



## **Enantia chlorantha and its Multiple Therapeutic Virtues: A Mini Review**

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### **Authors' contributions**

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

### **Article Information**

DOI: 10.9734/JPRI/2021/v33i45A32741

#### Editor(s):

(1) Rafik Karaman, Al-Quds University, Palestine.

#### Reviewers:

(1) Valerio Giaccone, University of Padova, Italy.

(2) Hanefi Özbek, Izmir Bakırçay University, Turkey.

Complete Peer review History: <https://www.sdiarticle4.com/review-history/75185>

**Mini-Review Article**

**Received 01 September 2021**

**Accepted 29 September 2021**

**Published 30 September 2021**

### **ABSTRACT**

*Enantia chlorantha* is a plant commonly employed traditionally in phytotherapy to treat various ills. It has been a source of interest for many scientific works due to its exceptional properties, thus in the essence of highlighting the most pertinent outcome of the results obtained, this review had as objective to present the plant, its traditional uses, its composition, and multitude of exploitable virtues. Nevertheless, the adverse effect and the toxicological aspect constituting a limit to its use in conventional medicine, was also treated.

**Keywords:** *Enantia chlorantha*; Medicinal plant; Therapeutic virtues; Phytochemicals.

## 1. INTRODUCTION

### 1.1 Taxonomy, Common Names, and Botanic Description

*Enantia chlorantha* is a dense tropical forest tree found along Central Africa and the west coasts of West Africa [1]. It belongs to the kingdom Plantae, the order of Magnoliales, the Annonaceae family [2] and is commonly known as African Yellow Wood [2]. This plant is also known by a variety of names in indigenous languages; Awopa, Osu pupa or Dokitaigbo (Yoruba), Osomolu (Ikale), Erumeru (Nigeria), Kakerim (Boki), Erenba-vbogo (Benin) [3], Mfo (Boulou), Mpouley (Mabea), Njie (Douala) [4]. The fair seized (70cm girth) tree may grow up to 30m high [5] with crowded foliage and spreading crown [2]. The fluted stem carries elliptic leaves which are about 0.14–0.15 m long and 0.05–0.14 m broad. The bark covering the stem is geometrically fissured, dark brown and thin on the outer part, while the inner bark is brown above and pale cream beneath [3].

### 1.2 Major Constituents

As most plants, *Enantia chlorantha* produces primary and secondary metabolites and the major use of this plant in phytotherapy is usually ascribed to its secondary metabolites. Studies revealed that ethanolic extracts from different parts of the plant contain alkaloids, flavonoids, tannins, saponins, phenols, steroids, cardiac glycosides, terpenoids, anthraquinones, proteins, aldehydes/ketones, and carboxylic acids [2]. The distribution of these compounds being uneven, tannins are mostly found in the leaves while stem and root contains mostly Saponin and alkaloid. Similar results were reported with acetone as solvent. But in phytochemical analysis done using methanol, flavonoid was the most abundant in the leaf and the stem bark [6]. Flavonoid and alkaloids are two therapeutically efficient constituents found in *E. chlorantha* [1]. They are hydroxylated phenolic substance known to be synthesized by plants in response to microbial infection and their antimicrobial activity is probably due to their ability to complex with extracellular and soluble proteins and to complex with bacterial cell walls [7]. In the same way, alkaloids are very useful and possess antiviral, antiplasmodial, analgesic, antispasmodic, and bactericidal effects. The alkaloids include palmatine, columbamine and pseudocolumbamine [7]. Among the alkaloids,

berberine is recognized as an active compound to which *E. chlorantha* owns it various virtues.

## 2. REVIEW METHODOLOGY

This review article was done by exploiting numerous review articles, original articles, and related books from reputable databases, such as Web of Science, PubMed, and Scopus. The literature investigation process was conducted between April and August 2021 and the literature investigations were conducted in English and French. The keywords explored during literature searching consisted of combinations of the following words: “*Enantia chlorantha*”, “properties”, “antimicrobial activity”, “antioxidant activity”, “antiplasmodial activity”, “toxicity”.

### 2.1 Main Uses and Therapeutic Virtues

*E. chlorantha* is traditionally used in the treatment of malaria, tuberculosis, infected wound [8], urinary tract infections, typhoid fever, infective hepatitis [9], fever, bacterial infection and stomach aches [10]. The treatment of these diseases is due to the multiple properties of this plant; they include antiplasmodial, antimicrobial, antipyretic, anti-ulcer, anticonvulsive, anti-inflammatory, analgesic, antioxidant, testiculoprotective, hepatoprotective, antitumor as well as antidiabetic activities [11].

#### 2.1.1 Antiplasmodial property

The antiplasmodial activity of the plant has been proven by various studies as *E. chlorantha* aqueous extract was shown to produced up to 70% *Plasmodium berghei* chemosuppression in a dose dependent manner in infected pregnant mice [5]. Similar results were reported by Basse et al. [5] who obtained 77.45 % chemosuppression of *Plasmodium berghei* in infected adult albino mice treated with extracts of *E. chlorantha* stem bark at a dose of 64.80mg/Kg. Alkaloids and flavonoids abundantly found in the stem have been attributed the antiplasmodial activity. A study aimed at investigating the in vivo antimalarial activity of total alkaloid extracts from *Enantia chlorantha* stem bark asserted that the alkaloid extract of the stem bark of *Enantia chlorantha* exhibit a direct plasmocidal activity against *P. berghei* [1].

#### 2.2.2 Antimicrobial property

Extracts of *E. chlorantha* have shown their potential in the control of pathogen including

multidrug resistant pathogens. This potential include antiviral, antibacterial and antifungal properties. The antifungal activities of *Enantia chlorantha* has been proven in many scientific works. In a study realized by Chukunda et al. [8], results showed that aqueous bark extracts of the plant inhibit the fungal mycelia growth of *Rhizopus stolonifer* and *Phoma glomerata*, usually associated to fungal spoilage of avocado fruits. Furthermore, this antifungal activity was comparable with that of standard antifungal (Ketoconazole). Similarly, in a study aimed to compare the antifungal activity of ethanol extracts (EE) of leaves of *E. chlorantha* with those of acidic (AEE), basic (BEE) and neutral (NEE) metabolites obtained from the extracts, it was revealed that fungal pathogens (*Rhizopus oligosporus*, *Aspergillus flavus*, *Aspergillus niger*, *Fusarium equiseti*, *Candida albicans*, *Saccharomyces cerevisiae* and *Aspergillus fumigatus*) were resistant to AEE and BEE. Meanwhile EE and NEE exhibited reasonable activity against the pathogens which were comparable with the activity of a standard drug [2]. Nevertheless, the antibacterial activity covers a large spectrum of gram positive and gram-negative bacteria by showing significant zones of inhibition. Saponin capable of causing leakage of proteins and certain enzymes from the cell, play an important role [6]. In some cases, *E. chlorantha* is even more effective than antibiotics in treating diseases [6]. Also, antiviral potential of *E. chlorantha* has been shown on Newcastle Disease virus in Ovo and completely inhibit virus growth at 100, 50 and 12.5 mg/ml.

### 2.2.3 Antipyretic property

Traditionally used to reduce body temperature, scientifically, *E. chlorantha* is also recognized as an efficient antipyretic. Experiments report that, at a dose of 15.0g/kg, extracts of the plant relieve induced fever in rabbits [12]. In the same way, when administered to rats at a dose of 50-200 mg/kg body weight, it equally exhibits antipyretic effects [10]. Alkaloids and flavonoids capable reducing excess rise in temperature by inhibiting prostaglandin synthesis in the hypothalamus, may account for this property. This leaves way for its potential use as antipyretic treatment with effect comparable to those of standard antipyretic drugs like indomethacin.

### 2.2.4 Anti-ulcer and gastroprotective properties

*E. chlorantha* has preventive and curative effect on ulcers. It stimulates the secretion of mucus

that protects the stomach lining and enhances re-epithelialisation. In addition, as reported by Bassey et al. [5], it reduced ulcer index in a dose dependent manner and prevented ulceration at 78% when administered at 96,20 mg/kg body weight. Aqueous extract also prevents delay in chronic gastric ulcer healing and accelerates the spontaneous healing of ulcers. As reported by Mesmine et al. [13], mice with acid-induced ulcers had healing rates ranging from 82.7% to 88.6% following 10 days treatment with *E. chlorantha* aqueous extract (250 - 500mg/kg), hence supplying evidence for its anti-ulcer and gastroprotective properties.

### 2.2.5 Anticonvulsive property

*E. chlorantha* extract can delay the onset of convulsion, as Bassey et al. [5] observed a significant ( $p < 0.01-0.001$ ) delay of the onset of clonic and tonic Pentylentetrazol and picrotoxin induced convulsions.

### 2.2.6 Anti-inflammatory and analgesic property

The anti-inflammatory action of *E. chlorantha* is favorably comparable to that of acetyl-salicylic acid, a common anti-inflammatory drug. Similar to the anti-ulcer property, the anti-inflammatory effect of *E. Chlorantha* is dose dependent [14]. It is also associated analgesic effects. Moreover, methanolic extracts of the stem bark was found to exhibit simultaneously anti-inflammatory and analgesic activities [14]. It also showed statistically significant activity at doses of 250.0mg/kg by exhibiting 90% inhibition post 6 hours induction of inflammation [15].

### 2.2.7 Antioxidant property

According to Djimeli et al., [16], during infections like typhoid fever, free radicals are produced, and *E. chlorantha* stem bark possess antioxidant necessary to eradicate these free radicals. Its mechanism of antioxidant action is also based on its ability to donate electrons, reduce ferric ions, scavenge nitric oxide, DPPH and hydroxyl radicals. Antioxidant activity is proportional to phenol and flavonoid content; as a result, appreciable phenolic and flavonoid contents of *E. chlorantha* account for its potent antioxidant activities [17].

### 2.2.8 Hepatoprotective property

*E. chlorantha* stem bark extracts possessed hepatoprotective activity. Certain flavonoids and

steroids have been found effective against hepatotoxins. Some of these compounds present in *E. chlorantha* have been found responsible for hepatoprotective properties and act as free radical scavenger [9]. Djimeli et al. [16] showed that, hepasor, a mixture of protoberberine alkaloids found in *Enantia chlorantha*, protects the liver and prevents hepatic injury. Another metabolite, palmatine, prevents calcium overload of hepatocyte via the inhibitory effects on delayed outward potassium currents and Ca<sup>2+</sup> release activated Ca<sup>2+</sup> current.

### 2.2.9 Testiculo-protective and related property

*Enantia chlorantha* extracts maintain the cytological integrity of testes, viability of sperm motility and sperm count. This protective effect of *E. chlorantha* is partially also due to its antioxidant property [18]. In addition, simple sugars are most likely involved in the observed increase in sperm motility and viability [7,19].

### 2.2.10 Antitumor property

*Enantia chlorantha* demonstrated potential for containing novel antitumor compounds as it was proven to be toxic to the cellular proliferation of tumors cell (breast and colorectal cancer cells) [20].

### 2.2.11 Antidiabetic property

*E. chlorantha* stem bark extracts displays antidiabetic potentials. it protects against diabetes-induced kidney damage [21]. It further exhibits  $\alpha$ -amylase and  $\alpha$ -glucosidase inhibitory activities and also normalizes hyperglycemia [22].

## 2.3 Toxicity and Side Effects

Toxicity is described by LD50. This value varies with the type of organism used in the toxicity study. Ajani et al. [21] found that in vertebrate, ethanolic extract of *E. chlorantha* bark did not show any toxic or adverse effect nor mortality at 5000 mg/kg dose. Nevertheless, side effects like abortion were induced in pregnant mice due to reduction in progesterone titer as observed by Babalola et al. [23]. It also can causes lung, hepatic and kidney disorders following medium-to-long term use at doses greater than 500 mg/kg [24]. Further side effects such as heart and kidney congestion occurred at 1000, 2000 and 3000 mg/kg [9]. In ovo models, the

cytotoxicity assay of *E. chlorantha* revealed that the extract is highly toxic at concentration of 250 to 200 mg/ml with 100 % mortality, while mild toxicity was observed at 150 mg/ml with 40 % mortality. 0 % mortality was observed from 100 to 12.5 mg/ml, indicating that these concentrations are safe. Recent work showed that the LD50 of the ethanolic bark extract was 37,30g/kg body weight on invertebrate models like *Galleria mellonella* larvae [25].

## 3. CONCLUSION

At a stage of civilization where the trend of "bio" consumption has become a lifestyle, the inexhaustive virtues of *E. chlorantha* give hope to the utilization of this plant to provide a possibility to return to bio product instead of conventional drugs. It may also solve actual issues like multidrug resistance. Nevertheless, administration of *E. chlorantha* may produce severe toxic effects at relatively high doses, thus caution should be exercised in its use. In addition, most of the results were obtained on animal models, thus clinical essays should be done to ensure the safety of its use.

## CONSENT

It is not applicable.

## ETHICAL APPROVAL

It is not applicable.

## ACKNOWLEDGEMENT

This study has been supported by the RUDN University strategic Academic Leadership Program.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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*Peer-review history:*  
The peer review history for this paper can be accessed here:  
<https://www.sdiarticle4.com/review-history/75185>