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Acacia nilotica (L.): A review of its traditional uses, phytochemistry, and pharmacology

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ABSTRACT

Acacia nilotica (L.) is an important ornamental and medicinal plant of tropical and sub-tropical regions belongs to family Fabaceae of genus *Acacia* commonly known as babul, is a source of many active secondary metabolites which may serve as potential candidates for drug development with greatest possibility of success in near future. The present review aims at providing an up-to-date summary of the traditional usage, phytochemistry, and pharmacological profile of *A. nilotica* (L). An exhaustive survey of literature has revealed that tannins, flavonoids, alkaloids, fatty acids and polysaccharides (gums) constitute major classes of phytoconstituents of this plant. Pharmacological data base reports have revealed significant anti-inflammatory, antioxidant, antidiarrhoeal, antihypertensive and antispasmodic, antibacterial, anthelmintic, antiplatelet aggregatory, anticancer and acetyl cholinesterase (AChE) inhibitory activities. Through this review authors have tried to explore the therapeutic potential of *A. nilotica* and thus may be a promising rout for new, safe, biodegradable and renewable source of drugs with high therapeutic index.

Contents

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1. Introduction

Since time immemorial, plants have been used as a source to provide mankind with medicines having high therapeutic potential to treat health disorders and to combat numerous pathogenic infections (Gurib-Fakim, 2006). The healing property of medicinal plants has been widely used in different traditional systems of medicine such as Ayurvedic, Unani, and Chinese (Schippmann et al., 2006; Uniyal et al., 2006). This healing ability is attributed to the presence of various classes of compounds present in medicinal plants (Lovkova et al., 2001). Ethnopharmacological data available has already led to the isolation of active and lead drugs from various plant species belonging to different genera (Farnsworth, 2008). Acacia is quite a large genius of the family Fabaceae, with about 1350 species. Most of the species belonging to Acacia genus are rich in secondary metabolites containing mainly condensed tannins, flavonoids and gums (Seigler, 2003). *Acacia nilotica* (L.) is a multipurpose tree of this genus found in Africa, Middle East and Indian subcontinent (Hill, 1940; National Academy of Sciences, 1980; Simmons, 1987). In several countries it has been introduced as fuel wood, forage and importantly as medicinal plant (Kriticos et al., 2003). *A. nilotica* is a rich source of polyphenols, mainly composed of condensed tannin and phlobatannin in addition to gallic acid, ellagic acid, (+) – catechin, and (-) – epigallocatechin-7-gallate (Singh et al., 2009a). In traditional system of medicine, all parts of the plant are attributed for their promising medicinal properties and have been used as remedy for various diseases and ailments in several parts of the world. Recently it has been investigated for its interesting biological activities including antidiabetic, hypolipidemic, antileishmanial, reducing pathogenicity of plasmodial infection and molluscicidal activities (Ahmad et al., 2008; Fatima et al., 2005; El-Tahir et al., 1999; Ayoub, 1982).

Previous genetic toxicological studies have shown that *A. nilotica* plant possesses antimutagenic and cytotoxic activities (Kaur et al., 2005). Epidemiological and biological studies have revealed that oxygen based free radicals (ROS) are involved in a number of biochemical processes and interrupt with the normal functioning of macromolecules (DNA) (Puddu et al., 2008; Riccioni et al., 2008). Antioxidants from vegetable origin and/or food sources are implemented in the treatment of cancer and aging by minimizing/scavenging the number of oxidative species (Free radicals) that initiate mutagenesis through oxidative cleavage/damage of biological macromolecules (Lori et al., 2008). *A. nilotica* is a potential source of antioxidant polyphenols (El-toumy et al., 2011; Omara et al., 2012; Singh et al., 2010) and supplementation of these antioxidants in functional food can prevent formation of oxidative species, eventually leading to the prevention of some diseases. In total 170, articles were reviewed to collect all scattered information on this plant by using online search engines like ScienceDirect, Scifinder, Springer, Scopus, PubMed and Google Scholar. The main objective of this review article is to present up-to-date knowledge of ethnopharmacology, traditional usage, phytochemical composition and pharmacodynamic potential which will be noteworthy for the design and synthesis of new promising lead compounds with full exploitation of all plant parts. The possible tendencies and future perspectives for the investigation of this plant will also be discussed.

2. Botany and ethnopharmacology

2.1. Botany

Acacia nilotica (L.) Wild ex. Del. belongs to family Fabaceae (subfamily: Mimosoideae) of genus *Acacia* containing an excess of 1350 species (Seigler, 2003) is a medium sized tree, 15–18 m tall, with a stem diameter of 2–3 m having low, spreading and almost symmetrical crown. Bark is fissured, dark brown to blackish in color with profound vertical grooves exposing inner gray–pinkish slash, exuding a reddish low quality gum (Bargali and Bargali, 2009). Young trees possess paired thorns at the nodes of stem which are roughly straight, slightly pointing backwards, 3–12 pairs in number and 5–7.5 cm in length. The leaves are of compound type with 3–6 pairs of pinnae; 4.5–7 cm long and 10–30 pairs of leaflets each (Ali et al., 2012). Bright golden–yellow flowers are located at the end of branches in globulous heads, 1.2–1.5 cm in diameter set up either auxiliary or whorly on 2–3 cm long peduncles (Singh et al., 2010). Hairy, thick and strongly constricted pods are white–grayish in color (Baravkar et al., 2008).

The plants of the same species are having immense importance for reforestation, wasteland reclamations (Skolmen, 1986), and soil improvement (Palmberg, 1981). *A. nilotica* can be grown in both moist and arid regions because of the fact that it can withstand to extremes of temperatures ($>50\,^{\circ}C$) and moisture stress. Micro propagation and symbiotic relationship with rhizobium and mycorrhizal fungi makes it one of the important species for increasing soil fertility (Dhabhai and Batra, 2012; Rajendren and Mohan, 2014; Woldemeskel and Sinclair, 1998) and is said to be a possible way for reproducing numerous plants for conventional breeding, reforestation, and mass propagation (Ortiz et al., 2000). It propagates through germination of seeds (Bargali and Bargali, 2009; Rajput et al., 2014) and auxiliary bud induction from nodal explants (Vengadesan et al., 2002).

2.2. Ethnopharmacology

Plants have been known since antiquity as promising sources of drugs and are extensively used in Ayurvedic, Unani, Chinese and other systems of medicine. Among the rich medicinal plants identified so far *A. nilotica* has been proven to possess remarkable therapeutic potential against various ailments/diseases like bacterial, fungal, viral, amebic, leucodermal diseases, bleeding piles (Singh et al., 2009a; Bhargava et al., 1998; Qasim et al., 2014), hypertension, hemorrhoid, cancer, congestion, menstrual problems (Ambasta, 1994) and earache (Ullah et al., 2014). To provide