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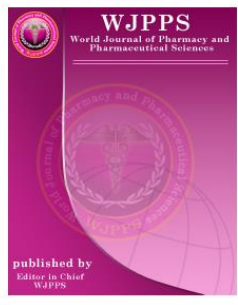
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## ZANTHOXYLUM ZANTHOXYLOIDES, A POTENTIAL SOURCE OF ACTIVE INGREDIENTS FOR THE MANAGEMENT OF ORAL DISEASES IN AFRICA

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### ABSTRACT

Plants for therapeutic use in the Pharmacopoeia constitute an alternative in the management of certain pathologies in developing countries. *Zanthoxylum Zanthoxyloides* is a highly exploited medicinal species in Africa and occupies a place of choice given its interesting pharmacological properties. This review proposes to make a synthesis on the state of chemical, biological knowledge and toxicological profile of the plant with a view to a wider use of the species. Several search engines and the Latin binomial “ *Zanthoxylum zanthoxyloides* ” were used for this bibliographical synthesis. The research was conducted over a period of at least twenty-five (25) years, at regular intervals of four years. Patents and citations have not been taken into account. At the end of this synthesis, it appears that the different organs of *Zanthoxylum Zanthoxyloides* are rich in various secondary

metabolites, the most represented of which are, among others, flavonoids, tannins, sterols and terpenoids. *Zanthoxylum* leaves *zanthoxyloides* are very rich in proteins and cellulose making this plant a species used in the diet of small ruminants. Several biological activities of *Zanthoxylum zanthoxyloides* have been demonstrated: these are antioxidant, anti-inflammatory, analgesic and anthelmintic activities. All parts of the plant are used in the treatment of several conditions including dental pain, sickle cell disease, fatigue, dysentery,

gonorrhoea, malaria, parasitic pathologies. The toxicological profile studied does not indicate any toxicity of the plant. The root and bark of *Zanthoxylum zanthoxyloides* are the most used organs. The roots have a very appreciable content of phenolic compounds. Investigations must be carried out to transform the active principles of the roots, the main organs involved in the relief of dental pain, into products that can be placed on the market to prevent and treat oral diseases.

**KEYWORDS:** *Zanthoxylum zanthoxyloides*, secondary metabolites, biological activities, toxicity.

## INTRODUCTION

For centuries, humans as well as animals have been largely dependent on plants for their food and medical needs (Uusiku *et al.*, 2010; Gbenou *et al.*, 2019). Across the continents, the use of medicinal plants to treat certain pathologies is an ancient technique based on cultural and religious values and transmitted from generation to generation. The tropical environment to which Africa belongs has an appreciable biological diversity (Adjanohoun *et al.*, 1999). In low-income countries, more than 80% of the population use traditional medicine for primary health care (WHO, 2004). The biological resources used by these populations have appreciable biological activities and their use is without undesirable effects and resistance phenomena (Thawebon *et al.*, 2011; Takahashi and Nyvad, 2011). *Zanthoxylum zanthoxyloides*, of the *Rutaceae* family, is a species of pre-forest savannahs and coastal thickets very widespread in tropical Africa and in the area of the Guinean-Congolese forest massifs (Zahoui *et al.*, 2016). This species, which is very present in the Beninese flora, has been the subject of numerous studies by researchers. Several studies have reported the beneficial interest of *Zanthoxylum zanthoxyloides* in the treatment of sickle cell anemia, malaria, general fatigue, fevers, dysentery (Anokbonggo *et al.*, 1990; Adjanohoun *et al.*, 1993) and mainly the use of the roots of the plant sold in several African markets, as a toothbrush to soothe dental pain (Bossokpi, 2003; Malgras, 1992). Previous pharmacological studies on *Zanthoxylum zanthoxyloides* have demonstrated several biological activities of the plant including, among others, anthelmintic, anti-inflammatory, analgesic and antioxidant activities. This review proposes to take stock of the knowledge available on *Zanthoxylum zanthoxyloides*, with a view to highlighting the insufficiencies of the literature and the prospects for research with the aim of its incorporation into drug formulations for the improvement of the living conditions of the population in primary health care. The

contributions of existing documentation on *Zanthoxylum Zanthoxylum* will focus on axes such as: (1): use in medicine and nutritional value of *Zanthoxylum zanthoxyloides*; (2): chemical studies carried out on the different organs of *Zanthoxylum zanthoxyloides*; (3): assessment of the principles isolated from the organs of *Zanthoxylum zanthoxyloides* (4): biological studies of the different organs of *Zanthoxylum zanthoxyloides*; (5): analysis of data from the literature. Perspectives can be identified following an in-depth analysis of the shortcomings of the literature.

## METHODOLOGY

The numerical approach was used during the data collection which was carried out by the introduction of the keywords "Zanthoxylum zanthoxyloides ", " *Fagara* " either alone or in combination with groups of words such as "chemical composition", "buccodental uses", "nutritional value", "biological activities" in the search engines Sciences Direct, Agora, Google scholar and Google. Books and other online material were also considered. Zotero connections have been created to receive updated *Fagara articles*. Resource persons were also consulted and the analytical flora of Benin was exploited (Akoègninou *et al.*, 2006). The time interval specified is four (04) years. Thus, over a period of at least twenty-five (25) years, all university publications as well as scientific documents containing the binomial "*Zanthoxylum zanthoxyloides*" have been identified.

## RESULTS

### **Botanical description of *Zanthoxylum zanthoxyloides*** (Arbonier, 2009; Traore, 2020)

*Zanthoxylum zanthoxyloides* (Synonym: *fagara zanthoxyloides*) is a thorny tree or shrub, more or less sarmentose, 6 to 8 m high, with a straight and often short stem, a rounded and fairly dense crown. The bark is gray to beige, rough, finely fissured vertically, often bearing corky conical protuberances corresponding to the corky base of the thorns, with a fragrant yellow slice above and yellow mottled with orange below. The spines are solitary, arranged at irregular intervals all along the branches, twigs and under the petioles (and sometimes under the main veins of the leaves), in a hook directed downwards, with a robust base, brown more or less streaked with beige, 0.1 cm long, on leaves, to 1.2 cm, on branches. The leaves are alternate, odd-pinnate, glabrous, with 7-11 opposite or alternate leaflets, ovate or elliptical, 5-10 x 2-4 cm, with obtuse or rounded apex and more or less apicular, with a wedge or rounded base. The blade is often leathery, more or less clearly riddled with translucent dots and gives off a peppery and lemony smell when crushed. The flowers are white or greenish, with a

corolla with 5 sepals which opens little and exceeds the stamens a little. The fruit is a globose capsule, 5-6 mm in diameter, brown when ripe, which opens into two valves and reveals a shiny, black or bluish seed that persists on the tree.



**Figure 1: Photo of *Zanthoxylum zanthoxyloides* (Daye, 2022).**

Table 1 summarizes the different names of the species in several Benin languages (Analytical Flora of Benin; Akpona *et al.*, 2009)

**Table 1: Different names in vernacular languages of *Zanthoxylum zanthoxyloides*.**

Country	ethnicities	Name in local languages
<b>Benign</b>	fon	Hetin
	Gun	Oxetin
<b>Nigeria</b>	Yoruba	Iguiata, ata
<b>Niger</b>	Hausa	fasakwari
<b>Senegal</b>	Fulani	Barkeley, bulebarkele
<b>Togo</b>	Akasselem	Bijakogoro
<b>mali</b>	Bambara	Wo, Gozongua

## USES OF *Zanthoxylum zanthoxyloides*

### Medicinal use

The root bark as an extract of *Zanthoxylum zanthoxyloides* is used to treat toothache, sexual impotence, malaria, abdominal pain, gonorrhoea and dysmenorrhoea (Adjanohoun *et al.*, 1989; Anokbonggo *et al.*, 1990; Adjanohoun *et al.*, 1993). Also this same part of the plant is traditionally used to prevent sickle cell disease (Sofowora *et al.*, 1974; Kouri, 2004) and is known for its anti-inflammatory activities (Ouattara *and al.*, 2004). In Mali the roots are used

in the treatment of painful menstruation (Sanogo, 2011). *Zanthoxylum zanthoxyloides* is an antiparasitic herb and is known for its anthelmintic properties (Sacca Sidi *et al.*, 2017).

Throughout West Africa the aromatic roots, stem bark and leaves are commonly used in traditional medicine. They are considered antiseptics, analgesics and diaphoretics. Stem or root bark macerations, decoctions or infusions are commonly taken to treat malaria, fever, sickle cell anaemia, tuberculosis, paralysis, edema and general fatigue. They are also commonly taken to treat intestinal problems, including colic, dysentery, intestinal worms, gonorrhoea and urethritis, as a stimulant and to treat pain during childbirth, migraines and neuralgia. The roots and stem bark produce a hot, pungent and narcotic effect on the palate when chewed, and are widely used in the treatment of gum pain, toothache and dental caries. A root decoction is used as a mouthwash and against sore throat (Schmelzer, 2013).

Sap from the pulp of the bark is used as eye drops against eye infections, especially conjunctivitis with pus in Côte d'Ivoire while in Ghana powdered root or stem bark is used in the taking in charge of whooping cough. In southern Nigeria a decoction of the roots and stem bark is used for the treatment of cancer. *Zanthoxylum zanthoxyloides* grows rapidly on cool, moist soils in tropical Africa, its use as a toothbrush is particularly recommended and its roots are used to soothe dental pain (Bossokpi, 2003). *Zanthoxylum zanthoxyloides* is effective against sickle cell disease, dental pain, angina, hemorrhoids (Yao-Kouassi *et al.*, 2014)

#### **Nutritional Uses of *Zanthoxylum zanthoxyloides***

*Zanthoxylum zanthoxyloides* is a species widely used in the diet of small ruminants in southern Benin in particular, its leaves are practically found in the feeding systems of these animals (Adjolohoun, 2008).

#### **CHEMICAL STUDIES OF DIFFERENT ORGANS OF *Zanthoxylum zanthoxyloides***

*Zanthoxylum* root powder *zanthoxyloides* harvested in Mali is rich in triterpene saponins which are used in the development of an ointment in the treatment of painful, anti-inflammatory conditions (Dembélé *et al.*, 2021).

The roots of *Zanthoxylum Zanthoxyloides* harvested in the Democratic Republic of Congo contain alkaloids, saponosides, tannins and flavonoids (Kosh-Komba *et al.*, 2017).

Phytochemical investigations of *Zanthoxylum root bark zanthoxyloides* harvested in Côte d'Ivoire contain monoterpenes and flavonoids (Kouamé *et al.*, 2021). Phytochemical analysis of aqueous extract of *Zanthoxylum root bark zanthoxyloides* revealed the presence of tannins, saponins, sterols, glycosides, polyterpenes, phenols, flavonoids, quinones and alkaloids (Chaaib, 2004). Nuto (1995) identified pellitorin, sesamin, fagarasterol as molecules with insecticidal properties at the level of the root bark.

The works of (Atindehou *et al.*, 2019) showed that the leaves of *Zanthoxylum Zanthoxyloides* harvested in Abomey- Calavi contain sterols, flavonoids and tannins.

*Zanthoxylum leaves zanthoxyloides* from the Democratic Republic of Congo are rich in alkaloids, saponosides, tannins and flavonoids (Kosh-Komba *et al.*, 2017).

The dosage of tannins by the method of the European Pharmacopoeia showed that the leaves of *Zanthoxylum zanthoxyloides* harvested in Abomey- Calavi (Benin) are rich in tannins with a content of 0.5g expressed in pyrogallol/100g of powder (Olounlade *et al.*, 2012).

The work of Kosh-Komba *et al.* (2017) highlighted the presence of alkaloids and flavonoids in the stem of *Zanthoxylum zanthoxyloides* harvested in the Democratic Republic of Congo.

Olushola-Siedoks *et al.* (2020) demonstrated the presence of trace elements in the stem bark of *Zanthoxylum zanthoxyloides* harvested in Nigeria (Lagos) which also contains sodium, magnesium, calcium, potassium and zinc. Phytochemical screening of *Zanthoxylum stem bark zanthoxyloides* reveals the presence of tannins, phenols, anthraquinones, alkaloids, terpenoids, reducing compounds, carbohydrates, phytosterols, cardiac glycosides, phlobatannins.

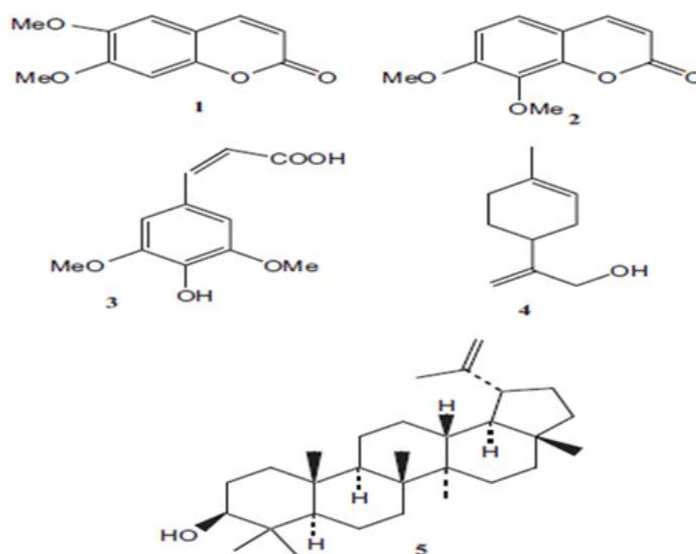
Ouattara *et al.* (2016) extracted the crude oil from *Zanthoxylum fruits zanthoxyloides* harvested in Burkina-Faso by the Soxhlet method with an extraction yield of 41.8±4.0%. *Zanthoxylum raw fruit oil Zanthoxyloides* is rich in saturated (26.65%) and unsaturated (72.35%) fatty acids. The most representative unsaturated fatty acids were oleic acid, linoleic acid and linolenic acid. The most representative saturated fatty acids were palmitic and stearic acids.

**Table 2: Summary of chemical composition of *Zanthoxylum zanthoxyloides*.**

Organs <i>Z. zanthoxyloides</i>	Chemical composition	References
<b>Stems and stem bark</b>	Sodium; magnesium; calcium; potassium; zinc; Alkaloids; flavonoids tannins, phenols, anthraquinones; terpenoids, reducing compounds, carbohydrates, phytosterols, cardiac glycosides, phlobatannins	(Olushola-Siedoks <i>et al.</i> , 2020) ; (Kosh-Komba <i>et al.</i> , 2017)
<b>Roots and root bark</b>	Triterpene saponins; alkaloids, saponosides, tannins and flavonoids; monoterpenes; sterols; glycosides, polyterpenes; quinones;	Dembélé <i>et al.</i> , (2021); Kosh Komba <i>et al.</i> , (2017) Kouame <i>et al.</i> , (2021) (Chaaib <i>et al.</i> , 2003; Adesina, 2005; Queiroz <i>et al.</i> , 2006; Zahoui <i>et al.</i> , 2010);
<b>Sheets</b>	Sterols; flavonoids; tannins; alkaloids, saponosides ;	Atindehou <i>et al.</i> , (2019); (Kosh-Komba <i>et al.</i> , 2017)
<b>seed oil</b>	Unsaturated fatty acids: oleic acid; linoleic acid ; acid linolenic. Saturated fatty acids: palmitic acid; stearic.	Ouattara <i>et al.</i> , (2016)

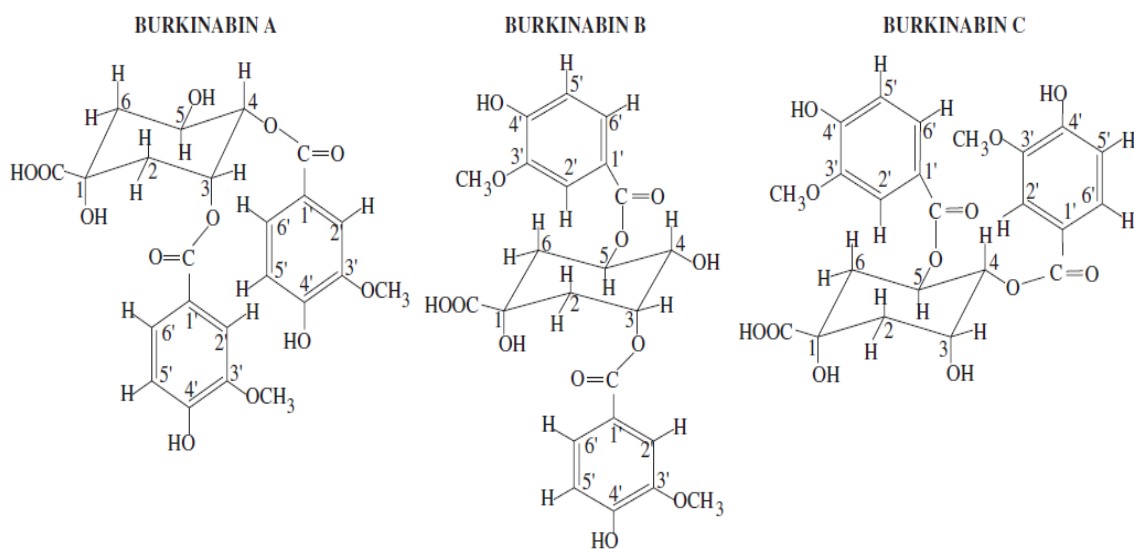
### BIOACTIVE MOLECULES ISOLATED FROM *Zanthoxylum zanthoxyloides*

*Zanthoxylum* fruit essential oil *zanthoxyloides* are rich in oxygenated monoterpneic compounds such as citronellol and geraniol, while non-alkaloid type compounds (1 to 5) have been identified and isolated in the methanolic extracts of the roots of the same plant harvested in Cameroon (Misra *et al.*, 2013). The structures of these compounds namely: scoparone (1); 7,8-dimethylcoumarin (2); sinapic acid (3); p-mentha-1,8-dien-9-ol (4);  $\beta$ -sitosterol, stigmasterol, lupeol (5),) are shown in figure 2.



**Figure 2: Structures of compounds isolated from *Zanthoxylum roots Zanthoxyloides* (Misra *et al.*, 2013).**

The work of Ouattara *et al.* (2009) made it possible to isolate in the ethyl acetate extracts from the root bark of *Zanthoxylum zanthoxyloides* harvested in Burkina, three derivatives of quinic and vanillic acids. These are 3,4 - *O* -divanilloylquinic acid, 3,5- *O* -divanilloylquinic acid and 4,5 - *O* -divanilloylquinic acid, named burkinabins A, B and C respectively. The structures of these compounds are shown in Figure 3.



**Figure 3: Structure of compounds isolated from *Zanthoxylum zanthoxyloides* root bark (Ouattara *et al.*, 2009).**

## BIOLOGICAL ACTIVITIES OF *Zanthoxylum zanthoxyloides* ORGANS

### Antibacterial and antifungal activities

The petroleum ether, dichloromethane and methanolic extracts of *Zanthoxylum zanthoxyloides* significantly inhibited the growth of *Candida albicans* strains (Bossokpi, 2003). Hydroethanolic extracts of *Zanthoxylum leaves zanthoxyloides* from the Democratic Republic of Congo are active against *Klebsiella pneumoniae*. These same extracts also possess fungicidal properties on *Candida albicans* with disc pit inhibition concentrations of 4 mg/disc (Kosh-Komba *et al.*, 2017).

*In vitro* studies have shown that the essential oils from the fruits and leaves, and the fruit and root bark extracts of *Zanthoxylum zanthoxyloides* harvested in Cameroon are active against *Salmonella enterica*, *Salmonella typhu*, *Bacillus subtilis*, *Listeria monocytogenes*, and *Staphylococcus aureus* (Ngassoum *et al.*, 2003; Gardini *et al.*, 2009; Misra *et al.*, 2013; Kamdem *et al.*, 2015).

### **Antioxidant activity**

The hydroethanolic extract of leaves of *Zanthoxylum zanthoxyloides* harvested in Abomey-Calavi has antioxidant activities with a median inhibitory concentration of 83µg/L (Atindehou *et al.*, 2019).

The aqueous, butanolic and exhausted extracts of *Zanthoxylum root zanthoxyloides* harvested in Mali are endowed with an antioxidant power evaluated by thin layer chromatography and revealed by 2,2-diphenyl-1-picrylhydrazyl (DPPH).

Methanolic extract of *Zanthoxylum root bark Zanthoxyloides* from Cote d'Ivoire possesses significant antiradical activities. This oxidizing power of the plant increases during excessive storage (Kouamé *et al.*, 2021).

### **Anti-inflammatory and analgesic activities**

*Zanthoxylum root powder zanthoxyloides* is used in the preparation of an ointment for the management of painful, anti-inflammatory, joint and analgesic conditions. The aqueous extract of *Zanthoxylum root powder bark zanthoxyloides* from Mali at a dose of 1500 mg/kg has anti-inflammatory activities (Bossokpi, 2003). The work of Prempeh and Mensah-Attipoe, (2008) showed that aqueous extract of *Zanthoxylum root zanthoxyloides* significantly inhibits prostaglandin E<sub>2</sub>, a chemical mediator of inflammation, thereby showing proven anti-inflammatory activity.

The hydroethanolic extract of *Zanthoxylum leaves zanthoxyloides* has anti-inflammatory and analgesic activities at a dose of 300 mg/kg evaluated respectively by the *in vivo method of* carrageenan -induced paw edema and in a pain model induced by acetic acid in mice (Diatta *et al.*, 2014).

The aqueous extract of *Zanthoxylum zanthoxyloides* from Mali showed a dose-dependent effect. At a dose of 1500 mg/kg, this extract showed an anti-inflammatory activity twice that of Aspirin and Indomethacin and an analgesic activity comparable to that of indomethacin (Bossokpi, 2003).

Zahoui *et al.* (2016) highlighted the contractile activity of aqueous extracts from the bark of *Zanthoxylum zanthoxyloides* collected in Côte d'Ivoire from isolated rat heart and isolated guinea pig aorta. The aqueous extract of *Zanthoxylum root bark Zanthoxyloids* at concentrations of 10<sup>-8</sup> to 10<sup>-5</sup> mg/ mL induced positive chronotropic and ionotropic effects

and at concentrations between  $10^{-4}$  to  $10^{-2}$  mg/ml caused negative chronotropic and inotropic effects. In contrast, on isolated aorta, the extract caused vasorelaxation at concentrations of  $10^{-8}$  to  $10^{-5}$  mg/ mL.

### **Anthelmintic activity**

The *in vivo* study conducted by Azando *et al.* (2011) showed that *Zanthoxylum* leaf powder *zanthoxyloides* from Benin has significant anthelmintic properties against adult *Haemonchus worms contortus* with doses administered between 3.2 mg/kg and 4.2 mg/kg. The essential oil obtained by hydrodistillation of *Zanthoxylum fruits zanthoxyloides* collected in Abomey-Calavi (Benin) has anthelmintic activity on adult *Haemonchus worms contorted* and on the excretion of strongyle larvae (Azando *et al.*, 2017). *Zanthoxylum* leaf extracts *zanthoxyloides* administered *in vivo* are effective against *Haemonchus larvae contortus*, the main parasite of small ruminant infections (Hounzangbe-Adote *et al.*, 2005); (Kuisseu *et al.*, 2021). The leaf powder of this plant has anthelmintic properties. Oral administration, *in vivo*, of a methanolic extract of the leaves at a dose of 0.6 g/kg of body weight is active on *Trichostrongylus colubriformis*, a gastrointestinal parasite of small ruminant infection (Minaflinou Sacca Sidi *et al.*, 2015).

The hydroethanolic and hydroacetone extracts of *Zanthoxylum* leaf powders *zanthoxyloides* from Benin, inhibit *in vitro* the larval migration of *Haemonchus contorted*. The hydroethanolic extract has significant anthelmintic activity at high doses (Olounlade *et al.*, 2011).

**Table 3: Summary of the pharmacological effects of *Zanthoxylum zanthoxyloides*.**

Organs	Form of use	Biological activities	Year	References
Sheets	Hydroethanolic extracts	Antimicrobial antifungal	2002; 2017	Bossokpi, (2002); Kosh Komba <i>et al.</i> , (2017);
	leaf essential oil	Antibacterial	2003; 2009; 2013; 2015	(Ngassoum <i>et al.</i> , 2003; gardini <i>et al.</i> , 2009; Misrah <i>et al.</i> , 2013; Kamdem <i>et al.</i> , 2015)
Sheet	Hydroethanolic extract	antioxidant	2019	Atindehou <i>et al.</i> , (2019)
Root	Aqueous and butanol extract	antioxidant	2021	Kouame <i>et al.</i> , (2021)
root bark	methanolic extract	Antiradical	2021	Kouame <i>et al.</i> , (2021)
root bark	Aqueous extracts	Anti-inflammatory	2002	Bossokpi, (2002)
Root	aqueous extract	Anti-inflammatory	2008	Prempeh and Mensah- Attipoe (2008)
Sheet	Hydroethanolic extract	Anti-inflammatory; analgesic	2014	Diatta <i>et al.</i> , (2014)
stem bark	aqueous extract	contractile activity	2016	Zahoui <i>et al.</i> , (2016)
Sheet	Powder	Anthelmintic	2011	Azando <i>et al.</i> , (2011)
Sheet	Hydroethanolic extract and hydroacetones	Anthelmintic	2011	Olounladé <i>et al.</i> , (2011)
Fruits	Essential oil	Anthelmintic	2017	Azando <i>et al.</i> , (2017)
Sheet	Sheet	Anthelmintic	2005; 2021	Hounzangbe-Adote <i>et al.</i> , 2005; Kuiseu <i>et al.</i> , 2021
Sheet	Sheet	Anthelmintic	2015	minaflinou Sacca Sidi <i>et al.</i> , (2015)

### **TOXICOLOGICAL PROFILE OF *Zanthoxylum zanthoxyloides***

The work of Bossokpi (2003) showed that the aqueous root extract of *Zanthoxylum zanthoxyloides* from Mali administered orally and intraperitoneally is non-toxic in batches of mice; the median lethal doses (LD<sub>50</sub>) are greater than 5g/kg and 1g/kg respectively for these two modes of administration.

Work by Neuwinger (1996) revealed that the root stem bark of *Zanthoxylum Zanthoxyloides* is toxic by subcutaneous administration at a dose of 10g/kg, whereas the leaves and stem bark of the same plant have proved to be less toxic. According to the authors, this toxicity of the root barks is linked to the presence of alkaloids such as fagaronine, skimmianine and atanine.

### **ANALYSIS OF LITERATURE DATA ON *Zanthoxylum zanthoxyloides***

Based on literature data, *Zanthoxylum Zanthoxyloides* is a widespread plant in West Africa. The plant is potentially widely used in several countries given its therapeutic virtues against several conditions. The different organs of the plant are very rich in secondary metabolites relayed by several authors. These include, among others: tannins, flavonoids, anthraquinones, alkaloids, reducing compounds, carbohydrates, phytosterols, cardiac glycosides, phlobatannins, triterpene saponins ; alkaloids, saponosides, sterols; glycosides, polyterpenes; quinones; unsaturated fatty acids (oleic acid; linoleic acid; linolenic acid); saturated fatty acids (palmitic acid; stearic acid). Several biological activities have been reported by many authors. These include antimicrobial, antifungal activities; antibacterial; antioxidant; anti-inflammatory; analgesic; anthelmintic. Among these activities, those anti inflammatory; analgesic; anthelmintic and antibacterial have been the subject of several studies. The most used organs of the plant are respectively in order of priority the root; the root bark; the stem and leaves in the treatment of various ailments (Nuto *et al.*, 2020). However, the literature provides very little information on the possibilities of products or drugs derived from *Zanthoxylum zanthoxyloides*. Of course, Chaaib *et al.* (2004) reported a tablet formulation from the roots of *Zanthoxylum zanthoxyloides* and marketed by a Togolese laboratory for the fight against sickle cell disease. Despite the numerous studies on the different parts of *Zanthoxylum zanthoxyloides*, these have hardly given rise to any formulation in the form of an improved traditional medicine in order to optimize the use of this plant in the management of ailments in Africa.

On analysis of these results, several perspectives are possible for a better use of *Zanthoxylum zanthoxyloides*. This involves, among other things, optimizing its biological activities through the development of a therapeutic toothpaste against oral diseases for the well-being of the Beninese population whose access to oral health care stays and remains a luxury restricted to a limited part of the population.

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