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A NOTABLE REVIEW ON *Terminalia ivorensis* A. Chev.

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ABSTRACT

Nowadays, many people utilize phytomedicines since they are more beneficial to health and have superior therapeutic effects than drugs made through chemical synthesis. Since ancient times, many modern medications have been separated from natural sources, many of them based on their traditional medical use. There are 18 genera and roughly 450 species in the family Combretaceae, of which 200 are in the genus *Terminalia*. The *Terminalia* species are well recognized for producing edible fruits and nuts with medicinal characteristics. The present study aims to develop a comprehensive understanding of the plant by summarising its description, taxonomy, phytochemical components, pharmacological activities, and medicinal and other uses. The plant profile development includes a description of the plant, local names, scientific classification, active chemical constituents, various reported pharmacological activities, and traditional and medicinal uses. In the world's traditional medicine, plants of the

genus *Terminalia* are among the most commonly utilized plants. Numerous *Terminalia* species offer diverse curative properties for various maladies and disorders. Due to its wide spectrum of therapeutic properties, *Terminalia ivorensis* is used in medicine.

Keywords: *Terminalia ivorensis*, phytochemicals, traditional uses, phytochemical components

INTRODUCTION:

Since herbal medicines have a wide range of biological and medical uses, demand for them is extremely high worldwide [1]. Natural products have been used since the dawn of human civilization, and the primary sources of drugs are mineral, plant, and animal-derived substances. Angiosperms, which make up about 13,000 genera and 250,000–300,000 species, account for the majority of plant species and account for 80% of the total plant kingdom [2]. Many of the hundreds of plants that are used medicinally, primarily as herbal preparations in the traditional medical systems of various nations, have withstood the test of time. As a result, modern medications have not been able to replace the majority of these [3]. Plants have been used by humans as essential ingredients in pharmaceuticals, beverages, cosmetics, and medicines for thousands of years, helping to preserve human health and improve quality of life [4]. These plants' therapeutic qualities are mostly attributed to bioactive substances such as flavonoids, terpenoids, alkaloids, phenols, and tannins [5]. According to a World Health Organisation (WHO) report, between 70% and 95% of people in most developing countries still depend on

traditional medicine as their main source of medication. Traditional medicines are the foundation of phytochemistry, also known as phytopharmaceuticals, and about 365 plants, animals, and minerals are said to have been used as medicines since ancient times [6].

According to reports, 70% of people in India receive their primary treatment through traditional medicine. In comparison to the anticipated US \$ 2.5 billion annual turnover of modern medications, the current annual turnover of herbal therapeutic goods produced by significant corporations is expected to be around US \$ 300 million [7]. There are 18 genera and roughly 450 species in the family Combretaceae, of which 200 are in the genus *Terminalia*. The family lives primarily in tropical and subtropical areas of the planet [8].

Terminalia is the world's second-largest genus in the family Combretaceae, most of which are medium-sized or large trees. The word "terminus" in Latin, which denotes that the leaves are found at the branch's tip, is where the name "*Terminalia*" originates [9]. In the world's traditional medicine, plants of the genus *Terminalia* are among the most commonly utilized plants. For their antibacterial, antifungal, antiprotozoal,

antiviral, antidiarrheal, analgesic, antimalarial, antioxidant, anti-inflammatory, and anticancer properties, many species are employed. Some species have also been linked with cardiovascular effects and the ability to heal wounds. Numerous *Terminalia* species offer diverse curative properties for various maladies and disorders. Due to its wide spectrum of therapeutic properties, *Terminalia ivorensis* is used in traditional medicine.

However, surprisingly little research has thoroughly explored this significant genus for its medicinal properties/mechanisms and phytochemistry, aside from the recognized ethnopharmacological usage of numerous *Terminalia* species. This is perhaps because many *Terminalia* species have significant levels of tannin and it is believed that these tannins are mostly responsible for their beneficial effects [10].

PLANT DESCRIPTION:

DISTRIBUTION:

The *Terminalia ivorensis* A. Chev is a deciduous tree in the family Combretaceae. This tree can be found in nations like Ivory Coast, Ghana, Nigeria, Cameroon, and Gabon and is native to West and Central Africa [11].

HEIGHT, DIAMETER, AND BOLE:

A substantial forest tree that is 50 feet (15.24 meters) to 150 feet (45.72 meters) in height or higher [12]. Under natural circumstances, it has a girth at breast height of 7-11' or 15'

(2.13–3.35 m or 4.57 m) [13]. Recent inventories in Ghana show that few trees of this species reach very large sizes [14]. With small, blunt buttresses and occasionally flutes, it is clean and extremely straight.

BARK:

Young trees have smooth, light grey bark that changes to dark brown, sometimes blackish, with deep longitudinal fissures (thus the name "Black Afara"). Long, thin strips of the bark flake off. A yellow slash appears.

BRANCHES AND GROWTH:

In young trees, the branches are whorled, and the foliage is slightly hairy and has new shoots. The branchlets' bark is light greyish brown and smooth with fine longitudinal fissures. The branches are arranged in flat, horizontal layers and are whorled at the apex of each upward development phase by the terminal bud. Orthotropic buds, which grow upright, and pleiotropic buds, which create horizontal side branches, are the two types of buds that are produced. A period of dormancy follows the rapid upward growth of the leading shoot, during which time lateral branches emerge from the leader's vicinity and grow horizontally.

LEAVES:

The size of the leaves is not significantly different, and their shape is largely constant; This does not, however, apply to young plants and grafts where the leading shoots leaves may be twice as large as those on the

lateral branches. They are widely oblanceolate to elliptic obovate, and range in size from 2.5" to 5" (6.4 cm to 12.7 cm) long by 1" to 2.4" (2.54 cm to 6.1 cm), narrowing from the middle to the base. The apex is abruptly and briefly, acuminate and progressively narrows to the cuneate base. Except for a few tiny hairs on the petiole, midribs, and major nerves beneath, the

leaves are glabrous. The tertiary nerves are prominently raised, and the upper surface has a deeply impressed midrib; However, the tertiary nerves are seldom raised on the lower surface, which also possesses secondary nerves and a fairly noticeable midrib. The petiole is thin and measures 0.5–1" (1.3–2.5 cm) in length [12].



Figure 1: *Terminalia ivorensis* A. Chev. Leaves

INFLORESCENCE AND FLOWERS:

2.6" to 3.7" (6.5 cm to 9.5 cm) long and densely tomentose, with a peduncle that is 1" to 1.2" (2.5 cm to 3 cm) long. Bisexual flowers are near the peak of axillary spikes that are 3" to 4" (7.6 cm to 10.2 cm) long. Compared to the upper receptacle, the lower one is more densely tomentose.

FLOWERING TIME:

From one locality to the next, *T. ivorensis* exhibits different phenological characteristics. In Sierra Leone, Liberia, and the Ivory Coast, it blooms when in full leaf, and the flowering season runs from April to June. In Ghana, the period is primarily in the

wet months of July and August while in Nigeria it lasts from April to August.

FRUITING TIME:

Each year, an abundance of fruits is produced, and the fruiting season is likewise variable. Usually, fruits appear in February and March when the tree is leafless. Young fruits start to appear in the Ivory Coast in July, the major fruiting season is thought to be between December and January in Ghana, and the fruits start to appear in Nigeria in July and last into the following dry season. The fruit of *Terminalia ivorensis* is a drupe, which is a fleshy fruit with a single seed encased in a tough stone or shell. The fruit is typically small to medium in

size, measuring between 1 and 2 cm in diameter. The fruit is frequently round or

oval in shape and may have a somewhat flattened look.



Figure 2: Unripen fruits

FLOWERING AND FRUITING AGE:

T. ivorensis seems to blossom and bear fruit at a relatively young age when grown in plantations. It was found that a six-year-old tree producing a heavy crop of fruits in Nigeria.

TEXTURE AND TASTE:

Like other drupe fruits, the fruit's flesh is frequently juicy and somewhat fibrous. The fruit's flavor might vary depending on its level of ripeness and the particular tree it comes from, but it is often characterized as sweet and moderately acidic.

SEED WEIGHT:

Single seeded, 5500-7260 seeds per kg, or roughly 2500 to 3000 seeds per lb.

SEED COLLECTION TIMING:

Each locality has a different seed fall timeframe. Ripe seeds are available in Sierra Leone between February and March, with the possibility of availability into April. While the primary fruiting period in Ghana is from December to January, fertile seeds have been gathered from August to May.

The seed autumn season in Nigeria lasts from December to March.

Seeds should be harvested from seed trees with healthy stem and crown formation as much as feasible. Many seeds are discovered to be bored both on the tree and the ground.

SEED TREATMENT AND STORAGE:

Insecticide should be used where seeds are likely to be affected by insects. Without significantly losing viability, seeds can be kept at room temperature for three to four months. *T. ivorensis* can be successfully stored at a maximum temperature of 5⁰C and a minimum of -5⁰C for approximately one year with little loss of viability [15].

GERMINATION AND GROWTH:

They took 17 to 40 days to germinate, after germination, growth is slow, but it quickens as seedlings develop leaves. They can be planted outdoors after 4 months and require some shade.

LEAF FALL:

Due to its deciduous nature, the tree occasionally goes for two to three months during the dry season without producing any

leaves [16]. In certain areas, the leaves are retained up until the conclusion of the dry season, when they are shed. For instance, in Ghana, *T. ivorensis*, in contrast to *T. superba*, keeps its leaves and fruits until March, or the end of the dry season, and then sheds them completely.

ROOT SYSTEM:

T. ivorensis develops a strong taproot that is backed by 6–8 robust lateral roots. However, there is also proof of a widespread, somewhat superficial root system, especially in inappropriate places.

HABITAT:

It is a deciduous tree that grows in both dry and moist evergreen forests [17].

LOCAL NAMES:

English: Ivory Coast almond, black afara;

French for Framire;

Terminalia in Spanish;

Mwalambe in Swahili;

Idigbo in Igbo;

Framire and black afara are trade names [18].

SCIENTIFIC CLASSIFICATION:

Kingdom – Plantae;

Phylum – Tracheophyta;

Class – Magnoliopsida;

Order – Myrtales;

Family - Combretaceae;

Genus - *Terminalia* L.;

Species: *T. ivorensis* A. Chev. [19-20].

CHEMICAL CONSTITUENTS:

There are known tannins, flavonoids, and sterols in *Terminalia* species [21]. The phytochemical analysis of the chloroform and methanol extracts of *T. ivorensis* trunk bark revealed the presence of saponins, flavonoids, terpenes/sterols, tannins, and polyphenols [22]. Terminolic acid, ellagic acid, sericic acid, quercetin, and glycyrrhethinic acid [23].

TRADITIONAL AND OTHER USES:

A plant known as *Terminalia ivorensis* is used to treat a variety of ailments including rheumatism, ulcers, blennorrhoea, malaria, yellow fever, and kidney issues [24]. In West Africa ethnomedicine is used to heal wounds, malaria, and ulcers [25]. For operations including reforestation, building homes, doors, windows, planks, fence posts, dug-out canoes, drums, and mortars. Its wood is corrosive to iron and prone to staining when in touch with various metals [26].

MEDICINAL USES:

The bark decoction or macerate is high in tannins and used to cure wounds, sores, and hemorrhoids. The powdered bark is applied to ulcers, while the pulped bark is applied to painful joints and muscles to ease discomfort [27].

VARIOUS REPORTED PHARMACOLOGICAL ACTIVITIES:

Anti-inflammatory and anti-nociceptive activities:

The anti-inflammatory and anti-nociceptive properties of methanol extracts of stem and root bark of *Terminalia ivorensis* A. Chev. were investigated by Avoseh *et al.* They concluded that due to its capacity to inhibit at both phases (anti-nociceptive and anti-inflammatory), the activity demonstrates that the extract is both a CNS stimulant and also as a non-steroidal anti-inflammatory medication (NSAID). The study also supports the traditional uses of the plant and the most effective plant parts for each activity [28].

Anti-diabetic activity:

According to Franklyn Iheagwam *et al.*, the Nigerian *Terminalia* genus contains plants with antidiabetic properties. The presence of phytochemicals such as tannins, phenolics, terpenoids, flavonoids, and other active bio components, as well as their synergistic effects, have been linked to this activity. It was also noted that the majority of tests on these species of *Terminalia's* ability to treat diabetes were conducted *in vitro*. However, further *in vivo* research should be done to identify the molecular mechanism underlying its anti-diabetic action. Nigeria is the sub-Saharan country with the highest prevalence of diabetes, which is a public health problem that needs to be resolved quickly. Therefore, more translational research is required to investigate the antidiabetic assessment of these *Terminalia* species directly on patients and extrapolate

outcomes that will be helpful to the Nigerian public health system [29].

Anti-fungal activity:

According to research by Ouattara Sitapha *et al.*, *Terminalia ivorensis* A. Chew. bark extracts had significant *in vitro* antifungal properties against two clinical isolates as well as identified strains of *Candida albicans* and *Aspergillus fumigatus*. Compared to standard antibiotics (Ketoconazole), the hydroalcoholic extract showed the strongest inhibitory impact on (*Candida albicans* and *Aspergillus fumigatus*) against the tested microorganisms. The current investigation supported the traditional use of *T. ivorensis* in treating skin conditions and the use of water and koutoukou (a traditional drink made from palm trees) as solvents [30].

Anti-plasmodium activity:

UPLC-MS fingerprint of promising extracts and fractions from *Terminalia ivorensis* A. Chev. and *Terminalia brownii* Fresen were studied by Mariscal Brice Tchata Tali *et al.* They found that the extracts and fractions from *T. ivorensis* and *T. brownii* showed very good anti-plasmodial activity, supporting the traditional use of the two plants in the treatment of malaria. Chemical markers and the well-known antimalarial component ellagic acid were discovered through chemical profiling of the extracts and fractions [31].

Anti-oxidant potential and phytochemical analysis:

The hydroalcoholic extracts of the barks of two Ivorian pharmacopeia plants, *T. mantaly* and *T. ivorensis*, were examined for their anti-oxidant activity and phytochemical composition by Kipré *et al.* They concluded that two commonly used plants in conventional medicine could be a source of novel natural antioxidant compounds. They can be researched in the hunt for treatments for Alzheimer's disease [32].

Anti-inflammatory activity and healing power:

The anti-inflammatory and wound-healing abilities of the hydroethanolic extract of *Terminalia ivorensis* were studied by Konan Gkna *et al.* in waster rats. They concluded that the hydroethanolic extract of the plant had good anti-inflammatory and wound-healing abilities [33].

Leaf properties, litterfall, and nutrient inputs:

In a tropical timber-food crop multi-strata system, L. Norgrove and S. Hauser investigated leaf characteristics, litterfall, and nutrient inputs of *Terminalia ivorensis* at various tree stand densities. They concluded that *Terminalia ivorensis* leaf litter production per tree, specific leaf area, and leaf litter nutrient concentrations showed few significant differences between treatments [17].

Neurobehavioral and analgesic properties:

According to Adeoluwa O.A. *et al.* investigation into the neurobehavioral and analgesic effects of *T. ivorensis* A Chev. (Combrataceae) ethanol bark extract in mice, *T. ivorensis* has shown sedative qualities and has produced a good analgesic effect in thermal and chemical models of nociception. This supports its use in traditional medicine as a sedative for psychosis and a pain reliever [34].

Anti-trypanosomal and anti-inflammatory activities:

The anti-trypanosomal and anti-inflammatory effects of extracts from nine different Nigerian medicinal plants on mice infected with *Trypanosoma brucei* were studied by Adelodun *et al.* They concluded that at the test dose administered, extracts of *Khaya senegalensis*, *Harungana madagascariensis*, *Terminalia ivorensis*, *Curcuma longa*, *Ocimum gratissimum*, and *Alcornea cordifolia* showed only mild anti-trypanosomal activity and did not significantly reduce parasitemia when compared to the positive control. The *U. chamae* leaf extract and its hexane fraction, on the other hand, showed a significant reaction (P 0.01). Oedema was 107% more suppressed by the portion at 1000 mg/kg. *Uvaria chamae* increased the life period of infected mice due to a decrease in parasitemia brought on by *T. brucei*,

demonstrating both anti-trypanosomal and anti-inflammatory characteristics [35].

CONCLUSION:

No plant on this planet is useless; plants are our natural healers. Nature has something in everything, whether it has been studied or not. The current review discussed *Terminalia ivorensis* taxonomy, description, phytochemical components, pharmacological activities, and therapeutic significance. Because of its safety and efficacy, it is a versatile medicinal plant with a wide variety of actions that can be used for further medical applications. The extensive potential of this plant to treat a wide range of ailments has been confirmed by the pharmacological studies done on *T. ivorensis*. To strengthen the utilization of *T. ivorensis* for future generations, more studies and clinical trials are required for product development.

CONFLICT OF INTEREST:

We formally declare that we have no conflict of interest.

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