



Research Article

Phytochemical Screening and Antioxidant profiles of *Vernonia amygdalina* (Delile) and *Senna alata* (L.) Roxb. Leaves obtained in Maiduguri

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ABSTRACT

This study investigates comparatively the phytochemical constituents and antioxidant properties of *Vernonia amygdalina* (Delile) and *Senna alata* (L.) Roxb. Leaves collected in Maiduguri, Nigeria. Both plants are widely used in traditional medicines. Qualitative phytochemical screening revealed the presence of alkaloids, flavonoids, tannins, saponins, and phenolics. Antioxidant activity was evaluated using DPPH radical scavenging assay. Results showed significant antioxidant activity in both extracts, with *V. Amygdalina* showing stronger effects. These findings support their ethnomedicinal use and encourage further pharmacological studies.

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INTRODUCTION

Medicinal plants continue to offer a rich repository of bioactive compounds with considerable significance for human health and pharmacology (Ugbogu *et al.*, 2021). In particular, *Vernonia amygdalina* (Delile) and *Senna alata* (L.) Roxb. are widely utilised in traditional Nigerian medicine for the treatment of conditions such as malaria, skin infections, and inflammatory disorders (Oladeji *et al.*, 2020; Isah *et al.*, 2015). The therapeutic efficacy of these species is largely attributed to their content of secondary metabolites namely: flavonoids, phenols, alkaloids, saponins, and tannins which also demonstrate strong antioxidant activities (Edo *et al.*, 2023; Karki *et al.*, 2023).

Although individually studied in various regions of Nigeria, comparative data on the phytochemical composition and antioxidant potential of these plants particularly when collected from specific agro-ecological zones such as Maiduguri in northeastern Nigeria are scarce. Environmental factors such as soil type, rainfall, and temperature influence secondary metabolite abundance and bioactivity (Degu *et al.*, 2024). Moreover, most prior investigations rely on qualitative screening or single antioxidant assays, rather than a combined qualitative comparative approach under uniform experimental conditions.

Therefore, this study aims to conduct a comparative analysis of the phytochemical constituents and antioxidant activities of *V. amygdalina* and *S. alata* leaves collected from Maiduguri, Nigeria. By applying both qualitative phytochemical assessments alongside DPPH radical scavenging assays using standardized protocols, the work offers region specific insights that strengthen the ethnopharmacological relevance and support potential Phyto medical applications of these species.

MATERIALS AND METHODS

Study Area and Plant Collection

The study was conducted in Maiduguri, Borno State, Northeastern Nigeria. Fresh, mature leaves of *Vernonia amygdalina* and *Cassia alata* were collected from cultivated home gardens in Maiduguri. The plants were identified and authenticated by a botanist in the Department of Biological Sciences, Kashim Ibrahim University, Maiduguri, and

voucher specimens were deposited for reference.

Sample Preparation

The collected leaves were washed thoroughly under running tap water, followed by rinsing with distilled water to remove dust and debris. The samples were then air-dried in the shade at room temperature (25–28°C) for two weeks to prevent loss of heat-sensitive phytochemicals. The dried leaves were ground into fine powder using pestle and mortar and stored in airtight, labelled glass containers at room temperature until further use.

Extraction Procedure

About 50 grams of the powdered leaves of each plant were subjected to extraction using 80% methanol through cold maceration. The plant powders were soaked in 250 mL of 80% methanol and left at room temperature for 72 hours with intermittent shaking. The mixtures were filtered using Whatman No. 1 filter paper. The filtrates were concentrated using a rotary evaporator at 40°C under reduced pressure. The extracts were further dried in a water bath and then stored in sterile, airtight containers at 4°C until further analysis.

The percentage yield of the extract was calculated according to the equation below (Sofowora, 1993)

Qualitative Phytochemical Screening

Standard procedures were employed to detect the presence of various phytochemicals: Phytochemical screening was conducted on *Vernonia amygdalina* and *Senna alata* (L.) leaves to validate the presence or otherwise of secondary metabolites such as alkaloids, cardiac glycosides, saponins, tannins, steroids, anthraquinones among others using standard methods as described by (Sofowora, 1993; Trease and Evans, 1989)

Alkaloids: Detected using Mayer's and Draggendorff's reagents. About 0.5 g of extract was diluted to 10 mL with acid alcohol, boiled and filtered. To 5 mL of the filtrate was added 2 mL of dilute ammonia solution. Five (5) mL of chloroform was added and shaken gently to extract the alkaloidal base. The chloroform layer was extracted with 10 mL of acetic acid. This was divided into two portions. Mayer's reagent was added to one portion and Draggendorff's reagent to the other portion. The formation of a cream or reddish-brown precipitate respectively was

regarded as positive for the presence of alkaloids.

Flavonoids: Shinoda test was used. A portion of the extract was heated with 10 mL of ethyl acetate over a steam bath for 3 min. The mixture was filtered and 4 mL of the filtrate was shaken with 1 mL of dilute ammonia solution. A yellow colouration indicates the presence of flavonoids.

Tannins: Detected with ferric chloride solution. About 0.5 g of the extract was boiled in 10 mL of water in a test tube and then filtered. A few drops of 0.1% ferric chloride were added and observed for a blue-black colouration

Saponins: Froth test for saponins. To 0.5 g of extract was added 5 mL of distilled water in a test tube. The solution was shaken vigorously and observed for a stable persistent froth. The frothing was mixed with 3 drops of olive oil and shaken after which it was observed for the formation of an emulsion

Glycosides: Keller-Kilianis' test. About 0.5 g of extract was diluted to 5 mL in water was added 2 ml of glacial acetic acid containing one drop of ferric chloride solution. One (1) mL of concentrated sulphuric acid was carefully added by side. A brown ring at the interface indicated the presence of a deoxy-sugar characteristic of cardenolides.

Phenols: Lead acetate test. To 2 mL of the extract was dissolved in 5 mL of distilled water in a test tube, 3 drops of ferric chloride was added, colour changed to purple.

Terpenoids and Steroids: Salkowski test. To 0.5 g each of the extract was added 2 mL of chloroform. Concentrated H_2SO_4 (3 mL) was

Table 1: Percentage Recovery of *Vernonia amygdalina* and *Cassia alata* extracts

Plant Species	Solvent	Weight of Plant Powder (g)	Weight of Extract (g)	% Yield
<i>V. amygdalina</i>	80% Methanol	50	7.5	15
<i>C. alata</i>	80% Methanol	50	6.0	12

The extraction of *Vernonia amygdalina* and *Senna alata* leaves using 80% methanol yielded 15% and 12%, respectively, indicating that both plants contain a substantial number of bioactive compounds extractable by polar solvents. The higher yield observed in *V. amygdalina* may be due to its higher content of polar phytochemicals such as flavonoids,

carefully added to form a layer. A reddish-brown colouration of the interface indicates the presence of terpenoids.

Antioxidant Activity Assay (DPPH Radical Scavenging Method)

The antioxidant potential of the plant extracts was evaluated using the DPPH (2,2-diphenyl-1-picrylhydrazyl) radical scavenging assay. A stock solution of DPPH (0.1 mM) was prepared in methanol using different concentrations of plant extracts (100, 200, 300, 400, and 500 μ g/mL).

Each 1 mL of extract was mixed with 1 mL of DPPH solution and incubated in the dark at room temperature for 30 minutes. The absorbance was read at 517 nm using a UV-Vis spectrophotometer. Ascorbic acid served as the standard antioxidant. Percentage inhibition was calculated using the formula:

$$\% \text{ Inhibition} = [(A_{\text{control}} - A_{\text{sample}}) / A_{\text{control}}] \times 100$$

Where A_{control} is the absorbance of the control (DPPH + methanol), and A_{sample} is the absorbance of the test sample.

The IC_{50} value (concentration at which 50% of DPPH radicals are scavenged) was obtained from a plot of % inhibition versus concentration.

Statistical Analysis

All experiments were carried out in triplicate, and results were expressed as mean \pm standard deviation (SD).

RESULTS AND DISCUSSION

Extraction

The percentage yield of the extract is presented in Table 1.

tannins, and saponins, which are more efficiently solubilized in methanol (Sofowora, 1993; Osama, 2004). The yields obtained are consistent with previous reports on methanolic extraction of medicinal plants in the region, suggesting the suitability of 80% methanol for maximizing the recovery of phytochemicals (Glew *et al.*, 1997).

Phytochemical Constituents

Table 2: Qualitative Phytochemical Constituents of *V. Amygdalina* and *C. alata*

Phytochemical	<i>V. amygdalina</i>	<i>C. alata</i>
Alkaloids	+++	++
Flavonoids	+++	++
Phenolics	++	+
Tannins	++	++
Saponins	++	+
Terpenoids	+	+
Glycosides	+	+
Steroids	+	+

(++) = Strong presence

(++) = Moderate presence

(+) = Trace

(-) = Absent

Qualitative screening revealed that *Vernonia amygdalina* and *Cassia alata* leaves contain several bioactive compounds including flavonoids, phenolics, alkaloids, tannins, and saponins (Table 2). Notably, *V. amygdalina* showed stronger presence of flavonoids and phenolics compared to *C. alata*. These compounds are well known for their

antioxidant potential and role in preventing oxidative stress-related diseases (Kahkonen *et al.*, 1999; Oboh *et al.*, 2010).

The presence of tannins and alkaloids also indicates potential antimicrobial, antidiarrheal, and anti-inflammatory properties, commonly associated with traditional medicinal use of these plants (Edeoga *et al.*, 2005).

Antioxidant Activity (DPPH Assay)

Table 3: DPPH Radical Scavenging Activity of *Vernonia amygdalina* and *Cassia alata* Extracts

Concentration ($\mu\text{g/mL}$)	<i>V. amygdalina</i> % Inhibition (Mean \pm SD)	<i>C. alata</i> % Inhibition (Mean \pm SD)	Ascorbic Acid % Inhibition (Mean \pm SD)
100	36.2 \pm 1.5	28.6 \pm 1.3	49 \pm 1.1
200	51.7 \pm 2.0	43.1 \pm 1.6	75 \pm 1.3
300	67.8 \pm 1.8	56.5 \pm 1.5	94 \pm 1.4
400	79.6 \pm 1.2	68.2 \pm 0.5	90 \pm 0.5
500	85.9 \pm 2.3	74.0 \pm 1.5	98 \pm 0.1
IC_{50} ($\mu\text{g/mL}$)	210.4	278.7	102.5

p-value < 0.05

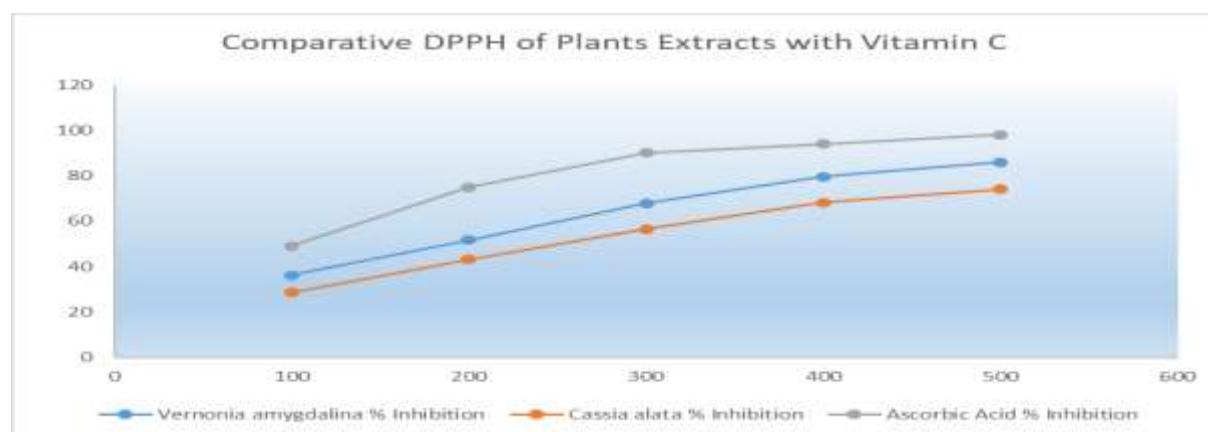


Figure 1: DPPH Radical scavenging Activity of *V. Amygdalina*, *C. alata* Extracts and Vit. C

The DPPH radical scavenging activity of the extracts increased in a concentration dependent manner (Figure 1). *V. amygdalina* extract demonstrated a stronger antioxidant effect than *C. alata*, with an IC_{50} of 210.4 $\mu\text{g/mL}$ compared to 278.7 $\mu\text{g/mL}$, while ascorbic acid (the standard) had an IC_{50} of 102.5 $\mu\text{g/mL}$ (Table 3 and Figure 1). The stronger activity of *V. amygdalina* may be attributed to its higher levels of flavonoids and phenolic compounds, which are effective hydrogen donors, neutralizing free radicals

(Rice-Evans *et al.*, 1996). This aligns with previous studies that showed a direct correlation between phenolic content and antioxidant activity in medicinal plants (Maisuthisakul *et al.*, 2007).

These findings support the traditional use of both plants in managing oxidative stress-related conditions such as inflammation, hypertension, and aging-related disorders. However, *V. Amygdalina* may have superior efficacy in this regard.

Table 4: ANOVA Table for the DPPH Data

Source	Ss	df	MS	F	p-value
Between groups	1898.95	2	949.48	144.14	<0.001
Within groups	79.21	12	6.60	-	-
Total	1978.16	14	-	-	-
					p-value < 0.05

There is a statistically significant difference in % inhibition among the three groups (*Vernonia amygdalina*, *Cassia alata*, and Ascorbic Acid) because the p-value is much less than 0.05. This represents the variation due to differences within the replicates of each group. It is relatively small compared to the variation between groups. The total variation in % inhibition is mostly explained by differences between the groups rather than within the groups.

The extracts (*V. amygdalina* and *C. alata*) and the standard (Ascorbic Acid) show significantly different antioxidant activities (% inhibition), indicating that their effects are not equal.

Conclusion

This study demonstrates that *Vernonia amygdalina* and *Cassia alata* leaves are rich sources of bioactive phytochemicals, particularly flavonoids and phenolic compounds, which contribute to their notable antioxidant properties. Qualitative analysis and DPPH radical scavenging assays showed that *V. amygdalina* possesses higher antioxidant activity than *C. alata*, reflected in its lower IC_{50} value. The concentration-dependent increase in % inhibition confirms the efficacy of these extracts as free radical scavengers.

These findings provide scientific validation for the traditional medicinal use of both plants in managing oxidative stress-related conditions.

Moreover, the study highlights the potential of *V. amygdalina* and *C. alata* as natural antioxidants that could be developed for pharmacological or nutraceutical applications. Further studies are recommended to explore their *in vivo* efficacy, safety profiles, and potential mechanisms of action.

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