Trema orientalis Linn. Blume: A potential for prospecting for drugs for various uses

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ABSTRACT

Medicinal plants are used by traditional practitioners to treat several ailments. Ethnomedicinal studies on *Trema orientalis* Linn. Blume (Ulmaceae) have shown that it is used in the treatment of diabetes mellitus, respiratory diseases, oliguria, and malaria. This article is aimed at providing comprehensive information on the medicinal uses, biology, phytochemical constituents, and pharmacological data available on *T. orientalis*. This has been done to explore its therapeutic potential for future research opportunities. This review was compiled with information obtained from databases such as Medline, Elsevier, Springer, Science Direct, Pubmed, Google Scholar, and a library search for articles published in peer-reviewed journals. Compounds present in the plant include tannins, saponins, flavanoids, triterpenes, phytosterols, and several constituents of xanthones. Some pharmacological research done on the plant has focused on, hypoglycemic activity, analgesic, anti-inflammatory activities, anti-plasmodial activity, diuretic activity, laxativity effect, anti-convulsant activity, anti-helmintic activity, anti-sickling effect, anti-oxidant, and anti-bacterial activity. This compilation strongly supports the view that *T. orientalis* has beneficial therapeutic properties, and indicates its potential as an effective herbal remedy for several diseases. The promising results from several research works could be further substantiated by clinical trials.

Key words: Phytoconstituents, *Trema orientalis* Linn. Blume, Ulmaceae

BACKGROUND

Trema orientalis is an evergreen tree which belongs to the family Ulmaceae. It has been used extensively in various ways. *T. orientalis* is the same as *Celtis orientalis* Linn., *Celtis guineensis* Schum. and Thonn., *Trema bracteolate* Hochst Blume, *Sponia orientalis* Linn. Decne, and *Trema guineensis* (Schum. and Thonn.) Ficalho. Aside its uses in paper production and in the manufacturing of poles, it has been used for medicinal purposes including the treatment of respiratory, inflammatory, and helminthic diseases. Almost every part of the plant is used as medicine in various parts of Africa.[1,2] The generic name *Trema* is derived from a Greek word which means perforation or hole and alludes to pitted seeds of the tree, whereas the specific name *orientalis* is derived from the Latin word "*orientalis*" meaning eastern. The plant has common names such as pigeon wood, hop out, charcoal tree, Indian charcoal tree, Indian nettle tree, and gunpowder tree.

Medicinal plants are a major source of compounds of therapeutic value, and contain different phytochemical compounds resulting in numerous pharmacological activities. According to a World Health Organization report, about 70-95% of the developing world populations rely on non-conventional medicinal sources, especially plants, for their primary healthcare.[3,4] The aim of this review is to provide comprehensive information on the botanical description, traditional uses, phytochemical constituents, and pharmacological activities available on the *T. orientalis* plant. This review was compiled with information obtained from search engines such as Medline, Elsevier, Springer, Science Direct, Pubmed, Google Scholar, and a library search for articles published

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in peer-reviewed journals. This was done with the view of exploring its therapeutic potential for future research opportunities.

ECOLOGICAL AND GEOGRAPHICAL DISTRIBUTION

T. orientalis is widely distributed all over the world in countries such as Ghana, Senegal, Sierra Leone, Niger, Cote d'Ivoire, Angola, Australia, Bangladesh, Brunei, Cambodia, Cameroon, Central African Republic, Chad, China, Democratic Republic of Congo, Ethiopia, India, Indonesia, Japan, Kenya, Laos, Madagascar, Malaysia, Mali, Myanmar, Nepal, Nigeria, Philippines, Saudi Arabia, South Africa, Sudan, Tanzania, Uganda, Vietnam, Zambia and Zimbabwe.[5] It is among the first few plants that establish on flood-damaged river banks. It can grow on a wide range of soils from heavy clay to light sand.[6]

Description of the plant

T. orientalis is a shrub or small to medium size tree and its height varies depending on the location and climatic conditions. It can grow up to 18 m high in forest regions, and up to 1.5 m tall in the savannah. The slender branchlets are covered with white velvety hairs.[6] It has an extensive root system that enables it to survive long periods of drought.

The leaves are simple, alternate and stipulate although the stipules drop early and usually three-nerved from the base. The leaf base is frequently unequal. Leaves taper from the base to the apex and vary from 2 to 20 cm long, and 1.2 to 7.2 cm wide.[7] Leaf margins are finely serrated, whereas the young leaves are rough and hairy, occasionally becoming smooth when old.[8] Photos of the leaves are shown in Figures 1a and 1b.

The flowers are small, inconspicuous, and greenish, carried in short dense bunches. They are usually unisexual, occasionally they are bisexual. Flowers appear irregularly from late February to April.[8] The fruits are small, round, and dark purple or green drupes that become black when ripe, and they are carried on very short stalks.[7] The onset of fruit ripening varies with the locality, but in most places, occurs from December to May. Birds are very fond of the fruit and disperse the fleshy drupes.[9]

Ethnomedicinal uses

The plant is used in various parts of Africa for medicinal purposes. The young leaves are eaten as spinach by the Zulus in South Africa, who also use the roots and stem bark as traditional medicine.[8] The fruit, leaves, bark, stem, twig and seeds are extensively used in traditional medicine.[10]

The root

The root of *T. orientalis* plants is used in folk medicine for treatment of trauma, blood stasis, hematuria and bleeding of intestines and stomach.[11]

The stem

The stem bark decoctions are used as vermifuge and anti-dysenteries.[12] The stems and twigs infusion are used to treat fever and toothache.[6] Both stem bark and leaf decoction of the *T. orientalis* are used to treat malaria, manage pain in tired muscles and aching bones as well as venereal disease.[13-15] Both, the stem bark and leaf decoctions are used as a gargle, inhalation, drink, vapor bath for relieve of toothache.[5]

The leaf

The leaf of *T. orientalis* is mixed with leaves of *Bidens pilosa, Citrus aurantifolia*, and peels of unripe pineapple. It is boiled and the decoction used in the management of jaundice.[16] The leaves macerated in lemon juice are used as remedy for bronchitis, pneumonia and pleurisy.[16,17] The leaves macerated in lemon juice are used as remedy for cough.[1] The leaves decoction of *T. orientalis* plants is also used as an anti-helminthic medicine for roundworms and hookworms in West Africa, East Africa, and some parts of Central Africa and Madagascar.[18]

The fruits and flowers

The fruits and flowers are used to prepare infusion that are administered to children as a therapy for bronchitis, pneumonia and pleurisy.[16,17]

Figure 1a: *Trema orientalis* leaves

Figure 1b: Underside of a single leaf of *Trema orientalis*

MAJOR PHYTOCHEMICAL CONSTITUENTS

The leaves of *T. orientalis* contain tannins, saponins, flavanoids, triterpenoid (simiarenol, simiarenone, trematol).[1] Octacosanoic acid, 1-octacosanyl acetate, simiarenone, simiarenol, episimiarenol, and a new triterpene alcohol, trematol has been isolated from stem bark.[19] Other studies have also reported the presence of methylswertianin, decussatin, glycosides of decussatin, sweroside, scopoletin, (–)-epicatechin, lupeol, *p*-hydroxybenzoic acid, adian-5-en-3-one, 2α, 3ß-dihydroxyurs-12-en-28-oic acid in the stem bark.[20-23] The stem bark also contains (–)-ampelopsin F, (–)-epicatechin, (+)-catechin, (+)-syringaresinol, *N*-(*trans-p*-coumaroyl) tyramine, *N*-(*trans-p*-coumaroyl) octopamin, *trans*-4-hydroxycinnamic acid, and 3,5-dimethoxy-4-hydroxyphenyl-1-*O*-ß-D-glucoside.[24] Chemical investigation of extracts from root bark of this plant has led to the isolation of compounds such as hexacosanoic acid, 3-O-ß-glucopyranosyl-ß-sitosterol, simiarenone, 3,4-dihydroxybenzoic acid, 2α,3α,23-trihydroxyurs-12-en-28-oic acid and ß-sitosterol.[20,21,25,26] Structures of some compounds are shown in Figure 1c.

Pharmacological activities

Researchers have reported the different pharmacological effects of *T. orientalis* in various test models. The aerial

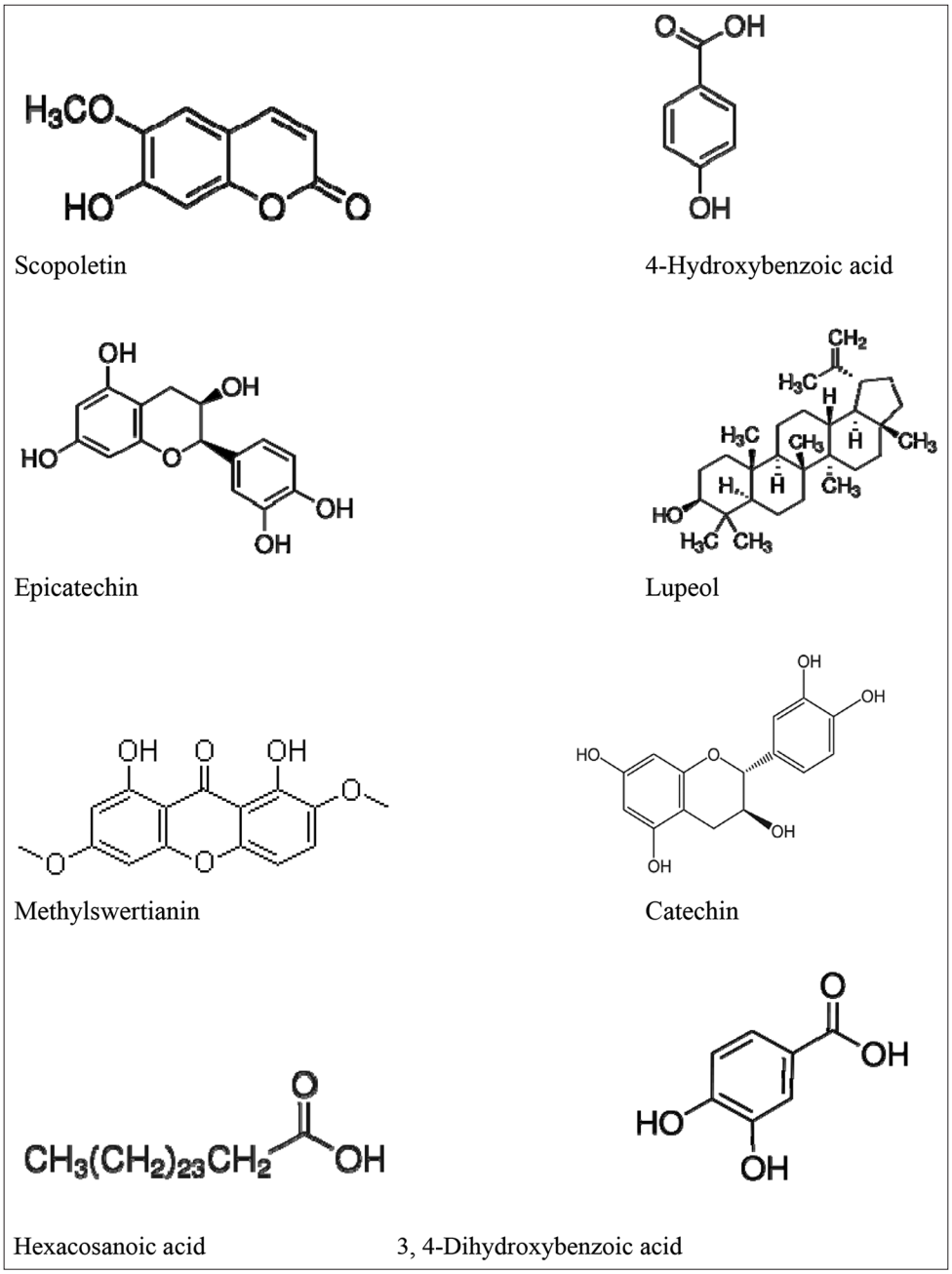

Figure 1c: Structures of some biological compounds isolated from different parts of *Trema orientalis* plant

parts, flowers, bark, and seeds of *T. orientalis* exhibit various pharmacological activities including laxativity, hypoglycemic, anti-pyretic, analgesic, anti-microbial properties, anti-convulsant activity, and anti-plasmodial.[27-31] These effects may be mainly due to the fact that it contains important biologically active compounds as shown in Figure 1c of this review. This section of the article focuses on the main pharmacological properties of *T. orientalis*.

Laxativity effect

Laxatives also known as purgatives are foods, compounds, or drugs taken to induce bowel movements or to loosen the stool, most often taken to treat constipation. Sufficiently high doses of laxatives cause diarrhoea. Aqueous extract of *T. orientalis* was found to induce the stimulation of rabbit duodenum contractility and therefore can be used as a laxative due to its stimulating effects on duodenal contractility.[28] An experiment to determine, the effects of the aqueous extract tested against the catalytic activity of the acetylcholinesterase extracted from the duodenal muscle, showed that aqueous extract of *T. orientalis* exerts cholinimimetic and anti-cholinesterasic effects, and therefore can be used as laxative in traditional medicine practice.[28]

Hypoglycaemic activity

Diabetes mellitus is a metabolic disease in which there are persistent high glucose levels in the blood, either because the body does not produce insulin at all or produces but it is insufficient because receptors are insensitive to insulin produced. This high blood glucose levels produces symptoms of polyuria, polydipsia, and polyphagia among others. Aqueous stem bark extract of *T. orientalis* was reported to have hypoglycemic effects in induced diabetic rats by mechanism different from that of sulfonylurea agents.[29] This study provides pharmacological evidence that the use of this plant in herbal medicinal practice can be of importance in diabetic patients.

Anti-plasmodial activity

Plasmodium falciparum is a protozoan parasite, one of the species of *Plasmodium* that cause malaria in humans. It is transmitted by the female *Anopheles* mosquito. *P. falciparum* is the most dangerous of these infections as *P. falciparum* malaria has the highest rates of complications and mortality. It is more prevalent in sub-Saharan Africa than in other regions of the world; in most African countries, more than 75% of cases are due to *P. falciparum*.[32] Hexane extract of stem bark of *T. orientalis* has anti-plasmodial activity against *P. falciparum*.[28] Also, the bark and leaf decoctions has been reported to have anti-plasmodial properties.[5]

Diuretic activity

The increased excretion of water from the body is a conditional metabolic process known as diuresis. There are several forms, although each class does occur in a distinct way. This may also help in getting rid of other water soluble wastes or toxins from the body. *T. orientalis* contains polyphenols which have potassium retention ability, and thus may be responsible for diuresis.[33]

Anti-convulsant activity

A convulsion is a medical condition where body muscles contract and relax rapidly and repeatedly, resulting in an uncontrolled shaking of the body. Convulsion is often a symptom of an epileptic seizure, thus the term is sometimes used as a synonym for seizure. However, not all epileptic seizures lead to convulsions, and not all convulsions are caused by epileptic seizures. Methanolic and aqueous extracts of *T. orientalis* leaves has anti-convulsant activity against pentylenetetrazole-induced seizures and maximum electroshock-induced seizures in mice.[31] This indicates that the plant has a good potential for the management of convulsion.

Analgesic and anti-arthritic activities

Pain is an unpleasant sensation often caused by intense or damaging stimuli and it is a response to malfunction of the body that occurs in association with every ailments. The leave extracts of *T. orientalis* have significant ability to reduce pain in mice in acetic acid induced writhing test, and in rats by the hot plate model.[33] The leaves extract have also been shown to have anti-arthritic effects in acute and chronic models in mice.[34]

Anti-bacterial activity

According to Chowdhury and Islam (2004), crude methanol and aqueous root extracts of *T. orientalis* both showed activity against Gram-negative bacteria. Though both extracts showed anti-bacterial activity against gram-positive bacteria and i.e., Gram-negative bacteria, aqueous extract showed higher anti-microbial activities than methanol extract.[35,36] The results obtained provide support for the use of this plant in traditional medicine.

Anti-helmintic activity

T. orientalis has been reported to have anti-helmintic properties against intestinal worms.[36] Also, according to Diehl *et al*. (2004), the leaf and root extract of *T. orientalis* showed 100% mortality rate on *Haemonchus contortus* larvae species.[37]

Anti-sickling effect

Anthocyanins extracts from *T. orientalis* have been found to possess anti-sickling activity, as treated sickle erythrocyte it reverted to the normal and classical biconcave form of red blood cells, with a radius value of 3.5 ± 0.2 μm similar to that of normal erythrocytes values.[38]

Anti-oxidant activity

Anti-oxidants are substances that protect cells against the effects of free radicals. Free radicals are molecules produced through physiological reactions, or by environmental

exposures like tobacco smoke and radiation. Free radicals can damage cells, and may play a role in heart disease, cancer, and other diseases.[39] In a study by Salprima *et al*. (2011), methanol extracts of the leaves of *T. orientalis* showed potential free-radical scavenging activity whereas aqueous extract showed very little free-radical scavenging activity. The methanol fraction extracted from *T. orientalis* leaves has been shown to exhibit an anti-radical activity that is almost similar to that of ascorbic acid.[40]

CONCLUSION

T. orientalis has emerged as a good source of phytomedicine. This compilation strongly supports the view that *T. orientalis* has beneficial therapeutic properties, and indicates that it has potential as an effective herbal remedy for several diseases. There is also the need to search for individual compounds responsible for these biological effects, and study their mechanism of actions and pharmacokinetics in detail. These promising results should be further substantiated by clinical trials.

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