

A prespective review on a novel plant balanites aegyptiaca (linn.)

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Abstract

Since ancient time plants and herbs are used to treat various types of diseases. At that time they were given by Vaidhya and Hakim's and named as Ayurvedic medicine. Some plants contain many phytochemical constituents which were used to treat many diseases. In the morden 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. One of such plant which have many medicinal activities is *Balanites aegyptiaca*. It possesses many biological activities such as antimicrobial, antioxidant, anti-diabetic, antiasthmatic, etc. It also possesses pharmacologically active substances such as flavonoids, saponins in their callus culture. Their anti-inflammatory activity has been known from the ancient period. The plant possesses promising applications for the drug development and research purposes. This review summarizes the biological activities of *Balanites aegyptiaca* which are obtained from the literature.

Keywords: Phytochemical, Antimicrobial, Anti-diabetic, *Balanites aegyptiaca*, Ayurvedic medicine.

Introduction

Balanites aegyptiaca is a tree, which belongs to the *Balanitaceae* family of plants. Its English name is Desert date. The tree is wide spread in the drier regions of India. It is also found in Israel, 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⁾

Balanites aegyptiaca had been used over thousands of years. It contains 64–72% carbohydrates, plus crude protein, steroidal, saponins, vitamin C, ethanol and other minerals.⁽³⁾ It seeds oil has been used in many countries as ingredient and substituent to ground nut oil in the preparation of local food. The seed kernel obtained after cracking the nut is an oil source. Oil is composed of molecules called triglyceride which chemically contain glycerol molecules with each other and fatty acid.⁽⁴⁾

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⁽⁵⁾ and as laxative, treatment of haemorrhoid, stomach aches, jaundice, yellow fever, syphilis, and epilepsy.⁽⁶⁾ It also used as anthelmintic and purgative. The seed oil is used to treat tumors and wounds.⁽⁷⁾ The plant has the Balanitin-7 which isolated from aqueous extract of *Balanites aegyptiaca* seed is reported as anthelmintic agent.⁽⁸⁾ In Egyptian folk medicine, water extract *Balanites aegyptiaca* fruit have been reported as

hypoglycaemic.^(9,10) It has antidiabetic effect in streptozotocin-induced diabetic mice.⁽¹¹⁾ The fruits are used as an oral hypoglycaemic⁽¹²⁾ and an antidiabetic; an aqueous extract of the fruit mesocarp is used in Sudanese folk medicine in the treatment of jaundice.⁽¹³⁾ Fruit is used in whooping cough, also in leucoderma and other skin diseases.

Balanites aegyptiaca fruit is used to treat liver disease and as a purgative, and sucked by school children as a confectionary in some countries.^(14,15) It is reported that whole and extracted pulp of *Balanites aegyptiaca* fruits reported a hypocholesterolemic effect when tested on adult albino rats.⁽¹⁶⁾ Bark is used as spasmolytic and in the treatment of syphilis, round worm infections, and as a fish poison. The aqueous leaf extract and saponins isolated from its kernel cakes have antibacterial activity.^(17,18) It is reported that bark aqueous extract of *Balanites aegyptiaca* used in treatment of both AIDS and Leukaemia.⁽¹⁹⁾

Chemical Constituents⁽²⁰⁻²⁷⁾

Balanites aegyptiaca contained saponin, furanocoumarin and flavonoid. The mesocarp of its fruit contains protein, sugars, organic acids, other constituents like 3-rutinoside and 3rhamnagalactoside of isorhamnetin, diosgenin,⁽²⁰⁾ it also contain 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]-22,26dihydroxyfurost-5-ene. Its kernel contained the xylopyranosyl derivative of above saponin present in mesocarp⁽²¹⁾ while nine saponins have been reported from kernel cake of *Balanites aegyptiaca*.⁽²²⁾ The leaves and fruit kernels of *Balanites aegyptiaca* were found to contain six diosgenin glucosides including di-, tri-, and tetraglucosides.⁽²³⁾ Its bark contains furanocoumarin bergapten and dihydrofuranocoumarin D- marmesin.⁽²⁴⁾

It also contains beta-sitosterol, bergapten, marmesin, and beta-sitosterol glucoside^(25,26) balanitin-1-2, and -3; balanitin-1 for example possesses a yamogenin aglycone with a branched glucose and rhamnose side chain.⁽²⁷⁾

Pharmacological Activity

Anti-hyperglycemic

Orally administered *Balanites aegyptiaca* to diabetic rats at dose of 300 mg/kg for 45 days showed significant antihyperglycemic and antilipid peroxidative effects as well as improved antioxidant defense mechanism. The antihyperglycemic activity of *Balanites aegyptiaca* is probably due to stimulation of insulin secretion from remnant pancreatic β -cells, which in turn enhance glucose utilization by peripheral tissues of diabetic rats.⁽²⁸⁾

Cardio protective cum antioxidant activity

The plant acts as antioxidant against 0 adriamycin-induced cardiotoxicity in experimental mice. Adriamycin when administered intraperitoneally, it cause elevation of serum lactate dehydrogenase, creatine phosphokinase, glutamate oxaloacetate transaminase, glutamate pyruvate transaminase, lipid peroxide, total nitric oxide, erythrocyte lysate superoxide dismutase (SOD), glutathione peroxidase (GPx), and plasma catalase (CAT) in mice heart tissue. Adriamycin drug reduced the activities of SOD, GPx, and CAT. Pretreatment with *Balanites aegyptiaca* extract significantly ($P < 0.05$) prevented these alterations and restored the enzyme activities to near normal levels.⁽²⁹⁾

Anthelmintic activity

In vitro anthelmintic activity of alcoholic extract of *Balanites aegyptiaca* on amphistome *Paramphistomum cervi*. 125 mg/ml concentrations of alcoholic extract gave total mortality at 5 hours. The treated and control *Paramphistomum cervi* was observe and compared by Light microscopy. The alcoholic extract of *Balanites aegyptiaca* showed discontinuous, damaging cells of tegument, vacuolization & breakage in oral sucker and acetabulum of *Paramphistomum cervi*. Study revealed that the potential role of *Balanites aegyptiaca* fruit extract as an anthelmintic activity against *Paramphistomum cervi*.⁽³⁰⁾

Antibacterial effects

The aqueous and organic leaves extracts of *Balanites aegyptiaca* and *Moringa oleifera* were reported to have antibacterial effect against *Salmonella typhi* isolated from blood clot culture using the disc diffusion method. The extracts of *Balanites aegyptiaca* plants demonstrated the highest activity than *Moringa oleifera*. The ethanolic extracts of both plants demonstrated the highest activity whereas the aqueous extracts of both plants showed the least activity at 100 mg/ml as compared with ethanolic extracts. The activities of these plant extracts were comparable with those of antibiotics, ciprofloxacin, cotrimoxazole, and chloramphenicol, commonly used for treating typhoid fever. The antibacterial activity appears to increase

when extracts of the two plants were used in combination at 100 mg/ml each. Preliminary phytochemical screening showed that plant extracts contain saponins, tannins, and phenols, and *Balanites aegyptiaca* possesses anthraquinones. The antibacterial activities of the extracts on *Salmonella typhi* were reasonably stable when treated at 4, 30, 60, and 100°C for 1 hour. However, it reduces significantly when the pH was altered toward alkalinity.

The aqueous and ethanolic extracts of leaves of six plants viz., *Balanites aegyptiaca* (L.) Del, *Hyptissuaveolens* Poit, *Lawsoniainermis* L., *Leuca saspera* L., *Phyllanthus maderaspatana* L. were reported as antibacterial when tested individually and in combinations against five different diarrheagenic bacteria *Bacillus cereus*, *Staphylococcus aureus*, *Escherichia coli*, *Salmonella enteritidis*, and *Listeria monocytogenes*. Ciprofloxacin (20 μ g) was used as antimicrobial standard. The highest antimicrobial activity was in both crude aqueous leaf extract and crude ethanolic leaf extract of *Lobelia nicotianifolia*, when all extracts were tested individually. However, in combination, the highest activity was observed in crude ethanolic leaf extract *Lobelia nicotianifolia* and *Balanites aegyptiaca* against *S. aureus*.⁽³¹⁻³³⁾

Antivenin activity

The acetone and methanolic extracts of stem bark of plant has reported an antivenin activity against saw-scaled (*Echiscarinatus*) viper venom concentration at lethal dose (0.194 mg/ml), when administered intramuscularly to Wistar albino rats. Both extracts were found to be effective at 75 and 100 mg/ml concentrations.⁽³⁴⁾

Anticancer activity

A mixture of steroidal saponins: balanitin-6 (28%) and balanitin-7(72%), isolated from *Balanites aegyptiaca* kernels, demonstrated appreciable anticancer effects in human cancer cell lines in vitro by using against A549 non-small-cell lung cancer (IC₅₀, 0.3 μ M) and U373 glioblastoma (IC₅₀, 0.5 μ M) cell lines. Bal6;7 displayed higher antiproliferative activity than etoposide and oxaliplatin, markedly less active than taxol. It indicated that balanitin 6;7 mixture is more a cytotoxic compound than a cytostatic one. In vitro anticancer activities are due to partly depletion of [ATP]_i, leading in turn to major disorganization of actin and it does not induce an increase in intracellular reactive oxygen species. In vivo, bal6; 7 increased the survival time of mice bearing murine L1210 leukemia grafts to the same extent reported for vincristine.⁽³⁵⁾

Anti-inflammatory and analgesic activities

The ethanol and petroleum ether extracts of aerial parts of *Balanites aegyptiaca* have been reported to have significant anti-inflammatory action on carrageenan-induced hind paw edema in rats, the paw volume was measured plethysmometrically at 0 and 3 hours after injection and analgesic activity by using Eddy's hot plate method and tail-flick method in albino

rats. The ethanol and petroleum ether extracts showed a greater anti-inflammatory and analgesic effects comparative with the standard drugs, indomethacin and diclofenac sodium, respectively. It also indicated that the ethanolic extract of *Balanites aegyptiaca* exhibited more significant activity than petroleum ether in the treatment of pain and inflammation.⁽³⁶⁾

In vitro antioxidant, xanthine oxidase and acetylcholinesterase inhibitory activities

It is reported that the galls and leaf extracts and fractions of *Balanites aegyptiaca* showed a significant antioxidant, xanthine oxidase, and acetylcholine esterase inhibitory activities. The total phenolics and flavonoids were measured using Folin-Ciocalteu and $AlCl_3$ reagents, respectively. Two methods, that is, FRAP (Iron (III) to Iron (II) reduction activity) and ABTS (2, 2-azinobis-3-ethylbnzothiazoline-6-sulphonate) assay were used to estimate the total antioxidant capacity of the plant materials. Dichloromethane fraction of the Gall and ethyl acetate fractions of the leaves were reported to have highest antioxidant activity. The antioxidant activities were correlated significantly with the total phenolic and flavonoid contents.⁽³⁷⁾

Anti-inflammatory, antinociceptive and antioxidant activities

Methanolic and butanol (BE) extracts and of two new saponins isolated from *Balanites aegyptiaca* showed significant anti-inflammatory, antinociceptive activity in the carrageenin-induced edema in the rat, and acetic acid-induced writhing test in mice and antioxidant action by using in vitro, using a method based on the Briggs–Rauscher oscillating reaction. The samples, extracts and pure substances, were intragastrically administered to animals.⁽³⁸⁾

Mosquito larvicidal activity Fruit kernel extracts against *Anopheles arabiensis*, *Culex quinquefasciatus*, and *Aedes aegypti*⁽³⁹⁻⁴¹⁾

A saponin extract and water extract from fruit kernel of *Balanites aegyptiaca* was investigated as a mosquito larvicide. Both extracts were tested against second and fourth instar larvae of the three mosquito species namely *Anopheles arabiensis*, *Culex quinquefasciatus*, and *A. aegypti*, and LC_{50} and LC_{90} values were determined. Second instar larvae were more susceptible than fourth instar larvae in all cases. The larvae of *Anopheles arabiensis* were more susceptible than *Culex quinquefasciatus* and *A. aegypti* to its larvicidal effects. The saponin was more active than the water extract. Mesocarp of fruit extracts against *A. aegypti*. The various extract mesocarps of fruits viz. chloroform, ME, BE, ethyl acetate, and five fractions of ME extract showed larvicidal activity against *A. aegypti* mosquito larvae. The highest larval mortality was found in ME extract. The amount of saponin is correlated with larval mortality. Mesocarp of fruit extracts has also reported mosquito larvicidal activity against *A. aegypti* and *Culex pipiens* and

saponins from *Balanites aegyptiaca* callus against *A. aegypti* mosquito have been reported.⁽³⁹⁻⁴¹⁾

Hepato protective activity

Administration of the aqueous extract to biliary duct-ligated rats showed a dose-dependent significant decrease in serum bilirubin level. For three days, the animals were given different concentration of the extract intraperitoneally. The bilirubin concentration was reduced by 22.2% in the animal that received 1.2 g bark extract each day, by 31.6% in those given 2.4 g, and by 45.9% in those given 4.8 g.⁽⁴²⁻⁴³⁾

Antidiabetic activity

The pure saponin, extracted from the *Balanites aegyptiaca* fruit mesocarp, and water extract have been reported as hypoglycemic agent when tested on albino rats in different concentrations dose and Daonil (as a standard medication). It also reported that it inhibit *Escherichia coli* growth in rats. The aqueous extract of the mesocarp of fruits of *Balanites aegyptiaca* was reported to have antidiabetic effect in streptozotocin-induced diabetic mice.⁽⁴⁴⁻⁴⁷⁾

Antiviral activity

It is reported that bark aqueous extract of *Balanites aegyptiaca* used in treatment of both AIDS and Leukemia. An oral administration of the aqueous extract (30% w/v given at 100 ml every 8 hours for 30 days) for the treatment of HIV patients have shown excellent results. The same was given to patients with leukemia and a good increase in platelets and a normal blood differential reading after one month was noted.

Wound healing activity

It is reported that *Balanites aegyptiaca* have potent wound-healing activity, as evident from the wound contraction. The results also indicated that plant possess potent antioxidant activity by inhibiting lipid peroxidation, bleaching DPPH (2,2-diphenyl-1-picrylhydrazyl) radical, and protecting against oxidant injury to fibroblast cells.⁽⁴⁸⁾

Hypocholesterolemic activity

It is reported that whole and extracted pulp of *Balanites aegyptiaca* fruits reported a hypocholesterolemic effect when tested on adult albino rats.⁽⁴⁹⁾

Diuretic activity

The ethanol and methanolic extract of leaves of *Balanites aegyptiaca* reported diuretic effect when tested on Wistar albino rats with (150 and 300 mg/kg) oral doses. Frusemide was used as standard. The results indicate that ethanol and methanol extracts shows a significant ($P < 0.05$) increase in the urine volume and electrolyte excretion ($P < 0.001$) when compared with control.⁽⁵⁰⁾

Conclusion

Overall data collected through journals, Internet and literature reveals that plant *Balanites aegyptiaca* is self has its traditional value and plant bark, seed, seed oil, leaves, fruit widely used in folk medicine. From the extensive literature survey it believed that *Balanites*

aegyptiaca scientifically possesses 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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