

Mini Review

# Hydnora Species between Folk Remedies and Ethnopharmacology: Limited Data for a Valuable Genus

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## ARTICLE INFO:

Received: 11 Jul 2021

Accepted: 11 Sept 2021

Published: 17 Jan 2022

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## ABSTRACT:

**Background:** *Hydnora* is a subterranean root holoparasitic angiosperm that is strictly parasitic on different species of Euphorbiaceae, some Burseraceae species, and some Fabaceae species. *Hydnora* is distributed in semi-arid areas of Asian and African continents. Available data about this genus are relatively limited, due to the small number of studies describing these species in comparison with its importance, which is caused by the rareness presence of these species all over the world. Till now, only eight species were identified under the genus *Hydnora* plus two newly identified species, *H. abyssinica* A.Br. and *H. africana* Thunb. are the common species that are used as a food and as folk remedies. Although some *Hydnora* species have been reported for their biological activities as antioxidant, antibacterial, antidiarrheal, antiproliferative agents, their chemical composition is still not well-studied.

**Object:** The aim of this review is to highlight the distribution and botanical features of the genus *Hydnora*. Moreover, point out the up-to-date ethnomedicinal uses, and chemistry of some *Hydnora* species.

**Conclusion:** Understanding the importance of this genus may contribute in its conservation as an alternative medicine and nutritional food source, and employing it as a functional food, and as a natural alternative or support to some of the currently used drugs.

**Keyword:** *Hydnora* species; *Hydnora abyssinica*; *Hydnora africana*; biological activities; ethnomedicinal uses.

## 1. INTRODUCTION

Nature remains the main source for new medicines discovery, and plants and microorganisms have the greatest share in these discoveries [1]. One of the rarest, not well-studied species is *Hydnora* which is a subterranean root holoparasitic angiosperm that is entirely parasitic on different species of Euphorbiaceae, some Burseraceae species, and some Fabaceae species in a host-specific manner. It is used in traditional medicine depending on their unclear pattern of distribution in specific environments in Africa, south Asia (Arab countries) and other [2]. Available information on the ethnobotany of *Hydnora* species are relatively insufficient due to being rarely collected, their cryptic nature, their flowers emerge seasonally, and due to the difficulty to preserve it. Till now, only eight species were identified under the genus *Hydnora*, which are *Hydnora abyssinica* A.Br.; *Hydnora africana* Thunb.; *Hydnora arabica*; *Hydnora visseri* Bolin, E. Maass, and Musselman;

*Hydnora esculenta* Jum and *Hydnora* Perrier; *Hydnora sinandevu* Beentje and Q. Luke; *Hydnora longicollis* (Welw.) Bolin; *H. triceps* Drège and E. Mey. However, two new species were recently identified [2-4]. Some studies are available describing mainly the two *Hydnora* species *Hydnora abyssinica* and *Hydnora africana* which are known for their significant uses in folk remedies. The first report describing *Hydnora* was in 1774 by Thunberg who mistakenly thought it is a fungus [5]. It was firstly named by indigenous people as “kannip”, then later known as “jackals-kost or jakkalskos”. The genus *Hydnora*, was described by Thunberg again and its name was driven from the word truffle in Greek [6]. In Yemen, *Hydnora abyssinica* is used as food and medicine for treatment of gastric ulcer, stomach diseases, and cancer [7]. Although *Hydnora* species are rarely present in herbarium collections, traditional healers and harvesters of traditional medicine can easily know and collect these species. Hence, local communities usually have the experience of knowing how and where to find *Hydnora* which is important to their physical and social

welfare [8, 9]. Studying *Hydnora* species, their occurrence, their chemical profiles and bioactivity of their containing compounds will further improve our understanding on the growth, distribution and potential applications of this genus. Hence, in this review, the distribution and botanical features of the genus *Hydnora* were described. Moreover, the up-to-date ethnomedicinal uses, chemistry, pharmacology of some *Hydnora* species were pointed out. Understanding the importance of this genus may contribute in its conservation as an alternative medicine and nutritional food source [10, 11].

## 2. DISTRIBUTION AND BOTANICAL FEATURES OF THE GENUS *Hydnora*

*Hydnora* species are generally distributed in arid and semi-arid regions of Asia and Africa. As illustrated in fig 1, *Hydnora* species are reported mainly in countries including Sudan, Northern Botswana, Angola, Namibia, Zaire, Zimbabwe, Swaziland, Madagascar, Botswana, Tanzania, Ethiopia, Uganda, Kenya, Somalia, and the Arabian Peninsula [2].

Due to their mushroom-like morphology, *Hydnora* species are thought to be mushroom, which causes a taxonomic challenge. Thus, approaches and full research are critically required to represent the systematics, distribution, uses, and applications of this underexplored genus. *Hydnora* species are underground holoparasitic herbs appear as a root-like rhizome with extremely reduced vegetative features, a dark brown periderm and fleshy red/pink interior, and their rhizomes are attached to the host [12]. The width of rhizomes are 1 cm, 4–5 angled, and they look terete, or flattened. The periderm is brick-red in colour and appear well developed, apart from the tip of the rhizome. Fresh rhizomes are pinkish or flesh-red in colour with gummy, bitter, and sever exudate. Warty haustorial outgrowths appear surrounding the whole rhizome. Rhizomes are covered with latent and active outgrowths in groups of 2–4. Flowers (bait-bodies) are 3, 4, or 5 merous. The floral envelope is clear and rests on the ground. Flowers are characteristically smelly and their size vary depending on the distance between rhizome, pedicel, and the ground. The ovary is unilocular and is located inferior, while the stigma is sessile, and the stamens are attached at the base [3, 4]. Pollen adhering to anthers is very sticky. Some species develop “bait bodies” in between the internal margin of the envelopes while other species contain concave petals. The fruits are globose and fleshy, with numerous seeds (Figure 2). The mature pedicel is very short and easily disconnected from the rhizome. Seeds irregular, hard, and brownish in colour [3, 4]. *Hydnora* species habitat and ecology: Most of the *Hydnora* species are found in the semi-arid and desert regions in Africa and south Asia (Arab countries). They are obligate parasites on various host plant species belonging to the Fabaceae and Euphorbiaceae families. *Hydnora* species

are rarely found and collected because of their uneven distribution and seasonal flowering [3, 4].

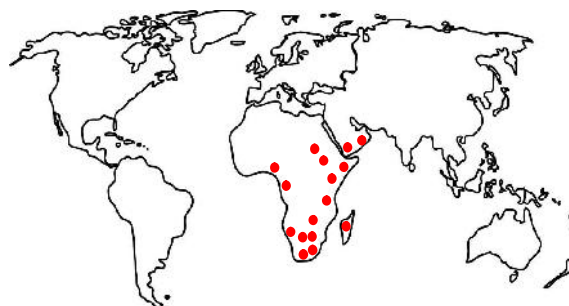


Fig 1: Distribution of *Hydnora* species in Africa and Asia shown in red dots



Fig 2: *Hydnora abyssinica* (Photos was taken by: Dr. Abdu Ghalib Al kolaibe. Locality: Taiz, Yamen).

## 3. USES AND EDIBILITY OF THE GENUS

### *Hydnora*

Thunberg in the 18<sup>th</sup> century has mentioned that the lower part of *Hydnora* (the fruit) is consumed by Hottentots, vevrae, and animals [5,6]. Also, Pappe in 1847 have reported the edibility of *Hydnora africana* [13], and he described its taste as (palatable). In Sudan, dried roots of *Hydnora abyssinica* are used to prepare charcoal and for leather tanning [14,15]. Also, the brownish red subterranean fruit of *Hydnora abyssinica* is utilized as food by some communities in Uganda and Kenya [16]. *Hydnora africana* is also used as food, and for preserving fishing nets, and leather tanning [6]. In Oman, *Hydnora arabica* is used as food by settlers of Jibbali [4], while fruits of *Hydnora abyssinica* are used as food and in tanning leather [17]. *Hydnora visseri*, *Hydnora triceps* and *Hydnora longicollis* are edible [3], while *Hydnora esculenta* is used as food, and for tanning

leather [18,19]. Flowers of *Hydnoraabyssinica* are used as wild food and in traditional medicine in South Yemen [7].

Currently, some *Hydnora* species are commercialized and became available in certain markets[20,11].

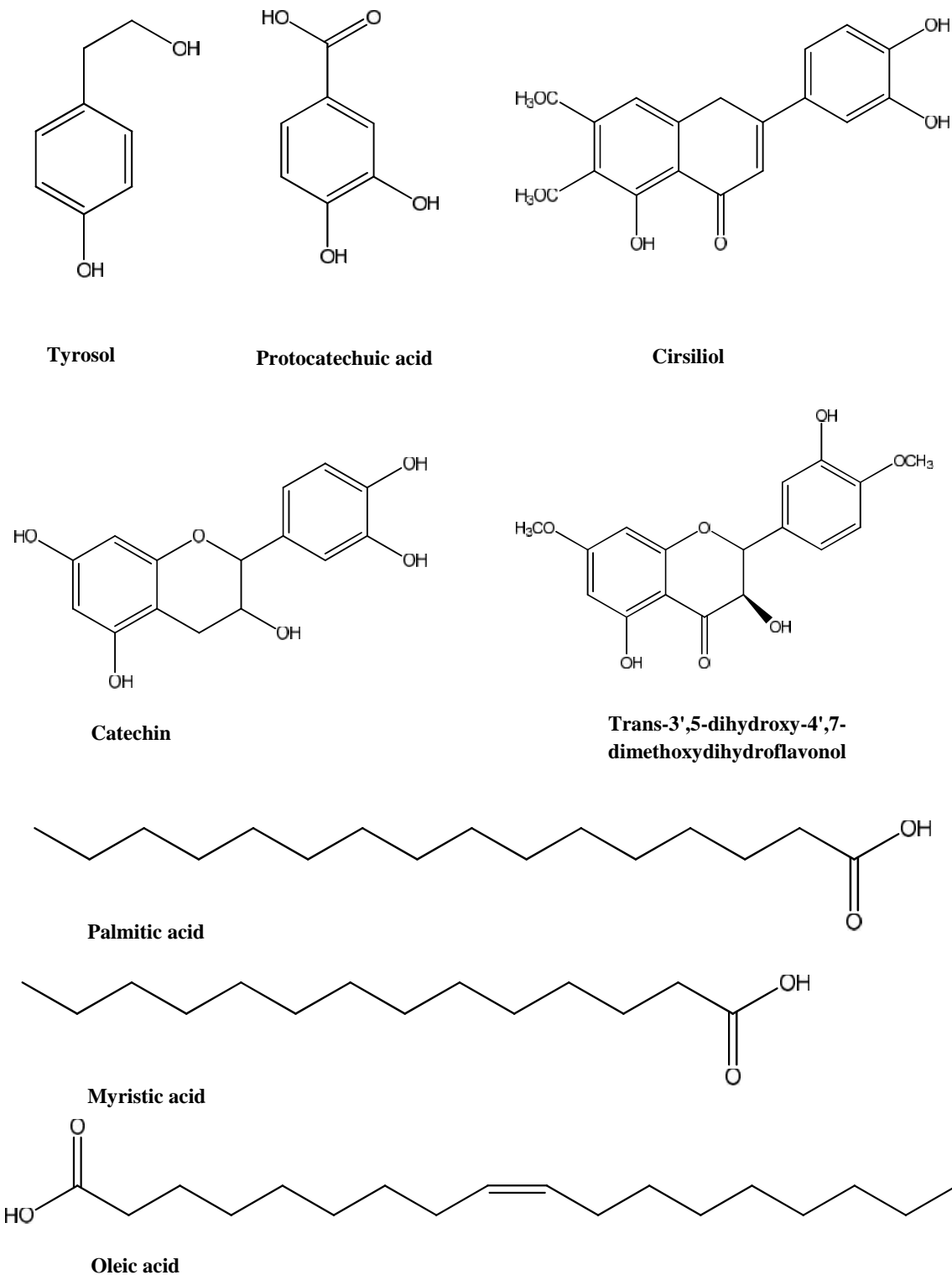
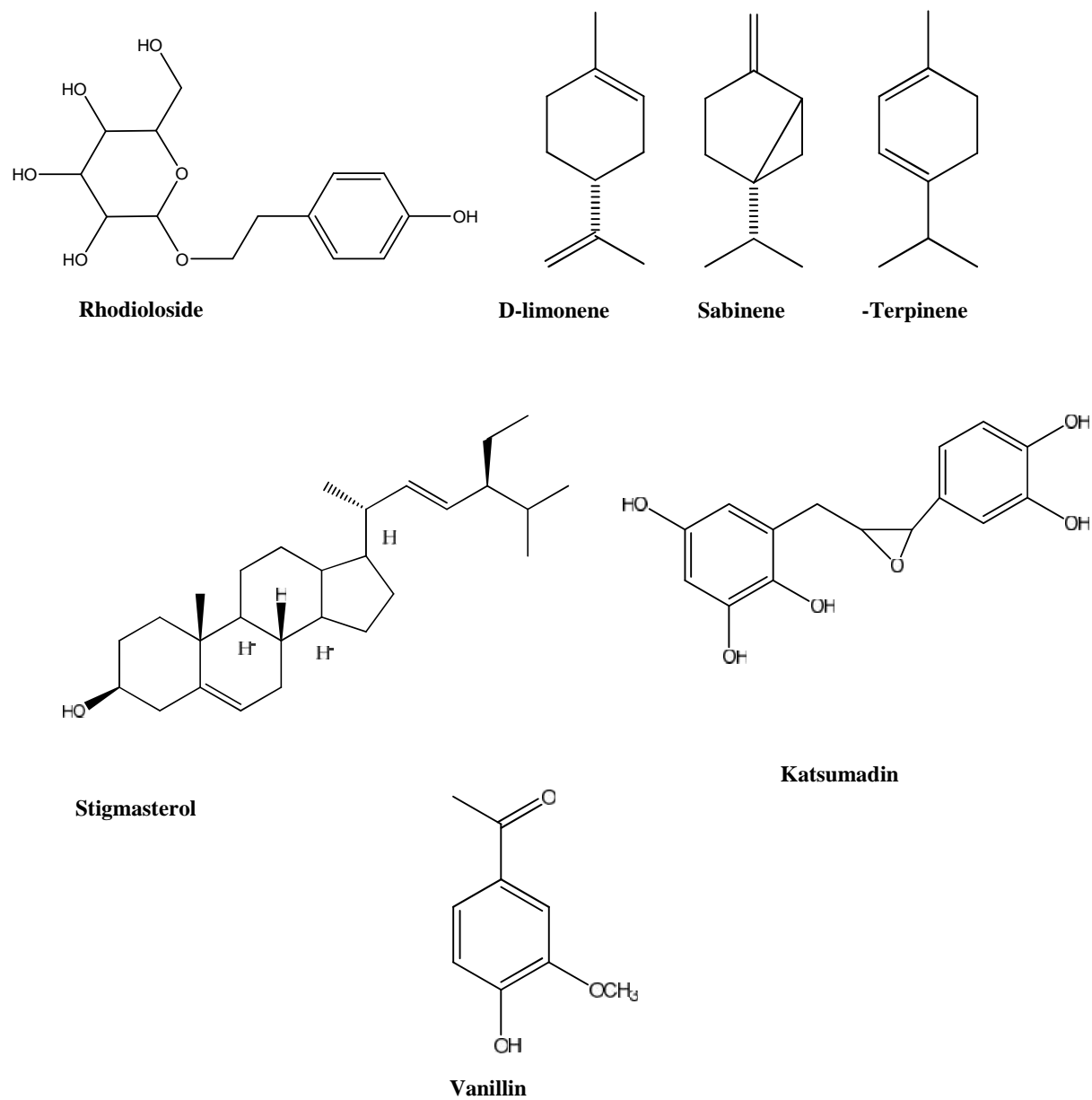


Fig 3: Chemical structure of some compounds originated from *Hydnoraabyssinica*



**Fig 4: (Continue) Chemical structure of some compounds originated from *Hydnoraabyssinca***

#### 4. MEDICINAL USES, POTENTIAL PHARMACEUTICAL APPLICATIONS OF THE GENUS *Hydnora*

As mentioned previously, many *Hydnora* species are used in traditional medicine, where knowledge is orally passed on from generation to another within the same community. However, available data on these species are relatively limited, due to the small number of studies describing these species which is caused by the rareness presence of these species all over the world and the difficulty of samples preservation that impede such studies. Out of the 8 identified

*Hydnora* species, only four species were used to cure more than twenty diseases. According to their medical importance, *Hydnora abyssinica* came first, followed by *Hydnora africana*. *Hydnora* different parts are involved in preparation of the treatment to produce decoctions, powders, and infusions, to cure intestinal metabolic, reproductive, skin, respiratory disorders, urinary tract infections, paralysis, cancer, and stytic diseases [2]. Therapeutic potentials of both *Hydnora abyssinica*, and *Hydnora africana* include having antimicrobial, antioxidant, anticancer, and antiproliferative activities [21-23]. Roots of *Hydnora abyssinica* and *Hydnora africana* are considered as traditional medicine in Mozambique and South Africa [2, 6,24]. The uses of *Hydnora* in folk remedies extend to treat various diseases. In Sudan, *Hydnora abyssinica* decoction is used as a traditional remedy for tonsillitis, inflammation, and dysentery [25,26]. In Ethiopia, the same species are used to heal wounds, haemorrhage, diarrhea, and mouth infections [27]. On the other hand, *Hydnora abyssinica* is used in Tanzania for treatment of swollen tonsils, and throat inflammations, while it is consumed as a stytic remedy in Angola [28, 29]. In Yemen, flowers of *Hydnora abyssinica* were used to treat cancer and gastrointestinal diseases [7]. Treatment with aqueous extract of *Hydnora abyssinica* showed its antidiarrheal activity without any toxic effects, which supported the claim of using *Hydnora abyssinica* as traditional treatment of diarrhoea [23, 26].

On the other hand, decoction of *Hydnora africana* is used for treating of chronic diarrhea, dysentery, persistent stomach cramps, and as a coagulant agent [2, 4], while infusions of *Hydnora africana* is used as a face cleanser to treat acne [6,2]. Furthermore, the root extracts of *Hydnora africana* are used in South Africa for relieving throat inflammation [18]. On the other hand, due to their high tannin quantities, both *Hydnora africana* and *Hydnora abyssinica* are used as antidiarrhea agents [6, 18]. Similarly, *Hydnora esculenta* is used as an astringent remedy to treat diarrhea due to its richness in tannins. *Hydnora sinandevu* is used for the treatment of throat infections [2]. On the other hand, *Hydnora abyssinica* is used in combination with other herbal drugs to treat many diseases including paralysis, hiccups, diabetes, diarrhea, measles, insomnia, fever, hypertension, and hemorrhoids [19, 30].

In spite of their intensive use of different *Hydnora* species in traditional medicine, their chemical profiles and biological significance are not yet well studied. Few studies have reported that flavonoids, tannins, proanthocyanidins, and phenols are the main compounds in *Hydnora africana* and *Hydnora abyssinica*. [20,21]. Chemical analyses of the extract prepared from *Hydnora abyssinica* A.Br. collected from Abyan governorate in Yemen revealed the presence of compounds related to different chemical classes including tannins, terpenes, flavonoids, and phenols [7, 31].

Analysing chemical profile of *Hydnora abyssinica* air-dried flowers resulted in detection of acetic acid, sabinene, ethyl

acetate, (+)-D-limonene, -terpinene, and -terpinene which are suggested to be responsible for the characteristic flavour and odor of the flowers [8, 32]. The chemical structures of some of the compounds extracted from *H. abyssinica* are listed in figure 3. Chemical analysis of an essential oil fraction originated from *Hydnora africana* that was collected from Cape Province in South Africa, has revealed the presence of 67 compounds that belong to ketones, terpenoids, aldehydes, carboxylic acids, and fatty acid esters [22, 33, 34].

## 5. CONCLUSION

The genus *Hydnora* is an important source of nutritional and pharmaceutical components, which nominate it to be applied in pharmaceutical applications and as a functional food. Their potency and variable capabilities encourage for studying available species, screening for new ones, promising, and potent species. Understanding the importance of this unique genus, and their current as well as prospective applications, can contribute in putting them in their right position as potent natural alternative and or support for some of the currently used drugs.

## 6. REFERENCES

1. Elkhateeb WA, Daba GM, Thomas PW, Wen TC. Medicinal mushrooms as a new source of natural therapeutic bioactive compounds. *Egypt Pharmaceu J.* 2019;18(2):88-101.
2. Mkala EM, Mutungi MM, Mutinda ES, Oulo MA, Wanga VO, Mwachala G, Hu GW. Understanding the Ethnobotany, Chemistry, Pharmacology, and Distribution of Genus *Hydnora* (Aristolochiaceae). *Plants.* 2021;10(3):494.
3. Bolin JF, Maass E, Musselman LJ. A new species of *Hydnora* (Hydnoraceae) from Southern Africa. *Systematic Botany.* 2011;36(2):255-260.
4. Bolin JF, Lupton D, Musselman LJ. *Hydnora arabica* (Aristolochiaceae), a new species from the Arabian Peninsula and a key to *Hydnora*. *Phytotaxa.* 2018;338(1):1-10.
5. Thunberg CP. *Travels at the Cape of Good Hope, Second series No.17*, Van Riebeeck Society, Cape-Town. 1774.
6. Dold T, Cocks M, Suzane N. Fine fare, rare remedy. *Veld & Flora.* 2003;89(1): 12-14.
7. Al-Fatimi M, Ali NA, Kilian N, Franke K, Arnold N, Kuhnt C, Lindequist U. Ethnobotany, chemical constituents and biological activities of the flowers of *Hydnora abyssinica* A. Br. (Hydnoraceae). *Die Pharmazie-An Inter J Pharmaceu Sci.* 2016;71(4):222-226.
8. Williams VL, Falcão MP, Wojtasik EM. *Hydnora abyssinica*: Ethnobotanical evidence for its occurrence in southern Mozambique. *South African J Botany.* 2011;77(2):474-478.

9. Yagi S, Chrétien F, Duval RE, Fontanay S, Maldini M, Piacente S, Laurain-Mattar D. Antibacterial activity, cytotoxicity and chemical constituents of *Hydnora johannis* roots. South African Journal of Botany. 2012;78:228-234.
10. Bolin JF, Musselman LJ. Epitypification and ecological notes for the Malagasy holoparasite *Hydnora esculenta* (Hydnoraceae). Nordic Journal of Botany. 2013;31(3):286-290.
11. Thorogood C. *Hydnora*: The strangest plant in the world?. Plants, People, Planet. 2019;1(1):5-7.
12. Tennakoon KU, Bolin JF, Musselman LJ, Maass E. Structural attributes of the hypogeous holoparasite *Hydnora triceps* Drège & Meyer (Hydnoraceae). American J Botany. 2007;94:1439–1449.
13. Pappé KWL. A list of South African indigenous plants used as remedies by the colonists of the Cape of Good Hope. GJ Pike. 1847.
14. Musselman LJ. Parasitic angiosperms of Sudan: Orobanchaceae, Hydnoraceae, and Cuscuta. Notes Royal Botanic Garden, Edinburgh. 1984;42:21-39.
15. El Ghazali GB, El Tohami MS, El Egami AB, Abdalla WS, Mohammed MG. Medicinal plants of the Sudan. Part IV. Medicinal plants of northern Kordofan. Khartoum: Medicinal and Aromatic Plants Research Institute. 1997;p.77.
16. Nyafuono JF, Remigius ZB, Odyek O. Taxonomy and ethnobotany of *Hydnora* in Lake Mburo national park (Uganda). J Plant Sci. 2000;48(2):99-103.
17. Serjeant RB. Plants of Dhofar, the southern region of Oman, traditional, economic and medicinal uses. J of the Royal Asiatic Society. 1989;121(2):338-340.
18. Musselman LJ, Visser JH. Taxonomy and natural history of *Hydnora* (Hydnoraceae). *Aliso: A Journal of Systematic and Evolutionary Botany*. 1989; 12(2):317-326.
19. Andriamparany JN. Diversity, local uses and availability of medicinal plants and wild yams in the Mahafaly region of south-western Madagascar, Universität Kassel: Kassel, Germany (Doctoral dissertation). 2015.
20. IUCN. International Union for Conservation Guidelines for the Prevention of Biodiversity Loss Caused by Alien Invasive Species Sec3; IUCN: Gland, Switzerland. 2000.
21. Bolin JF, Maass E, Musselman LJ. Pollination biology of *Hydnora africana* Thunb. (Hydnoraceae) in Namibia: brood-site mimicry with insect imprisonment. Inter J Plant Sci. 2009;170(2):157-163.
22. Saadabi AM, Ayoub SM. Comparative bioactivity of *Hydnora abyssinica* A. Braun against different groups of fungi and bacteria. J Medicinal Plants Res. 2009;3(4):262-265.
23. Nethathe BB, Ndip RN. Bioactivity of *Hydnora africana* on selected bacterial pathogens: Preliminary phytochemical screening. African J Microbiol Res. 2011;5(18):2820-2826.
24. Wintola OA, Afolayan AJ. The antibacterial, phytochemicals and antioxidants evaluation of the root extracts of *Hydnora africana* Thunb. used as antidysenteric in Eastern Cape Province, South Africa. BMC complementary and alternative medicine. 2015;15(1):1-12.
25. Wintola OA, Afolayan AJ. Chemical constituents and biological activities of essential oils of *Hydnora africana* thunb used to treat associated infections and diseases in South Africa. Appl Sci. 2017;7(5):p.443.
26. Nghinaunye T. Phytochemical, antimicrobial and cytotoxicity evaluation of rhizome extracts of *Hydnora Abyssinica* from Acacia Nigresces host (Doctoral dissertation, University of Namibia). 2019.
27. Wojtasik EM. Ethnoecology, trade and distribution of the parasitic genera *Hydnora* and Sarcophyte sold in South African muthi markets. Honours dissertation, School of Animal Plant and Environmental Sciences, University of the Witwatersrand, Johannesburg. 2009;1-10.
28. Koko WS, Mesaik MA, Ranjitt R, Galal M, Choudhary MI. Immunosuppressive phenolic compounds from *Hydnora abyssinica* A. Braun. BMC complementary and alternative medicine. 2015;15(1):1-9.
29. Hafeez AI, Ahmed A, Siror S. Extraction and Analysis of *Hydnora abyssinica* Root (*Tartose*) (Doctoral dissertation, Sudan University for Science and Technology). 2016.
30. Belayneh A, Asfaw Z, Demissew S, Bussa NF. Medicinal plants potential and use by pastoral and agro-pastoral communities in Erer Valley of Babile Wereda, Eastern Ethiopia. J Ethnobiol Ethnomed. 2012;8(1):1-11.
31. Watt JM, Breyer-Brandwijk MG. The Medicinal and Poisonous Plants of Southern and Eastern Africa: Being an Account of Their Medicinal and Other Uses, Chemical Composition, Pharmacological Effects and Toxicology in Man and Animal; E. & S. Livingstone: Edinburgh, Scotland. 1962.
32. Awadh Ali N, Ju'lich W, Kusnick A, Lindequist U. Screening of Yemeni medicinal plants for antibacterial and cytotoxic activities. J Ethnopharmacol. 2001;74:173–179.
33. Abosede Wintola O, Afolayan AJ. Chemical Constituents and Biological Activities of Essential Oils of *Hydnora africana* Thunb Used to Treat Associated Infections and Diseases in South Africa. Appl Sci. 2017;7(5):2076-3417.
34. Al-Fatimi M. Ethnobotanical survey of medicinal plants in central Abyan governorate, Yemen. J Ethnopharmacol. 2019;241:111973.

**CONFLICT OF INTEREST:** The authors declare no conflict of interest, financial or otherwise.

**SOURCE OF FUNDING:** None.

**AVAILABILITY OF DATA AND MATERIALS:** Not applicable.

**CONSENT FOR PUBLICATION:** Not applicable.

**ETHICS APPROVAL AND CONSENT TO PARTICIPATE:** CPCSEA Not applicable.

**HUMAN AND ANIMAL RIGHTS:** No animals and human used in study.