A Synthesis And Review Of Ethnomedicinal Uses, Phytochemistry And Biological Activities Of Brachylaena Huillensis O. Hoffm. (Asteraceae)

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Abstract: Brachylaena huillensis O. Hoffm. is a shrub or tree widely used as herbal medicine in tropical Africa. The main aim of this review is to provide an overview and critical analysis of the medicinal uses, phytochemistry and biological activities of B. huillensis. The information presented in this study was gathered using various databases such as PubMed, ScienceDirect, Scopus, Google Scholar and Web of Science, and review of books, journal articles and other scientific publications kept in the University library. The leaf and root infusion or decoction of B. huillensis are used as anticandida, and traditional medicine for diabetes, diarrhoea, gastro-intestinal problems, gonorrhoea, malaria and schistosomiasis. Chemical compounds identified from B. huillensis include sesquiterpenoids, carotenoids, coumarins, polyoses, steroids, tannins, triterpenoids and volatile oils. Ethnopharmacological review showed that B. huillensis and phytochemical compounds identified from the species have antibacterial, antifungal, antiprotozoal and antioxidant activities. Further research on B. huillensis should focus on the possible biochemical mechanisms of action of both the crude extracts and identified phytochemical compounds including toxicological, in vivo and clinical studies to corroborate the traditional medicinal applications of the species.

Index Terms: Asteraceae, Brachylaena huillensis, Compositae, ethnopharmacology, indigenous knowledge, traditional medicine, tropical Africa

1. INTRODUCTION

Brachylaena huillensis O. Hoffm. is an evergreen or deciduous shrub or tree of the Asteraceae or Compositae family which is commonly referred to as daisy, sunflower or aster family. Some species belonging to the Asteraceae are used as traditional medicines to treat and manage animal and human diseases and ailments such as gastro-intestinal problems, microbial infections, respiratory problems, intestinal parasites, skin infections, sores, wounds, sexually transmitted infections, eye problems, snake bites, dysmenorrhoea, gynaecological disorders, hypertension and anxiety [1-9]. The genus name Brachylaena R. Br. is a contraction of two Greek words “brachus” meaning “short” and “klaina” meaning “cloak”, in reference to the florests which are longer than the bracts surrounding the flower head [10]. The specific name “huillensis” implying that the type specimen of the species was collected from the Huíla region in Angola in west Africa [11,12]. The common names of B. huillensis include “lowveld silver-oak” and “silver oak” which are in reference to the silver-grey under-surface of the leaves of the species which often gives the tree a shiny and silvery appearance [11]. Synonyms associated with the name B. huillensis include B. hutchinsii Hutch., B. mullensis O. Hoffm. and Tarchonanthus camphoratus sensu Hiern. [13,14]. Brachylaena huillensis is a shrub or tree with an untidy appearance which usually reaches a height of 40 metres [15,16]. The bole is slender, often low-branching, curved, fluted and developing thin buttresses [17,18]. The bark of B. huillensis is rough, grey to light black in colour, longitudinally fissured and flaking in long narrow strips with lenticellate branches. The leaves of B. huillensis are elliptic to ovate in shape, alternate or clustered towards ends of branches, gloss green above and white-felted below [19,20]. The leaf margins of B. huillensis are entire or are slightly serrated with an apex broadly tapering with a bristle-like tip.

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The flower heads of B. huillensis are grouped into axillate panicles with creamy-white coloured flowers in terminal branched clusters. The fruits of B. huillensis are small achenes characterized by apical tuft of creamy brown bristles [19]. Brachylaena huillensis has been recorded in Botswana, Angola, Kenya, Mozambique, Tanzania, Uganda and Zimbabwe at an altitude which ranges from 25 m to 2000 m above the sea level [13,21-26]. The species has been recorded on sandy soils, well-developed volcanic clayey loam soils, red soils of coastal belts and often on rocky ridges and stony hillsides in bushveld, woodland, thicket, dry kloof forests, coastal forests, evergreen, montane and semi-deciduous forest [27-29]. Brachylaena huillensis is an important medicinal plant species in Mozambique [30]. The species is also categorized as a priority medicinal plant species in need of conservation in Tanzania [31]. Essential oil isolated from B. huillensis is recommended for soap, perfumery and as a fixative in perfumery [32]. However, B. huillensis is of conservation concern, categorized as Near Threatened using the IUCN Red List Categories and Criteria version 3.1 of threatened species (http://www.iucnredlist.org) [33]. The population decline of B. huillensis is due to over-collection as timber, habitat loss and modification due to agriculture and urbanisation [33]. Brachylaena huillensis is categorized as Critically Endangered in Uganda due to rapidly declining population as a result of selective logging for its timber required for local wood carving [34]. Similarly, scarcity of B. huillensis in Kenya led to importation of B. huillensis logs from Tanzania [35]. Research showed that between 1988 to 2000, an estimated 34% of the wood used in Kenya was from B. huillensis logs smuggled from Tanzania [35]. While B. huillensis is currently facing a much lower risk of extinction, it still require conservation action if viable populations are to be maintained. Thus, the aim of this review is to summarize the phytochemistry, biological activities and therapeutic potential of B. huillensis.

2. MATERIALS AND METHODS

A literature search was conducted using keywords such as Brachylaena huillensis, phytochemistry, biological activities, ethnopharmacology, botany and toxicity separately and in

combination within the electronic databases of PubMed, ScienceDirect, Scopus, Google Scholar and Web of Science, and review of books, journal articles and other scientific publications kept in the University library. The articles used in this study were published from 1975 to 2019.

3. RESULTS AND DISCUSSION

3.1 Medicinal uses of Brachylaena huillensis

Apart from being a major a source of woodcarving material throughout its distributional range, B. huillensis is also used as traditional medicine in east and southern Africa (Table 1). In Kenya, the leaf and root decoctions of B. huillensis are taken orally as herbal medicine for gastro-intestinal problems [37], while in Zimbabwe, the root infusion taken orally against malaria [38]. In South Africa, the leaf infusion of B. huillensis is taken orally as anticandida [39,40] or the leaves of the species are mixed with those of Psidium guajava L. as traditional medicine for diarrhoea [41]. In Tanzania, the leaf and/or root infusions of B. huillensis are taken orally as traditional medicine for diabetes, gonorrhoea and schistosomiasis [18,42-51].

TABLE 1: *MEDICINAL USES OF BRACHYLAENA HUILLENSIS*

Medicinal use	Part used	Country	Reference
Anticandida	Leaf infusion taken orally	South Africa	[39,40]
Diabetes	Leaf infusion taken orally	Tanzania	[18,44-46,48-51]
Diarrhoea	Leaves mixed with those of Psidium guajava L. and mixture taken orally	South Africa	[41]
Gastro-intestinal problems	Leaf and root decoctions taken orally	Kenya	[37]
Gonorrhoea	Leaf infusion taken orally	Tanzania	[43]
Malaria	Root infusion taken orally	Zimbabwe	[38]
Schistosomiasis	Leaf and root infusion taken orally	Tanzania	[18,42-51]

3.2 Phytochemical and pharmacological properties of Brachylaena huillensis

Brooks and Campbell [52] identified two tricyclic sesquiterpenoid oxo aldehydes from the heartwood of B. huillensis (Table 2). Chhabra et al. [42] identified carotenoids, coumarins, polyoses, steroids, tannins, triterpenoids and volatile oils from the leaves of B. huillensis. The volatile constituents have been identified from the leaves and wood of B. huillensis [53-55]. Viera et al. [56] identified the sesquiterpenoids from the bark of B. huillensis while Zdero et al. [57] identified aguerin A, aguerin B, cynaropicrin, lupeol and lupeol acetate from the aerial parts of the species. For example, coumarins are characterized by antitubercular, anti-inflammatory, antiadipogenic, anti-tumour, antioxidant, anticoagulant, antimicrobial, antihyperglycemic, antihypertensive, anticonvulsant and neuroprotective activities [58-62]. Similarly, steroids and triterpenoids are characterized by antidiabetic, antiprotozoal, antipruritic, immunosuppressant, hepatoprotective, antimicrobial, anti-inflammatory and anti-hypercholesterolemic activities [63-69].

TABLE 2: *PHYTOCHEMICAL COMPOSITION OF BRACHYLAENA HUILLENSIS*

Phytochemical compounds	Value	Plant part	Reference
Aguerin A	-	Aerial parts	[57]
Aguerin B	-	Aerial parts	[57]
β-bourbonene (%)	0.2	Leaves	[55]
Brachylaenalones A	-	Bark and heartwood	[52,56]
Brachylaenalones B	-	Bark and heartwood	[52,56]
Cadalene (%)	1.5	Leaves	[55]
α-cadinene (%)	0.3	Leaves	[55]
δ-cadinene (%)	8.5	Leaves	[55]
γ-cadinene (%)	3.5	Leaves	[55]
α-calacorene (%)	6.0	Leaves	[55]
β-calacorene (%)	1.5	Leaves	[55]
cis-calamenene (%)	10.5	Leaves	[55]
Carene-3- (%)	0.3	Leaves	[55]
β-caryophyllene (%)	19.1	Leaves	[55]
α-copaene (%)	9.0	Leaves	[55]
α-cubebene (%)	0.1	Leaves	[55]
β-cubebene (%)	15.5	Leaves	[55]
Cynaropicrin	-	Aerial parts	[57]
δ-elemene (%)	0.1	Leaves	[55]
β-eudesmol (%)	0.9	Leaves	[55]
Germacrene D (%)	0.1	Leaves	[55]
Ketoalcohols 8-ketocopaenol	-	Bark	[56]
8-ketoylangenol	-	Bark	[56]
Lupeol	-	Aerial parts	[57]
Lupeol acetate	-	Aerial parts	[57]
α-muurolene (%)	8.0	Leaves	[55]
Myrcene (%)	0.4	Leaves	[55]
β-oplopenone (%)	1.5	Leaves	[55]
α-pinene (%)	0.2	Leaves	[55]
β-pinene (%)	0.2	Leaves	[55]
Sabinene (%)	0.2	Leaves	[55]
α-santalol (%)	0.2	Leaves	[55]
Spathulenol (%)	1.2	Leaves	[55]
α-thujene (%)	0.5	Leaves	[55]
α-ylangene (%)	5.2	Leaves	[55]
Ylangenol	-	Bark	[56]

Preliminary antibacterial activity evaluations carried out by Chhabra et al. [70] showed that the leaves of B. huillensis have antibacterial activities against Staphylococcus aureus and Klebsiella pneumoniae. Similarly, Viera et al. [56] evaluated the antibacterial activities of the compounds brachylaenalones A, brachylaenalones B, ketoalcohols 8-ketocopaenol, 8-ketoylangenol and ylangenol isolated from the bark of B. huillensis against Brevibacterium ammoniagenes and Streptococcus mutans using the broth microdilution method. The compounds exhibited activities against the tested pathogens the minimum inhibitory concentration (MIC) value of 25.0 µg/mL [56]. Oliva et al. [55] evaluated the antibacterial activities of essential oils isolated from the leaves of B. huillensis against Bacillus cereus, Enterococcus faecalis, Micrococcus luteus, Staphylococcus aureus, Staphylococcus epidermidis, Escherichia coli, Klebsiella spp. and Proteus mirabilis using the disc diffusion method with gentamycin (10.0 µg) as positive control. The oil exhibited activities against Bacillus cereus, Enterococcus faecalis, Micrococcus luteus, Staphylococcus aureus, Staphylococcus epidermidis and Proteus mirabilis with inhibition zone ranging from 7.0 mm to 22.5 mm against inhibition zone of 13.0 mm to 30.0 mm exhibited by the positive control [55]. Van Vuuren et al. [41] evaluated antibacterial activities of crude extracts of B.

huillensis against Escherichia coli. The authors also evaluated the antibacterial interaction of B. huillensis used in combination with Psidium guajava L. by calculating the sum of the fractional inhibitory concentrations (∑FIC) against Escherichia coli. The ΣFIC for this combination ranged between 0.1 (synergistic) to 2.3 (non-interactive) when tested against the pathogen associated with diarrhoea [41].

Motsei [71] and Motsei et al. [40] evaluated the antifungal activities of aqueous, ethanol, ethyl acetate and hexane extracts of B. huillensis leaves against Candida albicans clinical isolates and Candida albicans (ATCC 10231) using a broth microdilution test with amphotericin B as positive control. The extracts exhibited weak activities against tested pathogens with the MIC values ranging from 8.4 mg/ml to 25.0 mg/ml in comparison to MIC value of 0.002 mg/ml exhibited by the positive control [40,71]. Omosa et al. [72] evaluated the antifungal activities of the crude extracts of B. huillensis leaves, root bark and stem bark using the GIBEX screens-to-nature (STN) system against Saccharomyces cerevisiae. The extracts exhibited weak to high activities against the tested pathogen. Omosa et al. [72] evaluated the antiprotozoal activities of crude extracts of B. huillensis leaves and root bark against Bodo caudatus using the protozoal lethality assay test. The extracts exhibited weak to high activities against the tested protozoa. Omosa et al. [72] evaluated the antioxidant activities of crude extracts of B. huillensis leaves and stem bark using the 2,2-azino-bis (3-ethylbenzothiazoline-6-sulfonic acid) ammonium salt (ABTS) free radical scavenging assay. The extracts exhibited low to high activities [72].

4. CONCLUSION

The current scientific evidence as illustrated by biological activities demonstrated by B. huillensis indicates its potential as traditional medicine. The biological activities exhibited by the extracts and compounds isolated from the species directly or indirectly support a wide range of physiological processes, which offers protection against growth of undesirable microbes. The present study showed that there are still some research gaps in the phytochemistry, pharmacological and toxicological properties of the species. Therefore, further rigorous research is required aimed at evaluating the phytochemical properties of the different plant parts used as sources of traditional medicines as well as clinical trials and in vivo experiments.

CONFLICT OF INTEREST

No conflict of interest is associated with this work.

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