

Uses, Phytochemistry, and Pharmacological Properties of *Scorodophloeus zenkeri*

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Abstract

Scorodophloeus zenkeri is an aromatic plant of the Caesalpiniaceae family distributed exclusively in a few countries in tropical Africa. The literature provides little information on *S. zenkeri*. Hence the idea to list in this mini-review the scientific data of ethnobotanical, phytochemical, and biological activity studies published on this plant. The majority of the ethnobotanical data collected reveals that *S. zenkeri* is used in the food, medicinal, stimulant, condiment, construction, and carpentry sectors. Furthermore, phytochemical studies show that *S. zenkeri* is a source of phytoconstituents and/or nutrients (proteins, amino acids, essential fatty acids, mineral salts, antioxidants, etc.) that are essential in nutrition and/or can be used in food (as a food additive), pharmaceutical and cosmetic industries. However, most phytochemical studies carried out on *S. zenkeri* focus only on its essential oils and show that the latter is composed mainly of sulfur compounds which are responsible for the aromatic potential (flavor and odor) of extracts from this plant. In addition, various scientific data from biological screenings carried out on *S. zenkeri* indicate that the extracts of this plant have antimicrobial, antioxidant, and anticancer activities. The essential oils of *S. zenkeri* are considered to be responsible for most of the pharmacological actions reported on this plant. *S. zenkeri* has, in addition to the flavor it imparts to foods, an interesting nutritional potential and is a source of proteins, essential fatty and amino acids, antioxidants, and minerals. It also has interesting functional properties and pharmacological virtues.

Keywords: *Scorodophloeus zenkeri*, Uses, Phytochemistry, Bioactivities, DRC

INTRODUCTION

Scorodophloeus genus comprises only 3 species confined to tropical Africa: *S. zenkeri*, *S. fischeri*, and *S. torrei* Lock [1]. *S. zenkeri*, is a small tree widespread in Central African mature rainforests. It is distributed in several African countries like Equatorial Guinea, Gabon and Cameroon, the Republic of Congo, and the Democratic Republic of Congo (DRC), but also in Angola (Cabinda) and Nigeria [1-3]. Latham *et al.* [4] and Malumba *et al.* [5], reported that *S. zenkeri* Harms occurs in all provinces of the DRC and Central Africa. In DRC, the tree grows in the provinces of Mayombe, Kasai as well as in Central Congo, Kisangani, etc. The trees grow in forests, on firm soils, and in groups [6, 7]. In Cameroon, it is found in the Atlantic and Dja evergreen forests. The garlic tree is found in forest environments. *S. zenkeri* grows well in light soils and badly in soils that become waterlogged, even temporarily. The tree is easily propagated by seed, which can be sown in nursery beds 2-3 cm deep in deep, loose soil. Germination is usually rapid and the germination rate is high. Seedlings are transplanted when they are 2-3 years old and 1.5-2 m high; it is recommended to stake the young plants [8, 9]. Seeds can also be sown directly in the field [1, 2, 4, 10].

S. zenkeri can reach 25-45 m in height and up to 200 cm in diameter; open crown with erect branches; straight, more or less cylindrical stem; slightly thickened base with grooves. Its leaves are composed of 10 to 20 small, asymmetrical, and alternate leaflets, oblong and ending in a point. Each leaflet is 3.5 to 4.5 cm long and 1.3 to 2 cm wide. They are sessile and their apex is more or less rounded at the base. The leaves are shiny above, dull, and lighter below; the main vein stands out prominently on the underside of the leaflets. Naturally, the leaves fall off during the dry season. It has an

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inflorescence in dense axillary or terminal clusters of 5-8 cm. Their white, small, hermaphrodite flowers consist of 4 sepals about 6 mm long, 5 petals, obovate 9-10 mm long, 5 stamens, and an ovary with 2 ovules. The flowers are borne in dense clusters 5-8 cm long. Its fruits are flat, oblong pods, about 10 cm long, pale green, smooth, and apiculate, with a sutural margin ending in a ridge on each side [4]. The fruits of *S. zenkeri* are black when dry. They contain only one dark-colored, oval, flattened, brown, shiny seed, about 2 cm in diameter. In the dry season, the pods burst and shed their seeds [4]. The bark of young trees is smooth, pale, greyish yellow, then scaly, about 1 cm thick, brittle, and yellow with a garlic smell. The whole tree, and especially the bark, has a characteristic garlic smell, especially after rain; this smell is related to the presence of sulfur compounds [4, 11, 12].

The literature contains several publications on *S. zenkeri* in relation to other species of the *Scorodophloeus* genus mentioned above. However, until now, little work has been carried out on *S. zenkeri* Harms. This review article aims to compile data from ethnobotanical, phytochemical, and

pharmacological studies carried out on extracts of *S. zenkeri* [13, 14]. The aim is to update the information on this species which valorizes this plant and will pave the way out for in-depth studies.

Literature Review Method

Several databases were used such as PubMed, PubMed Central, Science Direct, Scielo, DOAJ, Science Alert, and Google Scholar to identify data on the uses, chemical composition, and biological activities of *S. zenkeri*. The scientific name of the plant or the combination of different terms such as biological activity, phytochemistry, and uses with the scientific name of the plant were used as keywords during the literature search.

Literature Review Results

Taxonomical Classification of *S. zenkeri*

Uses of *S. zenkeri*

The table below shows the different uses of *S. zenkeri*.

Table 1. Uses of different organs of *S. zenkeri*

Part used	Uses	References
Wood	- Used in carpentry or to produce charcoal, or in food as a condiment - Used as a condiment and gives a garlic taste to food - The infusion of the bark is taken for constipation, and headaches, in Gabon - Crushed bark is used for headaches; it is also used as a fumigant to treat rheumatism,	[1, 4, 15]
Barks	- Bark decoction can be used orally, in a steam bath or sitz bath, or vaginally to treat bronchitis, genito-urinary problems, anaemia, or as an aphrodisiac, urinary antiseptic, antihelmintic, or against complications of measles, - Bark macerate has a purgative potential and is also used to treat wounds, spleen enlargement, nasal instillation headaches and backaches, - Extracts of the bark are used with that of <i>Aframomum melegueta</i> to treat hemorrhoids, diabetes, and obesity.	[3, 5, 15]
Leaves	- Young leaves are used as a condiment or consumed as a vegetable; - Leaf decocts are used to treat anaemia, urinary tract infections or as an antihelmintic	[1, 3, 5, 15]
Seeds	- These are dried and ground into a paste or powder and then used as a condiment to flavor dishes; - Seeds are also used in traditional medicine to treat hookworm infection or to relieve long and painful periods	[4, 5]
nd	- The use of <i>S. zenkeri</i> extracts mixed with chili or bitter aubergine to treat colds and coughs have been reported in the literature.	[3, 15]

The wood, fruit, leaves, and bark of *S. zenkeri* have multiple uses. They are used in the food, medicinal, stimulant, and condiment sectors, as well as in construction and carpentry. In traditional medicine, the different parts of *S. zenkeri* are used individually or in combination with other plants to treat various ailments. The wood, bark, young leaves, and seeds of *S. zenkeri* are used as a condiment; they give a garlic taste to

food. The local population in DR Congo uses *Olox gambecola* and *Hua gabonii* as a substitute for *S. zenkeri* [4].

Phytochemical Composition

The table below presents the data on the macronutrient composition of bark and fruit of *S. zenkeri*, (g/100 g of dry matter) as reported in the literature.

Table 2. Nutritional values of different organs of *S. zenkeri* (g/100 g dry matter)

Part used	Proteins	Fats	Carbohydrates	Fibers	Total Ashes	Water (%)	References
Barks	15.17 ± 0.01	1.18 ± 0.05	16.57 ± 1.02	54.73 ± 0.20	9.04 ± 0.16 to 9.2 ± 0.09	11.1 ± 1.1	[10]
Fruit	17.87 ± 0.04	4.59 ± 0.10	71.75 ± 1.40	4.17 ± 0.01	2.50 ± 0.01 to 9.5.5 ± 0.05	4.4 ± 1.2	[12]

The table below shows the essential amino acid composition of *S. zenkeri* fruits and peels.

Table 3. Determination of the essential amino acid composition expressed as a percentage per 100 g of dry matter

Part used	Total essential amino acids	histidine	methionine + cysteine	threonine	isoleucine	Leucine	lysine	Phe + Tyr	References
Barks	45.62±0.28	3.18±0.04	11.11±0.03	39.41±0.04	13.59±0.04	6.64±0.04	5.88±0.06	-	[10]
Fruit	79.81±0.14	10.7±0.06	-	-	8.76±0.03	9.79±0.03	12.33±0.06	4.04±0.03	[10]

The table below shows the micronutrient composition of the fruits and barks of *S. zenkeri*.

Table 4. Determination of micronutrient composition expressed per 100 g of dry matter

Part used	Iron (mg)	Calcium (mg)	Magnesium (mg)	Phosphorus (mg)	Potassium (mg)	Manganese (mg)	Sodium (mg)	Selenium (µg)	Zinc (mg)	Copper (mg)	Aluminium (mg)	References
Barks	4.66 – 5.9	223.6 -2789.35	22.5- 2800.65	1.36 ± 0.0	367.8	20.5	6.5	110.0	0.8	0.07	4.1	[10, 12]
Fruit	0.29-44.8	87.0-8789.13	145.2-228.28	8.88	288.8	10.1	31.1	310.0	6.7	0.25	10.1	[10, 12]

The table below shows the composition of polyphenolic compounds contained in the fruits and barks of *S. zenkeri*.

Table 5. Composition of polyphenolic compounds

Part used	Total polyphenols (g gallic acid/100g)	Flavonoids (mg rutin/100g)	Tannins (mg tannic acid/100g)	Proanthocyanidins (mg leucoanthrocynidine/100g)	References
Barks	13.4±0.14	1.75±0.09	125.17±0.68	7.69±0.29	[10]
Fruit	4.46±0.10	0.44±0.01	101.69±0.79	9.21±0.25	[10]

The table below shows some of the constituents of essential oils from the seed and sulfur compounds contained in *S. zenkeri* oils.

Table 6. Sulfur compound composition of *S. zenkeri* oils

Compounds	Contents	References
Constituents of essential oils		
Phenylpropanoids	1.6	[3]
Monoterpene hydrocarbons		
eugenol	1.6	[3]
limonene	0.2	[3]
(E)-b-ocimene	02	[3]
Sulfur Compounds		
2,4,5,7-tetrathiaoctane	51.5	[3]
2,3,5-Trithiahexane	24.2	[3]
2,4,5,6,8-pentathianonane	9.0	[3]
2,3,4,6-tetrathiaheptane	6.2	[3]
2,4-dithiapentane	trace amount	[3]
2,3,4-trithiapentane	0.6	[3]

1,3,5-trithiacyclohexane	trace amount	[3]
3-methyl-2,4,5-trithiahexane	0.1	[3]
3,6-dimethyl- 2,4,5,7-tetrathiaoctane	0.3	[3]
2,4,6,8,10-pentathiaundecane	2.3	[3]
alkylthiosulfide	nd	[5]
1,3,5-trithiahexane 5-oxyde	nd	[5]
2,4,5,7-tetrathiaoctane 2-oxyde	nd	[5]
S-(méthylthiométhyl)-methanesulfonylthioate	nd	[5]
methylthio(méthylthio-méthyl)sulfon	nd	[5]
2,3,5,7-tetrathiaoctane 3,3-dioxyde	nd	[5]
méthylsulfonylméthylthiométhane	nd	[5]
méthylmethanethiosulfonate,	nd	[5]
bis-méthylsulfonylméthane	nd	[5]
bis-(méthylthiométhyl)sulfone	nd	[5]
pentathianonanes,	nd	[5]
hexathiaundecanes,	nd	[5]

Bahati [16], showed that the bark of *S. zenkeri* has a large amount of alkaloids, tannins, saponins, terpenes, and sterols; however, he revealed a small amount of quinones. Fongang *et al.* [3], isolated sulfur compounds, flavonoids, and tannins from *S. zenkeri* seeds and barks. The study of Tchiégang *et al.* [12], revealed that the fruits of *S. zenkeri* fruits have high contents of lipids (4.59 ± 0.10 g/100 g DM), proteins (17.87 ± 0.04 g/100 g DM), total carbohydrates (71.75 ± 1.40 g/100 g DM) and phosphorus (8.88 ± 0.0 mg/100 g DM) compared to those of the bark (lipids: 1.18 ± 0.05 g/100 g DM; protein: 15.17 ± 0.01 g/100 g DM; total carbohydrates: 16.57 ± 1.02 g/100 g DM and phosphorus (1.36 ± 0.0 mg/100 g DM). Although the peels showed high contents of fibres (54.73 ± 0.20 mg/100 g DM), total ash (9.04 ± 0.16 g/100 g DM), iron (4.66 ± 0.30 mg/100 g DM), Ca (2789.35 ± 0.92 mg/100 g DM) and Magnesium (2800.65 ± 0.57 mg/100 g) compared to those of the fruits (crude fiber: 4.17 ± 0.01 g/100 g DM; total ash: 2.50 ± 0.01 g/100 g DM; Iron: 0.29 ± 0.01 mg/100 g DM; Ca: 89.13 ± 0.21 mg/100 g DM; Magnesium: 228.28 ± 0.35 mg/100 g).

Other studies, including that of Abdou [10], have shown that the bark of *S. zenkeri* bark has the following contents: water ($11.1 \pm 1.1\%$), calcium (223.6 ± 10 mg/100g), potassium (367.8 ± 14.7 mg/100g), manganese (20.5 ± 1.1 103 μ g/100g), total polyphenols (13.4 ± 0.14 g gallic acid/100g), flavonoids (1.75 ± 0.09 mg rutin/100g); tannins (125.17 ± 0.68 mg tannic acid/100g) and vitamin C (2.41 ± 0.24 g/100g) high compared to fruit (water: $4.4 \pm 1.2\%$), calcium: 87.0 ± 3.4 mg/100g, potassium: 288.8 ± 11.0 mg/100g, manganese: 10.1 ± 0.5 103 μ g/100g), total polyphenols: 4.46 ± 0.10 g gallic acid/100g, flavonoids: 0.44 ± 0.01 mg rutin/100g, ; tannins: 101.69 ± 0.79 mg tannic acid/100g) and Vitamin C (1.40 ± 0.16 g/100g).

In addition, the work of Abdou [10], revealed that the contents of ash ($9.5 \pm 0.05\%$), magnesium (145.2 ± 6.7 mg/100g), sodium (31.1 ± 1.4 mg/100g), selenium (310.0 ± 15.5 μ g/100g), zinc (6.7 ± 0.3 103 μ g/100g), copper (0.25 ± 0.01 103 μ g/100g) aluminum (10.1 ± 0.4 103 μ g/100g), iron (44.8 ± 2.1 103 μ g/100g), vitamin A (11.45 ± 0.03 mg/100g), vitamin E (1.65 ± 0.10 mg/100g) and proanthocyanidins (9.21 ± 0.25 in mg leucoanthocynidin/100g), are higher in the fruit compared to the rind (ash: $9.2 \pm 0.09\%$, magnesium: 22.5 ± 0.9 mg/100g, sodium: 6.5 ± 0.2 mg/100g, selenium: 110.0 ± 5.5 μ g/100g, zinc: 0.8 ± 0.05 103 μ g/100g, copper: 0.07 ± 0.00 103 μ g/100g, aluminum: 4.1 ± 0.2 103 μ g/100g, iron: 5.9 ± 0.3 103 μ g/100g, vitamin A: 4.56 ± 0.06 mg/100g, vitamin E: 0.51 ± 0.01 mg/100g and proanthocyanidins: 7.69 ± 0.29 in mg leucoanthocynidin/100g).

Furthermore, Abdou [10], showed in his study that the rind and fruit of *S. zenkeri* constitute a good source of protein and essential amino acids. The author showed that the fruit of *S. zenkeri* has a content of total protein ($13.97 \pm 0.12\%$) and essential amino acids ($79.81 \pm 0.14\%$ of total protein) compared to the bark of the plant (protein: $12.17 \pm 0.74\%$, total essential amino acids: $45.62 \pm 0.28\%$). Regarding the

characterization of essential amino acids, Abdou [10], revealed the presence of histidine ($10.7 \pm 0.06\%$), isoleucine ($8.76 \pm 0.03\%$), leucine ($9.79 \pm 0.03\%$), Phe + Tyr ($4.04 \pm 0.03\%$), lysine ($12.33 \pm 0.06\%$) in *S. zenkeri* fruits and also, the presence of histidine in the bark of the plant. *S. zenkeri* fruits and also, the presence of histidine ($3.18 \pm 0.04\%$), Meth + Cysteine ($11.11 \pm 0.03\%$), threonine ($39.41 \pm 0.04\%$), isoleucine ($13.59 \pm 0.04\%$), leucine ($6.64 \pm 0.04\%$) and lysine ($5.88 \pm 0.06\%$), in the peels. These essential amino acids are not synthesized by the body and are essential for its proper functioning. A diet rich in essential amino acids is strongly recommended by dieticians [10, 17].

In addition, Abdou [10], determined the fatty acid composition of *S. zenkeri* oils and showed that the oils of this plant consist of fatty acids with chains ranging from 8 to 24 carbons and particularly unsaturated fatty acids. In general, unsaturated fatty acids belong dietary to three main series: ω -3 and ω -6 and ω -9. The ω -3 are found mainly in fish oils and some vegetable oils, while the ω -6 are found mainly in vegetable oils. *S. zenkeri* fruits are rich in ω -3 fatty acids (35.65%) while the bark of *S. zenkeri* is rich in ω -6 fatty acids (13.03%) also called linoleic acid (C18:2n6C) [10]. The ω -3 are of the series of fatty acids that play an important role in the development and maintenance of the different organs in general, precisely the brain, and intervene in the prevention of various pathologies such as cardiovascular, psychiatric, neurological, dermatological diseases and rheumatological disorders [10, 18-20]. Oils with linoleic acid reduce atherosclerosis through interaction with HDL in the blood and cholesterol levels by about 10% [10, 20]. Some polyunsaturated fatty acids such as linoleic acid, linolenic acid (ω -6) and arachidonic acid known as vitamin F are necessary for skin growth and protection and are incorporated, at about 5%, in some dermatological creams, especially in tanning lotions [10].

Lemmens *et al.* [1] and Malumba *et al.* [5], reported that *S. zenkeri* seeds have about 12% of lipids or fat. According to Bayala *et al.* [21], the seed oils of *S. zenkeri* are mainly composed of sulfur-containing compounds, accounting for 91.0 to 96.1% of them which provide typical garlic- and onion-like odors of spices. They are principally represented by 2,4,5,7-tetrathiooctane (51.5%), 2,3,5-Trithiahexane (24.2%), 2,4,5,6,8-pentathianonane (9.0%), and 2,3,4,6-tetrathiaheptane (6.2%). Phenylpropanoids (1.6%) and monoterpene hydrocarbons (0.5%) were present only in small amounts. However, Fongang *et al.* [3], revealed that some volatile compounds detected in the seed sample used in their studies: 2,4-dithiapentane (trace amount), 2,3,4-trithiapentane (0.6%), 1,3,5-trithiacyclohexane (trace amount), 3-methyl-2,4,5-trithiahexane (0.1%), 3,6-dimethyl-2,4,5,7-tetrathiooctane (0.3%), and 2,4,6,8,10-pentathiaundecane (2.3%), were missing in the bark oil.

Moreover, Kouokan *et al.* [11, 22] highlighted some alkylthiosulphides reported by previous studies (2,3,5-trithiahexane, 2,4,5,7-tetrathiooctane, etc.) and other new

sulfurous or non-sulfurous compounds (pentathianonanes, hexathiaundecanes, etc.). They also identified oxygenated compounds containing sulfur (sulphoxides), like 1,3,5-trithiahexane 5-oxide and 2,4,5,7-tetrathiaoctane 2-oxide; three new sulphones: S-(methylthiomethyl)-methanesulfonylthioate, methylthio(methylthio-methyl) sulfone and 2,3,5,7-tetrathiaoctane 3,3-dioxide as well as four already known compounds belonging to the sulphone family: methyl-sulphonylmethylthiomethane, methylmethanethiosulfonate, bis-methyl-sulphonyl methane and bis-(methylthiomethyl) sulfone. These molecules (S-compounds) extracted in *S. zenkeri*, play an important role in determining the flavor and odor properties of many foodstuffs such as garlic and onion, in which they also constitute a source of antioxidants. According to the literature, some of these compounds have anti-cancer properties [1, 3, 5, 10, 11, 16, 22].

Dimethyldisulfide ($C_2H_6S_2$), found in the species from DRC, is commonly used as an additive in the food industry and is used in the preparation of cheeses, soups, fruit juices, and meat. It is also used as a sulphidizing agent in refineries and as a pesticide in the United States of America (USA). Then, 3,5-dimethyl-1,2,4-trithiolane ($C_4H_8S_3$) is used as a meat flavoring agent in the food industry, while tris(methylthio)methane ($C_4H_{10}S_3$) is used as a reaction intermediate in the pharmaceutical industry and in the synthesis of sulfur compounds used in pharmaceuticals [5]. Different studies using samples of *S. zenkeri* collected in DRC and Cameroon have shown the presence of different sulfur compounds. The profile and distribution of chemical compounds also vary according to the organ [1, 3, 5, 10, 11, 16, 22].

Biological Activities

The data concerning the biological actions of *S. zenkeri* are recorded in the table below:

Table 7. Biological activities of different organs of *S. zenkeri*

Parts used	Biological actions	References
Stem bark	- Antifungal, antibacterial, antioxidant, Action against Trypanosoma brucei and Leishmania infantum	[1, 3, 10, 23]
Fruit	- Antioxidant	[1, 3, 23]
Seeds	- Antioxidant	[1, 3, 23]

In addition to the antifungal, antibacterial, antiparasitic, and antioxidant actions of *S. zenkeri* extracts, the literature also informs us that the essential oils of this plant have an action against several types of cancers [10, 21, 24]. The study of Bayala *et al.* [21] and Fongang *et al.* [3], revealed that *S. zenkeri* oils have a strong inhibitory effect on the growth of human cancer cells, namely, T98G (human glioblastoma multiforme cell line), MDA-MB 231 (human breast

adenocarcinoma cell line), A375 (human malignant melanoma cell line), and HCT116 (human colon carcinoma cell line) cells.

Moreover, sulfur-containing compounds have been proven to exert cancer chemopreventive effects by induction of apoptosis in tumor cells [21]. So, 2,4,5,7-tetrathiaoctane; 2,3,5-trithiahexane; 2,4,5,6,8-pentathianonane; 2,3,4,6-tetrathiahepta were mentioned by Sharma *et al.* [25], as having an anti-cancer activity (human breast). Abdou [10], showed in his study that *S. zenkeri* extracts had a low antioxidant potential. Oils extracted from the bark of *S. zenkeri* have shown activity against fungi and bacteria. The antioxidant activity of extracts from the bark, fruit, or seeds has also been reported [1, 10].

Badawe *et al.* [26], showed that methanolic extracts of *S. zenkeri* seeds exhibit activity against resistant strains of *S. aureus*. Methanolic extracts of *S. zenkeri* are likely to optimize the action of certain antibiotics on resistant phenotypes of *S. aureus*. *S. zenkeri* could be used in combination with some antibiotics to combat bacterial resistance to antibiotics (tetracycline, chloramphenicol, ceftriaxone, etc.) [26]. Moreover, organosulfur compounds possess antioxidant activity (good DPPH and ABTS-scavenging activity); this is due to their S-atoms, which can appear in up to ten different oxidation states [16].

Kouokan *et al.* [27], identified several sulfur compounds with antibacterial or antifungal potential such as 2,4,5,7-Tetrathiaoctane; 2,4,5,6,8-pentathianonane; 2,3,4,6,8-pentathianonane; 2,3,5,6,8,10-hexathiaundecane, 2,3,5-trithiahexane 5-oxide; 2,4,5,7-tetrathiaoctane 2-oxide; 2,3,5,7-tetrathiaoctane 3,3-dioxyde and 2,3,5-trithiahexane 3,3-dioxyde. These compounds have effects not only on the growth of microorganisms but also on the synthesis of cellular ATP.

CONCLUSION

S. zenkeri is a tropical African plant commonly used by the population of Gabon, Cameroon, DRC, and the Republic of Congo in food as a condiment, in traditional medicine (alone or in combination with other plants) to relieve various ailments such as colds, coughs, headaches, rheumatism, bronchitis and genito-urinary problems, measles, constipation, wounds, enlargement of the spleen, nasal instillation, stomach aches, hemorrhoids, long and painful periods, anemia, or as an antihelminthic and purgative. Besides the food and medicinal sector, *S. zenkeri* is also used in construction for its wood and as an aphrodisiac.

Data from phytochemical studies inventoried in this mini-review show the presence of some secondary metabolites (alkaloids, tannins, saponins, flavonoids, terpenes, and sterols) as well as macros and micronutrients that are essential in nutrition and the prevention of chronic non-communicable diseases (cancers, cardiovascular diseases, etc.). These

essential oils are mostly composed of sulfurous phytoconstituents and can be used in the pharmaceutical, agri-food, or cosmetics industries. However, further phytochemical and biological studies are needed to: (i) scientifically justify the above-mentioned uses of *S. zenkeri*, (ii) characterize the secondary metabolites (alkaloids, flavonoids, tannins, essential oils, etc.) of *S. zenkeri*, (iii) identify the active ingredients of *S. zenkeri*, apart from the essential oils, and highlight their synergistic action or mechanism of action, and (iv) evaluate the toxicity of *S. zenkeri* extracts. We also recommend that scientists promote the use of *S. zenkeri* by local populations in African countries because of its nutritional potential (source of proteins, essential fatty and amino acids, micronutrients, and antioxidants) and its pharmacological virtues.

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