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Chemical composition, antimicrobial and antioxidant activities of leaf and twig essential oils of *Micriodesmis puberula* (Pandaceae)

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Abstract: *Microdesmis puberula* (PROTA) is widely utilised in traditional medicine across West and Central Africa for treating infections, inflammatory conditions, and reproductive disorders. This study presents the first comparative chemical and bioactivity analysis of essential oils derived from the leaves and twigs of this plant. Essential oils were extracted via hydrodistillation and characterised using GC-MS. Antimicrobial properties were assessed against six bacterial and four fungal strains using agar diffusion assays, while antioxidant activity was evaluated through DPPH free radical scavenging. The leaf and twig oils yielded 0.16% and 0.18% (w/w), respectively, and comprised 21 and 11 identified compounds, respectively. Leaf oil was dominated by non-terpenoids (43.27%), with (3E,7E)-4,8,12-trimethyltridec-1,3,7,11-tetraene as the major constituent, whereas twig oil contained high levels of fatty acids, predominantly palmitic acid (44.72%). Both oils exhibited moderate, concentration-dependent antimicrobial activity, with the twig oil showing notable inhibition against *Pseudomonas aeruginosa* (18±0.003 - 10±0.000 mm) and *Salmonella typhi* (18±0.003 - 10±0.002 mm). Antioxidant evaluation revealed moderate radical-scavenging capacity, with IC_{50} values of 1.00 µg/mL (leaf) and 1.35 µg/mL (twig). The bioactivity of the oils may be attributed to synergistic interactions among major and minor constituents. These findings support the ethnopharmacological relevance of *M. puberula* and highlight its potential as a natural antimicrobial and antioxidant agent.

Keywords: Antimicrobial activity, Antioxidant activity, Chemical constituents, Essential oils, Hydrodistillation, *Microdesmis puberula*.

Introduction

Microdesmis puberula (PROTA) (Pandaceae) is a dioecious species that can reach approximately 6 m in height when left undisturbed or not prematurely harvested.[1] It is predominantly distributed from Eastern Nigeria through the Democratic Republic of Congo to Uganda. In Nigeria, it is locally referred to as Mkpiri or Mbugbo in Igbo, Idi-apata in Yoruba, and Ntabit in Ibibio.[2] The plant is widely used in traditional medicine, with its stem bark, leaves, and roots reported to have diverse therapeutic uses.[3,4] In Eastern Nigeria, the roots are employed in the management of *gonorrhoea* and erectile dysfunction[5], while a decoction of the leaves is consumed to alleviate acute spleen pain. The plant has also been reported to possess analgesic and anti-stress properties.[2] In Sierra Leone's Eastern Province, a cold infusion of dried powdered leaves is traditionally used to control excessive menstrual bleeding. Leaf poultices mixed with clay are applied to drain cabbages, while cooked leaves in combination with other plants are administered for dysentery, joint pains, eye conditions, fracture healing, and drain boils.[6] The fruits reportedly serve as a laxative and enhance immunity against boils, whereas the bark and leaves are also administered as an enema.[7]

Across its distribution range, the stem, bark, leaves and roots are employed in numerous remedies. Leaf sap or crushed and charred twigs and roots are applied to snakebites and scarifications. Preparations of the plant are also used as enemas for diarrhoea, stomach disorders, intestinal worms, and genital ailments, including menstrual irregularities, sterility, miscarriage, impotence, and venereal diseases. They are also used to treat skin conditions such as eczema, scabies, burns, circumcision wounds, abscesses and gonorrhoeal sores; to manage malaria and cough; as eye and ear drops for blurred vision and ear infections; as parturients to facilitate childbirth; and for relief of renal pain and severe headache. Several polyamine derivatives have previously been identified in hydromethanolic extracts of the roots.[5,8] A comprehensive review on the ethno-botany, phytochemistry and pharmacology of *Microdesmis keayana* and *Microdesmis puberula* has been published by Okeke *et al*.[9] However, despite its extensive

traditional applications, no prior investigation has focused on the essential oils of *M. puberula*.

Materials and methods

Collection and preparation of plant materials

Fresh *Microdesmis puberula* specimens were sourced in April 2019 from Forestry Research Institute of Nigeria (FRIN), Oyo State (Latitude: 7.392293 ºN, Longitude: 3.86284 ºE). Botanical verification and authentication were conducted at FRIN, where the sample was catalogued under herbarium number FHI 112538. The collected material was sorted into leaves and twigs, which were air-dried for 7 days to remove residual moisture before being ground into fine particles. To prevent loss of volatile compounds and protect against contamination, the powdered samples were sealed in airtight containers and stored until hydrodistillation.

Isolation of essential oils

Finely ground samples of *M. puberula* leaves (450 g) and twigs (350 g) were subjected to hydrodistillation for 4 hours using a Clevenger-type all-glass apparatus equipped with a temperature-controlled heating mantle, in accordance with the British Pharmacopoeia guidelines.[10,11,12] The distillate, consisting of volatile oil, water and analytical-grade n-hexane (used to facilitate oil dissolution), was collected from the receiver arm. The resulting oil-hexane mixture was transferred into airtight glass vials and refrigerated at 4 °C until further chemical analysis and biological evaluation. Oil yield was quantified as the dry weight of plant material.

Gas chromatography-Mass spectrometry (GC-MS) analysis

The essential oils were analysed using gas chromatography-mass spectrometry (GC-MS) on an Agilent 7890A system coupled to an Agilent mass selective detector equipped with a split/splitless injector operating at 70 eV. The ion source was maintained at 200 ºC, and spectra were acquired across an m/z range of 50–700 at a scan rate of 1428 amu s^{-1}. Separation was achieved using an HP-5MS capillary column (30 m × 0.25 mm internal diameter, 0.25 µm film thickness). The oven programme commenced at 80 °C (2 min hold), followed by a ramp of 10 °C min^{-1} to 240 °C with a 6 min hold. Helium served as the carrier gas at a flow rate of 1 mL min^{-1}. The injection volume was 1.0 µL, with a linear velocity of 362 cm s^{-1} and a pressure of 56.2 kPa. A secondary temperature programme involved an initial hold at 60 °C for 1 min, then an increase to 180 °C at 10 °C min^{-1} (3 min hold), and finally to 280 °C at 10 °C min^{-1} (2 min hold). Both the injector and detector were maintained at 250 °C. Compound identification was carried out by comparing calculated retention indices with those of n-alkane standards and matching mass spectra against NIST 14.0 L and published reference data.[13]

Anti-microbial assay

The antimicrobial activity of the essential oils was evaluated against a panel of ten microbial strains, including six bacteria - four Gram-negative (*Escherichia coli*, *Salmonella typhi*, *Klebsiella pneumoniae* and *Pseudomonas aeruginosa*) and two Gram-positive (*Bacillus subtilis* and *Staphylococcus aureus*) - as well as four fungal species (*Candida albicans*, *Penicillium notatum*, *Aspergillus niger* and *Rhizopus*). All test organisms were clinical isolates sourced from the Department of Pharmaceutical Microbiology, University of Ibadan, Nigeria. Antibacterial screening was conducted using the agar diffusion technique, while antifungal evaluation followed the surface plate method.[14] For bioassay preparation, stock cultures were subcultured into freshly prepared nutrient agar and incubated aerobically at 37 °C for six hours. The essential oils were tested at five graded concentrations (62.5, 125, 250, 500 and 1000 µg/mL), and 1 mL of each dilution was applied to the wells containing the microbial inocula, following the previously established diffusion protocols.[15,16] Bacterial cultures were incubated for 24 hours at 37 °C, whereas fungal plates were maintained for 48 hours at the same temperature. Antimicrobial efficacy was then determined by measuring the diameter of the inhibition zones surrounding the wells. Dimethyl sulfoxide (DMSO) served as the negative control, while Gentamicin and Tioconazole were used as positive controls for bacterial and fungal assays, respectively. All experiments were conducted in triplicate, and inhibition values were recorded in millimetres (mm).

Antioxidant assay

The antioxidant capacity of the essential oils was assessed using the 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical scavenging assay, as described by Onocha *et al*.[17] For the analysis, 0.5 mL of each essential oil sample dissolved in methanol (prepared in triplicate) was mixed with 2.0 mL of DPPH solution in methanol (0.0394 µg/mL). After allowing the reaction to proceed for 10 minutes at room temperature, the absorbance of the mixture was recorded at 517 nm using a UV spectrophotometer. Serial dilutions of the samples were prepared at concentrations of 1000, 500, 250, 125, and 62.5 µg/mL, along with

standard antioxidants. Ascorbic acid and butylated hydroxyanisole (BHA) served as reference controls. After a 30-minute incubation to ensure complete interaction between the radicals and the test compounds, absorbance readings were taken against a methanol-DPPH blank. The percentage radical scavenging activity was then computed using the standard equation.

$$\%\ \textbf{Inhibition} = \frac{\textbf{Abs (Control)} - \textbf{Abs (sample or standard)}}{\textbf{Abs (Control)}} \times \mathbf{100}$$

where Abs (control) is the absorbance of the control (without sample), while Abs(sample) is the absorbance of the sample.

The same experiment was carried out on vitamin C, and butylated hydroxylanisole (BHA) was used as a standard for the antioxidant assay.

Data analysis

All experiments and analytical determinations were performed in triplicate to ensure the reproducibility and reliability of the results. Data are expressed as mean values ± standard deviation (SD). Statistical analyses were conducted using one-way analysis of variance (ANOVA) to determine significant differences among the treatment groups. Where significant differences were observed, Tukey's post hoc test was applied for multiple comparisons between group means. A p-value of less than 0.05 ($p < 0.05$) was considered statistically significant. All statistical analyses were carried out using GraphPad Prism version 5.0 (GraphPad Software Inc., San Diego, CA, USA).

Results and discussion

Physicochemical properties and percentage yield of the essential Oils

The hydrodistilled essential oils were transparent, indicating the absence of pigment-associated compounds. Extraction from both plant parts produced comparatively low yields, with the leaves generating 0.16% and the twigs 0.18% (w/w). Although the quantities were minimal, the oils emitted a pronounced natural aroma characteristic of fresh herbal materials. Such low extraction efficiency is commonly observed in many aromatic medicinal plants, where volatile constituents occur in trace amounts but still contribute significantly to fragrance and potential bioactivity. The noticeable scent of the oils suggests the presence of volatile terpenoids and related compounds, which are typically responsible for the therapeutic and organoleptic properties associated with traditional medicinal usage.

Chemical composition of essential oils

Table 1 provides a comprehensive overview of the chemical constituents identified in the essential oils obtained from the leaves and twigs of *M. puberula*. A total of 27 compounds were detected in the leaf oil, accounting for 95.48% of its composition (Figure 1: Supplementary material), whereas the twig oil comprised 11 compounds, which together represented the entirety (100%) of its volatile profile (Figure 2: Supplementary material).

In the leaf essential oil, the dominant constituents were (3E,7E)-4,8,12-trimethyltridec-1,3,7,11-tetraene (15.57%), phytol (9.84%), trans-2-hexenylhexanoate (7.95%), pentadecanal (7.84%), nerolidol (7.22%), α-ionone (6.76%), trans-β-ionone (5.66%), and farnesyl acetone (4.44%). These compounds indicate a strong presence of non-terpenoid derivatives (43.27%), followed by fatty acids and their esters (22.16%), oxygenated sesquiterpenes (15.06%), and oxygenated diterpenes (9.84%). The twig essential oil displayed a markedly different chemical profile, with palmitic acid emerging as the principal constituent at 44.72%. Other notable compounds included oleic acid (10.72%), cis-7,10,13-hexadecatrienal (9.95%), pentadecanal (7.40%), fenchol (7.08%), dihydroaplotaxene (6.84%), farnesyl acetone (4.01%), and phytol (3.85%). Accordingly, its chemical composition was primarily dominated by fatty acids and their esters (55.44%), followed by non-terpenoid compounds (22.92%), oxygenated sesqui-terpenes (7.40%) and oxygenated diterpenes (5.60%).

A comparative assessment of both oils revealed several shared constituents, notably pentadecanal, hexahydrofarnesyl acetone, farnesyl acetone, cembrene A, and phytol, albeit at varying concentrations. Interestingly, fenchol was the sole oxygenated monoterpene detected exclusively in the twig oil, whereas the leaf oil contained α-farnesene as the only hydrocarbon sesquiterpene. These observations suggest that while both plant parts share certain biosynthetic pathways, their metabolic priorities diverge significantly: the leaves favour non-terpenoid and sesquiterpene synthesis, whereas the twigs are more enriched in lipid-derived volatiles. This compositional divergence may underpin the differences in their pharmacological properties and ecological functions.

Table 1: Chemical composition of the leaf and twig of *Microdesmis puberula*

S/N	RT (min)	Compounds	*TIC (%)	
			Leaf	Twig
1	4.39	cis-2-hexenylbutyrate	1.75	-
2	7.01	cis-3-hexenylhexanoate	2.36	-
3	7.01	n-Hexylhexanoate	5.34	-
4	7.12	trans-2-hexenylhexanoate	7.95	-
5	7.62	α-ionone	6.76	-
6	7.79	Glutaric acid, tridec-2-yn-1-yl,4-methylpent-2-yl ester	1.86	-
7	7.97	Geranyl acetone	3.45	-
8	8.39	trans-β-ionone	5.66	-
9	8.66	α-farnesene	2.6	-
10	9.47	cis-hexenyl-3-benzoate	2.9	-
11	9.54	(3E,7E)-4,8,12-trimethyltridec-1,3,7,11-tetraene	15.57	-
12	10.67	8-heptadecene	1.15	-
13	11.13	Pentadecanal	7.84	7.4
14	12.25	Trans-2-tetradecen-1-ol	0.68	-
15	12.45	Neophytadiene	1.49	-
16	12.54	Hexahydrofarnesylacetone	1.74	2.12
17	12.98	Dihydroaplotaxene	-	6.84
18	13.05	cis-7-tetradecenal	3.82	-
19	13.05	cis,cis,cis-7,10,13-hexadecatrienal	-	9.95
20	13.31	Farnesyl acetone	4.44	4.01
21	13.72	Cembrene A	1.06	1.56
22	14.04	Palmitic acid	-	44.72
23	14.42	Nerolidol	7.22	-
24	15.21	Phytol	9.84	3.85
25	15.48	Cembrenol	-	1.75
26	15.59	Oleic acid	-	10.72
27	16.15	Fenchol	-	7.08
		Hydrocarbon Monoterpenes	-	-
		Oxygenated Monoterpenes	-	7.08
		Hydrocarbon Sesquiterpenes	2.60	-
		Oxygenated Sesquiterpenes	15.06	7.40
		Hydrocarbon Diterpenes	2.55	1.56
		Oxygenated Diterpenes	9.84	5.60
		Fatty acid and Fatty acid esters	22.16	55.44
		Non-terpenes/terpenoids	43.27	22.92
		Total	**95.48**	**100**

***TIC – Total Ion Concentration**

Antimicrobial activity of essential oils

The antimicrobial efficacy of *M. puberula* essential oils was evaluated against a panel of clinically relevant microorganisms. The oils extracted from both leaves and twigs were tested against six bacterial strains – comprising four Gram-negative (*Escherichia coli*, *Salmonella typhi*, *Klebsiella pneumoniae*, and *Pseudomonas aeruginosa*) and two Gram-positive species (*Staphylococcus aureus* and *Bacillus subtilis*) – as well as four pathogenic fungi (*Candida albicans*, *Penicillium notatum*, *Aspergillus niger*, and *Rhizopus stolonifer*). Different concentrations of the oils (62.5–1000 µg/mL) were applied using the agar well diffusion method, and antimicrobial activity was quantified by measuring the diameter of inhibition zones (Table 2).

The leaf-derived essential oil exhibited no detectable activity at the highest concentration (1000 µg/mL) against all tested microorganisms except *E. coli*, which remained resistant across

all concentrations. However, at intermediate concentrations (250–500 µg/mL), moderate inhibitory effects were observed against *K. pneumoniae*, *S. aureus*, *B. subtilis*, *S. typhi*, *C. albicans*, and *A. niger*. Lower concentrations (62.5–125 µg/mL) yielded only weak inhibition, particularly against *P. aeruginosa*, *K. pneumoniae*, *S. typhi*, *C. albicans*, and *A. niger*. Interestingly, the lack of inhibition at higher concentrations may suggest a paradoxical effect where excessive oil accumulation interferes with diffusion or blocks microbial target sites, thereby reducing bioactivity.[18]

In contrast, the twig-derived oil displayed broader antimicrobial coverage. While *S. aureus* showed complete resistance at all concentrations, P. aeruginosa and S. typhi were consistently inhibited across the full concentration range. *E. coli* responded only at 250–500 µg/mL, whereas *K. pneumoniae* and *B. subtilis* were inhibited at concentrations above 62.5 µg/mL. Regarding antifungal activity, *P. notatum*, *A. niger*, and *R. stolonifer* were sensitive at 250–500 µg/mL, while *C. albicans* demonstrated resistance at lower doses.

Comparative studies on other apocarotenoid-rich essential oils, such as those from *Maesobotrya barteri* have reported strong antimicrobial properties attributed to compounds like hexahydrofarnesyl acetone, geranyl acetone, α-ionone, and trans-β-ionone.[19–22] The relatively moderate antimicrobial performance of *M. puberula* oils in this study may be linked to the absence or low abundance of well-established antimicrobial monoterpenes such as linalool, terpineol, linalyl acetate, α-pinene, and camphor.[23–25] Nonetheless, the observed bio-activity suggests potential synergistic interactions among the detected constituents, warranting further investigation into their mechanistic roles and formulation potential for natural antimicrobial agents.

Antioxidant activity of *M. puberula* leaf and twig essential oils

The antioxidant potential of the *M. puberula* leaf and twig essential oils was assessed using the DPPH free radical scavenging assay. Their inhibitory effects, expressed as percentage radical scavenging activity and IC_{50} values, were benchmarked against standard antioxidants, as detailed in Table 3 and Figure 3: Supplementary material. Additionally, the variation in scavenging efficiency across different concentrations of the oils, relative to the reference compounds, is illustrated in Figure 3. This comparative approach provides insight not only into the overall potency of the oils but also into their dose-dependent antioxidant behaviour.

The antioxidant assessment revealed that the essential oil derived from the twig exhibited relatively weak radical-scavenging activity across the tested concentrations (1.0–0.0625 µg/mL), with inhibition values ranging from 31.35% to 38.67% and an IC_{50} of 1.35 µg/mL. In contrast, the leaf essential oil demonstrated slightly higher, though still moderate, activity within the same concentration range, showing scavenging percentages from 32.91% to 43.98% and an IC_{50} of 1.00 µg/mL (Table 3). Based on IC_{50} comparisons, the antioxidant strength of all tested samples followed the order: Ascorbic acid > BHA > MPL (leaf oil) > MPT (twig oil), confirming that both essential oils were markedly less potent than the reference antioxidants.

The moderate antioxidant response observed in the oils is likely influenced by the chemical profile of their constituents. Essential oils rich in phenolic or hydroxyl-containing compounds tend to display higher radical-quenching efficiency, as previously reported by Ogunlana *et al*.[26] Therefore, the relatively low proportion of phenolic derivatives in both the leaf and twig oils may account for their reduced activity. Nevertheless, interactions between major constituents and trace components could still contribute to a cumulative or synergistic effect, sustaining a measurable antioxidant capacity. As expected for natural extracts, antioxidant performance increased with concentration, indicating a dose-dependent response.

Comparable findings have been documented for essential oils from *X. frutescens* and *X. emarginata*, which exhibited stronger activity against both DPPH and ABTS radicals.[27,28] Their superior efficacy was attributed to dominant bioactive compounds, with secondary constituents such as geraniol and geranyl acetate providing supportive or complementary effects.[22] This suggests that strategic enrichment of phenolic or apocarotenoid-based constituents could enhance the antioxidant potential of *M. puberula* essential oils in future formulations.

Table 2: Antimicrobial properties of essential oils from leaf and twig of *Microdesmis puberula* (inhibition zone diameter in mm)

Concentration (µg/mL)	Inhibitory Zone (mm) of Tested Microorganisms										Sample
	Bacterial strains						Fungi strains				
	EC	***PA***	***KP***	***SA***	***BS***	***ST***	***CA***	***PN***	***AN***	***RS***	
1000	-	-	-	-	-	-	-	-	-	-	
500	-	14±0.001	17±0.001	18±0.003	17±0.002	17±0.002	17±0.001	14±0.001	16±0.001	12±0.000	
250	-	12±0.003	14±0.002	16±0.002	16±0.002	14±0.000	14±0.002	12±0.000	14±0.002	10±0.002	MPL
125	-	10±0.001	12±0.001	14±0.000	15±0.003	12±0.001	12±0.003	10±0.001	12±0.002	-	
62.5	-	10±0.001	10±0.001	11±0.001	10±0.001	10±0.001	10±0.000	-	10±0.000	-	
1000	-	18±0.003	-	-	-	18±0.003	-	-	-	-	
500	13±0.003	16±0.002	14±0.000	-	14±0.001	16±0.000	13±0.000	120.000	12±0.001	12±0.001	
250	10±0.001	14±0.003	12±0.002	-	12±0.001	14±0.001	12±0.001	10±0.001	10±0.000	10±0.000	MPT
125	-	12±0.001	10±0.001	-	10±0.001	12±0.001	10±0.000	-	-	-	
62.5	-	10±0.000	-	-	-	10±0.002	-	-	-	-	
	-	-	-	-	-	-	-	-	-	-	-ve control
	38±0.002	38±0.002	39±0.000	37±0.001	39±0.003	38±0.001	28±0.002	27±0.001	27±0.000	28±0.001	+ve control

Keys: ***EC***= *Escherichia coli* ***PA***= *Pseudomonas aeruginosa* ***ST***= *Salmonella typhi* ***SA***= *Staphylococcus aureus* ***BS***= *Bacillus substilis* ***KP***= *Klebsiella pneumoniae* ***CA***= *Candida albicans* ***AN***= *Aspergillus niger* ***PN***= *Penicillum notatum* ***RS***= *Rhizopus stolonifer*. -ve= negative control (DMSO) +ve= positive control (Gentamicin (10 µg/mL) for bacteria and Tioconazole (0.7 µg/mL) for fungal). MPL: *Microdesmis puberula* leaf, MPT: *Microdesmis puberula* twig

*The values given are means of triplicate analysis (mean ± Standard deviation)

Table 3: Absorbance measurement and IC_{50} in DPPH scavenging activity of leaf and twig essential oils of *M. puberula*

Sample	Mean Absorbance at each concentration (µg/mL)					IC_{50} (µg/mL)
	1.0	0.5	0.25	0.125	0.063	
MPL	0.613±0.001	0.631±0.002	0.701±0.001	0.715±0.001	0.734±0.001	1.00±0.001
MPT	0.671±0.000	0.720±0.001	0.728±0.001	0.731±0.001	0.751±0.000	1.35±0.001
VIT C	0.076±0.001	0.078±0.001	0.080±0.001	0.104±0.001	0.105±0.000	0.05±0.001
BHA	0.081±0.000	0.088±0.001	0.094±0.000	0.095±0.000	0.102±0.001	0.05±0.001

*The values are the means of triplicate analysis (mean-absorbance ± standard deviation), IC_{50} = Inhibitory Concentration at 50%.
MPL: *Microdesmis puberula* leaf; MPT: *Microdesmis puberula* Twig, VIT C: Vitamin C; BHA: Butylated hydroxy anisole

Statistical analysis using one-way Analysis of Variance (ANOVA) revealed a statistically significant difference ($P < 0.05$) in antioxidant activity between the essential oil samples (from leaf and twig of *M. puberula*) and the reference standard, vitamin C and BHA. This result indicates that the antioxidant properties of the essential oils differ significantly from that of the standard antioxidant, suggesting potential for unique or enhanced bioactivity. However, no statistically significant difference ($P>0.05$) was observed between the antioxidant activities of the leaf and twig essential oils of *M. puberula*, implying that both plant parts possess comparable antioxidant potential. This finding suggests that either part of the plant could serve as a viable source of antioxidant**.**

Conclusion

This study provides the first comparative evaluation of the chemical composition, anti-microbial, and antioxidant activities of essential oils obtained from the leaves and twigs of *Microdesmis puberula*. A total of twenty-seven bioactive constituents were identified, predominantly comprising monoterpenoids, sesquiterpenoids, diterpenoids, fatty acids, and non-terpenoid derivatives. While both plant parts shared key constituents such as pentadecanal, hexahydrofarnesyl acetone, farnesyl acetone, cembrene A and phytol, their profiles differed quantitatively, with non-terpenoids dominating the leaf oil and fatty acids prevalent in the twig oil. Biological assays revealed moderate anti-microbial and antioxidant activities in both oils, supporting the plant's traditional ethnomedicinal applications. Although neither oil demonstrated strong potency compared to standard controls, their activity suggests potential for further development as complementary therapeutic agents. Future work should focus on the isolation of major constituents, the mechanism-of-action studies, and formulation strategies to enhance efficacy.

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Conflict of interest's statement

The authors declare no conflict of interest

Authors contributions

PAO was involved in all the laboratory work, conceptualization, result interpretation, and writing (editing); GKO was involved in the antioxidant assay, result interpretation, and writing (editing); MEE carried out the sample collection, extraction of the essential oil, cytotoxicity, antioxidant assays, results interpretation, and manuscript write-up; MGI was involved in sample collection, extraction of the essential oil, cytotoxicity and manuscript write up; SO, OMI and OLI were involved in sample collection, extraction of the essential oil, all the laboratory work and result interpretation. All authors read and approved the final manuscript.

Supplementary data

Figures 1, 2 and 3 are provided as supplementary data.

References

1. Dounias, E. (2008). *Microdesmis puberula* Hook. F. ex Planch. In: *Plant resources of Tropical Africa*, 11(1).
2. Esonu, B.O., Azubuike, J.C. and Ukwu, H. O. (2004). Evaluation of *Microdesmis puberula* leaf meal as feed ingredient in laying hen diets. Int. J. Poult. Sci. 3(2): 96-99.

3. Okany, C.C., Ishola, I.O. and Ashorobi, R.B. (2012). Evaluation of analgesic and antistress potential of methanolic stem wood extract of *Microdesmis puberula* Hook. F. ex. Planch (Pandaceae) in mice. Int. J. Appl. Res. Nat. Prod. 5(3): 30-336.
4. Ajibesin, K.K., Ekpo, B.A., Bala, D.N., Essien, E.E. and Adesanya, S.A. (2008). Ethnobotanical survey of Akwa Ibom state of Nigeria. J. Ethnopharmacol. 115: 387-488.
5. Zamblé, A., Yao, D., Martin-Nizard, F., Sahpez, S., Offoumou, M., Duriez, P., Brunet, C. and Bailleul, F. (2006). Vasoactivity and antioxidant properties of *M. keayana* roots. J. Ethnopharmacol. 104: 263-269.
6. Samai, S.K. and Barnish, G. (1992). *Some medicinal plant receipts of the Mende of Sierra Leone*. 1st edition. Bunumbu Press, Bo, Sierra Leone. pp. 85-93.
7. Burkill, A.M. (1997). *Useful plants of West Tropical Africa*. Royal Botanical Garden, Kew. University Press of Virgina, 4: pp. 395-396.
8. Roumy, V., Hennebelle, T., Zamble, A.Y., Zamble, J., Sahpaz, S. and Bailleul, F. (2008). Characterization and identification of spermine and spermidine derivatives in *Microdesmis keayana* and *Microdesmis puberula* roots by electrospray ionisation, tandem mass spectrometry and high-performance liquid chromatography. Eur. J. Mass Spectrom. 14(2): 111-115.
9. Okeke, U.B., Adeboye, O.M., Adeniyi, F.R. and Agbebi, E.A. (2023). A review on ethnobotany, phytochemistry, and pharmacology of *Microdesmis keayana and Microdesmis puberula* (Pandaceae). J. Appl. Pharm. Sci. 13(10), 001-013.
10. British Pharmacopoeia, I. London: HM Station., 1980. pp. 109.
11. Oloyede, G.K., Oladosu, I.A. and Shodia, A.F. (2010). Chemical composition and cytotoxicity of the essential oils of *Crinum ornatum* (Ait.) Bury. Afr. J. Pure Appl. Chem. 4(3): 035-037.
12. Oloyede, G.K. and Ojeyinka, B.K. (2019). Effect of solvent on chemical composition and antioxidant activities of *Abelmoschus esculentus* (L.) Moench Pods oils extracts. J. Appl. Sci. 19, 133-139.
13. Adams, R.P. (2007). Identification of essential oil components by gas chromatography/mass spectrometry. Carol Stream, IL.: Allured Publishing Corporation.
14. Mshelia, E. H., Zaria, L. T., Mohammed, A. H. and Jaji, N. (2008). Phytochemical analysis and antibacterial screening of *Asparagus flagellaris* (Kunth) Bak, used in the traditional treatment of sexually transmitted diseases and urinary infections. EJESM 1(2): 44-48.
15. Onocha, P.A., Oloyede, G.K. and Akintola, J.A., (2016). Chemical composition, free radical scavenging and antimicrobial activities of essential oil of *Mariscus alternifolius* Vahl. Open Conf. Proc. J. 7, 160-167.
16. Kalemba, D. and Kunicka, A. (2003). Antibacterial and antifungal properties of essential oils. Curr. Med. Chem. 10: 813-829.
17. Onocha, P.A., Oloyede, G.K. and Afolabi Q.O. (2011). Chemical composition, cytotoxicity and antioxidant activity of essential oils of *Acalypha hispida* flowers. Int. J. Pharmacol. 7: 144-148.
18. Youmans, G.P., Peterson, P.Y. and Soumers, H.M., (1967). *The Biological and Clinical Basis of Infectious Diseases*. Longman London, pp. 721-725.
19. Salem, M.Z., Elansary, H.O., Ali, H.M., El-Settawy, A.A., Elshikh, M.S., Abdel-Salam, E.M. and Skalicka-Woźniak, K. (2018). Bioactivity of essential oils extracted from *Cupressus macrocarpa branchlets* and *Corymbia citriodora* leaves grown in Egypt. BMC Complement. Med. Ther. 18:2360.
20. Semeniuc, C.A., Pop, C.R. and Rotar, A.M. (2017). Antibacterial activity and interactions of plant essential oil combinations against Gram-positive and Gram-negative bacteria. JFDA 25, 403–408.
21. Sharafati Chaleshtori F., Saholi M. and Sharafati Chaleshtori R. (2018). Chemical composition, antioxidant and antibacterial activity of *Bunium persicum*, *Eucalyptus globulus*, and Rose Water on Multidrug-Resistant Listeria Species. JEBM 23, 25 – 37
22. Onocha, P.A., Ibok, M.G., Olaoluwa O.O., Oloyede, G.K. and Flamini, G. (2023). Cytotoxicity, antimicrobial and antioxidant activities of apocarotenoid-rich leaf essential oil of *Maesobotrya barteri Var. Barteri* (Baill.). *Trend in Technical & Scientific Research*, 6(1): 555-677.
23. Dorman, H.J. and Deans, S.G. (2000). Antimicrobial agents from plants: Antibacterial activity of plant volatile oils. **J.** Appl. Microbiol. 88: 308–816.
24. Magiatis, P., Skaltsounis, A.L., Chinou, I. and Haroutounian, S.A. (2002). Chemical composition and in-vitro antimicrobial activity of the essential oils of three Greek *Achillea* species. Zeitschrift fur Naturforschung. *Journal of bioscience,* 57: 287-290
25. Soković, M., Glamočlija, J., Marin, P.D., Brkić, D. and Griensven, L.J. (2010). Antibacterial effects of the essential oils of

commonly consumed medicinal herbs using an *in vitro* model. Molecules 15, 7532–7546.
26. Ogunlana, O.E., Ogunlana, O. and Farombi, O.E. 2006. *Morinda lucida*: Antioxidant and reducing activities of crude methanolic stem bark extract. Adv. Nat. Appl. Sci. 2(2): 49-54.
27. Kulisic, T., Radonic, A., Katalinic V. and Milos M. (2004). Use of different methods for testing antioxidative activity of oregano essential oil. Food Chem. 85(4) 13-24.
28. Miguel, G., Simões, M. and Figueiredo, A.C. (2004). Composition and antioxidant activities of the essential oils of *Thymus caespititius*, *Thymus camphoratus* and *Thymus mastichina*. Food Chem. 86(2): 23-36.