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Review on secondary metabolites and therapeutics activities of *Acacia nilotica* used in African phytomedicine

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ABSTRACT

Today, more than 80% of the West African population use traditional medicine in case of illness. However, several research studies are carried out in order to improve animal health, especially about antimicrobial resistance and vaccine failures observed in farms. This study aimed to review findings about second metabolites and therapeutics activities of *Acacia nilotica* used in African phytomedicine. Information has been searched on databases such as Agora, Hinari, Google Scholar, various journals, books and articles. Information capitalized are about traditional use of *A. nilotica*, antiviral, antifungal, antiparasitic, antibacterial, antiplasmodial, anti-inflammatory and anti-hypertensive activities of the plant. These notions constituted will help for better management of disease and other research perspectives like *in vivo* test of *Acacia nilotica* extracts on viral pathologies in Animal health.

Keywords: *Acacia nilotica*, Review, Traditional use, Pharmacological activities.

INTRODUCTION

Ethnomedicine and the African veterinary pharmacopoeia, as an art and science stemming from African practice and cultures, are practiced and transmitted within society and their content remains a heritage either of a family or of a particular social group in the village or region [1]. Today, more than 80% of the West African population use traditional medicine in case of illness [2]. Health care therefore depends very much on medicinal plants and the local knowledge associated with them [3, 4]. Currently, numerous and rigorous scientific work are trying to develop this ancestral art of diagnosis and treatment of livestock diseases [5]. However, in the African countries, domestic animals continue to pay a heavy price for various pathologies despite the import of veterinary drugs, which are at very uncompetitive costs [6]. Each year, the flock of poultry, small and large ruminants, pig, rabbits and other animal species are threatened. However, several research studies are carried out in order to improve animal health, especially about antimicrobial resistance and vaccine failures observed in farms. The mission of Akoegninou *et al.* [7] listed 2807 plant species used in traditional Beninese medicine, including *Acacia nilotica*. The same plant was identified during the census of 2500 plant species in Togo [8]. Therefore, many pharmacological investigations have been carried out on *Acacia nilotica*. The purpose of this document is to provide a bibliographic overview of the properties of *A. nilotica*, used throughout African countries in the control of bacterial, parasitic and viral diseases in both human and animal health. Indeed, authors have reported various properties as antiviral, antifungal, antiparasitic, antibacterial, antiplasmodial, anti-inflammatory and anti-hypertensive.

MATERIAL AND METHODS

The present review article involved secondary data analysis. Information has been searched on databases such as Agora, Hinari, Google Scholar, various journals, books and articles [9].

RESULTS AND DISCUSSION

Botanical description of *Acacia nilotica*

The genus *Acacia* belongs to the Leguminosae family, subfamily of Mimosoideae. The classification of the current species comes up against the continuous character of the variation of the characters within this genus. There are, however, three sub-genera with several sections [10].

- *s. g. Aculeiferum* (strong thorns, seeds without albumen)
- *s. g. Heterophyllum* (bipinnate leaves or phyllodes, seeds with albumen traces, absence of aril)
- *s. g. Acacia* (thorny stipules, specialized cytological characters).

Acacia is a large pantropical genus, which includes more than 1,300 species, most of which (more than 900 species) are found in Australia, more than 200 species in America, and about 130 species in Africa. *Acacia nilotica* belongs to the subgenus *Acacia*, which includes all African species of *Acacia* with straight thorny stipules. The different scientific names of *Acacia nilotica* are *Acacia nilotica* var. *Adstringens* (Schum. Et Thomn.); *Acacia nilotica* var. *Adansonii* (Guill. Et Perrott) and *Acacia nilotica* var. *Tomentos* (Benth) A. F. Hill [11, 12].

Synonyms and systematic of *Acacia nilotica*

We recorded seven synonyms of *A. nilotica*

- *Acacia arabica* (Lam) var *nilotica* (L.) Benth,
- *Acacia arabica* Willd,
- *Acacia scorpioïdes* (L.) var. *nilotica* (L.) A. Chev,
- *Acacia scorpioïdes* (Linn.) W. F. Whight,
- *Mimosa scorpioïdes* (Li),
- *Mimosa nilotica* (Linn),
- *Mimosa Arabica* (Lam).

The systematics of *A. nilotica* are as follows [13]: *A. nilotica* belongs to:

- Reign: Vegetable
- Group: Eukaryotes
- Branching: Spermaphytes
- Sub-branch: Angiosperms,
- Class: Dicotyledons
- Subclass: Dialypetales
- Order: Caliciflores
- Suborder: Legumes
- Family: Mimosaceae
- Gender: *Acacia*
- Species: *nilotica*

Common names

English: Egyptian mimosa

French: Gonakier, Acacia nilotique, Acacia du Nil

Vernacular names [14]

- BENIN : gbanni, vanli (Goun et Fon), gaudi (Peuhl)
- TOGO : boni (Ewe)
- BURKINA-FASO : bagana (Bambara), pegengá (Moore), soediele (Lyele), gawdi (Fulfulde)
- SENEGAL: nebnep (Wolof), bagana iri (Bambara)
- MALI: bagana (Bambara), bagana jiri (Malinké-Dioula)
- NIGERIA: bagawura (Hausa)
- GHANA : Odanwoma (Akan)

Habitat and geographic distribution

Acacia nilotica is widespread in the northern savannah regions. Its range extends from Mali to Sudan and Egypt. It requires a well-lit environment for its growth. Raw frost affects small seedlings and large trees. It is drought tolerant and grows best on rough, flat or slightly wavy alluvial soils and in ravine areas. It is considered a noxious weed in South Africa [14].

Plant description

Acacia nilotica is a tree, 10 to 12 m tall that can reach 20 m in the wetland with a straight cylindrical bole (Figure 1). The crown has a rounded appearance. The dark brown bark is deeply cracked in a

striated fashion. The branches are olive green or brownish. The thorns, arranged in pairs at the base of the leaves, are straight when they are long and, sometimes hooked when they are short [12].



Figure 1: Whole plant of *Acacia nilotica*

The leaves are gray green, alternate and composed bipinnate with 2 to 14 pairs of pinnae (Figure 2). The petiole is 0.5 to 2.5 cm long. The spine carries 2 to 8 pairs of pinnules long from 10 to 15 mm. The leaflets are composed of very fine leaflets with 2 to 8 pairs of long pinnules of 9 to 26 mm [15, 16]. The flowers of *Acacia nilotica* are golden yellow in color, sometimes in balls at the top of the twig (Figure 2). They are bisexual or male. The calyx lobes are 1 to 2 mm long, the corolla lobes are glabrous or pubescent. The stamens are numerous, free up to 6 mm long. The ovary is superior. The style is long and thin [15].



Figure 2: Leaves and flowers of *Acacia nilotica*

The fruits of *Acacia nilotica* are pubescent, greyish-colored pods (Figure 3). They are oblong to linear, flattened, straight or curved, with entire edges or deeply compressed between the seeds. They contain 4 to 10 seeds. The location of the seeds is clearly marked by clear protrusions on the pod valves [15, 16].



Figure 3: Fruits of *A. nilotica*

Chemical composition of *Acacia nilotica*

Phytochemical screening of *Acacia nilotica* has shown the presence of tannins, saponosides and flavonoids in fruit [17]. Furthermore, Mansouri *et al.* [18] reported in addition to these compounds, cardiac glycoside, mucilage, oses and holosides. Benbrahim *et al.* [10] report that *Acacia nilotica* is a plant with a high content of tannins, a compound present in almost all the different parts of the plant. According to Ndiaye [17], *Acacia nilotica* fruits are sources of tannins and gallic acids. However, the study of Kheraro and Adam [11] has shown that the root bark contains 36% tannins and the pods on average of 30%. These results are confirmed by Adewoye and Rao [14] who report the same percentage of tannins in pods.

In addition, Diagne [19] reports that the seeds of *Acacia nilotica* are rich in proteins, lipids containing several fatty acids (palmitic acid, oleic acid, arachidonic acid) and in mineral matter (potassium, calcium, sodium, magnesium and iron). Moreover, Sharma *et al.* [20] reports that the phytochemical study of the hydroalcoholic extract of *Acacia nilotica* reveals the presence of carbohydrates, glycosides, phytosterols, phenolic compounds, saponins and flavonoids as being major constituents of the plant. The same results have been found in the research of Raghavendra *et al.* [21], Solomon-Wisdom and Shittu [22] and Kalaivani *et al.* [23].

Traditional uses of *Acacia nilotica*

Acacia nilotica is used in many cultures to treat bronchitis, chest pain, colds, diarrhoea, dysentery, fever, haemorrhages, leprosy, eye disorders, pneumonia, sore throat [24, 25], syphilis [25, 26]; oral thrush, fungal skin infections [27, 28], malaria and toothache [29, 30]. Bark decoction is used to treat pre, intra and postpartum complications [31, 32] and root bark decoction is used for gastrointestinal complications and babesiosis [33]. The fruits are used against scabies [34]. The ancient Egyptians used it as a dewormer against internal bleeding, diarrhoea and dermatological problems [35]. In Africa, it is used as a haemostatic, healing ulcers, calming coughs [36], anti-diarrheal and anti-dysenteric infants, in mouth ulcers and gingivitis and also against eye inflammation [37]. Several species of *Acacia* are often used as reserve fodder in arid areas and for his forage value [10]. In veterinary, breeders used *A. nilotica* to treat foot and mouth disease syndrome [38]. It is also used, mixed with sodium bicarbonate, in racehorses suffering from tendinitis. Other authors also claim that acacias provide very good quality charcoal among which we have *Acacia nilotica* [36]. Diallo [39], through a survey of traditional healers in Mali (Toumbouctou region) reported that *Acacia nilotica* is used in various diseases. The table below summarizes the results related to this plant.

Table 1: Affection treated by *Acacia nilotica* according to traditional healers in Toumbouctou (Diallo, 2005)

Affection	Recipe and treatment	Duration of treatment
Inflammation of the tooth	Cut <i>Acacia nilotica</i> fruit into small pieces and then place them on the tooth. Repeat after each meal.	3 days
Pruritus and sores	The fruits or pods of <i>Acacia nilotica</i> are dried, pulverized, sieved and then mixed with a little water. The mixture obtained is thus applied to the wound or pruritus.	Apply the treatment until healing
Eye infection	The fresh or dried leaves of <i>Acacia nilotica</i> are made into a decoction in two tea glasses containing water. After cooling, the decoct is filtered and then 2 to 3 drops of the filtrate are applied every day to the eye.	3 days
Postpartum hemorrhage in women	Put in a decoction in a liter and a half of water, a handful of fresh leaves of <i>Acacia nilotica</i> . Then give a quarter of a liter of the decoct with fresh milk 3 times a day.	7 days
Dental pain in children accompanied by: diarrhea, vomiting, inability	Combine the fruits of <i>Acacia nilotica</i> with the seeds of <i>Cuminum siminum</i> and the seeds of <i>Khaya senegalensis</i> then infuse. The infused is to be drunk once in the evening.	3 days
Diarrhea	Put in a little sugar water 5 g of the powdered fruit of <i>Acacia nilotica</i> . Drink the mixture once in the evening.	3 days

However, Al Mustafa and Dafallah [40] reported risks of constipation following prolonged use of the decoction of the fruit of *Acacia nilotica*.

Biological and pharmacological activities of *Acacia nilotica*

• Antiviral activities

Antiviral activities related to *Acacia nilotica* fruits are reported by Mohamed and Abdelrahman [41] with regard to Newcastle disease and avian plague (Avian influenza). The methanolic extracts from the pods have shown their efficacy against HIV-PR [42]. Likewise, Hussein *et al.* [43] report that the methanolic extracts of the pod and bark powder are also inhibitors of the HIV-1 protease viruses. In addition, Hussein *et al.* [44] revealed in their study that parts of the fresh plant are reputed to be active against hepatitis C.

• Antibacterial activities

The aqueous extracts of *Acacia nilotica* have shown antibacterial properties *in vitro* [45]. The study of Atefeibu [46] revealed an antibacterial property from aqueous extracts of the fruits of the plant. These cause an important zone of inhibition at the concentration of 10 mg / ml on *Salmonella ordenez*, *Shigella flexneri*, *Escherichia coli*,

Pseudomonas aeruginosa and *Staphylococcus aureus*. Similarly, broad spectrum antibacterial effects are reported by Abd El Nabi [45] and Srinivasan *et al.* [27]. Al Mustafa and Dafallah [39] justify the antimicrobial activity of *Acacia nilotica* against Gram positive and negative bacteria due to the phytochemicals of the plant. Nilotican, a diterpene isolated from the bark, has shown antibacterial activity against Gram-positive bacteria *Bacillus subtilis* and *Staphylococcus aureus* [47].

• Antiparasitic activities

The tannins contained in extracts of *Acacia nilotica* have shown algicidal and mollucid effects against *Bulinus truncatus* and *Biomphalaria pfeifferi* snails from freshwater [48]. These results are confirmed by the studies of Bashir *et al.* [49]. Indeed, the powder is used as it is or extracted with ethyl acetate. The molluscid action is obtained by spraying the ethereal extract or the pod powder in lakes containing molluscs. This powder acts strongly on certain intermediate hosts of schistosomes such as: the planorbid (*Biomphalaria pfeifferi*) intermediate host of *Schistosoma mansonii*, the bulin (*Bulinus*

truncatus) intermediate host of *Schistosoma heamatobium*. El-Tahir *et al.* [50] and Jigam [51] have demonstrated that *Acacia nilotica* has antimalarial activity on *Plasmodium falciparum*. In addition, the tests carried out by Ngom [52] with the decocted powder of the pods of *Acacia nilotica* var. *adansonii* in people living with HIV in Dakar, revealed an antifungal activity comparable to that of fluconazole in the treatment of bucco-esophageal candidiasis. The hydroalcoholic extract of *Acacia nilotica* also has antifungal activity at high concentrations on *Candida albicans*, *Aspergillus fumigatus* and *Aspergillus niger* [19]. In addition, this author claims that the proliferation inhibition observed for *Aspergillus fumigatus* and *Aspergillus niger* is comparable to that of Fluconazole, a reference molecule in the treatment of fungal diseases. Other studies have also shown that different extracts from the plant have broad-spectrum antifungal effects [53]. Different extracts of the root bark and fruits have been shown to have a particular antifungal activity against yeasts and *Candida albicans* [54, 55].

• Healing activities

The research of Shah *et al.* [56] have shown that the methanolic extract of *Acacia nilotica* fruits exerts an anti-platelet aggregation effect by blocking calcium channels. This would explain the use of the plant as a healing agent by traditional healers.

• Analgesic activities

Faye [57] in his study about the analgesic activity of the aqueous, chloroformic and ethyl acetate fractions of the hydroalcoholic extract of the pods of *Acacia nilotica* var. *adstringens* in mice reports that the doses of 30 mg / kg and 100 mg / kg of the extract significantly reduce the number of contortions induced by the injection of acetic acid. This study reveals that the chloroform fraction shows greater analgesic activity than that of the aqueous fraction and that of ethyl acetate. In addition, the inhibition profile of the number of contortions of the chloroform fraction at 100 mg / kg is comparable to that of Aspirin® taken as a reference analgesic for peripheral action.

• Other activities

Studies have reported that *Acacia nilotica* contains bioactive molecules with anti-hypertensive, antispasmodic, anti-inflammatory, vasoconstrictor, anti-clumping and anti-cholinesterase properties [58-60]. Furthermore, the results of other studies have shown the antioxidant, anti-hyperglycemic properties of *Acacia nilotica* extracts [61-63], gastro-protective [64] and stimulating secretion and release of prolactin and lactation [65]. The work of Gueye [66] shows that extracts of *Acacia nilotica* appear to have an effect on the volatile sulfur compounds involved in halitosis. *In vitro* studies have shown that methanolic extracts from the stem bark, fruit and leaf provide complete protection against diarrhoea caused by castor oil, such as an anti-diarrheal drug, loperamide [67]. These extracts (0.5 to 3 mg / ml) showed a dose-dependent anti-diarrheal effect on the isolated rabbit jejunum with initial relaxation, which was quickly followed by the contraction of the jejunum to 3 mg / ml [67]. Sultana *et al.* [68] have also shown that bark extracts have antioxidant capacity *in vitro*, while Shah *et al.* [56] found that the alcoholic extract has an antagonistic platelet aggregation effect in a dose-dependent manner. Rich phenolic and polyphenolic ether, ethyl acetate and acetone fractions of the bark showed antimutagenic and cytotoxic effects in the Ames test [69].

CONCLUSION

The different researches on *Acacia nilotica* have come to justify the various uses and virtues that endogenous populations have lent to it for centuries. Given the different nutrients and properties of this plant, it would benefit from being considered in the efforts to contain cases of bacterial resistance increasingly frequent and to fight against animal viral disease like African Swine fever. Also, several *in vivo* investigations are needed to corroborate the main activities of the plant.

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