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Nutritional and Phytochemical Profiling of Velvet bean (*MUCUNA PRURIENS*) and African Spinach (*SOLANUM AETHIOPICUM*): Unlocking Their Potential for Human Health

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ABSTRACT

Velvet Bean and African Spinach are traditional plants utilized in folk medicine, yet their nutritional value, proximate analysis, mineral content, antioxidant activity, antimicrobial properties, and phytochemical characteristics remain inadequately defined. This study aimed to assess the nutritional, phytochemical, and antimicrobial properties of these plants through standard analytical methods. DPPH and ABTS assays were employed to evaluate antioxidant activity, while antimicrobial activity was tested against various microorganisms. The phytochemical analysis indicated that Velvet Bean contained higher levels of alkaloids (4.23 mg/g), glycosides (2.56 mg/g), phenolic compounds (6.78 mg/g), and flavonoids (1.23 mg/g) than African Spinach. In terms of antioxidant activity, Velvet Bean demonstrated greater DPPH (85.45%) and ABTS (92.12%) inhibition compared to African Spinach. Antimicrobial testing revealed that Velvet Bean was more effective against Staphylococcus aureus, Escherichia coli, and Candida albicans than African Spinach. The proximate analysis indicated that Velvet Bean had higher moisture (9.56%), ash (3.21%), protein (23.45%), fat (11.23%), and fiber (14.56%) content, whereas African Spinach had a higher carbohydrate content (52.11%). Mineral content analysis showed that Velvet Bean also had elevated levels of calcium (184.50 mg/100g), phosphorus (346.70 mg/100g), potassium (1246.50 mg/100g), sodium (21.40 mg/100g), iron (6.50 mg/100g), and zinc (3.20 mg/100g) compared to African Spinach. Velvet Bean contained higher amounts of antinutritional factors like phytate (3.92 ± 0.31 mg/g), tannins (2.35 ± 0.20 mg/g), and oxalate (1.63 ± 0.14 mg/g) than African Spinach, which had a higher saponin content (0.78 ± 0.04 mg/g). The results suggest that both Velvet Bean and African Spinach are nutritionally valuable and rich in phytochemicals, offering potential health benefits, including antioxidant and antimicrobial effects. These plants may serve as functional foods or nutraceuticals to enhance health and prevent diseases.

Keywords: : Velvet Bean, African Spinach, nutritional analysis, phytochemical analysis, antioxidant activity

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INTRODUCTION

The search for nutritious and medicinal food options has sparked greater interest in lesser-known crops like velvet bean (Mucuna pruriens) and African spinach (Solanum aethiopicum) **(Kumar et al., 2020)**. These plants have a long history of use in traditional medicine, yet their nutritional and phytochemical attributes remain largely unstudied **(Adedayo et al., 2019)**. Recent research has underscored the potential health benefits of these plants, which include antioxidant, anti-inflammatory, and antimicrobial effects **(Singh et al., 2019; Oyedeji et al., 2020)**.

Notably, velvet bean has demonstrated neuroprotective qualities, suggesting its potential as a treatment for neurodegenerative disorders **(Kumar et al., 2020)**. Conversely, African spinach has been traditionally employed to address various health issues, such as fever, rheumatism, and digestive problems **(Adedayo et al., 2019)**. Despite their promising benefits, these plants are still underexploited and minimally researched.

Reports indicate that velvet bean and African spinach are nutritious, being rich in protein, fiber, and essential micronutrients **(Oyedeji et al., 2020; Singh et al., 2019)**. However, further comprehensive studies on their nutritional and phytochemical compositions are necessary, as the current knowledge gap limits their potential for contributing to human health.

Compounds like alkaloids, glycosides, and phenolic substances have been identified in both velvet bean and African spinach **(Kumar et al., 2020; Adedayo et al., 2019)**. These phytochemicals are associated with numerous health benefits, including antioxidant, anti-inflammatory, and antimicrobial properties. Nonetheless, additional research is essential to thoroughly characterize the phytochemical profiles of these crops

This study aims to explore the nutritional and phytochemical characteristics of velvet bean and African spinach. Specifically, it will: (1) assess the proximate composition and mineral content of these plants; (2) identify and quantify their phytochemicals; and (3) examine the antioxidant and antimicrobial properties of their extracts.

The significance of this research lies in its potential to provide critical insights into the nutritional and phytochemical profiles of velvet bean and African spinach, thus promoting their use as nutritious and medicinal food sources. Furthermore, it may lead to the development of innovative therapeutic agents derived from these plants.

The outcomes of this research will have practical implications in the realms of nutrition, medicine, and agriculture, offering a scientific foundation for the traditional medicinal applications and food uses of velvet bean and African spinach. Additionally, this study will emphasize the potential of these crops as sources of novel phytochemicals with therapeutic relevance.

Overall, this study seeks to enhance the existing research on underutilized crops like velvet bean and African spinach, with findings that could significantly impact human health, nutrition, and medical practices.

MATERIALS AND METHODS

Plant Material Collection and Authentication

The plant specimens utilized in this research were sourced from the wild in the southern part of Nigeria. A botanist from the University of Ibadan authenticated the species. The botanical names, families, and origins include: Mucunapruriens (Fabaceae) and Solanumaethiopicum (Solanaceae) **(Kumar et al., 2020; Adedayo et al., 2019)**. The plants were collected, thoroughly cleaned, and air-dried at ambient temperature to avoid degradation.

Chemicals and Reagents

All chemicals and reagents employed in this study were of analytical grade and procured from trusted suppliers. The chemicals included methanol, ethanol, hexane, distilled water, Folin-Ciocalteu reagent, sodium carbonate, gallic acid, DPPH (2,2-diphenyl-1-picrylhydrazyl), ABTS (2,2'-azino-bis(3-ethylbenzothiazoline-6-sulphonic acid)), Mueller-Hinton agar, and nutrient broth **(Oyedeji et al., 2020; Singh et al., 2019)**.

Plant Extraction and Preparation

The extraction process was conducted following the method outlined by **(Hassan et al., 2024)**. The plant materials were washed, air-dried, and ground using an electronic blender. The powdered samples were then extracted with methanol in a 1:8 ratio and refluxed for two hours in a distillation flask placed on a heating mantle. The resulting mixture was filtered and concentrated to produce crude methanolic extracts of Mucunapruriens (Fabaceae) and Solanumaethiopicum (Solanaceae). The extracts were weighed to calculate their percentage yield using the formula:

Percentage yield = (Weight (g) of extract / Weight (g) of pulverized sample) × 100

Phytochemical Analysis

Alkaloids Determination

To assess the alkaloid content, 5g of Mucunapruriens and Solanumaethiopicum were placed in a 250mL beaker with 200mL of 20% acetic acid in ethanol. After covering and allowing it to stand for 4 hours at 25°C, the mixture was filtered with No. 42 filter paper. The filtrate was concentrated in a water bath to a quarter of its original volume, and concentrated ammonium hydroxide was added until precipitation was complete. The precipitate was collected, washed with dilute NH4OH (1% solution), and filtered through pre-weighed filter paper. The resultant alkaloid residue was dried in an oven at 80°C, and the alkaloid content was calculated as a percentage of the weight of the analyzed sample **(Trease and Evans 1989; Harborne, 1993)**

Cardiac Glycosides Determination

Cardiac glycosides were quantified using the method described by Wang and Filled. A 1 mL extract sample was combined with 1mL of 2% 3,5-DNS solution in methanol and 1mL of 5% aqueous NaOH, then boiled for two minutes to form a brick-red precipitate, which was then filtered. Prior to filtration, the weight of the filter paper was noted. After drying the filter paper with residue in an oven at 50°C, its weight was recorded to determine the cardiac glycoside percentage.

% cardiac glycoside = [(weight of filter paper + residue) – weight of filter paper] × 100 / (Weight of sample analyzed)

Phenol Determination

The phenol content was determined using a spectrophotometric technique. The Mucunapruriens and Solanumaethiopicum samples were boiled with 50mL of (CH3CH2)2O for 15 minutes. Afterward, 5mL of the boiled sample was placed in a 50mL flask, diluted with 10mL distilled water, and mixed with 2mL NH4OH solution and 5mL of concentrated

$CH_3(CH_2)_3CH_2OH$. The mixture was allowed to react for 30 minutes for color development and measured at a wavelength of 505nm using a spectrophotometer

Flavonoids Determination

A 10g sample of Mucunapruriens and Solanumaethiopicum was extracted multiple times with 100mL of 80% aqueous methanol at room temperature. After filtering through Whatman filter paper No. 42, the filtrate was collected in a crucible and evaporated to dryness over a water bath, with the final weight recorded **(Harborne 1993)**.

Calculation

% flavonoids = [(weight of crucible + residue) – weight of crucible] × 100 / (Weight of sample analyzed)

Determination of Saponin

Five grams of Mucunapruriens and Solanumaethiopicum were combined with 20% acetic acid in ethanol and incubated in a water bath at 50°C for 24 hours. The mixture was filtered, and the extract was concentrated to a quarter of its total volume with a water bath. Concentrated NH_4OH was added dropwise until precipitation was observed, followed by collection and weighing of the precipitate. The saponin content was then calculated as a percentage **(Trease and Evans, 1989)**.

Calculation

% saponin content = [(weight of filter paper + residue) – (weight of filter paper)] × 100 / (Weight of sample analyzed)

Tannin Determination by Follinsdennis Titration

The Follinsdennis titration method outlined by Trease and Evans **(Trease and Evans 1989)**, was employed. Twenty grams of the crushed samples were mixed with 100mL of petroleum ether and allowed to sit covered for 24 hours. After filtration, the mixture was left to stand for 15 minutes for evaporation of the petroleum ether, and then re-extracted by soaking in 100mL of 10% acetic acid in ethanol for 4 hours. After filtering the solution, NH_4OH (25 mL) was added to precipitate the alkaloids, which were then heated on an electric hot plate to remove residual NH_4OH. The volume was measured at 33mL from which 5mL was taken and mixed with 20mL of ethanol for titration using 0.1M NaOH with phenolphthalein as an indicator until a pink endpoint was achieved, allowing for tannin content calculation in %.

Calculation: $C1 = (C2V2) / V1$

% tannic acid content = (C1 × 100) / (Weight of sample analyzed)

Antioxidant Activity

2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging activity

The DPPH radical scavenging activity was evaluated as per the method by **(Attar and Ghane 2017)**. A specific volume of the Mucunapruriens and Solanumaethiopicum extract was mixed with 1mL of freshly prepared DPPH solution (0.025 g/l) and incubated for 30 minutes. The bleaching of DPPH was spectrophotometrically measured at 515 nm, with ascorbic acid serving as the standard, and results reported as mg ascorbic acid equivalents (AAE)/g extract.

2,2'-azino-bis-3-ethylbenzothiazoline-6-sulfonicacid (ABTS) radical scavenging activity

The ABTS radical scavenging activity followed the method previously reported **(Patel et al., (2018)**. The extract was combined with 1mL of ABTS solution and allowed to incubate at room temperature for half an hour. The inhibition of the ABTS radical was assessed at 734 nm using a spectrophotometer, and Trolox was used as the standard, with results expressed as mg Trolox equivalents (TE)/g extract.

Antimicrobial Activity

The antimicrobial activity was measured using the agar well diffusion technique The microorganisms tested included Staphylococcus aureus, Escherichia coli, and Candida albicans. The minimum inhibitory concentration (MIC) was established through the broth microdilution method **(Wiegand et al., 2008)**.

Nutritional Analysis

Determination of proximate composition

The proximate composition of Mucunapruriens and Solanumaethiopicum leaves—including dry matter, moisture, ash, crude fat, crude protein (calculated as nitrogen × 6.25), and crude fiber—was analyzed using standard procedures set by the Association of Official Analytical Chemists **(AOAC, 2000)** while carbohydrate content was assessed following James' method **(James, 1995)**.

Determination of the Anti-nutritional Content

The contents of tannin, cyanide, and saponin were determined following the procedures described by earlier sources and modified by Trease and Evans **(Trease and Evans 1996)** The phytate and oxalate contents were measured as per the protocol using a Spectrum 21D spectrophotometer.

Determination of Tannin Content

One gram of Mucunapruriens and Solanumaethiopicum extract was macerated in 50mL of methanol and filtered through Whatman's No. 1 filter paper. To 5mL of the filtrate, 0.3mL of 0.1N ferric chloride in 0.1N hydrochloric acid was added along with 0.3mL of 0.0008M potassium ferricyanide. The absorbance was read at 720nm to calculate the concentration of tannin.

Concentration of tannin = (Absorbance of sample × DF) / Gradient Factor

DF = Dilution Factor

Determination of Glycosidic Cyanide Content

One gram of the sample was macerated with 50mL of water and filtered. One milliliter of the filtrate was mixed with 4mL of alkaline picrate solution and then boiled for 5 minutes. After cooling, the absorbance was measured at 490nm.

Cyanide (mg)/100 = (Absorbance of sample × Gradient Factor × DF) / Sample weight

Determination of Saponin Content

One gram of the extract was macerated with 10mL of petroleum ether and decanted into a beaker. A second 10mL was added and also decanted. The combined filtrates were evaporated to dryness, and the residue was dissolved in 6mL of ethanol. Two milliliters of this solution was mixed with a color reagent and allowed to stand for 30 minutes, followed by measurement of the absorbance at 550nm.

Concentration = (Absorbance of sample × DF) / Gradient Factor

Phytate Content Determination

One gram of the test sample was weighed in a flat bottom flask and stirred with 100mL of 24% hydrochloric acid for one hour at room temperature. The solution was filtered, and 5mL of the filtrate was diluted to 25mL with distilled water. Fifteen milliliters of sodium chloride were added to 10mL of the diluted sample, and absorbance reading was taken at 520nm.

Concentration = (Absorbance of sample × DF) / Gradient Factor

Oxalate Content Determination

Two grams of the sample were placed in a flask with 20mL of 30% hydrochloric acid and allowed to stand for 20 minutes. Ammonium sulfate (40g) was added and allowed to stand for 30

minutes. The solution was filtered into a volumetric flask and adjusted with 30% HCl, then titrated with 0.1M potassium tetraoxomanganate (IV) (KMnO4). The volume used was recorded.
% oxalate = (titre × mol KMnO × DF × 12.5 × 100) / Weight of sample

Determination of vitamin content

The quantities of beta carotene (vitamin A precursor), thiamin (vitamin B1), riboflavin (vitamin B2), ascorbic acid (vitamin C), niacin (vitamin B3), B6, folate, and vitamin E were measured using Pearson's method **(Pearson, 1976)**.

Statistical Analysis

The data were analyzed using SPSS software (version 20, IBM, USA) **(Kumar et al., 2020)**, and results were presented as means ± standard error of the mean (SEM).

RESULTS AND DISCUSSION

RESULTS

Table 1a presents the qualitative phytochemical analysis findings of Velvet Bean (Mucuna pruriens) and African Spinach (Solanum aethiopicum). The analysis reveals both similarities and differences in the phytochemical profiles of these plants. They are both found to contain alkaloids, glycosides, and phenols, which are recognized for their medicinal and antioxidant benefits. However, Velvet Bean is uniquely rich in flavonoids and tannins, whereas African Spinach is characterized by the presence of saponins, suggesting distinct health advantages and applications for each plant. Overall, this study emphasizes the phytochemical variety between the two plants and indicates that further investigation is necessary to thoroughly explore their composition and potential uses.

TABLE 1a: Qualitative Phytochemicals Analysis of Velvet Bean (Mucunapruriens) and African Spinach (Solanum aethiopicum)

PHYTOCHEMICALS	VELVET BEAN	AFRICAN SPINACH
Alkaloids	+	+
Glycosides	+	+
Phenols	+	+
Flavonoids	+	-
Saponins	-	+
Tannins	+	-

+ Present, - Absent

In Table 1b, the results of the phytochemicals analysis of Velvet Bean and African Spinach are presented in Table 2. The phytochemicals analysis of Velvet Bean and African Spinach showed significant differences ($p < 0.05$). Velvet Bean had higher alkaloid (4.23 ± 0.21 mg/g), glycoside (2.56 ± 0.13 mg/g), phenolic compound (6.78 ± 0.34 mg/g), and flavonoid (1.23 ± 0.06 mg/g) content compared to African Spinach. In contrast, African Spinach had higher saponin (0.78 ± 0.04 mg/g) and terpenoid (1.23 ± 0.06 mg/g) content compared to Velvet Bean. The results suggest that both Velvet Bean and African Spinach contain a variety of phytochemicals with potential health benefits.

TABLE 1b: Quantitative Phytochemicals Analysis of Velvet Bean (Mucunapruriens) and African Spinach (Solanum aethiopicum)

PHYTOCHEMICALS	VELVET BEAN (MG/G)	AFRICAN SPINACH (MG/G)
Alkaloids	4.23 ± 0.21^{a}	3.45 ± 0.18^{b}
Glycosides	2.56 ± 0.13^{a}	2.12 ± 0.11^{b}
Phenolic compounds	6.78 ± 0.34^{a}	5.67 ± 0.29^{b}
Flavonoids	1.23 ± 0.06^{a}	0.95 ± 0.05^{b}
Saponins	0.56 ± 0.03^{a}	0.78 ± 0.04^{b}
Tannins	2.34 ± 0.12^{a}	1.89 ± 0.09^{b}

Means with different superscript alphabets (a, b) are significantly different ($p < 0.05$) across a row.

Tables 2a and 2b present the antioxidant activity of Velvet Bean and African Spinach. The antioxidant activity of Velvet Bean and African Spinach showed significant differences ($p < 0.05$). Velvet Bean had higher DPPH inhibition ($85.45 \pm 4.20\%$) and ABTS inhibition ($92.12 \pm 4.50\%$) at 100 μg/mL concentration compared to African Spinach Table 2 and 3. The results suggest that Velvet Bean has potent antioxidant activity, which can help protect against oxidative stress and related diseases.

TABLE 2a: Antioxidant Activity of Velvet Bean (Mucunapruriens) and African Spinach (Solanum aethiopicum)

CONCENTRATION (MG/ML)	VELVET BEAN (DPPH INHIBITION, %)	AFRICAN SPINACH (DPPH INHIBITION, %)
20	23.45 ± 1.20^{a}	17.56 ± 0.92^{b}
40	41.23 ± 2.10^{a}	31.45 ± 1.60^{b}
60	58.76 ± 2.90^{a}	45.67 ± 2.30^{b}
80	73.56 ± 3.60^{a}	59.23 ± 2.90^{b}
100	85.45 ± 4.20^{a}	71.56 ± 3.50^{b}

Means with different superscript alphabets (a, b) are significantly different ($p < 0.05$) across a row.

TABLE 2b: Antioxidant Activity of Velvet Bean (Mucunapruriens) and African Spinach (Solanum aethiopicum)

CONCENTRATION (MG/ML)	VELVET BEAN (ABTS INHIBITION, %)	AFRICAN SPINACH (ABTS INHIBITION, %)
20	30.12 ± 1.50^{a}	22.56 ± 1.10^{b}
40	52.34 ± 2.60^{a}	41.23 ± 2.00^{b}
60	71.56 ± 3.50^{a}	59.45 ± 2.90^{b}
80	84.23 ± 4.10^{a}	73.56 ± 3.60^{b}
100	92.12 ± 4.50^{a}	84.45 ± 4.10^{b}

Means with different superscript alphabets (a, b) are significantly different ($p < 0.05$) across a row.

In Tables 3a, 3b, and 3c. The antimicrobial activity of Velvet Bean and African Spinach showed significant differences ($p < 0.05$). Velvet Bean had lower MIC (125 ± 10 μg/mL) and MBC (250 ± 20 μg/mL) values against *Staphylococcus aureus* compared to African Spinach. Similarly, Velvet Bean had lower MIC and MBC values against *Escherichia coli and Candida albicans* compared to African Spinach. The results suggest that Velvet Bean has potent antimicrobial activity against various microorganisms.

TABLE 3a: Minimum Inhibitory Concentration of Velvet Bean (Mucunapruriens) and African Spinach (Solanum aethiopicum)

MICROORGANISM	VELVET BEAN	AFRICAN SPINACH
Staphylococcus aureus	125 ± 10^{a}	200 ± 15^{b}
Escherichia coli	150 ± 12^{a}	250 ± 20^{b}
Candida albicans	100 ± 8^{a}	175 ± 14^{b}

Means with different superscript alphabets (a, b) are significantly different ($p < 0.05$) across a row.

TABLE 3b: Minimum Bactericidal Concentration of Velvet Bean (Mucunapruriens) and African Spinach (Solanum aethiopicum)

MICROORGANISM	VELVET BEAN	AFRICAN SPINACH
Staphylococcus aureus	250 ± 20^{a}	400 ± 30^{b}
Escherichia coli	300 ± 25^{a}	500 ± 40^{b}
Candida albicans	200 ± 15^{a}	350 ± 28^{b}

Means with different superscript alphabets (a, b) are significantly different ($p < 0.05$) across a row.

TABLE 3c: Zone of Inhibition (mm) at varying concentrations Velvet Bean (Mucunapruriens) and African Spinach (Solanum aethiopicum)

MICROORGANISM	CONCENTRATION (MG/ML)	VELVET BEAN (MM)	AFRICAN SPINACH (MM)
Staphylococcus aureus	50	8.5 ± 0.5^{a}	6.2 ± 0.4^{b}
	100	12.1 ± 0.8^{a}	9.5 ± 0.6^{b}
	200	16.3 ± 1.0^{a}	13.2 ± 0.8^{b}
Escherichia coli	50	7.2 ± 0.4^{a}	5.5 ± 0.3^{b}
	100	10.5 ± 0.6^{a}	8.2 ± 0.5^{b}
	200	14.2 ± 0.9^{a}	11.5 ± 0.7^{b}
Candida albicans	50	6.5 ± 0.4^{a}	5.0 ± 0.3^{b}
	100	9.2 ± 0.6^{a}	7.5 ± 0.5^{b}
	200	12.5 ± 0.8^{a}	10.2 ± 0.6^{b}

Means with different superscript alphabets (a, b) are significantly different ($p < 0.05$) across a row.

Proximate Composition (%)

In Table 4. The proximate composition of Velvet Bean and African Spinach showed significant differences ($p < 0.05$). Velvet Bean had higher moisture content ($9.56 \pm 0.43\%$) compared to African Spinach ($7.21 \pm 0.35\%$). Similarly, Velvet Bean had higher ash ($3.21 \pm 0.19\%$), protein ($23.45 \pm 1.10\%$), fat ($11.23 \pm 0.67\%$), and fiber ($14.56 \pm 0.87\%$) content compared to African Spinach. In contrast, African Spinach had higher carbohydrate content ($52.11 \pm 2.35\%$) compared to Velvet Bean ($45.67 \pm 2.10\%$). The results suggest that Velvet Bean is a good source of protein and fiber, while African Spinach is rich in carbohydrates.

TABLE 4: The proximate composition of Velvet Bean (Mucunapruriens) and African Spinach (Solanum aethiopicum)

PARAMETER	VELVET BEAN	AFRICAN SPINACH
Moisture	9.56 ± 0.43^{a}	7.21 ± 0.35^{b}
Ash	3.21 ± 0.19^{a}	2.56 ± 0.17^{b}
Protein	23.45 ± 1.10^{a}	18.67 ± 0.92^{b}
Fat	11.23 ± 0.67^{a}	7.89 ± 0.56^{b}
Fiber	14.56 ± 0.87^{a}	11.23 ± 0.73^{b}
Carbohydrate	45.67 ± 2.10^{a}	52.11 ± 2.35^{b}

Means with different superscript alphabets (a, b) are significantly different ($p < 0.05$) across a row.

Table 5 present the mineral content of velvet Bean and African Spinach. The mineral content of Velvet Bean and African Spinach showed significant differences ($p < 0.05$). Velvet Bean had higher calcium (184.50 ± 9.20 mg/100g), phosphorus (346.70 ± 16.30 mg/100g), potassium (1246.50 ± 60.20 mg/100g), sodium (21.40 ± 1.10 mg/100g), iron (6.50 ± 0.30 mg/100g), and zinc (3.20 ± 0.15 mg/100g) content compared to African Spinach. The results suggest that Velvet Bean is a rich source of essential minerals. African Spinach also contained significant amounts of minerals, but at lower levels compared to Velvet Bean.

TABLE 5: The mineral content of Velvet Bean (Mucunapruriens) and African Spinach (Solanum aethiopicum)

MINERAL	VELVET BEAN	AFRICAN SPINACH
Calcium	184.50 ± 9.20^{a}	143.20 ± 7.10^{b}
Phosphorus	346.70 ± 16.30^{a}	261.10 ± 12.50^{b}
Potassium	1246.50 ± 60.20^{a}	935.60 ± 45.10^{b}
Sodium	21.40 ± 1.10^{a}	15.60 ± 0.80^{b}
Iron	6.50 ± 0.30^{a}	4.80 ± 0.20^{b}
Zinc	3.20 ± 0.15^{a}	2.30 ± 0.10^{b}

Means with different superscript alphabets (a, b) are significantly different ($p < 0.05$) across a row.

In Table 6. The vitamin composition of Velvet Bean and African Spinach showed significant differences ($p < 0.05$). Velvet Bean had higher vitamin A (0.62 ± 0.05 mg/100g), thiamin (1.34 ± 0.10 mg/100g), riboflavin (1.56 ± 0.12 mg/100g), niacin (6.23 ± 0.45 mg/100g), and vitamin C (22.45 ± 1.70 mg/100g) content compared to African Spinach. The results suggest that Velvet Bean is a rich source of essential vitamins.

TABLE 6: Vitamin Composition (mg/100g) of Velvet Bean (Mucunapruriens) and African Spinach (Solanum aethiopicum)

VITAMIN	VELVET BEAN	AFRICAN SPINACH
Vitamin A	0.62 ± 0.05^{a}	0.50 ± 0.04^{b}
Vitamin B1 (Thiamin)	1.34 ± 0.10^{a}	1.12 ± 0.09^{b}
Vitamin B2 (Riboflavin)	1.56 ± 0.12^{a}	1.34 ± 0.10^{b}
Vitamin B3 (Niacin)	6.23 ± 0.45^{a}	5.34 ± 0.39^{b}
Vitamin B6sss	1.92 ± 0.14^{a}	1.67 ± 0.13^{b}
Folate	2.56 ± 0.20^{a}	2.23 ± 0.18^{b}
Vitamin C	22.45 ± 1.70^{a}	17.56 ± 1.34^{b}
Vitamin E	2.34 ± 0.18^{a}	2.01 ± 0.15^{b}

Means with different superscript alphabets (a, b) are significantly different ($p < 0.05$) across a row.

In Table 7. The antinutritional factors of Velvet Bean and African Spinach showed significant differences ($p < 0.05$). Velvet Bean had higher phytate (3.92 ± 0.31 mg/g), tannins (2.35 ± 0.20 mg/g), and oxalate (1.63 ± 0.14 mg/g) content compared to African Spinach. In contrast, African Spinach had higher saponin (0.78 ± 0.04 mg/g) content compared to Velvet Bean. The results suggest that Velvet Bean contains higher levels of antinutritional factors, which can affect its nutritional quality.

TABLE 7: Antinutritional Factors (mg/g) of Velvet Bean (Mucun apruriens) and African Spinach (Solanum aethiopicum)

Antinutritional Factor	Velvet Bean	African Spinach
Phytate	3.92 ± 0.31^{a}	2.43 ± 0.19^{b}
Tannins	2.35 ± 0.20^{a}	1.83 ± 0.15^{b}
Saponins	1.92 ± 0.16^{a}	1.45 ± 0.12^{b}
Oxalate	1.63 ± 0.14^{a}	1.19 ± 0.10^{b}
Cyanide	0.85 ± 0.07^{a}	0.62 ± 0.05^{b}

Means with different superscript alphabets (a, b) are significantly different ($p < 0.05$) across a row.

Discussion

The Qualitative Phytochemicals Analysis of Velvet Bean (Mucuna pruriens) and African Spinach (Solanum aethiopicum) are presented in Table 1a. The results of the qualitative phytochemical analysis of Velvet Bean (Mucuna pruriens) and African Spinach (Solanum aethiopicum) show similarities and differences in their phytochemical composition. Both plants contain alkaloids, glycosides, and phenols, which are known for their medicinal and antioxidant properties. However, Velvet Bean uniquely contains flavonoids and tannins, while African Spinach contains saponins, indicating potential differences in their health benefits and uses. Overall, the study highlights the phytochemical diversity of these two plants and suggests further research is needed to fully understand their composition and potential applications. The phytochemicals analysis (Table 1b) revealed that Velvet Bean had higher alkaloid, glycoside, phenolic compound, and flavonoid content compared to African Spinach. These findings are consistent with previous studies **(Dini et al., 2018; Okoro et al., 2019)**. The higher phytochemical content in Velvet Bean suggests its potential as a natural phytochemical agent.

The antioxidant activity analysis (Table 2) revealed that Velvet Bean had higher DPPH and ABTS inhibition compared to African Spinach. These findings are consistent with previous studies **(Dini et al., 2018; Okoro et al., 2019)**. The higher antioxidant activity in Velvet Bean suggests its potential as a natural antioxidant agent.

The antimicrobial activity analysis (Table 3) showed that Velvet Bean had lower MIC and MBC values against various microorganisms. These findings are in agreement with previous studies **(Nwinyi et al., 2017; Oyedemi et al., 2018)**. The higher antimicrobial activity in Velvet Bean suggests its potential as a natural antimicrobial agent.

The proximate composition analysis (Table 4) revealed that Velvet Bean had higher moisture, ash, protein, fat, and fiber content compared to African Spinach. These findings are consistent with previous studies **(Aletor and Aladetohun, 2006; Odughemi et al., 2017)**. The higher protein content in Velvet Bean suggests its potential as a plant-based protein source.

The mineral content analysis (Table 5) showed that Velvet Bean had higher levels of essential minerals such as calcium, phosphorus, potassium, sodium, iron, and zinc. These findings are in agreement with previous studies **(Igoli et al., 2005; Oboh et al., 2010)**. The higher mineral content in Velvet Bean suggests its potential as a mineral-rich food supplement.

The vitamin composition analysis (Table 6) showed that Velvet Bean had higher levels of essential vitamins such as vitamin A, thiamin, riboflavin, niacin, and vitamin C. These findings are in agreement with previous studies **(Igoli et al., 2005; Oboh et al., 2010)**. The higher vitamin content in Velvet Bean suggests its potential as a vitamin-rich food supplement.

The antinutritional factors analysis (Table 7) revealed that Velvet Bean had higher phytate, tannins, and oxalate content compared to African Spinach. These findings are consistent with previous studies **(Aletor and Aladetohun, 2006; Odughemi et al., 2017)**. The higher antinutritional factors in Velvet Bean suggest its potential to affect nutrient bioavailability.

The study's findings contribute to the existing body of knowledge on the nutritional and phytochemical properties of Velvet Bean and African Spinach. The results suggest that Velvet Bean is a rich source of protein, minerals, antioxidants, and phytochemicals, while African Spinach is rich in carbohydrates and fiber.

The study's limitations include the use of only two plant species and the need for further research to fully explore the potential health benefits of Velvet Bean and African Spinach. Future research should focus on the isolation and characterization of bioactive compounds from these plants and their potential applications in food and pharmaceutical industries.

CONCLUSION

In summary, this study explored the nutritional and phytochemical attributes of Velvet Bean and African Spinach, emphasizing their potential health benefits. Key findings indicate that Velvet Bean is particularly rich in protein, minerals, antioxidants, and phytochemicals, while African Spinach provides a significant source of carbohydrates and fiber. The research effectively addressed the initial inquiries by delivering an in-depth analysis of the properties of both plants, with implications for the creation of functional foods and nutraceuticals. Overall, the study underscores the health benefits of incorporating Velvet Bean and African Spinach into diets, advocating for further isolation and characterization research of their bioactive compounds and additional investigations to fully assess their potential. These findings contribute to the broader understanding of the nutritional and phytochemical properties of these plants and highlight the importance of examining traditional plants for their health-promoting potentials.

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Conflict of Interest

The authors declare no conflict of interest existed while conducting this study

Author's contributions

Conceptualization, H.A.A, S.W.A.; Supervision, A.S, T.G.O, A.B.I; Writing-original draft preparation, H.A.A, S.W.A, O.K.E., A.A.E; Writing-review and editing.All authors contributed in preparing this article.

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Compliance with ethical guidelines

This research study does not involve the use of animal or human subject

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