Epiphytic medicinal plants as reliable sources of therapeutic agents with enhanced pharmacological activities

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Abstract

Epiphytes are bioindicator groups of plant species that give important information on how the ecosystem support evolution of life in its habitat and to what extent this is achieved owing to their sensitivity and responsiveness to environmental stimuli. The plants have been used for the treatment of non-infectious and infectious diseases including boils, wounds, ulcers, smallpox, diarrhoea, fever, colds, ulcers, malaria, and worm infections. They are also used to improve hepatic functions, treat rheumatism, diabetes, bronchitis, and enhance muscle tone. Some of the novel bioactive molecules identified in epiphytes include flavanthrinin, nudol, and fimbriol. The pharmacological activities of epiphytes were discussed following information obtained from databases such as Google scholar, Science Direct, PubMed, Prota, Web of Science, Prosea, Scifinder Scholar, and Scopus. The review evaluated and discussed the ethnomedicinal uses of ten (10) epiphytes including *Adiantum caudatum, Diaphananthe bidens, Nephrolepis cordifolia* etc. The phytochemical factors of the plants (catechin, quercetin, kaempferol, alkaloids, and flavonoids) with their traditional uses were presented. Interestingly, these plants have shown significant medicinal properties

including anticancer, antimicrobial, and anti-inflammatory activities.

Keywords: *Diaphananthe bidens*; Epiphytes; Ethnopharmacology; Medicinal plants; Orchids

Introduction

Epiphytic plant materials have been used for thousands of years as ethnomedicines for diseases prophylaxis and therapy. In recent times, epiphytic medicinal plants have gained increasing attention and their use have expanded globally across different cultures as various traditional medicine systems such as African, Chinese, Indian, and Japanese traditional medicine systems, have been documented. These plants have been used continuously among the poor rural dwellers in developing countries as recognized by the World Health Organization (WHO) and in developed countries where conventional or synthetic medicines is predominant (Adam *et al.*, 2012). Epiphytes (air plants) usually grow on other plants. The plants are found mostly in tropical rainforests especially on top of canopy trees and the minerals from these trees supply the nutrients required for their growth and maturity. They are classified as plants and fungi. They also obtain nutrients from the atmosphere, and participate actively in nutrient cycle of the rainforest. The stem serves as shelter for insects and birds use their materials for producing nests. Charles-François Brisseau de Mirbel originally used the word "*epiphytes*" in his encyclical "Eléments dephysiologie végétale et de botanique" published in 1815 (Ari *et al*., 2020; Benzing, 2004). Epiphytes are bioindicator groups of species that give important information on how the ecosystem support evolution of life in its habitat and to what extent this is achieved owing to their sensitivity and responsiveness to environmental stimuli (Buckley, 2011). They are categorized as vascular and non-vascular medicinal plants which include mosses, hornworts, liverworts, orchids, lichens, and ferns, and are further divided into holo- and hemi- epiphytes. Orchids are good example of holoepiphytes, the strangler fig is a hemiepiphyte. Geographically, epiphytes have been in existence since the pleistone epoch and were first described in an article written by Martinus de la Cruz called the Badianus which was published in 1552. It highlighted the use of a hemiepiphyte, *Vanilla fragrans* as source of perfume by the local people in Latin America (Burns & Dawson, 2005). Because of their unique growth ecosystem, they contain secondary metabolites with useful medicinal properties which are applied for treatment of certain diseases such cardiac disorders, cancers, inflammatory diseases, etc.

Non-vascular epiphytes such as lichens and bryophytes have been reviewed extensively showing their contents of secondary metabolites, and medicinal properties. In contrast, no such work has been done on the 913 genera, 73 families, and 27,614 species of vascular epiphytes like angiosperms, gymnosperms, and pteridophytes, to describe their medicinal properties and secondary metabolites composition (Burns & Zotz, 2010; Caners *et al*., 2010).

In this work, valuable information on vascular epiphytes were sourced using different search engines (Google scholar, Science Direct, PubMed, Prota, Web of Science, Prosea, Scifinder Scholar, and Scopus), and from databases of medicinal plants from Indonesia, Bhutan, Seychelles, India, China, Madagascar, Guyana, Comoros, and Mascarenes such as medicinal and poisonous plants of South-East Asia, mangrove guide for South-East Asia, and Cryptogams – Ferns and Fern Allies (Chang *et al*., 2007). The accepted names of epiphytes found in the plant database were compared with their scientific nomenclature to validate available information. The study covered the period from 2002 – 2020 when the initial data about these epiphytes were published (Chen & Popadiouk, 2002; Köster *et al*., 2011). Further, investigation revealed that vital information regarding the ethnomedicinal uses of epiphytes was handed down through verbal communication from one generation to another, especially among remote African practitioners (Chellan *et al*., 2010). Thus, there is a good possibility that certain knowledge about ethnomedicinal uses of these plants may not be reported. However, in this study, the phytochemical compositions and ethnomedicinal applications of ten (10) epiphytic plants were reviewed.

Important epiphytic plants and their pharmacotherapeutic properties

Asplenium nidus

Asplenium nidus is a fern, order polypodiales, belonging to the Aspleniaceae family, which is found in Eastern Australia, Hawaii, India, and Africa. **Figure 1**. It is commonly known as bird's nest fern, an epiphytic medicinal plant of the spleenwort family featuring simple, slowly-growing, strap-shaped, bright apple green fronds, glossy with contrasting dark brown to black midribs and undulating margins. Fronds spread upward and outward to form a vase-shaped, green rosette with a nest-like center (albeit memorialized by some as resembling a bird's nest) into which fallen leaves and other organic matter typically accumulate. The mature fronds of epiphytic plants grow 4-5 long and spread wide. Undersides often display sori (clusters of

sporangia) arranged in herringbone fashion in straight black lines from the central mid-rib to the frond margin. Species plants are native to tropical areas from Polynesia and Hawaii west to Southeast Asia, Australia, and Madagascar. They are often found growing on tropical rainforest trees as epiphytes which collect water and organic matter in their bowl-shaped rosettes. The genus name *Asplenium* comes from the Greek and means "without a spleen", possibly in reference to the belief that certain species of this plant could be used for treatment of the spleen. This name is common among other species in the Aspleniaceae family. The secondary metabolites that are present include alkaloids, steroids, tannins, flavonoids (Wang *et al*., 2007) etc. The plant is used by local healers for the therapy of asthmatic sores, headache, fever, weakness, difficult labour, halitosis, hair loss, and inflammation. It is also used as a sedative, contraceptive, edible food, and as an ornamental plant. It is usually prepared as used as a decoction or the leaves are pounded and mixed with coconut oil before use (Chen & Popadiouk, 2002).



Figure 1: Picture of *Asplenium nidus* (Wang *et al*., 2007)

Adiantum caudatum

Adiantum caudatum, commonly known as tailed maidenhair, walking maidenhair, trailing maidenhair, is an epiphytic fern, order polypodiales and belongs to the family Pteridaceae**.** *Adiantum caudatum* is an epiphytic plant terrestrial or epilithic, and 10-40 cm tall. The rhizomes are erect, short, scales deeply castaneous, lanceolate, and margins entire. The fronds clustered, stipe castaneous, 1-10 cm, densely dark brown or brownish multicellular hirsute; lamina 1-pinnate, lanceolate in outline, 15-30 × 2-4 cm, base slightly narrow; rachis same color as stipe and similarly sparsely hirsute, glabrescent when old, apex usually prolonged into a whiplike stolon rooting at tip to form new plantlet; 5-8 mm apart, pinnules 20-44 pairs, alternate, or lower ones sub-opposite, horizontally spreading or slightly obliquely spreading, lower pinnules gradually reduced,

middle ones dimidiate, sub-oblong, 0.7-2 × 0.6-1 cm, brownish green, papery, both surfaces sparsely multicellular hirsute and densely pubescent, base asymmetrical, entire and lower margins sub-straight, upper and outer margins deeply divided into many narrow lobes, upper side truncate, lobes linear, margins entire, upper part again lobed into fine linear segments, apex truncate, fine segments truncate or few dentate at apex, veins multi-dichotomously branching, visible on both surfaces, Sori 5-12 per pinna, false indusia dark brown, oblong and orbicular, hairy, upper margins flat and straight, entire, persistent. **Figure 2**. *Adiantum caudatum* is mainly found in shaded areas in South-East Asian countries such as Nepal, Burma, Bangladesh, India, Philippines, China, and Thailand. *Adiantum caudatum* contains different types of secondary metabolites which include alkaloids, saponins, coumarin, diterpenes, steroids, tannins, cardiac glycosides, anthocyanin, flavonoids, emodins (Simmler *et al.,* 2011) etc. It is used for treatment of skin diseases, bronchitis, inflammatory diseases, cold, cough and throat infections, and diabetes (Chen *et al*., 2008; Chen & Taylor, 2012).



Figure 2: Picture of *Adiantum caudatum* (Simmler *et al.,* 2011)

Huperzia phlegmaria

Huperzia phlegmaria is mainly known as common tassel fern, order polypodiales from the family Lycopodiaceae. **Figure 3.** It is found in the rainforests of Australasia, Asia, Pacific Islands, and Madagascar mainly amongst mosses. Members of the Lycopodiales, which are mostly vascular epiphytes, belong to the club mosses order. They resemble many species of moss and the special fluid-conducting tissues of epiphytic medicinal plants differentiate lycophytes from the more basal bryophytes (mosses and liverworts). The diploid sporophyte stage of the life cycle of lycophytes is dominant. Sporophytes produce tetrahedral spores of 37 × 35 μm, off-white in colour, with angles never exceeding 130°. *Huperzia phlegmaria* is a variable species and plants from different regions can vary widely in stature. They can

be identified by having petiolate sterile microphylls and small fertile microphylls on thin branching strobili. They have true root systems, elongated aerial stems hang from host trees (up to 80 cm long), spirally arranged leaves are lanceolate (lance like), narrow and rounded at the base. They become even narrower at the extreme base, where the sporangia are located in the fertile zone of the stem. Leaves are coriaceous (resemble leather). The leaves differ in morphology in the fertile zone, making distinction between the zones easy. Leaves in the fertile zone are known as sporophylls. Sporophylls are club shaped - hence the common name "club moss". Homosporous spores are produced in axils. Some secondary metabolites present in the plant include flavonoids, alkaloids, coumarins (Devi & Singh, 2011) etc. It is used to stimulate hair growth, and resolve skin diseases, rheumatic pain, arthritis, traumatic injury, sore throat, oedema and urticaria (Choo *et al*., 2007).



Figure 3: Picture of *Huperzia phlegmaria* (Devi & Singh, 2011)

Nephrolepis cordifolia

Nephrolepsis cordifolia is an epiphytic medicinal plant found in India. It has many common names such as fishbone fern, narrow sword fern, erect sword fern and herringbone fern **Figure 4.** *Nephrolepis cordifolia* is an epiphytic fern, order polpodiales belongs to the family Nephrolepidaceae with a short rhizome. It is a colony former and vigorous grower that produces small scaly tubers on their roots. *N. cordifolia* grows well on properly mixed soil in the tropics or subtropics and can easily propagate through wind-blown spores, and random distribution of its stolons, tubers, and rhizomes. It is used to treat cough, rheumatism, chest congestion, nose blockage, loss of appetite, and infections (antibacterial activity). The secondary metabolites present in the plant include

flavonoids, steroids, terpenoids, and alkaloids (Köster *et al*., 2011).



Figure 4: Picture of *Nephrolepis cordifolia* (Köster *et al*., 2011)

Ophioderma pendulum

Ophioderma pendulum is also referred to as the adder's tongue in the ancient times. It is a medicinal epiphytic fern, order ophioglossales from the family, Ophioglossaceae **Figure 5**. It grows on palm trees and also on rocks and produces pendulous fronds. The fronds are simple, branched dichotomously and are propagated by spores. They are found in both tropical and sub-tropical regions. The leaves are long, narrow and are shredded into coconut oil by the Moluccas. It is used as an ornament, crushed leaves used as hair treatment, for getting rid of first faeces, and its decoction is used as an anti-tussive (Majumdar *et al*., 2019). The phytochemical constituents that are present in the plant include alkaloids and flavonoids (Lai *et al*., 2009).



Figure 5: Picture of *Ophioderma pendulum* (Lai *et al*., 2009)

Pyrrosia piloselloides

Pyrrosia piloselloides (L.) M.G. Price is a medicinal epiphytic fern known commonly as twigs trees, order polypodiales from the family, Polypodiaceae. It is a small medicinal epiphytic fern, with a long rhizome and approximately 1mm in diameter. The leaves are simple and entire, sterile without stalks, fleshy with a smooth surface **Figure 6**. Fertile leaves have a stalk of about 1 cm in length and are elongated, 3 - 12 cm by 5 - 8 m. The potential bioactive compounds present in this plant include phenols, flavonoids, tannins, terpenoids, saponins and sterols (Changsang, 2005). It is used for the treatment of dentition problems, cough, urinary tract infection,

tuberculosis, rashes, gonorrhea, headache, dysentery, eczema, small pox, and gum inflammation (Luo & Chen, 2011).

Vittaria elongate

Vittaria elongate is a medicinal epiphytic fern commonly known as the tape fern with a short creeping rhizomes up to 3 mm thick, densely clothed by scales all over and branched. The scales lanceolate, about 5 x 0.25 mm, uniformly dark, uniformly thickened, margin sparsely dentate, apex long acuminate, and gland tipped. The fronds is about 2 mm apart, simple, up to 50 x 0.8 cm, linear-oblong lanceolate, progressively narrowing towards the base and apex, basal part with 1-1.5 cm long flattened stipe-like portion, apex acuminate, margin entire, and midrib distinct **Figure 7**. This epiphytic medicinal plant, order polypodiales belongs to the family Vittariaceae. Phytochemically, it contains flavonoids, alkaloids, flavanone, flavone and flavonol, and are used for treatment of rheumatism, boil, inflammation, and cancer (Mannan *et al*., 2008).



Figure 6 Picture of *Pyrrosia piloselloides* (Luo & Chen, 2011)



Figure 7: Picture of *Vittaria elongate* (Mannan *et al*., 2008)

Cassytha filiformis

Cassytha filiformis is a medicinal epiphytic plant commonly known as parasitic vine or love-vine in the order laurales. It belongs to the family Lauraceae. It is an obligate parasitic plant found in tropical and sub-tropical region, and has orange to pale green stem. Flowers are borne in spikes or sometimes solitary, stem branched, slender, parasitic or semi-parasitic plant, green leafless, scrubby and perennial plant. It poses a threat to endangered plant species in coastal habitats in the tropics. It is used in the management of skin cancer, malaria, cough, dysentery, headache, diarrhea, syphilis, intestinal problems, gonorrhea, nephritis, eczema, oedema, haemoptysis, hepatitis, aphrodisiac, sinusitis, parasitic skin, and scalp. It is also used to induce lactation. (Nugraha & Keller, 2011). **Figure 8.** The secondary metabolites that have been identified in the extracts or decoctions, or other herbal preparations of this plant include phenols, alkaloids, carbohydrates, saponins, flavanoids, and terpenoids (Mannan *et al*., 2018).



Figure 8: Picture of *Cassytha filiformis* (Nugraha & Keller, 2011)

Cuscuta reflexa

Cuscuta reflexa Roxb is a medicinal epiphytic plant which belongs to the order solaales, and family, Convolvulaceae. **Figure 9.** This epiphyte is known as an extensive climber parasite because its stem has thread-like filaments grow and attach to nearby host plants. It is commonly known as dodder, devil's gut, or beggar weeding in English while traditional healers call it ‘Akash belin’ in Hindi. *Cuscuta* seeds are called ‘tulsi zi’ in Chinese. It is used for treatment of abdominal pain in children, fever, and itches. It has no chlorophyll and therefore cannot photosynthesize (Nugraha *et al*., 2013). The phytochemical components present in it include alkaloids, tannins, flavonoids, and phenolics (Nugraha *et al*., 2013).



Figure 9: Picture of *Cuscuta reflexa* (Nugraha *et al*., 2013)

Diaphananthe bidens

Diaphananthe bidens (Afzel. Ex. Sw) Schltr. is an epiphytic plant species of the family Orchidaceae. It is characterized by tough wiry stems, elongate, pendent stem of about 50 cm long and this enables the plant to hang gracefully from the branches of forest trees and adorned with salmon pink, yellowish pink or white flowers **Figure 10**. It is commonly called wax orchid by the English, and 'bombins' by Sierra Leoneans. The Yoruba tribe of South-West Nigeria call it 'ikori', but the plant has no known common name among the Igbo tribe of South-East Nigeria. However, locals of South-East Nigeria use its decoctions in the therapy of inflammatory diseases, asthma, and diabetes mellitus. Phytochemically, the epiphyte contains flavonoids, alkaloids apigenin, and glycosides (Ojo *et al*., 2007, Umeyor *et al*., 2021).



Figure 10: Picture of *Diaphananthe bidens* (Ojo *et al*., 2007)

Functional evaluation of epiphytic plants as ethnomedicines

Preliminary information

The study was done using ten (10) epiphytic plants based on their ethnomedicinal profiles. Data collated from the plants included the species names, families, regions where epiphytes are used as ethnomedicine, parts used, methods of preparation, and applications.

Parts of epiphytic plants used for preparation of medicinal products

The leaf is the major plant part used in traditional medicines. It is harvested easily without specialized equipment, skill, and processing unlike other plant parts such as stem and root. In contrast to other higher

plants, epiphytic plants are usually harvested and used wholly in the preparation of medicinal products due to their small biomass. The stem-like stripes of ferns are utilized for preparation of medicine. The rhizomes and roots of epiphytes are easily harvested and processed for use as medicines, compared to other plant parts such as the roots and stems (Samuel *et al*., 2012).

Dosage forms of epiphytic medicinal plants

Generally, epiphytic medicinal plants are prepared as decoctions and poultices. Phytochemically, they contain flavonoids, alkaloids, apigenin, and glycosides. Similar to other medicinal plants, most epiphytic medicinal plants are administered through external application. Decoctions could be ingested for the treatment of infectious diseases such as small pox. Poultices could be prepared for skin diseases and applied topically (Ding *et al*., 2008).

Phytochemical compositions

Epiphytic plant have distinct secondary metabolites such as lupeol, kaempferol, apigenin, coclonin, gigantol, and daucosterol (Ding *et al*., 2008) due to their method of growth. They do not grow on the terrestrial soil but derive their nutrients from their host plants. They grow on other plants in canopy habitats which shapes the morphologies of epiphytic plants and their method of acquiring nutrients. Epiphytic plants obtain nutrients from the debris of their canopies including nitrogen and phosphorus. These nutrients are also derived from the foliar leaching of the host tree and this influences the soil nutrient cycle of the canopy (Ding *et al*., 2008). Due to their harsh environmental conditions, epiphytic plants use the process of Crassulacean acid metabolism to convert sunlight into chemical energy. The cell wall of epiphytic plants is rich in steroids, especially sitosterol and stigmasterol, and this is present in about twenty-two (22) epiphytic medicinal plants (Uddin *et al*., 2012).

Phytochemical compounds from epiphytic plants host interactions

The molecular interactions between epiphytic plant and their hosts culminate in tapping phytochemicals, and the formation of a physical portal signifying the development of an interaction. The channel referred to as haustorium, facilitates the transfer of the secondary metabolites from the host plants to the epiphytes. It was initially believed that the interaction between *Scurulla oortiana* (Korth.) Danser and three different host species - *Camellia sinensis, Persea Americana,* and *Citrus maxima* resulted in three flavonoids such as rutin, isoquercitrin, and quercitrin (Yang *et al*., 2003). However, extensive spectroscopic and chromatographic studies

revealed that these metabolites were independent of the host plants (Umeyor *et al*., 2021a).

Conclusion

Epiphytic medicinal plants are very important vascular plants which act as reliable sources of phytochemical constituents with pharmacological activities including antimicrobial, anticancer, antimalarial, anti-inflammatory, and antioxidant activities. There is urgent need for further research and investigations into these epiphytic plants by isolation and structural identification of the bioactive molecules, and screening their activities. Through this means, the epiphytic plants might serve as a portal for the discovery of useful lead compounds which could result in novel drugs for the treatment of diseases. Since this study has shown that only two epiphytic medicinal plants are indigenous to Africa in general and one is indigenous to Nigeria in particular, it is imperative to carry out further studies on epiphytic medicinal plants in order to enrich literature with more valuable information about epiphytic medicinal plants.

Table 1. Ethnopharmacological profile of epiphytic medicinal plants

No	Epiphyte species	Family	Location	Part of Plants	Preparation and Route of Administration	Indication (traditional)	Pharmacological activity
1	*Adiantum caudatum* L.	Adiantaceae	India, Indonesia, Malaysia	LF	Decoction	Cough, heal wound, cold, tumors of spleen, liver and other viscera, skin diseases, bronchitis, and inflammatory diseases (Umeyor *et al*., 2021b)	Antimicrobial (Methanol extract, gram positive and negative bacteria, fungi) (Umeyor *et al*., 2021b)

2	*Asplenium nidus* L.	Aspleanceae	Tahiti, Malaysia, Philippines, Vanuatu, Indonesia	LF, WP	Ointment, decoction, Eaten	Headache, hair loss (pounded leaves mixed with coconut oil), ease labor, fever (decoction), contraceptive, depurative, sedative agents. edible food (young leaves), ornament, anti-inflammation promote blood circulation	Antioxidative (Methanol extract, DPPH), tyrosinase inhibiting (Methanol extract, microtitre), antibacterial (Methanol extract) (Wang *et al*., 2008)
3	*Huperzia phlegmaria* (L.) Rothm	Lycopodiaceae	South-East Asia, India	WP	Ointment	Stimulate hair growth, skin Diseases (Wang *et al*., 2008)	Cytotoxic activities against HuCCA-1, A-549, HepG2, and MOLT-3 cancer cell lines (81, 79, **77**) (Wang *et al*., 2008)
4	*Nephrolepis cordifolia* (L.) C. Presl	Oleandraceae	India	RZ	Decoction (fresh leaves)	Cough, rheumatism, chest congestion, nose blockage, loss appetites,	Antibacterial, anti-fungal (extract fractions aerial part) (Wang *et al*., 2010)

						infection (antibacterial), pinnae is used to treat cough, wounds, jaundice, anti-fungal, styptic, anti-tussive (Wang *et al*., 2010)	
5	*Ophioglossum pendulum* L.	Opioglossaceae	Indonesia, Philippines	LF	Ointment, decoction	Hair treatment (crushed leaves), cough (decoction), rid the first faeces (spores), ornament (Wang *et al*., 2010)	Cell activator, skin whitening agent and antioxidant (patent, mixed with other Ophioglossum species) anti-diarrhea (stipe Methanol extract, rabbit jejenum) (Wang *et al*., 2010)
6	*Pyrrosia piloselloides* (L.) M.G. Price	Polypodiaceae	Indonesia, Malaysia, China, Philippines, Pacific islands	LF	Decoction (internal), chewed, poultice (external)	Smallpox, rashes, gonorrhea, dysentery, tuberculosis, urinary tract infection, headache,	Antibacterial, anti-fungal (extracts) (Wangchuk *et al*., 2011)

						cough, gum inflammation, tooth sockets, eczema, coagulate blood (Wangchuk *et al*., 2011)	
7	*Vittaria elongata* Sw.	Vittariaceae	South-East Asia, Andaman	LF	Decoction	Rheumatism (Wangchuk *et al*., 2011)	Cytotoxicity against two human cancer cell lines, lung carcinoma (NCI-H460) and central nervous system carcinoma (SF-268), antioxidant (DPPH) (Wangchuk *et al*., 2011)
8.	*Cassytha filiformis* L	Lauraceae	India, Taiwan, China, Vietnam, Malaysia, Philippines, Indonesia, Fiji, Africa,	WP, NT	Decoction	Cough, dysentery, diarrhea, intestinal problems, headache, malaria fever, nephritis, edema, hepatitis, sinusitis,	An _1 adrenoceptor antagonist (Rat thoracic aorta) antiplatelet and vasorelaxing actions (Rabbit platelet, aortic contraction), anti-trypanosomal,

			Central America.			gonorrhea, syphilis, skin ulcer, eczema, Prevent haemoptysis. Parasite skin and scalp. Induce lactation (after still birth), promote hair growth, diuretic, vermifuge, laxative agent, saliva blood removal (childbirth) (Wangchuk *et al*., 2017)	cytotoxicity, antioxidant (Wangchuk *et al*., 2017)
9.	*Cuscuta reflexa* Roxb.	Convolvula-ceace	India	WP	Decoction, poultice	Mixed with the twigs of *Vitex negundo* L. applied as fomentation on the abdomen of kwashiorkor children, fever, itchy (Wangchuk *et al*., 2017)	Anti-viral , anti-HIV, analgesic, relaxant (ether extract) antisteroidogenic activity (Methanol extract), antibacterial activity, hair growth activity in androgen-induced

							alopecia, anti-inflammatory (murine macrophage cell line RAW264.7), anti-cancer (Hep3B cells by MTT assay), antioxidant (ethylacetate extract, DPPH), anti-obesity (ethylacetate extract) (Wangchuk *et al*., 2017)
10	*Diaphananthe bidens* (Afzel. Ex. Sw) Schltr.	Orchidaceae	Sierra Leoneans, Nigeria	LF, ST, RZ, SD, WP	Decoction leave juice	Analgesics, Diabetes, Headache, Fever (Wangchuk *et al*., 2017)	Anti-inflammatory, Antioxidant, Antihyperglycaemic, Antimalarial, Antimicrobial (Wangchuk *et al*., 2017)

Key: LF – Leaf, WP – Whole part, RZ – Rhizome, NT – Nut, ST – Stem, SD – Seed

Competing interests

The authors declare that there are no conflicts of interests regarding the publication of the manuscript.

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