



JOURNAL OF PHARMACEUTICAL SCIENCE AND BIOSCIENTIFIC RESEARCH (JPSBR)

(An International Peer Reviewed Pharmaceutical Journal that Encourages Innovation and Creativities)

Phytochemical and Biological Evidence of *Balanites aegyptiaca*

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Article History:

Received 08 March 2021

Revised 05 May 2021

Accepted 07 Jun 2021

Available online 10 July 2021

Citation:

Khaled R., Phytochemical and Biological Evidence of *Balanites aegyptiaca*. *J Pharm Sci Bioscientific Res.* 2021. 10(6): 305-309

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ABSTRACT

Balanites aegyptiaca Del. is known as desert date. It belongs to the family Balanitaceae and is distributed throughout the drier parts of India. It is spiny shrub or tree up to 10 m tall, widely distributed in dry land areas of Africa and South Asia. It is traditionally used in treatment of various ailments i.e., jaundice, intestinal worm infection, wounds, malaria, syphilis, epilepsy, dysentery, constipation, diarrhea, hemorrhoid, stomach aches, asthma, and fever. It contains protein, lipid, carbohydrate, alkaloid, saponin, flavonoid, and organic acid.

KEY WORDS: *Balanites aegyptiaca*; chemical compounds, plants, bioactivities

INTRODUCTION

Since ancient time plants and herbs are used to treat various types of diseases. Some plants contain many phytochemical constituents which were used to treat many diseases. In the modern era chemical constituents of plants are extracted and their activities are increase so that they can work efficiently and then medicines are prepared from them which are given by doctors. *Balanites aegyptiaca* is a tree, which belongs to the Balanitaceae family of plants. Its English name is Desert date. The tree is widespread in the drier regions of India. It is also found in Arabia, Africa and Pakistan [1]. The fruit of *Balanites aegyptiaca* has an edible mesocarp and a hard woody endocarp enclosing an edible oil-rich seed kernel. The seed kernel oil is reported to be rich in saturated fatty acids and is used as cooking oil [2]. *B. aegyptiaca* is a mutibranched, spiny shrub or tree which grows up to 10 m in height. The leaves are alternate, two foliate, petioles are 3–6 mm long, leaflets are elliptic and have broadly pointed petioles up to 5 mm long. The spines of the plant are simple, straight, stout, rigid, green, alternate, supraaxillary, up to 5 cm long. Inflorescence is supraaxillary clusters or rarely supracemose. The flowers are small, bisexual, greenish white, fragrant, in axillary

clusters, few or many in number, cymes or fascicles. The petals are five in number (two free), oblong-obovate, longer than the sepals. The stamens are ten in number, filaments glabrous, and anthers are dorsifixed. The ovary is ovoid, silky, five-celled and ovules are solitary in each cell, the style is short and conical. Fruit is an ovoid drupe, 2–5.6 cm long, found on a short thick stalk, and is faintly five grooved. The ripe fruit is brown or pale brown with a brittle coat enclosing a brown or brown-green sticky pulp and a hard stone seed. Seeds are found embryo is with thick plano-convex, or two-lobed cotyledons and a superior radical [3]. Almost all the parts of *Balanites aegyptiaca* plant are traditionally used in several folk medicines. It has potent wound-healing activity and it possess potent antioxidant activity by inhibiting lipid peroxidation, bleaching DPPH (2,2-diphenyl-1-picrylhydrazyl) radical, and protecting against oxidant injury to fibroblast cells. Seed is used as expectorant, antibacterial, antifungal, febrifuge [4] and as laxative, treatment of haemorrhoid, stomach aches, jaundice, yellow fever, syphilis, and epilepsy [5]. It also used as anthelmintic and purgative. The seed oil is used to treat tumors and wounds [6]. The plant has Balanitin which isolated from aqueous extract of *Balanites aegyptiaca*

seed is reported as anthelmintic agent [7]. This review gave some phytochemicals and biological effects of *Balanites aegyptiaca*.

Chemical Compounds

Balanites aegyptiaca contained saponin, furanocoumarin and flavonoid. The mesocarp of its fruit contains protein, sugars, organic acids, other constituents like 3-rutinoside and 3-rhamnogalactoside of isorhamnetin, diosgenin, [8].

It also contains a mixture of 22R and 22S epimers of 26-(O β -D glucopyranosyl)-3- β -[4-O-(β -D-glucopyranosyl)-2-O-(α -rhamnopyranosyl)- β -D-lucopyranosyloxy]22,26 dihydroxyfurost-5-ene. Its kernel contained the xylopyranosyl derivative of above saponin present in mesocarp [9], while nine saponins have been reported from kernel cake of *Balanites aegyptiaca* [10].

The leaves and fruit kernels of *Balanites aegyptiaca* were found to contain six diosgenin glucosides including di-, tri-, and tetraglucosides [11]. Its bark contains furanocoumarin, bergapten and dihydrofuranocoumarin D-marmesin.[12]. It also contains beta-sitosterol, bergapten, marmesin, and beta-sitosterol glucoside [13]. Balanitin-1-2, and -3; balanitin-1 for example possesses a yamogenin aglycone with a branched glucose and rhamnose side chain [14].

Biological activities

Antidiabetic Activity

The bark extract of *B. aegyptiaca* has been also shown to have a moderate effect on the activity of α -amylase which is responsible for the degradation of oligosaccharides [15]. *B. aegyptiaca* fruit extracts (1.5 g/kg bw) reduced the blood glucose level by 24% and significantly decreased the liver glucose-6-phosphatase activity in diabetic rats [16]. The water and ethanolic extracts of *B. aegyptiaca* fruit extract induced significant reduction in serum glucose, glucagon, total lipids, total cholesterol, triglycerides level and transaminases [aspartate aminotransferase (AST), alanine aminotransferase (ALT) and γ GT (gamma aminotransferase)] activities [17]. An aqueous extract of mesocarps of the fruits of *B. aegyptiaca* exhibited a prominent antidiabetic activity on oral administration in streptozotocin-induced diabetic mice. It is believed that the antidiabetic activity was due to the presence of steroidal saponins in the extracts [18].

Anti-inflammatory Activity

The ethanolic extract of aerial parts of *B. aegyptiaca*, when given orally as a suspension at 300 mg/kg bw per day, reduced the paw volume by 55.03%, whereas in the case of administration of 600 mg/kg bw per day it was 65.54%, indicating that the effect was dose dependant. The significant anti-inflammatory activity was evaluated in methanolic and ethanolic extracts of the bark in two different animal models, the carrageenan-induced oedema in the rat, and acetic acid-induced writhing test in mice[19] Ethanolic extract of fruit of *B. aegyptiaca* also exhibited a proinflammatory activity [20]. The phytochemicals responsible for these activities were found to be flavonoids, saponins B1 and B2 isolated from bark and aerial parts of the plant [19,21].

Antihelminthic and Molluscicidal Activity

The root, bark, seed kernel, fruit and whole plant extracts were found to be lethal to snails, miracidia and cercariae of schistosomes in various studies [22, 23]. A mixture of deltonin and 25-isodeltonin extracted from seeds was found to be molluscicidal against snail species *Biomphalaria glabrata* [24]. The antihelminthic properties of extract of *B. aegyptiaca* were compared with those of albendazole and praziquantel [25, 26]

Antiparasitic

The crude methanolic extract has been found to have a moderate biological activity on *Leishmania major* in an in vitro study [27]

Anticancerous and Antioxidant effects

The mixture of balanitin-6 (28%) and balanitin-7 (72%) was evaluated in vitro for anticancer activity against six different human cancer cell lines, using the [3-(4, 5-dimethylthiazol-2yl)-diphenyltetrazolium bromide] colorimetric assay and in vivo in the murine L1210 leukaemia model. The mixture has demonstrated appreciable anticancer effects in human cancer cell lines *in vitro* as it displayed higher antiproliferative activity than etoposide and oxaliplatin but markedly lesser activity than taxol. The in vitro anticancer activities result at least partially from depletion of ATP, leading in turn to major disorganisation of actin cytoskeleton, ultimately resulting in the impairment of cancer cell proliferation and migration. In vivo, bal6/7 increased the survival time of mice bearing murine L1210 leukaemia grafts to the same

extent as that reported for vincristine. These preliminary in vivo data suggest that it may be possible to generate novel hemi-synthetic derivatives of balanitin-6 and -7 with potentially improved in vitro and in vivo anticancer activity and reduced in vivo toxicity, thus markedly improving the therapeutic ratio [28]

Antifungal Activity

Aqueous and methanolic (80%) extracts of root bark were screened for anticandidal activity by bioautography agar overlay method, using a standard strain of *Candida albicans* (ATCC 90028). These extracts revealed strong anticandidal activity. The identification of compounds responsible for the activity was not done [29] The stem bark extracts isolated in various solvents were screened for their antifungal effects against *Aspergillus niger* and *C. albicans*, and these extracts also showed high antifungal activity against *C. albicans* (MFC 250 µg/ml) [30].

Hepatoprotective Activity

The extracts of leaf, stem, stem bark and root of *B. aegyptiaca* were screened for hepatoprotective activity in Wistar albino rats. The stem bark extracts of the plant showed significant ($P < 0.05$) hepatoprotective effects as revealed by a decrease in the activity of serum transaminase and alkaline phosphatase enzymes as compared to control rats. The effect of lyophilised extracts of *B. aegyptiaca* (1 g/kg) and silymarin (0.1 g/kg), a standard hepatoprotective agent, given for 5 consecutive days, was tested on liver damage induced by paracetamol (0.6 g/kg) in the mice. *B. aegyptiaca* had a relatively modest hepatoprotective activity (27%) while silymarin protected about 92% of the treated mice [31] These results suggest that the extract could protect the paracetamol-induced liver damages perhaps by eliminating the deleterious effects of toxic metabolites from the drug.

Antibacterial activity

The leaf extracts of *B. aegyptiaca*, prepared in aqueous and organic solvents (acetone and ethanol), were tested for their antibacterial activity against *Salmonella typhi*, by using the disc diffusion method. Ethanolic extracts demonstrated higher antibacterial activity (16 mm zone of inhibition) while the aqueous extracts showed the least activity (4 mm zone of inhibition) at 100 mg/ml. The preliminary phytochemical analysis revealed the presence of saponins, tannins, phenols and anthraquinones in the extracts, and these were considered for antibacterial

activity [32]. Methanolic and aqueous extracts of whole plant extract showed 4 mm inhibition zone in *Staphylococcus aureus* and 11 mm zone of inhibition in case of *Staphylococcus epidermidis* [33]. The extract of *B. aegyptiaca* supplemented with a 60–100 mg mineral (kadosero) revealed 100% reduction in bacterial colony in untreated well water.

CONCLUSION

Balanites aegyptiaca has many traditional values and plant bark, seed, seed oil, leaves, fruit widely used in folk medicine. From the extensive It believed that *Balanites aegyptiaca* scientifically has antihyperglycemic, cardioprotective, antioxidant, anthelmintic, antibacterial, antivenin, anticancer, anti-inflammatory, analgesic, larvicidal, hepatoprotective, antibiotic, antiviral, wound healing, hypocholesterolemic, diuretic activity. By this overall study it is concluded that *Balanites aegyptiaca* is a novel multipurpose plant and further studies are needed to explore the *Balanites aegyptiaca* for the development of medicines.

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