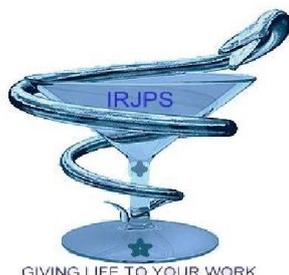


Review



PHYTOCHEMICAL, ETHNOPHARMACOLOGICAL REVIEW OF *ACACIA NILOTICA* (DESI KIKAR) AND TAXO-PHARMACOLOGY OF GENUS *ACACIA*

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ABSTRACT: *Acacia nilotica* (Linn), commonly known as “DesiKikar” is a tannin rich medicinal plant. It belong to genus *Acacia* that contains 900 species. It has great Anti-viral and Cytotoxic potential. We have document phytochemistry, ethnobotany, ethnoparmacological review of *Acacia nilotica* (Linn) and taxo-pharmacology of genus *acacia*.

KEY WORDS: Phytochemical Review, Ethnoparmacological Review, *Acacia nilotica*

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INTRODUCTION:

DesiKikaris a tannin rich medicinal plant. It contains significant amount of polyphenols, saponins, alkaloids, terpenoids, proteins and polypeptides [1][2] which strengthen its ranking in medicinal plants. Stembark of *Acacia nilotica* (Linn) is used as astringent, spasmolytic, hypoglycaemic. Gum is used as demulcent (soothing agent for inflammatory conditions of the respiratory, digestive and urinary tracts). Pods are used in urogenital disorders. Seed oil is used as antifungal. Flowers, pods and gum resin are used in diarrhoea and dysentery [3]. List of synonyms along with their English, Ayurvedic, Unani and Tamil names are mentioned in table 1

Table 1: Synonyms of *Acacia nilotica* (Linn), along with their different names [3]

Synonyms	<i>Acacia arabica</i> (Lam.) Willd. <i>Mimosa arabica</i> Lam. <i>Mimosa nilotica</i> Linn.
English Name	Babul, Black Babul, Indian, Gum arabic tree.
Ayurvedic	Babbuula, Babbuuri, Baavari, Aabhaa, Shuulikaa, Shitaka, Kinkiraata, Yugmakantaka, Sukshmapatra, Pitapushpaka.
Unani	Aqaaqia, Babuul, Kikar, Mughilaan, Samur.
Siddha/Tamil	Karu-velamaram, Karuvelei. Velampisin (gum).

HABITAT:

Acacia represents 900 species. There is a tremendous morphological difference among these species. *Acacia nilotica* distributed throughout subcontinent is traditionally used as food for ruminants and possesses antiviral potential against different RNA viruses

[4][5][6][7]. It can withstand an extreme temperature of above 50°C and also can also tolerate air dryness.

TAXONOMICAL FEATURES

Acacia nilotica is an erect tree of moderate size and belongs to the family Fabaceae[6]. In young trees, the bark is green and in mature ones it is almost black characterized by longitudinal fissures. Leaves of the tree are thin and straight with an approximate length of 1.3- 3.8 cm. Mature trees generally do not contain thorns. Flowers of the tree are golden-yellow, characterized by globules heads and have a diameter of about 1.2-1.5cm. They are situated at the end of branches. Pods are 7-15cm in length, green when immature and greenish black when matured. There are constrictions between seeds in the pods thus giving an appearance of necklace to them. Each pod contains about 8-12 seeds. The seeds are shiny, ovoid, compressed and dark brown in color [8]. Taxonomical classification of the plant is given in table 1.

Table 2: Taxonomical classification of *Acacia nilotica*

TAXONOMICAL CLASSIFICATION	
Kingdom	Plantae
Subkingdom	Tracheobionta
Super division	Spermatophyta
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Rosidae
Order	Fabales
Family	Fabaceae
Genus	<i>Acacia</i>
Species	<i>nilotica</i>



Figure 1: *Acacia nilotica* tree

CHEMICAL CONSTITUENTS

Acacia nilotica contains tannins [9], terpenoids [10], crude protein [1], kaempferol, alkaloids, tannins, phenols, volatile oil, essential oil, steroids, oleosins, terpenes, resins [2], saponins, steroids, triterpenoid and flavonoids [11][12]. The plant is quite rich in flavonoids [1][2] and phenolic acids [2]. Ethanol extract of *Acacia nilotica* bark contains catechin [13], gallic, caffeic and ellagic acids, quercetin [14], alkaloids, glycosides, tannins and other different polyphenols [15]. Leaves of the plant are rich in tannins (Mueller-Harvey et al. 2007) and proteins [12]. Phytochemical analysis of leaves of the plant revealed that its chloroform extract contains polyphenols, phytosterols, fixed oils, and fats. Aqueous extract contains saponins, phenolic acids and flavonoids while the ethanol extract contains fixed oils in addition to all the components of aqueous extract [16].

PHARMACOLOGICAL PROPERTIES

Pods, leaves and bark of the plant possess cytotoxic, anti-mutagenic, spasmogenic, vasoconstrictor, anti-pyretic, anti-asthmatic, anti-diabetic, anti-platelet aggregatory, anti-Hepatitis C virus (HCV), anti-plasmodial, molluscicidal, anti-human immunodeficiency virus (HIV), anti-fungal, anti-spasmodic, anti-bacterial and anti-hypertensive properties [2]. Recent studies have confirmed that the plant also possesses anti-cancer, anti-oxidant and anti-malarial activities. All these diverse medicinal properties are due to its chemical constituents or secondary metabolites [17]. Traditionally decoction of stem, bark and gum of the plant is used for bronchitis and asthma [18]. Bark of the plant is used to treat liver disorders and inflammation [19]. Leaves of the plant are used traditionally to treat epiphora [12]. In Pakistan, it is used to treat redness of eyes, conjunctivitis and pain [20]. Juice of its roots or bark together with sugar is used to cure jaundice. For strengthening of the gums, branches of the plant are used as tooth sticks [21]. Bark of *Acacia nilotica* is also used commonly as tooth brush in Pakistan by the people of different areas and is traditionally named as Miswak. It is tough and curved. Its taste is sweet and slightly bitter [6]. Miswak removes the plaque on teeth and all together massages an individual's gums. This cleaning effect of Miswak is due to discharge of valuable chemical constituents. Repeated chewing releases these constituents. Tannin applies its astringent action on mucous membrane, consequently reducing gingivitis. Alkaloids bring their bactericidal action in oral cavity and other constituents also exert their effective role all together. Throughout developing countries, farmers use legumes and leaves of different species of *Acacia* including *Acacia nilotica* to feed small ruminants [5]. In Pakistan,

grazing lands are splendidly populated with *Acacia nilotica* to feed small ruminants [22]

Cytotoxic potentials

In Sudan fourteen medicinal plants including *Acacia nilotica* were evaluated for their cytotoxic effects on 3T3 cell line by adopting MTT [3-(4,5-dimethylthiazol-2-yl) 2-diphenyltetrazolium bromide] colorimetric assay. In the study, all ethanolic extracts of the plant were found to be cytotoxic at higher concentrations [22]. In a study, leaves of the plant were sequentially extracted by chloroform, ethanol and water to evaluate their cytotoxic effects on Vero and HeLa cells grown in 96-well cell culture plates. The confluent monolayer of the cells was treated with the extracts and their OD (optical density) values were measured by using an absorbance plate reader at 570nm. Extracts produce their cytotoxic effect in a dose dependent manner. Ethanolic extract was most cytotoxic of all followed by chloroformic and aqueous extracts both for Vero and HeLa cells [24]. Pods of *Acacia nilotica* contain various polyphenols with reported cytotoxic activity against certain cell lines. In addition to all these polyphenols, studies had revealed that methanolic extract of the pods also contains an additional cytotoxic compound known as gallic acid. In a study, spectroscopically identified gallic acid was proved to be cytotoxic to 92.1 and OCM3 uveal melanoma cell lines [25]

Antiviral potentials:

In Sudan methanolic and aqueous extracts of seventy one commonly used traditional medicinal plants were screened for their activity against HCV by using different in-vitro assays. Among these plants, methanolic extract, of *Acacia nilotica* was found to be

effective against the virus at 100 µg/ml [26]. In a study, seventy five Moroccan plants including *Acacia gummifera* were examined for their antiviral activity against three different mammalian viruses: *Sindbisvirus*, *Poliovirus* and *Herpes simplex virus (HSV)*. Methanolic extract of the plant was found effective against HSV at 1.5 µg/ml [27]. In an in-vitro study, ten plants including *Acacia nilotica* were screened for their activity against *Bovine Herpes Virus, type-1 (BHV-1)* by using cytopathic inhibition assay and Madin-Darby Bovine Kidney (MDBK) cell line. Before conducting antiviral study, cytotoxicity of the extracts was evaluated by using MTT assay. In the study, *Acacia nilotica* inhibited the virus at its non cytotoxic concentration [28]

TAXO-PHARMACOLOGY OF GENUS ACACIA

Acacia pods

Antiviral activity of aqueous extract of *Acacia nilotica* pods was reported against HIV in terms of its activity on viral replication and infectivity at concentrations ranging from 50 – 200 µg/ml by using H9 cell line. Microtiter syncytium formation assay was used to measure the infectivity of virus and Reverse Transcriptase activity was used to measure its replication. In both assays phosphate buffer was kept as positive control, however, Azidothymidine was used as negative control. The extract significantly inhibited infectivity and replication of the enzyme at 200 µg/ml [29]. (Khan et al. 2006). In a study, antiviral activity of seeds of *Acacia arabica* was explored against HSV-1, HSV-2 and Vaccinia Virus by using Vero, Human erythroleukemia (HEL) and Human epithelial carcinoma (HeLa) cells. The extract was found to be effective against HSV-1, HSV-2 and vaccinia virus [38]. In-vitro antiviral activity of

aqueous extract of leaves and pods of *Acacia nilotica* was evaluated against *BHV-1* and *Foot and Mouth Disease (FMD) Virus* by using antiviral screening assay. Aqueous extracts of both the leaves and pods of the plant resulted in good activity against *BHV-1* but leaves were found significantly more effective against *BHV-1* than pods. However both parts of the plant did not show any activity against *FMDV* [30].

Acacia leaves

Antiviral activity of ethanolic and aqueous extracts of forty-nine Thai medicinal plants including *Acacia consinna* were examined against *HSV*, *Polio* virus and *Measles* virus by using plaque reduction assay. At 50 µg/ml and 100 µg/ml both extracts were found ineffective against all the three viruses [31]. Aqueous extract of leaves of *Acacia arabica* was screened against *Buffalopox* virus by using cytopathic effect inhibition assay on Vero cell line. The extract did not show any activity against the virus in the study [32]. In a study, antiviral activity of aqueous extracts of *Acacia arabica* leaves was examined against *Goatpox* virus. In the study, the extract exerted a significant antiviral effect [33]. Methanolic extract of leaves of *Acacia nilotica* was screened against *Newcastle Disease (ND)* virus and *Fowlpox* virus at 100 µg/ml and 200 µg/ml by using chorio-allantoic membranes. The plant was found effective against both viruses in the study [34]. The antiviral activity of acetonetic and methanolic extracts of *Acacia nilotica* leaves was determined against *HCV* by using Huh-7 cell line at the concentration range of 1.512 µg/ml to 200 µg/ml. Cytotoxicity of the extracts was evaluated by using MTT assay. In the study OD values of viable cells was measured by using enzyme-linked immunosorbent assay plate reader. Both the

extracts exerted their antiviral effect at non-toxic concentration of 100 µg/ml [15]

Acacia bark

Methanolic and aqueous extracts of *Acacia nilotica* pods and bark were evaluated for their antiviral activity against *HIV-1* by using MT-4 cells. Methanolic extract of both parts of the plant and aqueous extract of its pods were found effective in inhibiting *HIV-1* protease. Cytotoxic concentration of both extracts of bark was ≥ 125 µg/ml while the pods showed cytotoxicity at ≥ 62.50 µg/ml. Activity of the plant against the virus was considered because of tannins probably due to their binding ability. Tannin content of the plant was quantified by using methylene blue. The results revealed that both the pods and bark of the plant are quite rich in tannin. However, aqueous extract of the bark showed tremendously highest tannin content [35]. It has been reported that *Acacia nilotica* possesses an inhibitory activity against the enzyme *HCV* protease. Pods of the plant also exhibited inhibitory activity against the enzyme, *HIV-1* protease [39]. In-vivo antiviral activity of stem bark of *Acacia mellifera* was evaluated against *HSV-1* by using mice. The infected mice were given an oral dose of 500 mg/kg of *Acacia mellifera*. The plant was found effective against the virus. No acute toxicity was observed in the mice at therapeutic dose of 500 mg/kg. The study concluded that the plant possesses anti-*HSV* agents [36]. In-vitro antiviral potential of aqueous extract of *Acacia arabica* (Babul) was explored against *PPR* (*Peste des petits ruminants*) virus replication by using Vero cell line. Different antiviral assays: PCR, Cytopathic effect inhibition assay, sandwich-ELISA (s-ELISA) and virus titration assay were used in the study to evaluate antiviral activity of the plant at its non-cytotoxic concentrations of 150 µg/ml and 200 µg/ml.

At both doses the plant showed significant reduction in virus load. The study suggested that the plant may possess effective phyto-antiviral agents against PPRvirus[37]

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