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Zanha golungensis Hiern (Sapindaceae): review of its botany, medicinal uses and biological activities

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Abstract

Zanha golungensis is a medium-sized to large tree widely used as herbal medicine throughout its distributional range in tropical Africa. This study was aimed at providing a critical review of the botany, medicinal uses and biological activities of *Z. golungensis*. Documented information on the botany, biological activities and medicinal uses of *Z. golungensis* was collected from several online sources which included BMC, Scopus, SciFinder, Google Scholar, Science Direct, Elsevier, Pubmed and Web of Science. Additional information on the botany, biological activities and medicinal uses of *Z. golungensis* was gathered from pre-electronic sources such as book chapters, books, journal articles and scientific publications sourced from the University library. This study showed that the bark, leaves, roots, stem bark and twigs of *Z. golungensis* are mainly used as herbal medicine for facilitating childbirth and pregnancy disorders, gastro-intestinal problems, toothache, analgesic, inflammation and pain, wounds and sores, broken limbs and sprains, fever and malaria, respiratory problems and headache. Pharmacological research revealed that the leaf and stem bark extracts of *Z. golungensis* exhibited antibacterial, antioxidant and molluscicidal activities. *Zanha golungensis* should be subjected to detailed phytochemical, pharmacological and toxicological evaluations aimed at correlating its medicinal uses with its phytochemistry and pharmacological activities of the species.

Keywords: Ethnopharmacology, herbal medicine, indigenous pharmacopeia, Sapindaceae, *Zanha golungensis*

INTRODUCTION

Zanha golungensis Hiern is a medium-sized to large tree belonging to the Sapindaceae or soapberry family. Family Sapindaceae consists of 138 genera and about 2000 accepted species.[1,2] These species are mostly trees, treelets, shrubs, lianas or herbaceous climbers characterized by multiple vascular cylinders growing in tropical, subtropical and sub-temperate areas.[3] Some species of the Sapindaceae family are characterized by natural products such as saponins, flavonoids, triterpenes, caffeine, xanthenes, cathequines and cyanolipids.[4-12] Cyanolipids are known to exhibit a potential hazard to humans and animals but may have a protective physiological role.[2] Some species of the Sapindaceae family are characterized by antimalarial, antimicrobial, antioxidant, antimigrane, anti-inflammatory, anti-ulcerogenic, anti-cancer, antiolytic, analgesic, anti-trichomonas, anti-diabetic, hepatoprotective, insecticidal, molluscicidal, piscicidal and spermacidal properties.[2,12-21] Members of the Sapindaceae family are regarded as important plant resources in West Africa due to their multiple uses as food plants and herbal medicines.[22] Several species of Sapindaceae that are of economic importance such as fruit trees or herbal medicines such as *Blighia sapida* K.D. Koenig are known to be highly toxic when eaten unripe[23] and species of *Paullinia* L. have been reported to be useful in the preparation of fish, human and arrow poisoning.[24,25]

Zanha Hiern is a genus of three species confined to east, central and southern Africa and Madagascar.[3,26-41] The fruits of all the three *Zanha* species are edible[3,42-48] but their seeds contain acid saponin which is believed to be poisonous if swallowed.[45,46] *Zanha golungensis* is a multipurpose tree species used as a source of edible fruits, timber for construction, household furniture, agricultural implements and also widely collected as firewood and herbal medicine.[45] The fruits of *Z. golungensis* are eaten by both humans and animals in the Democratic Republic of Congo (DRC), Malawi, Togo and Uganda.[42,44,49-53] *Zanha golungensis* is categorized as a multipurpose tree species in Mozambique and a priority for conservation.[54] Similarly, *Z. golungensis* is categorized as a multipurpose species in Tanzania[43,55] and Uganda where it is used as a source of timber and herbal medicines, and in need of conservation as it is over-exploited.[56] *Zanha golungensis* is threatened with extinction in Benin[57] mainly due to over-exploitation as herbal medicine[58,59] and firewood.[60] *Zanha golungensis* is an important medicinal plant in tropical Africa[61-63] and its leaves are sold in informal herbal medicine markets as traditional medicine for sores in Nigeria.[64] Due to its value as a multipurpose plant species in Togo, *Z. golungensis* is conserved in home gardens as a fruit tree, source of timber and firewood.[65] It is therefore, within this context that the current study was undertaken aimed at reviewing the botany, medicinal uses and biological activities of *Z. golungensis*.

Botanical profile of *Zanha golungensis*

The name *Zanha* is probably in honour of Karl Hermann Zahn (1865 - 1940), a German plant collector and botany professor[66] and the specific name *golungensis* is derived from Golungo Alto in Cuanza Norte province in Angola where the type specimen was collected.[41] The synonym of *Z. golungensis* are *Balsamea fraxinoides* Hiern, *Commiphora fraxinoides* (Hiern) K. Schum., *C. fraxinoides* K. Schum. and *Z. golungensis* Hiern & A. Chev. The English common name of the species is smooth-fruit zanha mainly because the species has hairless fruits and leaves.[29] The genus *Zanha* comprises three species, namely *Z. africana* (Radlk.) Exell., whose distribution overlaps with that of *Z. golungensis* and *Z. suaveolens* Capuron, a small tree species that is endemic to Madagascar.[45] *Zanha* golungensis is a medium-sized to a large, spreading, deciduous and dioecious tree growing

to a height of 40 metres.[26,30,45] The bole is cylindrical, branchless, irregular, sometimes crooked, up to 170 centimetres in diameter,[45] with grey to reddish, smooth to flaking bark and heavily-branched with a dense crown. The leaflets are alternate to sub-opposite, elliptic in shape, hairless, thinly textured and glossy light green in colour. The leaflets have a tapering apex, which is sometimes rounded, often notched, base tapering with entire margins that are often scalloped or bluntly toothed. The inflorescence is a terminal or axillary panicle with a dense cluster of small and inconspicuous flowers that are regular, unisexual, sweet-scented and greenish in colour. The fruits are ovoid in shape, fleshy, hairless drupes that are bright orange in colour that are often produced in large quantities that the branches bend under the weight. The species has been recorded from Senegal east to Ethiopia and Kenya, and south to Zambia, Angola, Namibia, Mozambique and Zimbabwe.[37,45] *Zanha golungensis* has been recorded in well-drained soils in open woodland, deciduous woodland, often on termite mounds, in densely wooded ravines, riparian or fringe forest, in semi-evergreen forest, lowland forest and transitional rainforest at an altitude ranging from 300 m to 1700 m above sea level.[26,34,45]

Medicinal uses of *Zanha golungensis*

The bark, leaves, roots, stem bark and twigs of *Z. golungensis* are mainly used as herbal medicines for facilitating childbirth and pregnancy disorders, gastro-intestinal problems, toothache, analgesic, inflammation and pain, wounds and sores, broken limbs and sprains, fever and malaria, respiratory problems and headache (Table 1, Figure 1). Other medicinal applications recorded in a single country but supported by at least two literature records include use of roots for amenorrhoea,[45,67] hernia,[43,45,67] uterus prolapse[45,67] and use of bark and roots for skin diseases.[43,45,68]

Table 1: Medicinal uses of *Zanha golungensis*

Medicinal use	Parts used	Country	References
Amenorrhoea	Roots	Tanzania	Bosch[45]; Chhabra et al[67]
Analgesic, inflammation and pain	Bark and leaves	Nigeria and Tanzania	Shangali et al.[68]; Schlage et al.[69]; Sofidiya et al.[70]
Broken limbs and sprains	Bark, leaves, roots and twigs	Mozambique, Nigeria and Senegal	Bosch[45]; Sofidiya et al.[70]; Bruschi et al.[71]
Convulsions	Bark	Tanzania	Ruffo et al.[43]
Facilitating childbirth and pregnancy disorders	Bark and roots	Malawi and Tanzania	Ruffo et al.[43]; Morris[50]
Fever and malaria	Bark, leaves, roots, stem bark and twigs	Mozambique, Nigeria and Tanzania	Ruffo et al.[43]; Chhabra et al[67]; Sofidiya et al.[70]; Bruschi et al.[71]; Isaiah et al.[72]
Galactagogue	Bark	Kenya	Kokwaro[73]
Gastro-intestinal problems (constipation, dysentery and stomachache)	Bark, leaves, roots and twigs	Mozambique and Tanzania	Ruffo et al.[43]; Bruschi et al.[71]
General weakness	Bark, leaves, roots and twigs	Mozambique	Bruschi et al.[71]
Headache	Bark, leaves, roots, stem bark and twigs	Malawi, Mozambique, Nigeria and Tanzania	Ruffo et al.[43]; Morris[50]; Chhabra et al[67]; Bruschi et al.[71]; Isaiah et al.[72]
Hernia	Roots	Tanzania	Ruffo et al.[43]; Bosch[45]; Chhabra et al[67]
Impotence	Bark	Tanzania	Ruffo et al.[43]
Intestinal worms	Bark	Tanzania	Ruffo et al.[43]
Mental illness	Bark	Tanzania	Ruffo et al.[43]
Muscular pain	Bark, leaves, roots and twigs	Mozambique	Bruschi et al.[71]
Respiratory problems (catarrh, chest pains, colds and tuberculosis)	Bark, leaves and stem bark	Kenya, Nigeria and Tanzania	Ruffo et al.[43]; Chhabra et al[67]; Shangali et al.[68]; Schlage et al.[69]; Sofidiya et al.[70]; Kokwaro[73]; Bally[74]; Woodcock[75]
Skin diseases (abscesses and fungal infections)	Bark and roots	Tanzania	Ruffo et al.[43]; Bosch[45]; Shangali et al.[68]
Toothache	Bark, leaves, roots and twigs	Ethiopia and Mozambique	Bruschi et al.[71]; Bahru et al.[76];
Uterus prolapse	Roots	Tanzania	Bosch[45]; Chhabra et al[67]
Wounds and sores	Bark, leaves, roots and twigs	Mozambique and Nigeria	Sofidiya et al.[64]; Sofidiya et al.[70]; Bruschi et al.[71]; Fasola and Iyamah[77]; Nworu and Akah[78]

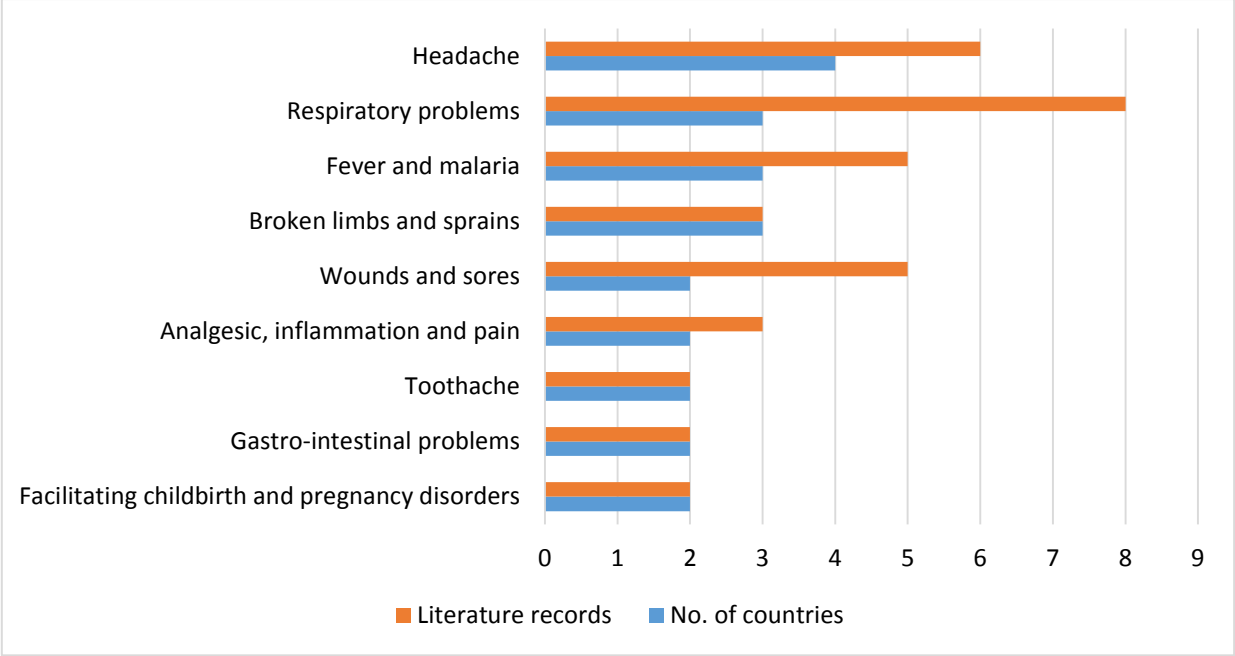

Figure 1. Medicinal applications of *Zanha golungensis* derived from literature records

Phytochemical and nutritional composition of *Zanha golungensis*

Very little attention has been paid to the macro- and micro-elements of *Z. golungensis*. Two reports done by Malaisse[44] and Rogers et al.[49] partly studied this subject and reported values of the nutritional composition of fruits of *Z. golungensis* (Table 2). Triterpenoids, zanhic acid and zanhic acid-y-lactone,[79] and prosapogenins, 3β-0-(4-deoxy-β-D-hex-4-enopyranosyluronic acid), 2β-hydoxy-olean-12-en-23,28-dioic acid and 3β-0-(4-deoxy-β-D-hex-4-enopyranosyluronic acid), 2β, 16α-dihydroxy-olean-12-en-23,28-dioic acid[80] have been isolated from the rootbark of *Z. golungensis*. Lavaud et al.[81] isolated 3-O-β-D-glucuronopyranosyl-zanhic acid, 3-O-(6-O-methyl)-β-D-glucuronopyranosyl-zanhic acid, 3-O-β-D-glucuronopyranosyl-28-O-[α-L-rhamnopyranosyl-(1→2)-β-D-(4-O-acetylfucopyranosyl]-zanhic acid, 3-O-β-D-glucuronopyranosyl-28-O-[α-L-rhamnopyranosyl-(1→2)-β-D-(4-O-3,3-dimethylacryloyl-fucopyranosyl]-zanhic acid, 3-O-β-D-glucuronopyranosyl-28-O-[α-L-rhamnopyranosyl-(1→2)-β-D-(4-O-[3'-S-hydroxy-2'-S-methyl-butyroyloxy]-3-S-hydroxy-2-S-methyl-butyroyloxy)-fucopyranosyl]-zanhic acid, 3-O-β-D-glucuronopyranosyl-28-O-[α-L-rhamnopyranosyl-(1→2)[β-D-xylopyranosyl-(1→3)]-β-D-(4-O-acetyl-fucopyranosyl]-zanhic acid, D-glucuronic acid, D-glucose, D-xylose, L-rhamnose and D-fucose from the root bark of *Z. golungensis*. Future research should focus on evaluating the biological activities of the isolated compounds.

Table 2: Phytochemical and nutritional composition of *Zanha golungensis*

Phytochemical and nutritional composition	Values	Plant parts	References
Acid digestible fibre (%)	11.7 – 20.6	Fruits	Rogers et al.[49]
Calcium (mg/100g)	140.0	Fruits	Malaisse[44]
Condensed tannins (%)	18.7 – 39.5	Fruits	Rogers et al.[49]
Crude protein (%)	3.6 – 5.1	Fruits	Malaisse[44]; Rogers et al.[49]
Crude lipid (%)	0.9 – 1.1	Fruits	Rogers et al.[49]
Energy (kJ)	1449.0	Fruits	Malaisse[44]
Fat (g/100g)	1.5	Fruits	Malaisse[44]
Fibre (g/100g)	3.2	Fruits	Malaisse[44]
Iron (mg/100g)	5.0	Fruits	Malaisse[44]
Moisture (%)	58.5 – 67.8	Fruits	Rogers et al.[49]
Phosphorus (mg/100g)	60.0	Fruits	Malaisse[44]
Protein (g/100g)	2.1	Fruits	Malaisse[44]
Total flavonoids (mg quercetin/g)	5.8	Leaves	Sofidiya et al.[70]
Total phenolics (%)	10.3 – 12.3	Fruits	Rogers et al.[49]
Total polyphenol (mg tannic acid/g)	11.7	Leaves	Sofidiya et al.[70]
Total proanthocyanidins (mg catechin/g)	6.5	Leaves	Sofidiya et al.[70]
Water soluble carbohydrates (%)	13.3 – 48.0	Fruits	Rogers et al.[49]

Biological activities of *Zanha golungensis*

The following biological activities have been reported from the leaf and stem bark extracts of *Z. golungensis*: antibacterial,[70] antioxidant[70] and molluscicidal[72] activities.

Antibacterial activities

Sofidiya et al.[70] evaluated the antibacterial activities of methanol leaf extracts of *Z. golungensis* against *Bacillus cereus*, *Staphylococcus epidermidus*, *Staphylococcus aureus*, *Micrococcus kristinae*, *Streptococcus pyrogens*, *Escherichia coli*, *Salmonella pooni*, *Serratia marcescens*, *Pseudomonas aeruginosa* and *Klebsiella pneumonae* using microdilution technique with chloramphenicol and streptomycin as positive controls. The extract exhibited activities against *Bacillus cereus* with minimum inhibitory concentration (MIC) value of 1.0 mg/ml, the same value exhibited by streptomycin while chloramphenicol exhibited MIC value of 0.1 mg/ml.[70]

Antioxidant activities

Sofidiya et al.[70] evaluated the antioxidant activities of methanol leaf extracts of *Z. golungensis* using 2,2′-azinobis-3- ethylbenzothiazoline-6-sulfonic acid (ABTS), 1,1-diphenyl-2-picrylhydrazyl (DPPH) and ferric reducing ability of plasma (FRAP) assays with ascorbic acid, butylated hydroxytoluene (BHT), catechin and quercetin as positive controls. At 0.02 mg/ml, the interaction of the extract with ABTS radical gave 80.5% inhibitions and this percentage inhibition did not change up to 0.1 mg/ml, the highest concentration used in the study. In the DPPH free radical scavenging assay, the extract showed a concentration-dependent scavenging activity. In the FRAP assay, the extract exhibited reducing ability of 47.2 µmol Fe II/g which was comparable to 62.4 µmol Fe II/g exhibited by BHT, the positive control.[70]

Molluscicidal activities

Isaiah et al.[72] evaluated the molluscicidal activities of leaf and stem bark extracts of *Z. golungensis* by placing snails of *Biomphalaria glabrata* in different concentrations of 100, 110, 120, 130, 140, 150, 200, 300, 400 and 500 ppm and the number surviving after 24 hour exposure followed by a 24 hour recovery period in fresh de-chlorinated water. The stem bark exhibited 100% mortality at 150 ppm with median lethal concentration (LC_{50}) value of 60 ug/l.[72]

CONCLUSION

The present review summarizes the ethnomedicinal uses, phytochemistry and biological activities of the bark, leaves, rootbark and roots extracts of *Z. golungensis.* The historical traditional usage of *Z. golungensis* as herbal medicine in tropical Africa calls for detailed phytochemical and pharmacological studies aimed at correlating its documented ethnomedicinal uses with the phytochemical and pharmacological properties of the species. There is need for clinical and toxicological evaluations since *Z. golungensis* contains potentially toxic compounds. Therefore, future research should focus on identification of toxic compounds, the possible side effects caused by taking *Z. golungensis* as herbal medicine, and mechanisms of how potential toxic components of the species can be managed when the species is used as herbal medicine.

Conflict of interest

The author declares that he has no conflict of interest.

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