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Original Article

Pharmacognostical and Phytochemical Screening of Leaves of *Cajanus Scarabaeoides* (L.) Thouars

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ABSTRACT

Background: The plant *Cajanus scarabaeoides* (L.) Thouars has potent medicinal values. It has wound healing, anti-diabetic, anti-bacterial, anti-inflammatory, anti-diarrheal, hepatoprotective activities. **Objectives:** Pharmacognostical examination of organoleptic, microscopical characters including bromatological analysis, preliminary phytochemical screening, powder behaviour, fluorescence properties, antioxidant and free radicle activity of leaf part. **Materials and Methods:** Freshly prepared plant extracts were systematically analysed using qualitative phytochemical screening methods. The leaf powder was subjected for organoleptic study and bromatological analysis. Extracts of selected solvents prepared for antioxidant analysis and free radicle activity. **Results:** The macro and microscopic study revealed that Leaves pinnately 3-foliolate, ovate, pubescent with glandular trichomes; leaflets papery to leathery, petiole 1-2 cm. This crude drug powder showed the characteristic physicochemical values like 3±0.02% (total ash), 61.33±0.06% (moisture content), 38.66±0.08% (dry matter content), 3.1±0.28% (crude fat content), 17.86±0.02% (crude fibre content), 6.91±0.04% crude protein content. The plant contains phytochemicals like alkaloids, carbohydrates, proteins, phenolic compounds, flavones, tannin, saponin, glycosides, steroids. Ethanol and acetone are potent solvents for preliminary detection. Leaf powder exhibited characteristic behavior and fluorescence with various chemical reagents, while ethanol and acetone extracts showed significant antioxidant activity due to phenols, flavonoids, and free radical scavenging properties. **Conclusion:** The findings from this study of *Cajanus scarabaeoides*, underscore its potential as a valuable resource in the development of novel therapeutic agents.

Keywords: *Cajanus scarabaeoides*, Pharmacognostic, Morphological, Bromatological, Fluorescence.

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INTRODUCTION

Wild edible plants are a valuable resource that has been largely underutilized by many communities around the world. Despite their potential to provide nutrition and medicinal benefits, they remain overlooked and underappreciated in modern society. These plants often serve as a vital source of nutrition during times of food insecurity, poverty, extreme weather conditions, or political instability, when other food sources may be scarce. These days, people are increasingly aware of the medicinal benefits of wild edible plants in addition to their nutritional value.[1,2] The chemical constituents present in wild edible plants mainly consist of proteins, vitamins, minerals, carbohydrates along with variety of other compounds, out of which vitamins and minerals are particularly important, as these are not present in sufficient quantity in cereals and pulses, which form important component of human diet.[3] The genus *Cajanus* is a diverse and widespread group of plants, comprising 32 species that are distributed across various regions of the world. Among these species, a significant number are found in the Indian subcontinent, with 17 species reported from this area. Additionally, 13 species are reported from Australia, and 1 species is found in New Guinea. Notably, *C. scarabaeoides*, is common to all of these regions, demonstrating its adaptability and wide distribution. *Cajanus scarabaeoides* is a creeper-climber, has straight or winding branches up to 135 cm long, supported by grass and small shrubs, with white-pubescent stems and pinnately trifoliate leaves, featuring obovate end leaflets and obliquely obovate side leaflets, and exhibits indeterminate and sporadic flowering from early June to late November. *C. scarabaeoides* is most widely distributed wild species of pigeon pea, belongs to the secondary gene pool and is native to tropical and temperate regions of India, Sri Lanka, Australia, Africa, China etc.[4]

This species is likely to be a highly resilient and versatile plant, capable of thriving in a range of environments and climates. The Indian subcontinent, with its vast and varied landscape, is

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home to many *Cajanus* species, many of which are endemic to this region. Although our planet is home to a diverse array of plant species, only a limited number have been domesticated and utilized as food sources by humans. This highlights the fact that many plant species remain unexplored and untapped.

Plants have been traditionally used to treat numerous health issues, yet its phytochemical properties and composition remain largely unexplored. This underutilized herb has the potential to offer valuable insights and applications, warranting further investigation and research to uncover its secrets and fully harness its potential.

MATERIALS AND METHODS

Collection and Identification

The plant material of *Cajanus scarabaeoides* (L.) Thouars (Leaves) was collected from Adavali (16.925837º N, 73.587964º E), Taluka-Lanja, District-Ratnagiri, Maharashtra, India. The botanical identity of plant was made possible through a multidisciplinary approach incorporating herbarium taxonomy and ethnobotanical information from local informants. Subsequent authentication and herbarium preparation were conducted at the Department of Botany, Shivaji University, Kolhapur. These leaves were washed under running tap water. The fresh leaf specimens were utilized for the evaluation of macroscopic and microscopic characteristics, whereas the shade-dried, powdered leaf material was employed for the investigation of physico-chemical, pharmacognostic, and preliminary phytochemical properties.

Macroscopic and Organoleptic study

The macroscopic analysis of the medicinal plant is essential for the rapid identification of plant material and plays a vital role in drug standardization. Fresh leaves were carefully examined for macroscopic traits, including key organoleptic properties such as colour, odour, appearance, taste, and texture.

Microscopic study

The hand sections of Leaf specimen were sectioned using a sharp blade, and then stained with staining reagent safranin, mounted with glycerine and after coverslip was placed gently. The stained sections were observed under a microscope for detailed analysis. The study performed accordingly method as described by.[5] Vein islet, Vein termination, Stomatal number and Stomatal index were also counted.

Bromatological analysis

The bromatological parameters were analysed according to conventional methods, which encompass the assessment of total ash content, total moisture content, total dry matter, crude fat, crude fibre, crude protein, and extractive yield. These parameters were performed by methods given by researchers.[6,7]

Determination of Total ash

A precise quantity of 2 g of leaf powder was placed in a pre-ignited and weighed silica crucible. The crucible was then gently incinerated in a controlled muffle furnace, ensuring the complete removal of carbonaceous material. After incineration, the crucible was then allowed to cool before being re-weighed to determine the total ash content. The percentage of total ash was calculated.

$$\text{Ash\%} = (\text{Weight of ash} / \text{Weight of sample}) \times 100$$

This standardized procedure enables the accurate determination of the total ash content, providing valuable insights into its mineral composition and potential phytochemical properties.

Determination of moisture content and dry matter

2 g sample of powdered leaf material was subjected to thermogravimetric analysis by drying in a heat oven at 105ºC until a steady state weight was achieved. Moisture content and dry matter was then calculated.

Moisture Content (%) = (Initial Weight - Final Weight) / Initial Weight × 100

Dry matter content (%) = (weight of dish + weight of dried sample)-weight of dish/ weight of sample before drying.

Crude fat content

2 g sample of leaf powder was subjected to Soxhlet extraction with 200 ml of solvent. After extraction, the solvent was transferred to a pre-weighed evaporating dish (a) and evaporated to dryness. The dish was then cooled in a desiccator and reweighed (b). Crude fat percentage was calculated using the formula:

$$\text{Crude Fat (\%)} = ((b - a) / \text{Weight of sample}) \times 100$$

Crude fibre content

2 g sample of leaf powder was heated with 200 ml of 0.25 M H_2SO_4 on a hot plate for 30 min, using bumping chips to maintain consistent heating. The mixture was then filtered through a Buchner funnel and washed with hot distilled water to remove acid residues. The residue was subsequently boiled with 200 mL of 0.03 M NaOH for 30 min, filtered and washed repeatedly with hot distilled water. Additional washing was performed with 25 mL of alcohol. The residue was then placed in a pre-weighed crucible (W1) and dried at 130ºC for 2 hr. The weight of the material was recorded (W2) after cooling in a desiccator. Finally, the sample was ignited in a muffle furnace at 600ºC for 30 min, and the weight was recorded again (W3). The percentage of crude fibre was calculated.

$$\text{Crude Fibre (\%)} = ((W2 - W1) - (W3 - W1)) / \text{Weight of sample} \times 100$$

Crude protein: Crude protein was determined on the basis of nitrogen content. The percentage of nitrogen is multiplied by 6.25 value.

Extractive Yield

2 g sample of dry leaf powder was placed in a thimble and subjected to Soxhlet extraction with 200 ml of solvent. After extraction, the remaining leaf powder was oven-dried and weighed and then extractive yield was calculated.

Powder behaviour and fluorescence analysis

Crude drugs exhibit distinct fluorescence colours Under Ultraviolet (UV) radiation, which is attributed to their unique chemical composition. This analysis aids in detecting adulterants during crude drug assessment. In this study, one gram of crude drug was placed in a watch glass and subjected to fluorescence analysis in its raw form under visible light, short (254 nm) and long (366 nm) wavelength after treatment with various reagents. The study was conducted by methods given by.[8]

Preliminary phytochemical analysis

Preliminary phytochemical screening involves chemical testing to identify phytochemicals in leaf extract with different solvents. The study followed the methodology given by.[9-11]

Secondary metabolite analysis

Total phenol content

The total phenolic content in the plant extracts was assessed using a slightly modified Folin Ciocalteu method[12,13] with gallic acid serving as the reference standard. In summary, 0.5 mL of the extract was combined with 0.5 mL of 10% aqueous Folin-Ciocalteu reagent and gently mixed. After allowing the reaction to proceed for 5 min, 2.0 mL of 10% aqueous sodium carbonate (Na_2CO_3) was added, followed by 2.0 mL of distilled water to reach a final volume of 4.0 mL. The solution was then incubated at 40°C for 1 hr. Subsequently, the absorbance was recorded at 750 nm using a UV-visible spectrophotometer, with methanol employed as the blank.

Total flavonoid content

Total flavonoid content was measured using a colorimetric method described by.[14,15] In this procedure, 0.5 mL of the sample extract was combined with 0.8 mL of distilled water, followed by the addition of 0.1 mL of 5% sodium nitrite. After 5 min, 0.1 mL of 10% aluminium chloride ($AlCl_3$) was added. 6 min later, 0.1 mL of 1 M potassium acetate was introduced. The mixture was then immediately diluted with 1 mL of distilled water and mixed thoroughly. Absorbance was recorded at 415 nm using a spectrophotometer, with distilled water as the blank. Quercetin was used to generate the standard calibration curve, and results were expressed as milligrams of quercetin equivalents per gram of sample (mg QE/g).

Free radicle anti-oxidant analysis

DPPH

The antioxidant capacity was evaluated using the DPPH (2,2-diphenyl-1-picrylhydrazyl) assay, based on the method described[16,17] with minor modifications. A DPPH stock solution was prepared by dissolving 25 mg of DPPH in 1000 mL of methanol. The absorbance of this solution was measured and used as the control. For the assay, 2.8 mL of the DPPH solution was mixed with sample extracts at different concentrations (0.625, 1.25, 2.5, 5, and 10 mg/mL), followed by incubation in the dark at room temperature for 30 min. After incubation, the absorbance was recorded at 512 nm using a UV-visible spectrophotometer. The antioxidant activity was calculated as the percentage of Radical Scavenging Activity (RSA%) using the following formula:

$$RSA\ (\%) = (\text{Absorbance of control} - \text{Absorbance of sample}) / (\text{Absorbance of control}) \times 100$$

ABTS

The ABTS assay was conducted as described by[18] with slight modifications. Briefly, the ABTS radical cation ($ABTS^{\bullet+}$) was generated by reacting 7 mM ABTS stock solution with 2.45 mM potassium persulfate in ethanol. The mixture was incubated in the dark at room temperature for 12-16 hr to allow the formation of the stable $ABTS^{\bullet+}$ radical. Prior to use in the assay, the resulting solution was diluted with ethanol to obtain an absorbance of 0.70±0.02 at 734 nm. 0.1 mL plant extract with various concentrations of different solvents (0.625, 1.25, 2.5, 5, 10 mg/mL) mixed with 0.9 mL diluted ABTS solution. At the wavelength of 734 nm, after 15 min absorbance was taken. Results are also expressed in RSA %.

Total antioxidant capacity (Phosphomolybdenum assay)

The Total Antioxidant Capacity (TAC) of each sample was evaluated using the phosphomolybdenum assay, as described[19] with slight modifications to optimize experimental conditions. Briefly, 0.2 mL of the test sample was mixed with 2.0 mL of the phosphomolybdenum reagent solution, consisting of 0.6 M sulfuric acid, 28 mM sodium phosphate, and 4 mM ammonium molybdate. The reaction mixture was incubated in a water bath at 95°C for 20 min. Following incubation, the samples were allowed to cool to room temperature, and the absorbance was measured at 695 nm using a UV-vis spectrophotometer. A blank control was prepared by replacing the test sample with 0.1 mL of Dimethyl Sulfoxide (DMSO) under identical conditions. The antioxidant capacity of each sample was quantified and expressed as Ascorbic Acid Equivalents (AAE).

RESULTS

Medicinal plants and herbs are enriched with essential phytochemicals, which are a variety of primary and secondary plant metabolites responsible for anti-hyperglycaemic, anti-inflammatory, anti-diabetic, and anti-microbial effects and other known biological activities.[20,21] In order to confirm and validate the identification, purity, and quality of a crude medication, pharmacognostic research requires a systematic and organised approach. This comprehensive and well-structured pharmacognosy study offers important findings that can direct future investigations.

Macroscopic and Organoleptic Studies

The macroscopic evaluation includes detailed observation of morphological characters and taxonomy. The morphological characters of leaves were noted as Leaves pinnately compound 3-foliolate; stipules small, ovate, hairy, usually deciduous; petiole 1-2 cm; stipels absent; petiolules extremely short; leaflets papery or nearly leather like, with glandular spots, pubescent on both surfaces, denser abaxially, basal veins 3, obviously convex below; terminal leaflet elliptic or obovate-elliptic to obovate, 1.2-4×0.8-1.5 cm, apex obtuse or rounded; lateral leaflets smaller, obliquely elliptic to obliquely obovate. Organoleptic evaluation can be done by means of organs of sense and thereby define some specific characteristics of the material which can be considered as a first step towards establishment of identity and degree of purity. The observed sample presents as a dried plant material, indicative of reduced moisture content, which favors prolonged shelf life and minimizes microbial degradation. Its olive-green appearance may reflect the presence of chlorophyll or other plant-based pigments. A mild aromatic scent is noticeable, suggesting the existence of low levels of volatile organic compounds. The sweetness on tasting implies the presence of natural constituents such as sugars or glycosidic compounds.

In terms of tactile properties, the material feels coarse and rough, pointing to a fibrous or particulate structure. These combined features are characteristic of botanical substances commonly utilized in herbal medicine or traditional pharmacological preparations.

Leaf surface and microscopic Studies

The leaf epidermis, a peripheral layer of cells enveloping the leaf, exhibits surface-specific morphological divergences. Adaxial cells possess sinuous walls, while abaxial cells display irregular. This variation in cell shape and wall texture between the two surfaces is a notable feature of the leaf's epidermis. The upper and lower surfaces of leaves have non-glandular, unicellular trichomes with pointed apex. The layer of palisade mesophyll tissue observed under upper epidermis. Spongy mesophyll is present above the lower epidermis. Distinct layers of xylem and phloem are seen. Leaves are generally amphistomatic. Stomata are strictly paracytic type. The vein islet number of the sample ranges from 5 to 7, with an average of 5.6±0.21 mm^2. The vein termination number falls between 6 and 8, with an average value of 7.3±0.19 mm^2. The stomata number ranges from 22 to 24, averaging 23±0.18 mm^2. Lastly, the stomatal index lies between 40 and 45, with a calculated mean of 42.59±0.22 (Figure 1).

Bromatological analysis

Bromatological analysis is a scientific technique used to analyse the nutritional content of plant-based materials. The physicochemical analysis of the sample revealed a total ash content of 3.00±0.02%, indicating the presence of inorganic residues. The moisture content was found to be 61.33±0.06%, while the corresponding dry matter content measured 38.66±0.08%, reflecting the water composition and solid constituents, respectively. The crude fat content was determined to be 3.10±0.28%, and the crude fiber content was 17.86±0.02%, suggesting a substantial amount of indigestible plant material. Additionally, the crude protein content was measured at 6.91±0.04%, indicative of the sample's nutritional potential and protein yield.

Extractive Yield

The ethanol extract exhibited the highest extractive yield, reaching just above 25%, indicating its strong ability to solubilize a broad range of phytochemicals, likely due to its polar nature and compatibility with both polar and moderately non-polar compounds. Similarly, acetone also showed a high extractive yield of approximately 25%, closely matching ethanol and highlighting its effectiveness as a versatile solvent.

Among the other solvents, butanol, ethyl acetate, and aqueous extracts demonstrated moderate extractive capacities, with yields ranging between 15% and 18%. Butanol showed a slightly higher extractive yield compared to ethyl acetate and aqueous, suggesting it may have been more effective in extracting specific polar constituents.

The chloroform and toluene extracts produced yields around 13%-14%, placing them in the lower mid-range. This result may reflect their more non-polar character, which limits their ability to extract hydrophilic compounds.

The petroleum ether extract showed the lowest extractive yield, at approximately 10%, which is expected given its non-polar nature, generally extracting only lipophilic substances such as fats, oils, and waxes.

Powder Behavior

The behavior of powdered drug would be essential tool for detection of adulterants. In powder behavior leaf powder treated with different reagents showing various reactions indicates presence of particular compound i.e., inference. Among the various chemical treatments, the leaf powdered of *C. scarabaeoides* showed the characteristic fluorescent green colour when treated

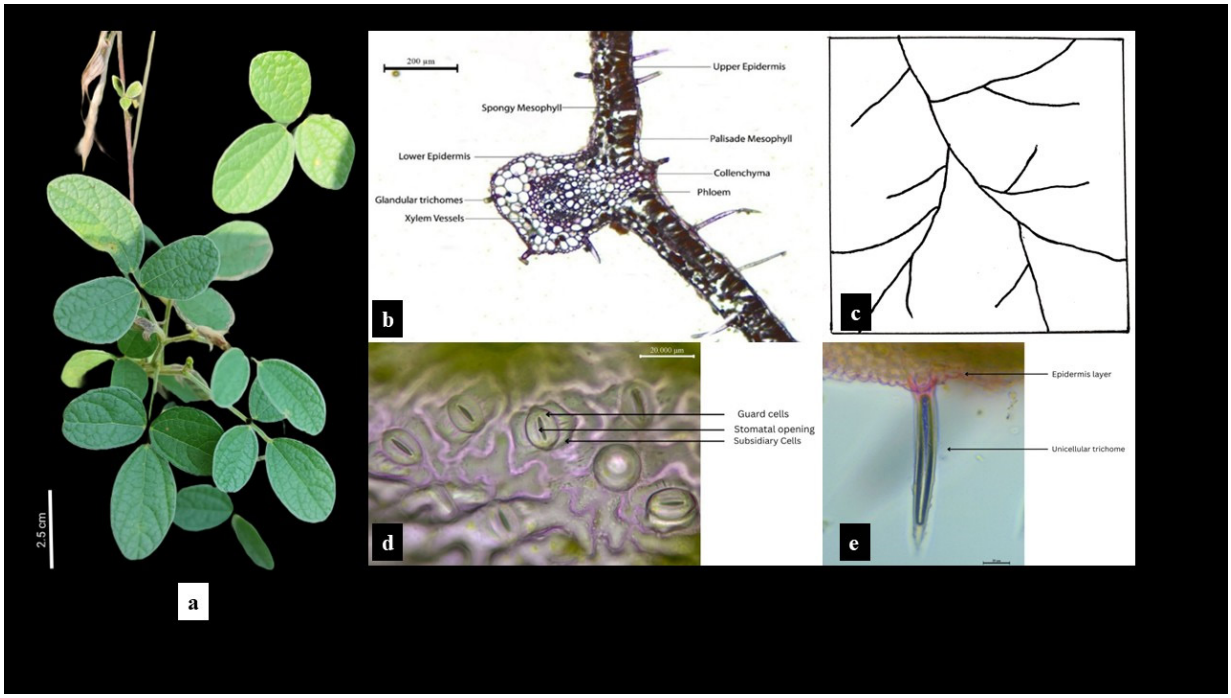

Figure 1: Morphological and anatomical features of *Cajanus scarabaeoides* leaf. (a) Habit of the *Cajanus scarabaeoides* showing pinnately compound leaves. (b) Transverse section of the leaf showing internal anatomy including epidermis, mesophyll, vascular bundles, and glandular trichomes. (c) Vein islet and veinlet termination pattern observed in a cleared leaf preparation. (d) Surface view of the lower epidermis showing paracytic stomata. (e) Microscopic view showing a unicellular trichome emerging from the epidermal layer.

with 1N alcoholic NaOH, 50% H_2SO_4, Conc. HCl, NH_3 and acetone under short UV light (Table 1).

Fluorescence analysis

The powder shows distinct colour changes when exposed to different reagents and lighting, indicating the presence of reactive chromophores or fluorescent compounds. Acidic and oxidative reagents like H_2SO_4 and HNO_3 cause the most dramatic shifts, especially under UV light. Basic environments (NaOH, KOH) generally shift colours toward green or Sacramento green, particularly under short UV. $FeCl_3$ and Iodine produce deep brown/orange hues, which could suggest phenolic or conjugated systems. These colorimetric changes under UV suggest possible use in chemical identification, forensic testing, or qualitative analysis (Table 1).

Preliminary phytochemical analysis

Preliminary Phytochemical screening is a method for identification of bioactive compounds that is undiscovered in plant extracts through qualitative study. It is also a preliminary stage in a phytochemical study that aims to give an overview of the class of compounds present in plants that are being studied. In this study various phytocompounds have been discovered like alkaloids, carbohydrates, proteins, phenols, flavones, tannin, saponin, glycosides, steroids etc. Ethanol, methanol and acetone are well potential solvents for phytochemical screening of leaf powder of *C. scarabaeoides* among selected solvents (Table 2).

Secondary metabolite analysis

Total Phenol Content

Solvent polarity greatly influences phenol extraction efficiency. Ethanol is the most effective solvent for extracting phenolic compounds from leaf, showing the highest phenol content (55.30±1.05 mg/g GAE DW). Aqueous extracts the least number of phenols (25.06±1.32 mg/g GAE DW), which could be due to poor solubility of certain phenolic compounds in water. The statistical letters (a, b, c, d) indicate significant differences between the groups (Table 3).

Total flavonoid content

Ethanol is the most efficient solvent for extracting flavonoids among selected, followed closely by acetone. Ethanol extract showed 71.26±0.52 mg/g QE DW. While Aqueous 36.74±1.05 mg/ gm QE DW respectively. The extraction efficiency pattern (Ethanol>Acetone>Ethyl Acetate>Aqueous) matches the polarity of the solvents and how well flavonoids dissolve in them. Flavonoids dissolve best in solvents with medium polarity, like ethanol and acetone, and less in water, which is highly polar (Table 3).

Free radicle anti-oxidant analysis

All solvents exhibit notable antioxidant activity, but their effectiveness varies by assay. The antioxidant activity of *Cajanus scarabaeoides* leaf extracts were evaluated using DPPH, ABTS, and Total Antioxidant Capacity (TAC) assays. Extracts were

Table 1: Powder behavior and fluorescence analysis of leaf of *C. scarabaeoides*.

Sl. No.	Reagents	Behaviour	Inference	Visible	Short wavelength (254 nm)	Long wavelength (366 nm)
1	Powder such as	Olive green	-	Olive Green	Forest Green	Olive Green
2	Powder+1N NaOH	Clay orange	-	Army Green	Sacramento green	Sacramento green
3	Powder+Iodine	Moss green	-	Sage Green	Hunter Green	Sage Green
4	Powder+Conc. H_2SO_4	Dark brown	Steroids	Hunter Green	Macaroon	Dark Brown
5	Powder+$FeCl_3$	Caramel brown	tannin	Amber Orange	Chocolate Brown	Tawny Brown
6	Powder+5% KOH	Ginger orange	cysteine	Moss Green	Sacramento Green	Army Green
7	Powder+Conc. HNO_3+Ammonia	Brown	Xanthoprotein	Coffee Brown	Corn Yellow	Gingerbread Brown

Table 2: Preliminary phytochemical analysis of Leaf of *Cajanus scarabaeoides*.

Constituents	Inference							
	Tests	Meth	Ace	Chl	PE	EA	ETH	DW
Alkaloids	Dragendorff's test	++	+++	+	-	++	+++	++
	Hager's test	+++	-	-	-	++	+++	++
	Wagner's test	++	+	-	-	+	++	-
Carbohydrates	Fehling's test	+	-	-	-	+	++	-
	Benedict's test	++	-	-	-	-	+++	-
Protein	Biuret test	+++	++	-	-	++	+++	-
	Ninhydrin test	+	-	-	-	-	++	-
Phenols	Ferric chloride test	+++	++	-	-	++	+++	++
Flavones	Shinod's test	-	+	-	-	-	++	++
Anthraquinones	Borntrager's test	-	-	-	-	-	-	-
Saponin	Foam test	++	-	-	+	++	+++	+
Tannin	Lead acetate test	-	+	+	+	+	+++	+
Glycosides	Keller killani test	++	-	-	+	+	++	-
Steroids	Salkowski test	-	+	+	-	-	++	+

(Note: += Low ++ = Medium +++ = High - = Not detected)

prepared with ethanol, acetone, ethyl acetate, and water, and IC_{50} values (mg/mL) were reported as mean±standard error. Statistically significant differences were determined at $p<0.05$. In the DPPH assay, the ethanol extract showed the highest activity (0.49 ± 0.04^a mg/mL), followed by acetone (0.51 ± 0.07^b), ethyl acetate (0.53 ± 0.02^c), and aqueous (0.56 ± 0.01^d). For ABTS, the acetone extract had the strongest activity (0.47 ± 0.08^a mg/mL), significantly better than ethanol (0.53 ± 0.05^b), aqueous (0.60 ± 0.08^c), and ethyl acetate (0.66 ± 0.04^d). In the TAC assay, the aqueous extract showed the best performance (0.26 ± 0.04^a mg/mL), followed by ethyl acetate (0.31 ± 0.02^b), acetone (0.37 ± 0.03^c), and ethanol (0.44 ± 0.05^d) (Table 3).

DISCUSSION

The current study provides a detailed analysis of the pharmacognostic, phytochemical, nutritional, and antioxidant properties of *Cajanus scarabaeoides* (L.) Thouars. The results build upon traditional knowledge with scientific evidence, offering a clear path for further exploration in pharmaceutical, nutraceutical, and botanical research.

A significant observation in this study was the presence of distinct fluorescence characteristics in the leaf powder of *C. scarabaeoides* under Ultraviolet (UV) light. This trait indicates the presence of specific chemical compounds that naturally emit light when

Table 3: Correlation of Free radicle scavenging activity with Phenolic and Flavonoid Content in Different Solvent-Based Extracts.

Solvent	DPPH IC_{50} (µg/mL)	ABTS IC_{50} (µg/mL)	TAC IC_{50} (µg/mL)	Total Phenolic Content (mg GAE/g)	Total Flavonoid Content (mg QE/g)
Ethanol	0.49 ± 0.04^{a}	0.53 ± 0.05^{b}	0.44 ± 0.05^{d}	55.30 ± 1.05^{a}	71.26 ± 0.52^{a}
Acetone	0.51 ± 0.07^{b}	0.47 ± 0.08^{a}	0.37 ± 0.03^{c}	47.11 ± 1.57^{b}	66.30 ± 1.05^{b}
Ethyl Acetate	0.53 ± 0.02^{c}	0.66 ± 0.04^{d}	0.31 ± 0.02^{b}	38.62 ± 1.32^{c}	56.78 ± 1.57^{c}
Aqueous	0.56 ± 0.01^{d}	0.60 ± 0.08^{c}	0.26 ± 0.04^{a}	25.06 ± 1.32^{d}	36.74 ± 1.05^{d}

(Note: IC_{50} values are expressed as mean±standard error. Different superscript letters within a column indicate significant differences ($p<0.05$) according to Duncan's Multiple Range Test (DMRT). Lower IC_{50} values indicate stronger antioxidant activity; thus, values with different superscripts are significantly different, with the lowest IC_{50} representing the most potent antioxidant effect.)

exposed to UV rays. The reproducibility and consistency of these fluorescence patterns make them useful as a simple and effective tool for the identification, authentication, and quality control of the plant, especially in its powdered or crude form. This is particularly valuable in herbal industries, where misidentification can lead to reduced efficacy or harmful substitutions.

The phytochemical analysis of the leaf extracts revealed a wide range of bioactive compounds, including alkaloids, phenolic compounds, flavonoids, tannins, proteins, and carbohydrates. These compounds play critical roles in plant defence and have been widely studied for their pharmacological benefits. The presence of alkaloids suggests potential analgesic, antimicrobial, and anticancer activities. Phenols and flavonoids are well-established antioxidants that help neutralize free radicals, reduce inflammation, and prevent oxidative damage to cells. Tannins contribute to antimicrobial and wound-healing properties. The detection of these compounds confirms that *C. scarabaeoides* contain functionally important secondary metabolites that may be developed into therapeutic agents.

The study also assessed the efficiency of various solvents ethanol, acetone, and water in extracting these compounds. These solvents were chosen due to their varying polarity, which influences their ability to dissolve different classes of phytochemicals. Ethanol and acetone, being semi-polar solvents, proved to be the most efficient, extracting high concentrations of phenols, flavonoids, and other antioxidant compounds. This highlights their suitability for use in herbal extraction procedures and suggests that solvent selection is a critical factor in maximizing the medicinal potential of plant materials.

The extracts rich in phenol and flavonoid content also showed notable antioxidant activity, especially in the ethanol and acetone fractions. This is an important finding, as antioxidants play a crucial role in protecting the body from oxidative stress, which is a major contributor to chronic diseases like cardiovascular disorders, diabetes, neurodegenerative diseases, and certain cancers. The observed antioxidant potential of *C. scarabaeoides* supports its role as a natural source of antioxidant compounds and underlines its preventive and therapeutic relevance in managing oxidative damage.

In addition to its medicinal properties, the plant was also analysed for its nutritional content through bromatological evaluation. The presence of carbohydrates and proteins adds to the nutritional importance of the plant, supporting its traditional use as a food or supplementary dietary component. This dual medicinal and nutritional profile suggests that *C. scarabaeoides* may be developed into functional foods or nutraceuticals, offering both health benefits and nourishment.

The physicochemical analysis further confirmed the high quality and purity of the plant material. A low total ash content of 3% indicates minimal contamination by inorganic substances such as dust, sand, or other extraneous matters. This is a key indicator of the plant's cleanliness and suitability for medicinal use. Additionally, the extractive values in different solvents help assess the plant's solubility profile and are important for developing standard procedures for herbal product formulation. These values also serve as useful markers for the consistency and potency of herbal extracts.

Taken together, these findings highlight the multi-dimensional potential of *C. scarabaeoides* as a source of both therapeutic agents and nutritional compounds. Its clear fluorescence characteristics, rich phytochemical profile, strong antioxidant activity, and clean physicochemical properties make it a valuable candidate for further research and application in traditional and modern medicine.

To enhance the utility of these findings, future research should aim to isolate, purify, and characterize the individual bioactive compounds using advanced analytical techniques such as High-Performance Liquid Chromatography (HPLC), Gas Chromatography-Mass Spectrometry (GC-MS), and Nuclear Magnetic Resonance (NMR) spectroscopy. Additionally, in vivo and in vitro studies are needed to evaluate the pharmacological activities of these compounds in biological systems. Safety evaluations through toxicity testing and clinical trials will also be essential before any therapeutic application can be recommended.

Furthermore, exploring the mechanism of action of key bioactive compounds, along with molecular docking and bioinformatics studies, could provide insight into how these substances interact

with biological targets. This would facilitate the development of plant-based drugs for the treatment of specific diseases. Lastly, given the plant's nutritional potential, its inclusion in community health programs and functional food development should be encouraged, especially in regions where it naturally grows and is already part of the local diet.

CONCLUSION

Evaluation of sensory qualities by organoleptic study is helpful for ensuring quality of drug. Microscopy shows paracytic stomata and non-glandular trichomes, aiding species-specific standardization. Leaf shows high moisture, notable fiber, and moderate protein, indicating good nutritional value and purity. Ethanol, methanol and acetone were effective solvents for preliminary detection. Fluorescent colour reactions show the presence of key natural compounds, with no signs of adulteration. Consistent Green and Brown colour under UV results support the sample's purity and authenticity. Ethanol and acetone extract solvents showed good antioxidant activity for phenol and flavonoid content and showed significant free radicle activity for the same extract solvents. The plant's phytochemical richness and antioxidant potential suggest promising applications in herbal formulations, nutraceuticals, and therapeutic antioxidants for managing various disorders.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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ABBREVIATIONS

AAE: Ascorbic acid equivalent; **ABTS:** 2, 2-Azino-bis (3-ethylbenzothiazoline-6-sulfonic acid); **ACE:** Acetone; **$AgNO_3$:** Silver nitrate; **$AlCl_3$:** Aluminium chloride; **Aq:** Aqueous; **CHL:** Chloroform; **Conc.:** Concentrated; **DPPH:** 2,2-diphenyl-1-picrylhydrazyl; **DW:** Dry weight; **EA:** Ethyl acetate; **ETH:** Ethanol; **$FeCl_3$:** Ferric chloride; **GAE:** Gallic acid equivalent; **g:** Gram; **H_2SO_4:** Sulfuric acid; **HCl:** Hydrochloric acid; **HNO_3:** Nitric acid; **IC_{50}:** Half-maximal inhibitory concentration; **KOH:** Potassium hydroxide; **METH:** Methanol; **Mg:** Milligram; **mL:** Millilitre; **Na_2CO_3:** Sodium carbonate; **NaOH:** Sodium hydroxide; **NH_3:** Ammonia; **Nm:** Nanometre; **$p<0.05$:** Statistically significant; **PE:** Petroleum ether; **QE:** Quercetin equivalent; **RSA:** Radicle scavenging activity; **SE:** Standard error; **Sq. mm:** Square millimetre; **TAC:** Total antioxidant capacity; **UV:** Ultraviolet; **Alco:** Alcoholic; **DMRT:** Duncan's Multiple Range Test.

ETHICAL STATEMENT

This research was carried out following established ethical guidelines and good scientific practice. The plant materials utilized were sourced lawfully and with due consideration for biodiversity, ensuring that no endangered or protected species were involved. The study did not include any experiments on human subjects or animals. All procedures adhered to institutional and national ethical standards. The authors affirm that the data presented are original, accurately reported, and free from fabrication or manipulation. No conflicts of interest are declared by the authors.

SUMMARY

The study explored the medicinal and nutritional potential of *Cajanus scarabaeoides* through a range of laboratory tests. The study began by examining the leaf's appearance, texture, and structure, both with the naked eye and under a microscope, noting features like hairy surfaces and specialized cells. Nutritional analysis showed that the leaves contain a good amount of protein, fiber, and other essential nutrients. Different solvents like ethanol, acetone, and aqueous were used to extract useful compounds from the plant, and ethanol and acetone proved especially effective.

To help identify and authenticate the plant material tested for, how the powdered leaf reacted with various chemicals under regular and UV light, revealing distinct colour changes. Further chemical tests confirmed the presence of important plant compounds such as alkaloids, flavonoids, and tannins, which are known for their health benefits. The extracts were then tested for their antioxidant abilities using three different methods (DPPH, ABTS, and total antioxidant capacity assays), all showing that the plant is rich in antioxidants particularly when extracted with ethanol or acetone. These results support the traditional use of *Cajanus scarabaeoides* and suggest it could be a promising candidate for future herbal or pharmaceutical products.

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