



E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2021; 10(3): 29-33
Received: 15-03-2021
Accepted: 18-04-2021

Author's details given below

Review of the literature of *Eleusine indica*: phytochemical, toxicity, pharmacological and zotechnical studies

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DOI: <https://doi.org/10.22271/phyto.2021.v10.i3a.14060>

Abstract

The objective of this study is to synthesize knowledge on the pharmacological properties, phytochemistry and toxicity of *Eleusine indica*. To achieve this, specific keywords were used to explore scientific databases such as PubMed, Google Scholar and Researchgate. The scientific data collected show that *Eleusine indica* has antidiabetic, antimalarial, antibacterial, antifungal, anti-trypanosomal, antihelminthic, antioxidant, anti-inflammatory, antiurolithiasic, antiviral, phytoremediating, hepatoprotective and phytoremediating properties. These pharmacological properties are associated with a richness of the herb in secondary metabolites. It has been reported, the presence of alkaloids, terpenes, flavonoids, tannins, anthraquinones, saponins, cardiac glycosides and anthracene glycosides in several extracts of the plant. In addition, schaftoside (C-glycosyl-6-C-arabinosyl-8 apigenin) and vitexin (apigenin-8-C-glucoside) were isolated from aerial parts. Toxicologically, an absence of toxicity was noted. All this makes *Eleusine indica*, a plant with an interesting pharmacological potential, which should be valorized by further work and the development of phytodrugs.

Keywords: Antihelminthic, tannins, phytodrugs, pharmacological properties

1. Introduction

Medicinal plants have been used in traditional health care systems since prehistoric times and are still the most important source of health care for most of the world's population [1]. The art of healing with plants has been known and practiced in Africa for a long time because it exploits knowledge transmitted orally from generation to generation to certain categories of initiated individuals such as traditional healers and herbalists [2]. Like many African countries, traditional medicine is also practiced in Benin. The work of some researchers has identified more than 814 species belonging to 130 botanical families with medicinal properties. Among the medicinal plants used in Benin, *Eleusine indica* has an important place. *Eleusine indica* from the Poaceae family, generally considered as a weed species, is native to the tropics and subtropics [3]. Gooseberry has a wide tolerance to a wide range of environmental conditions, but its vegetative growth is significantly reduced during dry seasons [4]. The whole plant, especially the root, is depurative, diuretic, febrifuge and laxative, and therefore is used for the treatment of influenza, hypertension, oliguria and urine retention. The plant has been the component of the "basic remedy" in traditional Vietnamese medicine [4], and also used for kidney problems in Trinidad and Tobago [4]. The seed is sometimes used as a famine food and also in the treatment of liver disorders. *Eleusine indica* is also considered an annual weed, widely distributed in Asia, Africa, South America and southern parts of North America [5]. The plant is considered one of the five most harmful weeds in the world, which significantly affects the production of 46 different crop species in more than 60 countries [6]. It is considered one of the most invasive weeds and is very difficult to control. [7]. Pharmacologically, *E. indica* is believed to have anti-inflammatory activities [8], antioxidant [9], antimicrobial, hepatoprotective, antiplasmodial and antidiabetic [8].

By linking all the previous data and taking into account its multiple therapeutic uses, we ask ourselves some questions. What are the pharmacological activities of *E. Indica*? What do we know about its toxicological characteristics? What is the chemical composition of *E. Indica*? These are all questions that justify this literature review study in order to improve the use of this plant for the benefit of the scientific community and the general public. The objective of this work is to take stock of the work carried out, to identify the strengths of the plant in order to make suggestions on its optimal use in therapy, in human or veterinary medicine.

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2. Nomenclature of *Eleusine indica*

Eleusine indica (L.) Gaertn. belongs to the Poaceae family. The species has several synonyms such as *Agropyron geminatum* Schult. & Schult.f., *Eleusine distachya* Trin. ex Steud. (inv.), *Eleusine marginata* Lindl and others [10]. Commonly, it is called ragweed, white crabgrass, crow's foot, Indian ragweed, wire or silver crabgrass [6]. In Benin, it is called Gamatori or Gomateri in Bariba, Tchouan in Berba and Torohundo in Yom [10]. The genus *Eleusine* comprises about 9 species and East Africa is considered to be its center of diversification with eight species: *E. africana*, *E. coracana*, *E. kureziensis*, *E. indica*, *E. floccifolia*, *E. intermedia*, *E. multiflora* and *E. jaegeri* occurring in this region. Species in this genus show few morphological differences among themselves and include annual and perennial growth forms [11].

Area	:	Eukaryota
Reign	:	Plantae
Phylum	:	Spermatophyta
Sub-branch	:	angiospermes
Class	:	Monocotyledonae
Order	:	Cyperales
Family	:	Poacées
Genus	:	<i>Eleusine</i>
Species	:	<i>indica</i> [11]

3. Geographical distribution

The geographical origin of *E. Indica* is uncertain but it is considered to be native to Africa and temperate and tropical Asia. Currently, it is distributed almost throughout the tropical world and extends significantly in the subtropics, especially in North America, Europe and Africa. It occurs up to 2000 m altitude in the tropics. It is perhaps most noticeable in annual row crops such as grains, pulses, cotton, tobacco and vegetables, where it is able to establish quickly before the crop is sufficiently shaded. [10].

4. Botanical features of *Eleusine indica*

Eleusine indica is distinguished from other weeds by the very white color of the crown and lower stems (Figure 1). It can reach a height of 60 cm. It is common that it is sometimes mistakenly identified as crabgrass. The reason is that *Eleusine indica* and crabgrass have similar emergence patterns. Both have membranous ligules and similar shaped leaves. However *Eleusine indica* is a darker green, with a whitish and silvery color near the base of its attentive stem. Moreover, it does not have hairs on the upper surface of the leaves, like the crabgrass [6].

The leaves are narrow and arranged in two rows; the blade is glabrous and the sheath is hairy. The leaf blades are floating or folded, 15-30 cm long and 4-6 mm wide. The inflorescence is in a whorl of 2 to 7 (usually 5) finger tips from the top of the culm, with a single tip or two separate tips below. The spikelets are 3 to 5 flowers, up to 4 mm long, Auvergne and dark green. The glumes are membranous, with a lower part 1 to 1.5 mm long, pointed, rough on the keel and single-veined, and an upper part 3 mm long, pointed or tapering progressively to a point, with a smooth keel, one to five nerves; the lemmas are similar in texture and shape to the glumes, ovoid and pointed. The grain is reddish brown to black, oblong, ovoid and streaked [10].



Fig 1 : Leafy stem of *Eleusine indica* [6]

5. Traditional uses

Eleusine indica is used as a traditional remedy in the management of diabetes and malaria in Nigeria [7]. Cats with stomach problems eat its leaves to recover [12]. In Malaysia the whole plant, especially the root, is used as a diuretic, anthelmintic, diaphoretic and febrifuge and to treat coughs and other ailments. Decoctions of the boiled plant are consumed as an anthelmintic and febrifuge treatment [13]. In Brazil an infusion of the aerial parts is used against influenza and pneumonia [14]. In the Philippines, it is reported to have anticancer potential [15].

6. Pharmacological properties of *E. indica*

6.1 Antiplasmodial activity

In vitro, a strong antiplasmodial activity of the methanolic extract of *E. indica* has been demonstrated on the chloroquine-resistant strain *Plasmodium falciparum* (D6) [16]. In another study, the ethanolic extract of *Eleusine indica* leaves showed remarkable antiplasmodial activity in mice infested with *Plasmodium berghei*. The activity was comparable to that of chloroquine 5 mg/kg [7].

6.2 Anti-trypanosome activity

The methanolic extract of *E. indica* had a 90% inhibition rate on *Trypanosoma brucei*, thus giving *E. indica* an interesting anti-trypanosomal potential [16].

6.3 Antidiabetic activity

Ethanolic extract from *Eleusine indica* leaves had anti-diabetic (hypoglycemic) properties in rats experimentally made diabetic with alloxan [7].

6.4 Antibacterial activity

Chloroform and methanolic extracts of *E. indica* have shown activity against *Staphylococcus aureus*, *Enterobacter aerogenes*, *Escherichia coli*, *Proteus vulgaris*, *Klebsiella aerogenes*, *Pseudomonas aeruginosa* and unspecified species of *Streptococcus* and *Bacillus* [16, 17]. According to other work, the extract also inhibits *Salmonella Typhi*, *Streptococcus faecalis*, *Streptococcus faecalis* and *Lactobacillus lactis* [12].

6.5 Antifungal activity

E. indica has interesting antifungal activity. The methanolic extract inhibited the reference fungal strains: *Candida albicans* ATCC 90028 and *Aspergillus fumigatus* ATCC 204305 [16].

6.6 Antioxidante activity

By chemiluminescence, the oxidizing capacity of *Eleusine indica* extracts against hydrogen peroxide and superoxide anion has been demonstrated [18]. The extract also has a reducing power on the DPPH radical [9]. Scientific data suggests that the strong antioxidant potential of *E. indica* may be part of the factors associated with its tolerance to herbicides [19].

6.7 Anti urolithiasis activity

E. indica has an anti urolithiasis property. In one study, nephrolithiasis was induced by ethylene glycol in *Rattus norvegicus*. *E. indica* root extract had a significant effect on serum creatinine, blood urea nitrogen and uric acid levels in albino rats. *E. indica* root extract also had effects on the excretion of urinary nitrite, protein, and calcium oxalate crystals in rats. It prevents nitrituria, proteinuria and oxaluria in treated subjects. Besides, the extract prevents the disruption of the normal structure of the glomeruli and tubules of the rat kidney and contributes to the restoration of the already disrupted glomeruli and renal tubules to the normal structure [20].

6.8 Anti-inflammatory activity

It is known that lipopolysaccharides (LPS) induce the maturation of dendritic cells by producing a large amount of TNF- α . The anti-inflammatory activity of *Eleusine indica* extracts was determined by evaluating the production of TNF- α by imDC after culture of DC with different concentrations of the extract in the presence of LPS. A dose-dependent inhibition of TNF- α production by imDC induced by LPS was observed. The extract exhibited very interesting anti-inflammatory activity [18]. In another study, ethanolic and ethyl acetate extracts of *E. indica* were shown to dose-dependently reduce rat paw edema induced by xylem [20].

6.9 Antiviral activity

E. indica has a strong inhibition of Herpes Simplex virus (HSV-1) [21].

6.10 Lipid reducing activity

It has been demonstrated in *E. indica*, the potential to reduce the blood lipid level. The hexane extract of *Eleusine indica* has shown a strong potential in the inhibition of porcine pancreatic lipase. [22]. Animal experimentation tests, carried out on rats, showed that this extract significantly reduced the body weight of rats and improved the serum lipid profile, with

a reduction in serum triglycerides, total cholesterol, low lipoproteins. density and an increase in high density lipoproteins [22].

6.11 Phytoremediatory properties

Some plants have the natural property of accumulating contaminants in their tissues. This property, called phytoremediation, has many environmental and health applications. Several scientific studies attribute phytoremediation properties to *Eleusine indica*. *Eleusine indica* had interesting growth and phytoremediation performances on soil artificially polluted by dichlorovinyl dimethyl phosphate (DDVP, 1000EC) at different concentrations [23].

6.12 Hepatoprotective activity

E. indica has significant hepatoprotective effects against CCl₄-induced hepatotoxicity in rats [9].

6.13 Anti-hypertensive properties

Ethanolic extract and chloroform extract of *E. indica* have proven anti-hypertensive properties. This property of the plant was assessed on the basis of an experimental study. The results showed that hypertension was significantly inhibited by the ethanolic extract. The methanolic extract also exhibited relatively low activity [24].

6.14 Phytochemical composition

The results of the phytochemical screening of the extract of *E. indica* reveal the presence of alkaloids, terpenes, flavonoids, tannins, anthraquinones, saponins and cardiac glycosides [7]. This chemical composition can vary according to the extracts, as shown by Morah and Otuk [12]. These authors observed, by a qualitative phytochemical screening, that the methanolic extract contained tannins, unlike the aqueous and ethanolic extracts. Likewise, anthracene glycosides are present in ethanolic and methanolic extracts, unlike the aqueous extract. In another study, the quantification of total polyphenols made it possible to highlight an interesting content of total polyphenols in the methanolic extracts [25]. Among the flavonoids, schaftoside (C-glycosyl-6-C-arabinosyl-8 apigenin) and vitexin (apigenin-8-C-glucoside) have been isolated from aerial parts [14]. P-Coumaric acid and isoschaftoside have also been identified in the herbal medicine [26]. The compounds isolated from the organs of *E. indica* are summarized in Table 1:

Table 1: *E. indica* isolated compounds

Organs	Extracts	Compounds	References
Aerial parts	Lyophilized extract	Schaftoside	[26]
Aerial parts	Lyophilized extract	Isoschaftoside	[26]
Aerial parts	Lyophilized extract	acid p-coumarique	[26]
Aerial parts	Lyophilized extract	Vitexine	[26]
Aerial parts	Hexane extract	1 - [[[(2- aminoethoxy) hydroxyphosphinyl]oxy]methyl]1-,2-ethandiyylester	[27]
Aerial parts	Methanol extract	Acide hexadecanoique	[27]
Leave	Essential oil	Heptacosane	[28]
Leave	Essential oil	Pentatriacotene	[28]
Leave	Essential oil	Docosanol	[28]
Leave	Essential oil	2-methylhexan-1-ol	[28]
Leave	Essential oil	Nonadecane	[28]
Leave	Essential oil	Cis-13-eicosenique	[28]
Leave	Essential oil	2,6,10-trimethyltetradecane	[28]
Leave	Essential oil	Tert-hexadecanethiol	[28]
Leave	Essential oil	Nonadocane	[28]

7. Toxicity

7.1 Cytotoxicity

E. indica exhibits low cellular toxicity. An experiment on Vero cells showed very low cytotoxicity, with CC_{50} between 15 and 60 mg/mL [21].

7.2 Acute oral toxicity

Data on the acute oral toxicity of *E. indica* indicate an absence of toxicity. The acute oral toxicity of *E. indica* hexane extract on female Sprague-Dawley rats showed the extract to be of low hazard because mortality, symptoms of clinical toxicity, severe pathological or histopathological damage did not occur. been observed [22].

8. Conclusion

This literature review made it possible to identify for the first time all the scientific data available at the pharmacological, chemical and toxicological level on *E. indica*. From this synthesis, it emerges that *E. indica* possesses numerous pharmacological properties justified by numerous scientific studies. The presence of secondary metabolites is at the origin of its properties. In addition, the toxicological studies identified report an absence of toxicity of the medicinal plant. All of this justifies the many known traditional uses for this member of the Poaceae family. *E. indica* needs to be valorized in more in-depth scientific work, through more sophisticated pharmacological tests, the isolation of active ingredients and the development of phytomedicines.

9. Acknowledgments

The authors of this study are grateful to National University of Agriculture, Benin, for enabling them have access to Library of University for their search, discussions and internet.

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