



Phytochemistry, pharmacology and perceived health uses of non-cultivated vegetable *Cyphostemma adenocaula* (Steud. ex A. Rich.) Desc. ex Wild and R.B. Drumm: A review

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ABSTRACT

Vegetables have been one of the often recommended and cheap solution to the undernourishment/malnutrition challenge experienced worldwide. Beside the cultivated and exotic vegetables, there are greater number of non-cultivated and wild edible plants' species. Documenting and revalorizing these neglected vegetables is a must and growing trend these days. The thrust of this study is to offer and give up-to-date knowledge cum perceive health uses of one of these edible plant species called *Cyphostemma adenocaula* (Steud. ex A. Rich.). This study clearly showed that *C. adenocaula* is a non-cultivated vegetable eaten by most countries in Africa. Empirical facts about the nutritional advantage inherent in this edible plant is scarce, more studies are needed to establish its functionality. There are enormous records of traditional uses of this wild vegetable though the biological and pharmacological evidences are very few, there is urgent need to justify this claims. Phytochemistry studies is scanting, showing twelve compounds mostly are ceanothane-type triterpenoids, have been isolated so far including some polysaccharide. This review tends to gather works till date on this plant so as to provide enough information for future research hence it is clear that the phytochemistry of this plant is yet to be explored fully.

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Introduction

Among the main sources of foods that gives more than ordinary nutrition, vegetables are the chief, they are extremely useful in safeguarding human health and in the deterrence of illness and diseases [53,43]. Vegetables are part of the existing global biodiversity and biodiversity preservation and management is of utmost importance for agriculture and world food

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supply. Verdant native vegetables of a particular or peculiar area, which may have its origin the local or may spread to other areas [25]. These set of plants accounts for almost 15% of the world higher plants which are mostly regarded as weeds. It has been reported that only about 31,000 of the more than 300,000 present plant species are fit for human consumption, however only 7000 are formally grown or harvested by human for sustenance at one time or the other [23,14]. Many of these thousands of species may thus be believed to contribute to food security but their importance and worth is undervalued and underrated. Some of these indigenous vegetables are most found in the wild, growing without any proper or official cultivation. Many of them are tough, irrepressible, adaptive and can withstand severe climatic circumstances more than the exotic ones [51,44].

Even though, these wild vegetables can be cultivated at a moderately cheap cost and on a negligible poor soil, they have continued to be neglected due to lack of knowledge of their inherent health promoting advantages. Locals and rural dwellers have continued to utilize these plants to supplement nutrition, provide food security and revenue making [46,6,18]. These neglected and underutilized vegetables present to us a crucial and vital component of human diet, giving the human body more than culinary uses [4,47,21]. Though, they are cheap, ready available and highly nutritive yet their knowledge is scarce hence underutilized. The information and knowledge on wild and non-cultivated edible plants in developing nations i.e. Africa countries, each of these vegetables such be studied for its nutritional value, phytochemistry and functions that are beyond culinary uses i.e. health promoting abilities. This is the thrust of this review, to know the research gap and inherent obvious advantages in this neglected vegetable called *Cyphostemma adenocaulis* (Steud. ex A. Rich.), though wild and edible vegetable have been said to take a centre role in complementing stables with micronutrients [61]. Thus, proper documentation and revalorizing of both local and empirical knowledge and understanding of neglected vegetables are urgently necessary to uphold and further encourage nutritional health and to preserve biodiversity [56].

Review methodology

Search was made on keywords like *Cyphostemma adenocaulis*, *Cissus adenocaulis* Steud. ex A. Rich., *Cissus serjanioides*, *Vitis adenantha* and *Vitis adenocaulis*, these are the names of the same medicinal plant. The search was done on "Google Scholar", "PubMed", "Science-Direct", "Scopus" and "Web of Science" databases. Many journals' sites and plant databases were queried too JSTOR Global Plant, The Plant List, Springer, Elsevier, and dissertation search engines like Open-thesis, OATD, ProQuest and EthOs were put to use.

Ethnobotany

General characterization

Cyphostemma adenocaulis (Steud. ex A. Rich.) is one of these neglected vegetables, a genus that belongs to the Vitaceae family. The plant has been reported to be a popular and non-cultivated vegetable eaten in many parts of Africa i.e. Nigeria, Ghana, Congo, Uganda, Ethiopia and Eritrea [13,45,19,24,19,35], it is usually garnered from the wild for use. *Cyphostemma adenocaulis* is widespread in West Africa countries, from Senegal east to Eritrea and south to Angola, Malawi and Mozambique. The plant is commonly cultivated in Ethiopia. This species is wide-spread in the savanna regions of tropical Africa and is also found in bushland, thickets, grassland with or without scattered trees, in rainy and gallery forests, secondary forest, sandy river-banks, granitic rocks and abandoned cultivations as well [11]. *Cyphostemma adenocaulis* is an herbaceous climber with annual stem thrown up from a large fleshy perennial rootstock (caudex) with slightly fleshy 5-foliolate leaves and branched tendrils. Flowers are yellow green and red. *C. adenocaulis* is an extremely variable species, varying from glabrous to densely pubescent and from non-glandular to densely glandular. This species is wide-spread in the savanna regions of tropical Africa and is also found in bushland, thickets, grassland with or without scattered trees, in rainy and gallery forests, secondary forest, sandy river-banks, granitic rocks and abandoned cultivations as well [11,19,35].

Names

This non-cultivated vegetable has a string of names by which it is called in countries of Africa as illustrated in Table 1. *Cyphostemma adenocaulis* is synonymous to *Cissus adenocaulis* Steud. ex A. Rich., *Cissus serjanioides* Planch., *Vitis adenantha* Baker and *Vitis adenocaulis* (Steud. ex A. Rich.) Miq., there are further six (6) names that are synonymous to these [26,14,57].

Nutritional importance

Cyphostemma adenocaulis's leaves and fruits are popular as vegetables, they are taken as soup or as salad in DR Congo, Ghana, Kenya and Uganda. The leaves are cooked with beans, cowpeas, groundnut, sesames and pigeon peas. In Côte d'Ivoire and Tanzania, fruits of this plant is a delicacy, the cooked roots are eaten in Ethiopia and the roots are dried, pounded and stored in famine periods in Uganda. But in defining the food and nutritional quality of a plant, the nutritional facts and empirical figures should be one of the major concern. It has been assumed that plant antioxidants may contribute to the beneficial health and therapeutic effects of vegetables. There is friendly relationship between antioxidant and nutrition and vice versa, [50] reported the *in vitro* anti-oxidative property of methanol extract of ten medicinal plants and *C. adenocaulis*

Table 1
Other names of *Cyphostemma adenocaulis*.

Country	Name	Language	References
Nigeria	yáákùwár fátààkéé	Hausa	[11]
Ghana	Wɔwa/wɔwo	Fante	[11]
Southern Uganda	Akabombo	Nilotic	[49]
Northern Uganda	Emorosi	Nyoro	[45]
Tshopo District, DR. Congo	bombeye	Bantu	
Somalia	Carmo co'ley/ Carmo Lo'loy.	Mushunguli	[11]
Kenya	Mukoyegoye	Swahili	[19]
Somalia, Tanzania, Mozambique,	Mwengele, Mwengere, Mwenjere	Swahili (Kiswahili):	[17]
Ethiopia	Aserkuka fetahkuka	Amharic	[54]
Iganga, Uganda	Eibombo eitono	Kuliak	[48]; [32]
Central Uganda	Akabombo aka- tono		[42]; [32]
Central Africa	Kibombo/Bombo, Kimara	Runyankole	[11]
Ethiopia	Aserkuca asergundi /Aserkush tebetebkus H		[1,52]
Cameroon	Deuh tsieh	Yemba	[60]
Southern Ethiopia and Eritrea	Keta	Koorete and Oromiffa	[24]
Kenya	Lordo	Samburu	[22]

is one of the tested medicinal plant. This property was justified by assessing their total contents in phenols, flavonoids; the anti-oxidative and reducing power were evaluated. These extracts were tested for their scavenging activity using DPPH, ABTS, superoxide, hydroxyl and nitric oxide radicals and hydrogen peroxide. It was reported that the methanol extract of *C. adenocaulis* displayed a moderate anti-oxidative effect in all the assays employed [50].

Ethnomedicinal uses

Many species of *Cyphostemma* genus have been reported in many traditional pharmacopeias and their use as vegetables in many cultures is pronounced [10,35,37,24,19,35]. Traditionally uses of other members of *Cyphostemma* have been reported and acknowledged by many authors [36,20,7,8]. As seen in Table 2, the root of *Cyphostemma adenocaulis* is reported to be used to treat malaria and paste is made from the roots and applied topically to draw abscesses and shrink bumps on skin in northern East Africa, Gabon and Ghana [10,35,37]. Various parts of *Cyphostemma adenocaulis* i.e. the whole plant, leaves, stem, leaves sap, roots and root-bark are used in therapy. The traditional uses of *Cyphostemma adenocaulis* from many cultures in Africa have been reported in Table 2.

Phytochemistry

Phytochemical reports on the genus are limited. Only few species in this genus have compounds isolated from them. Chouna et al. [33] isolated some compounds from the methanol extract of bark and wood of *Cyphostemma adenocaulis* as shown in Fig. 3. Some of these compounds are: betulin (6), betulinic acid (7), cyphostemmamic acid A (1), cyphostemmamic acid B (2), cyphostemmamic acid C (8), cyphostemmamic acid D (9), epigouanic acid A (3), lupeol (5), zizyberanal acid (4), β -sitosterol (11) and its glucoside (12), and 3 β , 28-dihydroxy-30-norlupan- 20-one (10) [33]. Feyisayo and Oluokun [2] isolated crude polysaccharide from the stem and root of *C. adenocaulis* by cold and hot water extraction and ethanol was employed to precipitate the compound. These isolated polysaccharides were found to be a hetero-polysaccharide, which include galacturonic acid, galactosamine and glucose [2].

Pharmacological studies

Antiplasmodial activity

Chouna et al. [33] evaluated the isolated triterpenes (Compounds 1 - 10) *in-vitro*, for their antiplasmodial activity against the *P. falciparum* 3D7 strain. All the tested compounds displayed poor activity except for 3 β , 28-dihydroxy-30-norlupan-20-one (10) that exhibited an IC₅₀ value of 10.1 μ g/mL against the chloroquine sensitive strain 3D7 [33].

Antioxidant activity

Akinwunmi et al. [3] assessed the antioxidant activity of both the ethanolic extracts of leaf and root of *C. adenocaulis* (Steud). Total phenolic, total flavonoids, reducing power and DPPH radical scavenging activity were employed to evaluate the antioxidant activity. The total phenolic and flavonoid contents of the ethanolic leaf extract was 108.0 ± 0.27 mg/g TAE (tannic acid equivalent) and 33.4 ± 0.32 mg/g QE (Quercetin equivalent) while that of the root extract was 182.6 ± 0.38 mg/g TAE and 103 ± 0.43 mg/g QE. The DPPH radical scavenging activity of the extracts of this medicinal plant were dose-dependent and possess quite reducing power. It was concluded that the root extracts possess higher antioxidant activity than the leaf extract [3]. Asso et al. [50] reported the antioxidant activity of the ethanol extract of the stem bark of *C. adenocaulis* [50].

Table 2
Ethnomedicinal potential of *Cyphostemma adenocaula*.

	Parts used	Country	Preparation	Ethnopharmacology	Other uses	Isolated compounds	References
1	Leaves/Leaves sap	DR Congo and Tanzania	Boiled leaves are applied externally on the head/ The sap is applied directly on the eyes	Ophthalmia/treatment of migraine and mental diseases/ wound treatment		Oxalic acid	[10,35,37,31,9]
2	Leaves/Roots	Tanzania	Water from the boiled leaves/A decoction of the roots mixed with three other plants	Aids heal of wound and cuts, against pneumonia /treatment of stomach pain and to reduce extensive menstrual bleeding		Oxalic acid	[30,31,15,26,9]
3	Root	Ethiopia	Dried roots are ground into powder, mixed with butter and dressed on affected area/ Half of finger-sized root is chewed to detoxify poison	Skull wound, Snake bite, Snake venation			[1]
4	Whole Plant	Iganga, Uganda	Crushed in water	Malaria		Carotenoids, xanthophylls, Vitamin C, tocopherols and tocotrienols	[48,5,60]
5	The whole plant/ leaves	Southern Ethiopia	Crush, homogenize with cold water and drink	treat anthrax, cough, diarrhea, fashiolsis, FMD, madness, tuberculosis, skin rash and wound			[1] [60]
6	Macerated leaves/mixed with honey	Tanzania	Squeezing by hand, chewing	Sore throat and Cough treatment			[16,15,9]
7	Roots	Tanzania	Decoction of the roots	Treatment of hernia, appendicitis and uvulitis/used in treatment of excessive bleeding/ irregular and painful menstruation		Saponins and tannins	[16,15,40,9]
8	Leaves/Tuber	Uganda	Boil leaves & bath or infusion mixed with local brew drunk	Hook worms, tape worms			[32,34]
9	Leaves sap	Kenya, Cameroon	Soup prepared from the sap of the leaves	Tuberculosis, arthritis, Stomachache			[22,38,12]
10	Leaves	Ethiopia	Pounded leaves	Rabies, Congenital abnormality			[52]
11	Roots/tubers	Tanzania, kenya	Porridge with the dried inner part of the roots/ A decoction of the tubers is drunk warm	Eaten against enlarged spleen, stomachaches, migraine, mental disease and to prevent abortion for treatment of syphilis, abdominal pain during pregnancy and 'tambazi' (Swahili), a joint disease usually affecting the knee or the shoulder and characterized by internal pain and external swelling.		Saponins and tannins	[16,15,26,9,41]

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Table 2 (continued)

	Parts used	Country	Preparation	Ethnopharmacology	Other uses	Isolated compounds	References
12	Leaves	Uganda	Infusion smeared on infected area, infusion drunk	Genital warts, induce labor, Measles			[49,40]
	Whole Plant	Central, Uganda	½ glass 3 times a day for 1 month	Management of Hernia			[42]
13	Leaf and Root	Uganda	Strong infusion of the leaves/ a mild decoction of the root / plant part is crushed and packed into or onto the surface of the skin or over a wound.	Yellow fever, boils, tapeworm and septic wounds			[29]
14	Leaves	East Africa	Leaf decoction and leaves heated over fire	Reduce swelling and cure pneumonia		Oxalic acid	[26,9]
15	Leaves and Roots	East Africa, Kenya	Decoction of the roots /Infusion of the leaves/ the leaves are heated over a fire. They are also put on the chest as a poultice/An infusion of the boiled leaves	Purgative and treatment of swollen abdomen /applied as a poultice to swellings/in the treatment of pneumonia		Oxalic acid	[38,59,39]
16	Leaves and Roots	DR Congo	Macerated Roots/ cooked or concoction of the leaves	Taken against tapeworm and cure for malaria/ head ache, abscess		Tannins	[40]
17	Roots/Tubers	Ghana, Gabon and East Africa	Paste made from the Roots/the pounded roots is mixed ointment and rub on the surface/ A paste from the tubers	Reduce swelling and draw abscesses/ poultice to draw out abscesses and to reduce swellings			[39]
18	Roots	Ghana, Gabon and East Africa	Decoction of the roots	Syphilis and abdominal pain and to prevent abortion.			[35]
19	Leaves	Burkina Faso, Senegal and Guinea Bissau	Concoction of the leaves and leaves	Diarrhea of the blood			[59]
20	Fresh roots/ Fresh roots without bark./ Fresh or dried roots.	Somalia	A piece of the root, three fingers wide, is boiled with two glasses of water/One kilogram of the powdered root is boiled with two glasses of water/the roots are crushed or powdered and mixed with cold water.	Against dysmenorrhea and to treat sterility in women.			[26]

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Table 2 (continued)

	Parts used	Country	Preparation	Ethnopharmacology	Other uses	Isolated compounds	References
21	Leaves/Root-bark		Leaves are powdered and root-bark boiled and taken orally as an infusion half a glass (150 ml) once a day until recovery. Usually taken together with <i>Phyllanthus fischeri</i> Pax leaves and stem bark, <i>Hippocratea africana</i> (Willd.) Loes. leaves and roots, <i>Spermacoce princea</i> leaves and <i>Solanecio mannii</i> (Hook.f) C. Jeffrey leaves	Colorectal/breast/ skin cancer			[19]
22	The whole plant/Leaves	Uganda	leaves crushed in water/ the boiled plant is	applied to wounds for healing	Used as trap crop against <i>Taylorilygus vosseleri</i> an insect pest of cotton, used as an insecticide against chicken lice		[27,55]
23	Leaves/Stem/Roots	Kenya	Boiled roots	Roots is a remedy for the prevention of abortion	Used to make water safe for drinking for cattle		[58]



Fig. 1. *C. adenocaula* vegetative distribution in Africa.



Fig. 2. *C. adenocaula* plant.

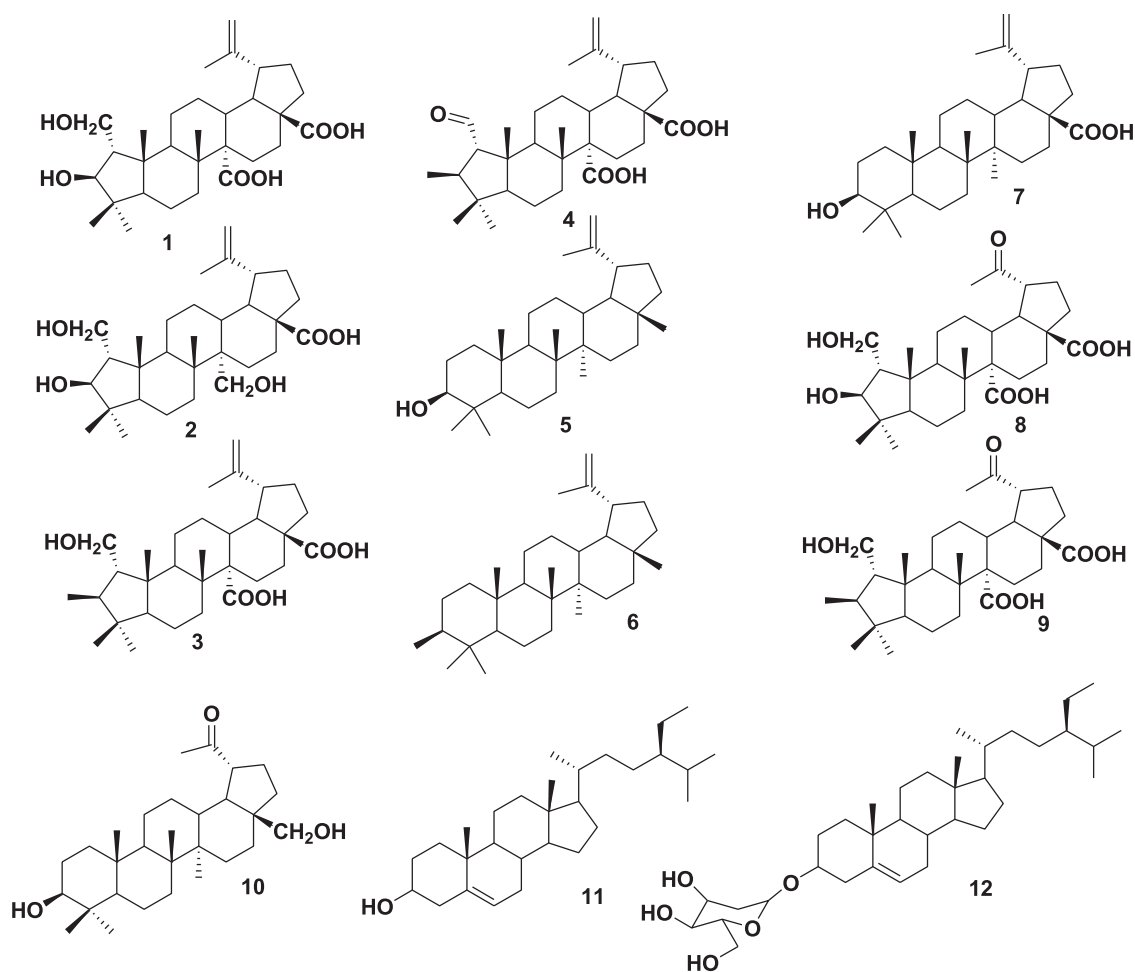


Fig. 3. Isolated Compound from *Cissus adenocaulis*.

Anti-inflammatory activity

Membrane stabilizing potential of ethanolic extracts of the leaf and root of this medicinal plant were evaluated by some authors. Both extracts protect red blood cell (RBC) membrane against hypotonic and heat induced lyses in a concentration dependent manner. The modes of action were monophasic at various concentrations assayed and were comparable to the standard non-steroidal anti-inflammatory drug used as positive control. The extracts possess appreciable anti-inflammatory potential [3].

Antimicrobial activity

Hamill et al. [28] carried out a survey of antimicrobial medicinal plants in Southern Uganda and *C. adenocaulis* (Steud) was selected as one of the plants used traditionally in that area against microorganisms. The crude methanolic extracts of the *C. adenocaulis* was screened against eight microorganisms i.e. *Escherichia coli* ATCC25922, *Pseudomonas aeruginosa* ATCC27853, *Candida albicans* ATCC14053, *Staphylococcus aureus* ATCC29213, *Staphylococcus aureus* NCRL, *Staphylococcus epidermidis* NCRL, *Staphylococcus faecalis* ATCC29212, *Bacillus subtilis* NCRL. Though, the extract of this plant displayed a poor susceptible to inhibition or killing towards the tested organisms [28].

Other important uses

Insecticides

The used of *C. adenocaulis* as trap crop against *Taylorilygus vosseleri* an insect pest of cotton has been reported, when cotton field is treated with insecticide to prevent the growth of great populations of the pest, *Cyphostemma adenocaulis* was

discovered to give significant defence and protection to the cotton crop in Uganda and water collected from the soaked leaves of *C. adenocaulis* is used as an insecticide against chicken lice [27,55].

De-worming of live-stocks

Tumwesigye [32] studied the deworming property of fresh and dry extract of *Cissus adenocaulis* on cows. The leaves and roots of this medicinal plant were collected, some were air-dried and grounded in powder while others were employed fresh. These were dissolved in water and given to the cows at various dosages. Egg count per gram (ECG) of the cows' dung were carried out in the laboratory, treatment was done for eight weeks and fourteen days on the first and second set cows respectively. The extracts of the dry leaves and roots proved to be more effective (unpaired *t*-test with equal variance at (=1%; *t* = 1.7889; associated *p* value = 0.0741)) than the positive control drug employed (Albendazole) [32].

Conclusion

Cissus adenocaulis is widely dispersed around the world mostly in Africa, as this review noticed, it is mostly regarded as non-cultivated or wild vegetable. Its medicinal importance is well pronounced as well as its culinary applications in these countries. Though, its traditional uses are much studied in this review yet pharmacological studies and reports are very scanty, the phytochemistry of this species is few (only twelve compounds isolated), nutritional justifications are few and these few studies could not give enough and strong reasons why it could be better than the common and cultivated vegetables. Therefore, there is need for further and in-depth research on the usefulness of *Cissus adenocaulis* and its compounds whether it could be employed as the base ingredient for health products or dietary supplements.

Conflicts of interest

No conflicts of interest among the authors.

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Supplementary material

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