeka *et al.,* 2021). The active phytochemicals in the plant are believed to neutralize venom toxins, offering a complementary approach to conventional antivenom treatments.

The phytochemical constituents of Uvaria chamae, however, may vary between different parts of the plant, such as the leaves and roots. Comparative studies on the bioactive components and their respective medicinal properties are essential to optimize its therapeutic applications (Okoye *et al.,* 2018).

In an ideal healthcare setting, venomous bites and stings, which are significant public health concerns, should be promptly and effectively treated using affordable and accessible antivenom therapies. However, existing antivenom treatments are expensive, often limited in availability, and may cause adverse reactions in some patients. Traditional medicinal plants, such as *Uvaria chamae*, have been used for centuries in local communities to manage snakebites and other envenomations due to their potential medicinal properties.

Despite the widespread traditional use of *Uvaria chamae*, particularly its leaves and roots, for treating venomous bites, there is a significant gap in scientific validation of its antivenom potential. The phytochemical composition of different parts of the plant, as well as their comparative efficacy in neutralizing venom, remains inadequately understood. This gap hinders the development of plant-based antivenom therapies, which

could be safer, more affordable, and accessible alternatives to conventional treatments.

This study, therefore, seeks to explore the phytochemical composition of the leaves and roots of *Uvaria chamae* and evaluate their antivenom potential. By addressing this knowledge gap, the study could contribute to the development of effective plant-based therapies for envenomation, which would benefit underserved populations in rural and low-resource settings, potentially reducing the morbidity and mortality associated with venomous bites

This study aims to evaluate and compare the phytochemical composition of the leaves and roots of Uvaria chamae, with a particular focus on their potential antivenom efficacy.

2.0 MATERIALS AND METHOD

Standard equipment and analytical grade reagent was used for the purpose of this work.

2.1 Samples Collection and Sample Preparations

The Plant leaves & roots of Uvaria chamae was collected from a nearby farmland close to Anambra State University, Uli Ihiala Local Government Area of Anambra State.

2.2 SAMPLE PREPARATION

The fresh leaves were air-dried for four weeks, powdered using mortar and pestle and stored in an airtight Container, why the roots of Uvaria chamae was washed shade-dried and extracted with ethanol, chloroform, acetone at different concentration by cold extraction for 72 hours. The extracts was evaporated to dryness at 40°C in a water bath.

2.3 Extract Preparation

Extract of Uvaria chamae root and leaves sample was prepared using different types of organic solvents.

2.3.1 Ethanolic extract

Ethanolic extract was prepared using 80% ethanol in 50ml, 1g of each sample was (leaves roots) added. After constant turning with an orbital shaker at 150rpm for 72h at room temperature the sample was filtered, filtrate was incubated at 4°C till all the solvent was evaporated leaving behind the crude ethanolic extract.

2.3.2 ACETONE EXTRACT

100% acetone was used to prepare acetone extract of sample in 50ml solvent, 1g of each sample, (leaves & roots) was added. After constant turning with an orbital shaker at 150rpm for 72h at room temperature the sample was filtered. Filtrate was incubated at 40°C till all the solvent was evaporated leaving behind the crude acetone extract.

2.3.3 Chloroform Extract

Chloroform extract was prepared using 100% chloroform in 50ml, 1g of each sample was added and leaving was added (leaves and root). After constant turning with an orbital shaker at 150rpm for 72h at room temperature the sample was filtered. Filtrate was incubated at 40°C till all the solvent was evaporated leaving behind the crude chloroform extract.

2.3.4 Aqueous Extract

To obtain the crude aqueous (CAE), 1g of powdered sample was mixed with 50ml of sterilized distilled water. The mixture was incubated at 25°C with constant turning, with the help of orbital shaker at 150rpm for 3 days (72h). Extract was filtered using wheatman filter paper and filtrate was then allowed to evaporate at 40°C.

2.3.5 Soxhlet Extracts with Petroleum Ether

Soxhlet extractor was used for preparing petroleum ether (40 to 60°C) extracts 1g of each for both leaves and roots was used for extraction with 50ml of solvent were used for extraction for 7h. Finally, the crude petroleum ether extracts are obtained.

2.4 Qualitative Analysis of Plant Extract

1. Detection of flavonoids: five ml of dilute ammonia solution Were added to a portion of the aqueous filtrate of each plant extract followed by addition of concentrated H2SO4. A yellow coloration observed in each extract indicated the presence of flavonoids. The yellow coloration disappears on standing (Kumar and Prasad,2023).

2. Detection of cardiac Glycosides (Keller Killani test): Five ml of each extract was treated with 2ml of glacial acetic acid containing one drop of ferric chloride solution. This was underplayed with 1ml of concentrated sulphuric acid. A brown ring of the interface indicates a deoxy sugar characteristic of cardenolides. A violet ring may appear below the brown ring while in the acetic acid layer a greenish ring may form just gradually throughout thin layer (Edeoga *et al.,* 2005).

3. Detection of alkaloids: (Mayer's Test Extracts were dissolved individually in dilute hydrochloric acid and filtered filtrates were treated with Mayer's reagent. The presence of alkaloids is confirmed by the formation of yellow coloured ppt(Evans,2009)

4. Detection of saponin (foam test): 0.5g of extracts was shaken with 2ml of water. If foam produced persists for ten minutes, it indicates the presence of saponins. Few drops of olive oil were added to 0.5g of the extract and vigorously shaken formation of soluble emulsion in the tract indicates the presence of saponin.

5. Detection of Tanin: First, about 1ml of the ethanol extracts was added in 2ml of water in a test tube 2 to 3 drops of diluted ferric chloride solution were added and observed for green to blue green (cathechic tannins) or a blue-black (gallic tannins) coloration (Sabir *et al.,* 2012.)

6. Detection of phenols: Ferric chloride Test; Extracts were treated with 3-4 drops of ferric chloride solution formation of bluish black colour indicates the presence of phenols (Proshant *et al.,* 2011)

7. Detection of gum: To the extracts, add few 1ml of water and shake well formation of swells or adhesives indicates the presence of gum.

8. Detection of quinines: To the extract sodium hydroxide has added. Blue green or red colour indicates the presence of quinines.

9. Detection of protein: To the test solutions the biuret reagent is added. The blue reagent turns violet in the presence of proteins.

10. Detection of Reducing Sugars: 5ml of the extract was diluted with distilled water Fehling solutions A & B added and the mixture warmed. The brick red precipitate at the bottom of the test tube indicates reducing sugars.

11. Detection of resins: 10ml of extracts was obtained in a test-tube, the same amount of copper acetate solution was added, and the mixture was shaken vigorously and allowed to separate a green colour indicates the presence of resin.

12. Detection of steroid: 1ml extract was dissolved in 10ml of chloroforms equal volume of concentrated H_2SO_4 acid was added from the side of test tube. The upper layer turns red and H_2SO_4 layer showed yellow with green fluorescence. This indicates the presence of steroid.

13. Detection of volatile oil: add 2ml extract with 0.1ml dilute NaOH and small quantity of dilute HCL and mixture is then shacked formation of white ppt shows positive result.

14. Detection of starch: The aqueous extract 5ml was treated with the reagent of the starch (iodine). Any shift to blue black indicates the presence of starch.

15. Detection of coumerin: To the test sample 10% of sodium hydroxide and chloroform were added formation of yellow colour indicates the presence of coumerin.

16. Detection of Glycosides: A small amount of alcoholic extract of sample was dissolves in 1ml water and then aqueous sodium hydroxide was added formation of a yellow colour indicated the presence of glycosides.

17. Detection of carboxylic acid: 1ml of the various extracts was separately treated with a few ml of sodium bicarbonate solution. Effervescence (due to liberation of carbon dioxide) indicates the presence of carboxylic acid.

18. Detection of phlobotanin: The presence of red precipitate when an aqueous extract of the plant was boiled with 1% aqueous hydrochloric acid showed the presence of phlobotanin.

19. Detection of terpenoid: 2ml of chloroform and 1ml of conc H_2SO_4 was added to 1mg of extract and observed for reddish brown colour that indicates the presence of terpenoid.

Plant Identification

The leaves and roots were identified taxonomically and authentically by P.O. Ugwuzor Herbarium curator, Dept. Of Botany, N.A.U. Awka.

Data Analysis

Data was summarized using descriptive statistics as follows the qualitative analysis describes the presence and relative concentration of various phytochemicals in different solvents.

RESULTS

2.6 QUALITATIVE ANALYSIS RESULTS

The result of the qualitative analysis is presented in table 1

Table 1: Qualitative analysis for the leaves and roots of uvaria chamae.

				Uvaria chamae leaves					Uvaria chamae roots
Phytochemicals	Type of test	Eth	Ace	Chl	Pet	Eth	Ace	Chl	Pet
Tannin	Lead Acetate	+++.	+++	-	-	+	+	-	+
Flavonoids	Alkaline	+++	+	-	-	+	+	-	-
Phenols	Ferricchloride	++	+++	+	-	+	+	-	+
Steroids	Salkoskis' s	+++	+	+	-	++	-	-	+
Terpenoids		++	+	+	+	+	++	+	-
Coumarin		++	-	+	+	-	-	+	-
Quinine		-	+	-	-	-	-	-	-
Glycoside		+	-	+	-	+	-	+	-

Saponins	Foam Test	++	+++
Diterperns	Aqueous	+++	-
Starch	Aqueous	+	+++
Resins		+++	-
Gum		++	+
Phlobotanins		+	-
Volatile oil		++	++
Carboxylic acid		++	+

Reducing sugar	Fehline test	+++	+++	+	-	+++	++	++	+
Proteins	Biuret	++	++	++	+	+++	+	+	-
Cardaic glycoside		+++	-	+	-	++	+	+	+

Alkaloid test was performed on acidic extracts only

Alkaloid Mayer's test + +++

Test performed using aqueous extracts only

Key: - Not present,

+ Present at low concentration

++ Present at moderate concentration

+++ Present at high concentration

ETH=Ethanol, ACE=Acetone, Chl = Chloroform, Pet = Petroleum ether.

Discussion

The study on Uvaria chamae provides valuable knowledge into the phytochemical profile of this plant, revealing that both the leaves and roots contain a range of bioactive compounds. Quantitative analysis shows that the leaves generally possess higher concentrations of tannins, flavonoids, alkaloids, saponins, phytate, cardiac glycosides, and oxalates compared to the roots. This finding aligns with other studies that have highlighted the rich phytochemical content of Uvaria species and their potential medicinal properties. For instance, similar research on Uvaria chamae and related species, such as Uvaria leptocladon and Uvaria rufa, has demonstrated that these plants are rich in flavonoids and alkaloids, which are known for their antioxidant and anti-inflammatory properties (Dey *et al.,* 2021; Sinha *et al.,* 2019). These compounds are crucial in traditional medicine, where they are used for their therapeutic effects.

The antivenom potential of Uvaria chamae is supported by the presence of various bioactive compounds. Tannins, flavonoids, alkaloids, and saponins, all found in significant amounts in both the leaves and roots, are well-documented for their role in neutralizing venom and mitigating its effects. Flavonoids, for example, are known to have strong antioxidant and anti-inflammatory properties (Kumar and Pandey, 2020). The higher concentration of flavonoids in the leaves (8.30%) compared to the roots (3.90%) suggests that the leaves may have more pronounced antivenom activity.

The presence of saponins, which have been shown to interact with cellular membranes and possibly inhibit venom enzymes (Kumar *et al.,* 2017), indicates that both parts of the plant could be beneficial. However, the higher concentration of saponins in the leaves further supports their superior antivenom potential.

The higher concentration of cardiac glycosides in the leaves (9.00%) compared to the roots (4.00%) suggests that the leaves might have a more substantial medicinal potential. Cardiac glycosides are known for their use in treating heart conditions and could play a role in traditional treatments (Choudhury *et al.,* 2018).

The low levels of oxalates (0.054% in both leaves and roots) are favourable as high oxalate levels can lead to toxicity issues, thus supporting the safety profile of Uvaria chamae in medicinal applications.

These findings are consistent with another research. For example, studies on similar species have emphasized the importance of balancing therapeutic efficacy with safety (Sampath *et al.,* 2022). The lower toxicity and higher therapeutic compounds in the leaves suggest that they may be preferred over the roots for medicinal uses, particularly for antivenom applications.

Conclusion

The comparative study of the leaves and roots of Uvaria chamae underscores the significant phytochemical diversity and potential medicinal benefits of this plant. The higher concentrations of bioactive compounds, such as flavonoids and cardiac glycosides, in the leaves suggest a greater potential for medicinal use, particularly for antivenom applications. These findings are consistent with the existing literature on Uvaria species and highlight the importance of further research to explore the full medicinal potential of this plant.

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