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Evaluation of Phytochemical Constituents and Elemental Profiling of Selected Medicinal Plants in South-West, Nigeria

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ABSTRACT

Background and Objective: Phytochemicals are responsible for the definite physiological effects exerted on the human body by various parts of the plant and it has been reported to play a major role in nutrition and control of diseases. This study aimed to comparatively investigate the phytochemical and elemental components of five medicinal plants commonly used in South-Western, Nigeria. **Materials and Methods:** Qualitative and quantitative phytochemical screening of all the extracts was done using different standard methods. Calcium, potassium, magnesium, phosphorus, iron and other elements were determined using standard procedures. **Results:** Preliminary qualitative phytochemical screening indicates the presence of glycosides, saponins, tannins, flavonoids, alkaloids and anthraquinones. The quantitative phytochemical screening revealed that glycosides, saponins, tannins, flavonoids, alkaloids and anthraquinones were significantly ($p<0.05$) higher in ethanol extract compared to ethyl acetate extract in all the studied medicinal plants, however, the reverse was the case in *Urena lobata*. Sodium (Na), potassium (K) and calcium (Ca) were significantly ($p<0.05$) higher in ethyl acetate extract than in ethanol extract in all the studied medicinal plants. While, iron (Fe), lead (Pb), cadmium (Cd) and arsenic (As) were significantly ($p<0.05$) higher in ethanol extract compared to ethyl acetate extract in all the studied medicinal plants. **Conclusion:** This study suggests the different range of phytochemicals present in the medicinal plants studied with their potential therapeutic benefits, emphasizing the significance of these plants in traditional and modern medicine. Furthermore, the elemental composition sheds light on the nutritional and essential value of these plants, which could contribute to their holistic healing properties.

KEYWORDS

Ethnopharmacy, plant chemistry, chemical profiling, therapeutic potential, trace element, spectroscopic analysis

INTRODUCTION

Medicinal plants produce numerous secondary metabolites, including bioactive compounds like alkaloids, tannins, flavonoids, sterols and terpenes[1]. These compounds are essential for drug efficacy[2] and are

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responsible for the physiological effects exerted by plant parts on the human body[3]. They play a significant role in nutrition and disease control[1]. Bioactive compounds, also known as phytochemicals, are widely used in herbal medicines worldwide for treating various health challenges[4].

Citrus sinensis, also known as sweet oranges, belongs to the family Rutaceae. It is a native of Asia and is now widespread globally[5]. It is a rich source of vitamin C, a powerful antioxidant that builds the body's immune system[6]. *Citrus sinensis* is traditionally used to treat various ailments, including cramps, colic, stress, depression, hypertension, cold, cough, obesity, angina and tuberculosis[7]. It has been shown to prevent diseases like cancer, cardiovascular disease, neurological diseases and the ageing process. Its antibacterial, antifungal, antiparasitic, antioxidant, hypocholesterolemic, anti-obesity, antiosteoporotic, relaxant, sedative and anxiolytic activities have been reported[8-11].

Lawsonia inermis, also known as henna, mignonette and Egyptian privet, is a shrub with reddish-brown bark and opposite, sub-sessile, elliptic or broadly lanceolate leaves[12]. It is commonly grown in Africa, the Middle East and India[13]. It belongs to the Lythraceae family and has astringent, anti-hemorrhagic, hypotensive, cardio-inhibitory, sedative, hypoglycemic, immunostimulant, hepatoprotective, anti-inflammatory, tuberculostatic, anti-cancer and antioxidant properties[14-16]. The plant is used for various health conditions, including rheumatoid arthritis, headaches, ulcers, diarrhoea, fever, heart disease, hair loss, leukorrhea, smallpox, skin disease, burns and diabetes[17]. The primary chemical components of henna are Lawsone (2-hydroxynaphthoquinone), mucilage, mannite, gallic acid and tannic acid[15]. The plant also contains coumarins, flavonoids, naphthalene, derivatives of gallic acid, triterpenoids, steroids and aliphatic hydrocarbons[13].

Albizia zygia L., which belongs to the family Fabaceae. It is also known as West African walnut. It is indigenous to West and East Africa, India and Australia[18]. In traditional medicine, *Albizia zygia* is used to cure several ailments, including fever, malaria, diarrhoea, oedema, insanity, wounds, toothaches, yaws, sores, waist pain, fever and venereal diseases[19,20]. *Albizia zygia* exhibits cytotoxicity against human T-lymphoblast-like leukaemia and prostate and breast cancer cell lines[21]. Phytochemical studies reveal that the plant contains cardiovascular glycosides, flavonoids, tannins and triterpenes[22]. Some reported pharmacological activities of *A. zygia* include antiprotozoal[19], antimalarial[23], gastro-protective[24], anti-inflammatory and anti-nociceptive[20,25], anti-depressant and anti-psychotic[26,27], antimicrobial and antioxidant[28], antipyretic and analgesic[29].

Urena lobata L., belongs to the family Malvaceae. It is commonly known as Caesar weed or Congo jute. It is grown in Brazil, Southeast Asia and the Congo and widely distributed throughout the world[30]. *Urena lobata* is a well-known plant in folk medicine used in the treatment of diuretic, febrifuge, dysentery, cough, dropsy, edema, abdominal colic, rheumatism, leucorrhea and gonorrhea[31], due to its wide range of biological activities, which include anti-hyperglycemic, antioxidant, anti-nociceptive, anti-diarrheal, anti-inflammatory, anti-proliferative, antibacterial, anxiolytic and wound healing activities[32-34]. A phytochemical screening of the plant revealed the presence of mangiferin, quercetin, flavonoids, lignans, coumarins, triglycerides, phenylethyl glycosides, megastigmane glycosides, lignins and urenalignosides A-D[33,35-38].

Olax subscorpioidea is a tree or shrub that grows widely in Nigeria, Zaire, Senegal and other regions of Africa, which belongs to the family of Olacaceae[39]. Traditionally, in Nigeria, it is one of the recipes used to treat cancer and asthma[40]. More so, it is used as a chewing stick for oro-dental hygiene, treatment of inflammatory and mental diseases, convulsion, pain, obesity, diabetes mellitus, malaria, parasitic infections, diarrhoea, gastric ulcer, depression, fever, anxiety and constipation[40-43]. In Congo Republic, the decoction of the stem, bark and leaves of *O. subscorpioidea* has been used against rheumatism and arthritis pains[40],

venereal diseases and guinea worms[44]. Preliminary phytochemical screening revealed the presence of saponins, alkaloids, tannins, phenols, phlobatannins, carbohydrates, cardiac glycosides, terpenoids, steroids and flavonoids. These phytochemicals are responsible for the analgesic properties[39,40]. Also, elemental studies revealed the presence of calcium, copper, manganese, magnesium, sodium, zinc, potassium, aluminium, silicon, sulphur, cobalt, nickel, bromine, phosphorus, chlorine, iron, rubidium and strontium[45,46]. Pharmacological activities include antidepressant, anticonvulsant, sedative, anxiolytic, anti-Alzheimer's, cytotoxicity, antioxidant, hypolipidemic, analgesic, anti-inflammatory, antiarthritic, hypoglycaemic, antiulcer, anticancer, antimicrobial, anthelmintic, hepatoprotective, apoptotic and antiprotease activities[39,40,45,46].

It is well-known that plants produce phytochemicals to protect themselves, however, it has been demonstrated that they can also be used to protect humans against numerous diseases[47]. Globally, there are more than a thousand known phytochemicals[48,49]. Some phytochemicals known as phytotoxins are toxic to humans[50], for instance, aristolochic acid is carcinogenic even at low doses[51], while some phytochemicals are anti-nutrients, i.e. they interfere with the absorption of nutrients. Others, such as some polyphenols and flavonoids, may be pro-oxidants in high ingested amounts[52]. Minerals play vital metabolic and physiological roles in the living system[53]. They are also regarded as activators, as well as components of many plant enzymes[54]. Deficiency as well as excess amount/quantity of the minerals might disturb normal biochemical functions of the body leading to abnormal physiological functions too[55]. Therefore, this study seeks to comparatively investigate the phytochemicals (quantitative and qualitative) and mineral elements of ethyl acetate and ethanol extracts of these medicinal plants commonly used by the Yoruba tribe in South-Western Nigeria for cosmetics, food and medicinal purposes.

MATERIALS AND METHODS

Study area: The study was designed and carried out in the Department of Science Laboratory Technology, School of Sciences and Engineering, D. S. Adegbenro ICT Polytechnic, Ekuru-Itori, Ewekoro, Ogun State, Nigeria. The duration was from October, 2021 to December, 2021.

Collection and identification of plant materials: Fresh leaves of *Lawsonia Inermis*, *Albizia zygia*, *Citrus sinensis*, *Urena lobata* and *Olax subscorpioidea* were collected from different locations within Ewekoro Local Government Area in Ogun State and Afijio Local Government Area in Oyo State, Nigeria. The identification and authentication of the plant materials were done at Forest Research of Nigeria, Jericho Hill, Ibadan, Oyo State, with the voucher number FHI 113335 (*Olax subscorpioidea*), FHI 113336 (*Lawsonia Inermis*), FHI 113355 (*Urena lobata*), FHI 113356 (*Albizia zygia*) and FHI 113360 (*Citrus sinensis*) deposited for further reference.

Extraction of plant materials: The collected samples were air-dried at room temperature for 21 days. The samples were ground into powder using a pulverizer and stored in an air-tight bottle. After weighing, 200 g of the ground sample of the leaf was dissolved in 500 mL each of ethanol and ethyl acetate and was kept in the refrigerator for 72 hrs with intermittent shaking. The extract was filtered using a chess cloth and Whatman filter paper No. 1 (125 mm), to obtain filtrates of the respective solvents of ethanol and ethyl acetate. The filtrates were evaporated to dryness using a water bath (at 40°C) to obtain the slurry, which was persevered in a phial, labelled appropriately, stored in the refrigerator at 4°C and was used for phytochemical and mineral analysis.

Preliminary qualitative screening of phytochemical constituents: Preliminary qualitative analysis of phytochemical constituents was carried out to identify the secondary metabolites present in the ethyl acetate and ethanol extracts of *Lawsonia inermis*, *Albizia zygia*, *Citrus sinensis*, *Urena lobata* and *Olax subscorpioidea* leaves[56,57]. The qualitative analysis of the various phytochemicals was carried out by using Meyer's reagents (alkaloids). Other tests carried out include the Frothing test (saponins), ferric chloride test (tannins), Schinoda test (flavonoids), Fehling's test (glycosides) and Borntrager's test (anthraquinones).

Quantitative screening of phytochemical constituents

Determination of alkaloid: Alkaloid was determined according to the method of Obadoni and Ochuko[58] and the percentage of total alkaloid content was calculated as:

$$\text{Total alkaloids (\%)} = \frac{\text{Weight of residue}}{\text{Weight of sample taken}} \times 100$$

Determination of flavonoid: The total flavonoid content was determined using the procedure described by Ejikeme *et al.*[59]. The percentage of total flavonoid content was calculated as:

$$\text{Total flavonoid (\%)} = \frac{\text{Weight of residue}}{\text{Weight of sample taken}} \times 100$$

Determination of saponin: Saponin quantitative determination was carried out using the method described by Obadoni and Ochuko[58]. The saponin content is calculated as percentage:

$$\text{Total saponin (\%)} = \frac{\text{Weight of residue}}{\text{Weight of sample taken}} \times 100$$

Determination of tannin: Tannin content was determined using the method of Kaur and Arora[60], using tannic acid as standard. The percentage tannin content was calculated using the formula:

$$\text{Total tannin (\%)} = \frac{\text{Absorbance of sample} \times \text{Gradient factor} \times \text{Dilution factor}}{\text{Weight of sample} \times 10000}$$

Determination of glycoside: Glycoside content was determined using the method of Ezeonu and Ejikeme[61]. The glycoside content is calculated as percentage using the formula:

$$\text{Total glycoside (\%)} = \frac{\text{Absorbance of sample} \times \text{Gradient factor} \times \text{Dilution factor}}{\text{Weight of sample} \times 10000}$$

Determination of anthraquinones: Anthraquinones was determined using the method described by Bussmann *et al.*[62]. The percentage anthraquinone is calculated using the formula:

$$\text{Total anthraquinones (\%)} = \frac{\text{Absorbance of sample} \times \text{Gradient factor} \times \text{Dilution factor}}{\text{Weight of sample} \times 10000}$$

Determination of the mineral composition: The mineral contents of the plants were determined by the procedure of Adelantado *et al.*[63]. Calcium, potassium, magnesium, phosphorus, iron and other elements were measured with Atomic Absorption Spectrophotometer (ThermoFisher Scientific S Series Model GE 712354) after digesting with perchloric-nitric acid mixture. The extracts were digested and placed in a 125 mL Erlenmeyer flask. Perchloric acid (4 mL), concentrated sulphuric acid (2 mL) and concentrated HNO_3 (25 mL) were added and the mixture was heated in a digester until a thick white fume appeared. The heating process was sustained for 30 sec, then cooled. About 50 mL of distilled water was added and the solution was filtered and diluted with distilled water into a Pyrex volumetric flask (564050/EMD; FisherScientific Inc., Pittsburgh, Pennsylvania, USA). The process was repeated until the solution was a consistent and effective solvent. Subsequently, the mixture was analyzed utilizing an Atomic Absorption Spectrophotometer (ThermoFisher Scientific Inc., Waltham, Massachusetts, USA).

Statistical analysis: Statistical analysis was carried out using One-way Analysis of Variance (ANOVA) test. Resulting data were represented as Mean±Standard Deviation of triplicate determinations. GraphPad Prism 9® (Version 9.3.1, GraphPad Software Inc., San Diego, United States of America) software was used for the statistical analysis and statistical significance was obtained at $p<0.05$.

RESULTS AND DISCUSSION

It is no doubt that most plants have at least a medicinal property, which is because of secondary metabolites present in such plants. In this study, plants such as *Lawsonia inermis*, *Albizia zygia*, *Citrus sinensis*, *Urena lobate* and *Olax subscorpioidea* were considered and analysed to elucidate its various phytochemicals present and comparatively evaluate which solvents yield more of the bioactive constituents. The qualitative phytochemical screening indicates the presence of glycosides, saponins, tannins, flavonoids, alkaloids and anthraquinones (Table 1).

The quantitative phytochemical screening revealed that glycosides, saponins, tannins, flavonoids, alkaloids and anthraquinones were significantly ($p<0.05$) higher in ethanol extract compared to ethyl acetate extract in all the studied medicinal plants, however, the reverse was the case in *Urena lobata* (Table 2). Comparatively, tannin content was higher in *Urena lobata* in both solvents, followed by *Lawsonia inermis*, *Citrus sinensis*, *Olax subscorpioidea* and *Albizia zygia* in descending order. Saponin content was higher in *Lawsonia inermis* in ethyl acetate solvent, followed by *Urena lobata*, *Citrus sinensis*, *Olax subscorpioidea* and *Albizia zygia*, but for the ethanol solvent, *Lawsonia inermis* was still the highest followed by *Urena lobata*, *Olax subscorpioidea*, *Citrus sinensis* and *Albizia zygia*. Alkaloid content was higher in *Lawsonia inermis* in both solvents, followed by *Urena lobata*, *Olax subscorpioidea*, *Citrus sinensis* and *Albizia zygia*. Glycoside content was higher in *Urena lobata* in both solvents, followed by *Lawsonia inermis*, *Citrus sinensis*, *Olax subscorpioidea* and *Albizia zygia*. Flavonoid content was higher in *Citrus sinensis* in ethyl acetate solvent, followed by *Lawsonia inermis*, *Urena lobata*, *Albizia zygia* and *Olax subscorpioidea*. For the ethanol solvent, *Citrus sinensis* was higher followed by *Lawsonia inermis*, *Albizia zygia*, *Olax subscorpioidea* and *Urena lobata*. Anthraquinone content was higher in *Urena lobata* in ethyl acetate solvent, followed by *Albizia zygia*, *Lawsonia inermis*, *Citrus sinensis* and *Olax subscorpioidea*, but for the ethanol solvent, *Albizia zygia* has the highest content followed by *Urena lobata*, *Citrus sinensis*, *Lawsonia inermis* and *Olax subscorpioidea*.

The results of this investigation corroborated the numerous phytochemical investigations conducted on these plants[8,13,22,33,35-40]. Phytochemicals provide medical benefits to human beings. For example, saponin has demonstrated promising medicinal capabilities in the treatment of many conditions such as cardiovascular diseases, infections from bacteria, cancer and diabetes[64,65]. Flavonoids have been acknowledged for their advantageous impact on wellness. They are also considered an essential element in multiple pharmacological, nutritional product, therapeutic and cosmetic applications[66]. This compound possesses anti-oxidative, anti-mutagenic, anti-inflammatory and anti-carcinogenic effects, as well as the capacity to regulate essential cellular enzyme efficiency[66].

Research has shown that the phytochemicals found in plants can potentially be influenced by the extraction procedures employed and the specific formulations of solvents used[65], so the concentration of such phytochemicals is determined by the state of the chemical employed as the solvents in the extraction method, in addition to its development and preservation situations[67,68] However, considering the various factors that can influence the identification of these chemicals in plants, it is unsurprising that certain compounds were found in significant quantities in the ethyl acetate solvent, while others were present in the ethanol solvent.

It is vital to know that the therapeutic benefits of herbal remedies in conventional medicine can be linked to the presence of trace elements in extremely small amounts. Essential trace elements, like iron, play a dual role in both treating and preventing disorders such as anaemia[69]. The elemental analysis revealed the

Table 1: Qualitative phytochemical analysis of ethyl acetate and ethanol extracts of some medicinal plants commonly in South-Western, Nigeria

		Lawsonia inermis		*Abizia zygia*		*Citrus sinensis*		*Urena lobata*		*Olax subscorpiodea*	
Phytochemicals	Tests used	Ethyl acetate	Ethanol	Ethyl acetate	Ethanol	Ethyl acetate	Ethanol	Ethyl acetate	Ethanol	Ethyl acetate	Ethanol
Tannins	Ferric chloride test	++	++	+	+	+	+	++	++	+	+
Saponins	Frothing test	++	++	+	+	+	+	++	+	+	+
Alkaloids	Meyer's reagents	++	+++	+	+	+	++	+++	++	++	++
Flavonoids	Schinoda test	++	++	++	++	++	+++	++	++	+	++
Glycoside	Fehling's test	+	+	+	+	+	+	+	+	+	+
Anthraquinone	Borntrager's test	+	+	+	+	+	+	+	+	+	+

+: Present, ++: Present in moderate and +++: Present in more quantity

Table 2: Quantitative phytochemical analysis of ethyl acetate and ethanol extracts of some medicinal plants commonly in South-Western, Nigeria (%)

	Lawsonia inermis		*Abizia zygia*		*Citrus sinensis*		*Urena lobata*		*Olax subscorpiodea*	
Phytochemicals	Ethyl acetate	Ethanol	Ethyl acetate	Ethanol	Ethyl acetate	Ethanol	Ethyl acetate	Ethanol	Ethyl acetate	Ethanol
Tannins	5.12 ± 0.104^{a}	6.32 ± 0.280^{b}	1.32 ± 0.120^{c}	1.58 ± 0.060^{cd}	3.13 ± 0.050^{e}	3.51 ± 0.105^{f}	8.13 ± 0.040^{g}	7.32 ± 0.100^{h}	1.32 ± 0.120^{cd}	2.89 ± 0.100^{e}
Saponins	6.92 ± 1.00^{a}	8.14 ± 0.860^{a}	1.82 ± 0.020^{b}	2.11 ± 0.010^{bc}	3.48 ± 0.030^{cd}	2.55 ± 0.100^{bcde}	5.66 ± 0.730^{a}	3.51 ± 0.105^{cdef}	2.11 ± 0.110^{bdef}	3.76 ± 0.223^{cdef}
Alkaloids	8.93 ± 1.030^{a}	12.18 ± 0.920^{b}	4.36 ± 1.000^{c}	4.16 ± 0.071^{cd}	4.82 ± 0.200^{cde}	6.91 ± 0.010^{af}	10.67 ± 1.050^{abg}	8.91 ± 1.010^{afgh}	5.89 ± 0.300^{cdef}	8.14 ± 0.140^{afh}
Flavonoids	7.38 ± 1.120^{a}	9.11 ± 0.980^{ab}	6.92 ± 1.030^{abc}	6.11 ± 1.110^{ad}	8.66 ± 1.000^{abcde}	10.45 ± 1.050^{be}	7.61 ± 0.890^{abcdef}	5.92 ± 0.980^{acdefg}	3.72 ± 0.120^{dg}	6.62 ± 1.000^{abcdefg}
Glycoside	0.84 ± 0.040^{a}	1.02 ± 0.020^{b}	0.44 ± 0.050^{c}	0.38 ± 0.017^{cd}	0.61 ± 0.020^{e}	0.78 ± 0.010^{af}	1.21 ± 0.021^{g}	1.16 ± 0.010^{g}	0.45 ± 0.010^{cd}	0.78 ± 0.010^{af}
Anthraquinone	0.57 ± 0.092^{a}	0.61 ± 0.021^{ab}	$0.810.030^{c}$	0.71 ± 0.015^{bcd}	0.41 ± 0.030^{e}	0.67 ± 0.080^{abdf}	0.83 ± 0.017^{cd}	0.69 ± 0.020^{abcdf}	0.28 ± 0.010^{g}	0.52 ± 0.030^{abe}

Values were performed in triplicates and represented as Means±Standard Deviations, identical superscript (i.e. a) on the same row means there is no significant difference between the comparing groups at $p>0.05$ and non-identical superscripts (i.e. a, b, c, d, e, f, g, h) on the same row means there is significance between the comparing groups at $p<0.05$

Table 3: Mineral compositions of ethyl acetate and ethanol extracts of some medicinal plants commonly in South-Western, Nigeria (mg/L)

	Lawsonia inermis		*Abizia zygia*		*Citrus sinensis*		*Urena lobata*		*Olax subscorpiodea*	
Minerals	Ethyl acetate	Ethanol	Ethyl acetate	Ethanol	Ethyl acetate	Ethanol	Ethyl acetate	Ethanol	Ethyl acetate	Ethanol
Sodium (Na)	4.17 ± 0.100^{a}	3.65 ± 0.173^{b}	3.82 ± 0.112^{b}	3.12 ± 0.016^{c}	3.11 ± 0.014^{c}	2.65 ± 0.004^{d}	2.60 ± 0.004^{d}	2.14 ± 0.003^{e}	2.87 ± 0.001^{f}	2.34 ± 0.002^{e}
Potassium (K)	1882.11 ± 1.000^{a}	1369.28 ± 1.000^{b}	1569.14 ± 1.000^{c}	1302.45 ± 2.000^{d}	2345.18 ± 1.000^{e}	1894.10 ± 4.000^{f}	1873.41 ± 2.000^{g}	1518.34 ± 2.000^{h}	2156.384 ± 2.000^{i}	1821.635 ± 1.000^{j}
Calcium (Ca)	81.61 ± 1.000^{a}	77.34 ± 1.732^{b}	75.62 ± 1.000^{bc}	70.07 ± 0.9663^{d}	78.09 ± 1.000^{bc}	73.59 ± 1.000^{c}	60.78 ± 1.000^{e}	52.89 ± 1.004^{f}	65.38 ± 1.005^{g}	61.09 ± 1.000^{h}
Iron (Fe)	172.69 ± 2.100^{a}	181.16 ± 1.528^{b}	211.68 ± 1.000^{c}	228.91 ± 3.000^{d}	181.796 ± 1.000^{be}	185.67 ± 2.000^{bef}	178.01 ± 2.000^{be}	184.50 ± 1.001^{bef}	206.78 ± 1.000^{c}	219.00 ± 1.008^{g}
Lead (Pb)	0.038 ± 0.002^{a}	0.132 ± 0.002^{b}	0.098 ± 0.002^{c}	0.176 ± 0.003^{d}	0.112 ± 0.002^{e}	0.172 ± 0.001^{d}	0.142 ± 0.001^{f}	0.193 ± 0.002^{g}	0.211 ± 0.001^{h}	0.284 ± 0.002^{i}
Cadmium (Cd)	0.148 ± 0.001^{a}	0.213 ± 0.001^{b}	0.288 ± 0.001^{c}	0.314 ± 0.002^{d}	0.442 ± 0.002^{e}	0.496 ± 0.001^{f}	0.384 ± 0.004^{g}	0.411 ± 0.001^{h}	0.561 ± 0.001^{i}	0.602 ± 0.002^{j}
Arsenic (As)	0.811 ± 0.002^{a}	0.981 ± 0.003^{b}	0.653 ± 0.003^{c}	0.783 ± 0.097^{ad}	0.448 ± 0.052^{e}	0.634 ± 0.034^{cf}	0.602 ± 0.004^{cfg}	0.814 ± 0.004^{ad}	0.416 ± 0.006^{ef}	0.573 ± 0.003^{cg}

Values were performed in triplicates and represented as Means±Standard Deviations, identical superscript (i.e., a) on the same row means there is no significant difference between the comparing groups at $p>0.05$ and non-identical superscripts (i.e., a, b, c, d, e, f, g, h, i) on the same row means there is significance between the comparing groups at $p<0.05$

presence of sodium (Na), potassium (K), calcium (Ca), iron (Fe), lead (Pb), cadmium (Cd) and arsenic (As). The result shows that sodium (Na), potassium (K) and calcium (Ca) were present in higher amounts in ethyl acetate extract than in ethanol extract in all the studied medicinal plants. While, iron (Fe), lead (Pb), cadmium (Cd) and arsenic (As) were present in high amount in ethanol extract compared to ethyl acetate extract in all the studied medicinal plants (Table 3).

Also, it was shown that amongst all the plants, *Citrus sinensis* has the highest composition of potassium (K) in both solvents, followed by *Olax subscorpioidea*, *Lawsonia inermis*, *Urena lobate* and *Albizia zygia* in descending order. *Lawsonia inermis* has the highest composition of sodium (Na) in both solvents, followed by *Albizia zygia*, *Citrus sinensis*, *Olax subscorpioidea* and *Urena lobata*. *Lawsonia inermis* has the highest composition of calcium (Ca) in both solvents, followed by *Citrus sinensis*, *Albizia zygia*, *Olax subscorpioidea* and *Urena lobata*. For iron (Fe), *Albizia zygia* has the highest composition followed by *Olax subscorpioidea*, *Citrus sinensis*, *Urena lobate* and *Lawsonia inermis*. More so, *Olax subscorpioidea* shows the highest lead (Pb) composition followed by *Urena lobata*, *Citrus sinensis*, *Albizia zygia* and *Lawsonia inermis*. *Lawsonia inermis* shows the highest composition of arsenic (As) followed by *Urena lobata*, *Albizia zygia*, *Citrus sinensis* and *Olax subscorpioidea*. Likewise, *Olax subscorpioidea* shows the highest cadmium (Cd) composition followed by *Citrus sinensis*, *Urena lobata*, *Albizia zygia* and *Lawsonia inermis* (Table 3).

In humans, iron makes tendons and ligaments, certain chemicals of the brain are controlled by the presence or absence of iron and it is also essential for the formation of haemoglobin, which carries oxygen throughout the body[70]. Trace element deficits in humans can develop in many dietary situations. According to Shirin *et al.*[71], it has been suggested that certain diseases previously thought to be incurable can potentially be treated by restoring the balance of certain elements in the human body. Recently, zinc (Zn) has shown positive effects on people suffering from atherosclerosis. There may be a relationship between Zn and its ability to fight cancer, as it is necessary for the growth and multiplication of healthy cells and the enzymes that facilitate the synthesis of nucleic acids utilize Zn[72].

The study highlights the diverse phytochemical composition of medicinal plants in South-West Nigeria, indicating potential therapeutic applications. The compounds identified could be used in developing new pharmaceuticals or supplements. The findings also suggest the potential for ethnomedicine, validating traditional uses and guiding healthcare practices.

Future research should focus on the isolation and characterization of bioactive compounds and collaboration between traditional healers and modern practitioners could enhance herbal remedies' integration into mainstream medicine. Variability in plant composition and other valuable species should also be considered. Additionally, the study's focus on selected medicinal plants implies that other potentially valuable species warrant investigation.

CONCLUSION

This study highlights the diverse range of phytochemicals present in the medicinal plants studied with potential therapeutic benefits, emphasizing the significance of these plants in traditional and modern medicine. Furthermore, the elemental composition sheds light on the nutritional and elemental value of these plants, which could contribute to their holistic healing properties. This study not only expands our knowledge of the chemical constituents within medicinal plants but also lays the foundation for further studies exploring their potential applications in pharmaceuticals, nutraceuticals and holistic healthcare. Ultimately, this study underscores the importance of harnessing the inherent properties of medicinal plants to promote human well-being and drive advancements in the field of natural medicine.

SIGNIFICANCE STATEMENT

Unveiling the chemical and elemental intricacies of medicinal plants indigenous to South-West Nigeria is pivotal in unlocking the therapeutic potential embedded in traditional herbal remedies. By conducting

a meticulous analysis of phytochemical constituents and elemental composition, this study not only contributes to the scientific validation of traditional medicine but also lays the foundation for the sustainable exploitation of these botanical resources. The findings hold promise for future pharmacological studies and the development of evidence-based herbal therapies, thereby fostering the integration of traditional and modern healthcare systems.

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