

Review Article

Pharmacological Activities of *Balanites aegyptiaca* (L)- A Perspective ReviewGajalakshmi S, Vijayalakshmi S[#], Devi Rajeswari V*

School of Biosciences and Technology, VIT University, Vellore, Tamilnadu, India.

[#]CO₂ Research and Green Technologies center, VIT University, Vellore, Tamilnadu, India.

*Corresponding author's E-mail: sdevirajeswari@gmail.com

Accepted on: 13-06-2013; Finalized on: 31-08-2013.

ABSTRACT

Medicinal plants are known to exhibit many biological activities from the ancient period. They were applied in the ayurvedic medicines for the treatment of various diseases. They were proved to possess many of the phytochemical constituents that were responsible for the actual mechanism of the activities. One such plant possessing the novel biological activities is *Balanites aegyptiaca*. They possess many biological activities such as antimicrobial, antioxidant, anti diabetic, antiasthmatic, etc. They were found to be toxic to pests, molluscs and larvae. Even though they are said to be toxic, their minimum level of consumption do not cause any serious effects. They possess 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 the plant obtained from the literature.

Keywords: *Balanitaceae*, Diosgenin, pedunculate fascicle, hypoglycemic, *Tribolium castaneum*, *Aedes aegypti*, saponins.

INTRODUCTION

For the period of around thousands of years, plants were utilized as the basis of the traditional medicine systems in Nigeria, India, China, Indonesia etc¹. They were also utilized as the source for the potent and powerful drugs². Even the developing countries have initiated the adaptation of the traditional medical practice to be the integral part of their culture. Plants were still remains as the primary source of supply of many important drugs and minerals in the orthodox medicine today³. Plants are being exploited for its active compound which is responsible for their biological function.

One among the promising plant is the *Balanites aegyptiaca* (L.) del which belongs to the family of *Balanitaceae*. It is found to be an evergreen xerophytic tree of tremendous medicinal importance and was found to be distributed throughout the dried parts of India. In India and Asia, it was reported to be used in a variety of folk medicines. Various parts of the plants has been used in the Ayurvedic and other folk medicines in order to treat different ailments which includes syphilis, jaundice, liver and spleen problems, epilepsy, yellow fever. The plant also possess several biological activities such as insecticidal, antihelmintic, antifeedant, molluscicidal and contraceptive activities⁴. They were also used in the treatment of illnesses such as laxative, diarrhoea, hemorrhoid and stomach aches⁵.

The fruits of the plant were reported to be used for the treatment of the liver disease and as a purgative .They were sucked by the schools children as a confectionary in some countries^{6,7}. The bark has been investigated for its treatment against round worm infections and also as a fish poison. The kernel cakes aqueous leaf extract and saponins was reported to possess anti- bacterial activity⁸ and potent larvicidal activity⁹ respectively. The plant

contains the active compounds such as Diosgenin, Balanitisin 4, 5, 6 and 7, Steroidal saponins, Deltoin, Protodeltoin, Alkaloids, Balanitoside, Cryptogenin, Balanitisin -3 & 6-methyl Diosgenin, Flavonol glycoside, Isorhamnetin-3-O-robinobioside, Isorhamnetin-3-Orutinoside, (25R and S)-spi-rost-5-en-3β-ol, Bergapetin, (+)- Marmesin¹⁰. This review accounts the plants traditional and recent investigations for its application in the current medicinal field.

LOCAL NAMES OF THE PLANT

Amharic (kudkuda, jemo, bedeno); Arabic [zachun, zaccone, heglig (tree), zacon, kuge, lalob (fruit)]; Bemba (katikayengele, mubambwangoma); Bengali (hin); English (soap berry tree, simple-thorned torchwood, simple thorned torch tree, Jericho balsam, lalob tree, heglig, Egyptian myrobalan, desert date, torch wood); French (myrobalou d'Egypte, dattier sauvage, dattier du desert, myrobalau d' Egypte); Hindi (engua, ingudi, betu, hingan, hingn, hingot, hongot, hingota); Lozi (mwalabwe); Luganda (musongole); Mandinka (sumpo); Nyanja (nkuyu); Sanskrit (ingudi); Swahili (mjunju, mwambangoma); Tamil (nanjunda); Tigrigna (indrur, mekie); Tongan (mulyanzovu, mwalabwe)¹¹.

BOTANICAL DESCRIPTION

Plant is found to be crown rounded, dense with long stout branchlets. Trunk and bark were grey and deeply fissured longitudinally. Leaves were found to be compound and spirally arranged on the shoots. They were dark green with 2 firm coriaceous leaflets; dimensions and shapes varying widely. Petiole is canaliculate from 5 mm to 20 mm with a short rachis. Most accounts have indicated a maximum length of 8 mm for Uganda. Margin of each leaflet entire; lamina generally up to 6 cm long, 4 cm broad, although apparently smaller (1-3 x 0.3-1.5 cm) in



the Sahara and in Palestine. Inflorescence remains a sessile or shortly pedunculate fascicle of a few flowers. Flower buds are ovoid and tomentose. Individual flowers were hermaphroditic, pentamerous an actinomorphic, 8-14 mm in diameter and generally greenish-yellow. Pedicels densely greyish, pubescent and rarely reaching 10 mm in length, although 15 mm is reported for Zambia and Zimbabwe. The usual length is about 8 mm. Fruit is ellipsoid and up to 4 cm long, green. Ripe fruit brown or pale brown with a brittle coat enclosing a brown or brown-green sticky pulp and a hardstone seed¹¹.

BIOLOGICAL ACTIVITIES OF THE PLANT

Anti-Inflammatory Activity

The aerial part of *Balanites aegyptiaca* (L.) Del was investigated first time for their anti-inflammatory activity using ethanol extract. The activity has been evaluated in rat by using a carrageenan induced paw oedema method. When compared to the reference standard, the ethanolic extract was identified to exhibit potent anti-inflammatory activity at the concentration of 200 mg/kg 3 hrs. The safety of this was also evaluated by the acute toxicity studies. From the results, it was found that the ethanol extract did not show any behavioral changes or mortality even at a dosage of 2000 mg/kg. Thus, the ethanolic extract of the aerial part of the plant can be used for the treatment of the inflammatory disorders¹².

Toxicity Study

Balanites aegyptiaca seed oil was used as the ingredient and substitute to the groundnut oil in Nigeria region for the preparation of the local foods. The four week repeated dose toxicity study was done in male Wister strain rats to evaluate the toxicity of crude *B.aegyptiaca* seed oil. The result has indicated that the dietary exposure of the crude *B. aegyptiaca* seed oil in the rats did not show any remarkable changes in the toxicological parameter that has been assayed. Thus, their consumption at the present level of exposure does not cause any such serious safety concern, especially on liver and kidney injury. From the experiments, it was concluded that the dietary exposure of crude *Balanites aegyptiaca* seed oil to rats did not show any toxicological concern. But, they must be used with caution having indicated subtle hepatotoxic effects in the 5% treated group¹³.

Anti – Diabetic Property

The water and the ethanolic extracts obtained from the fruits of the plant has been investigated for their hypoglycemic and hypolipidimic effect in the normal senile diabetic rats in addition to the hormones that are associated to diabetes mellitus. The changes in the serum total protein, albumin and globulin level during the experimental period was found to be insignificant. The experiments conducted have suggested the beneficial role of *Balanites aegyptiaca* fruit as a hypoglycemic, hypolipidimic agent and also as a protective agent of liver from damage or injury. The fruit flesh was found to

attribute at least in part to the increased glucose metabolism and produces an increase in serum insulin concentration¹⁴.

Anti-Microbial Activity

Flavonoid extracts obtained from the callus tissue of *Balanites aegyptiaca* were screened for their antimicrobial effect against *Escherichia coli*, *Proteus vulgaris*, *Pseudomonas aureginosa*, *Citrobacter amalonaticus*, *Staphylococcus aureus*, *Micrococcus lylae*, *Bacillus subtilis* and *Sporolactobacillus*. The evaluation was done by using the adopted disc diffusion method. The results obtained were compared with the zone of inhibition that is produced by commercially available standard antibiotics. The free flavonoid fraction of callus tissue was found to exhibit more anti-microbial activity against gram +ve bacteria than the ethyl ether and ethyl acetate bounded flavonoid extracts showing moderate activity against both the gram +ve bacteria as well as gram -ve bacteria¹⁵.

Pesticidal Effect

Balanites aegyptiaca's active component, saponin was investigated for its biopesticidal value against *Tribolium castaneum* (Red flour beetle or Bran bugs). The saponins were extracted by using Soxhlet and maceration extraction methods with aqueous and different solvents. The study was conducted at different concentrations from 1-5% and to higher 2.5-17.5%. The results obtained were found to be dose dependent. Because, At 5% concentration 100% mortality has been seen in the period of 8 days whereas 17.5% concentration showed 100% mortality in the period of 24 hours itself. Thus, *B.aegyptiaca* was proved to contain the insecticidal property that was evaluated against *Tribolium castaneum*. On increasing the concentrations of the extracts, the subsequent reduction in the time of 100% mortality was observed. Thus, the utilization of the higher concentration of the extract will be helpful in controlling the post harvest damage by stored grain pest *Tribolium castaneum*¹⁶.

Hepatoprotective and Antioxidant Effect

The plant was used in Ayurvedic and other folk medicine for the treatment of various ailments including syphilis, jaundice, liver and spleen problem, epilepsy and yellow fever. The ethanolic extract obtained from the aerial parts of the plant was evaluated for their hepatoprotective and antioxidant effect in CCl4 induced hepatotoxicity in the rats. The plant was found to exhibit potent hepatoprotective effect evaluated from the activities of liver marker enzymes, Serum glutamate pyruvate transaminase, serum glutamate oxaloacetate transaminase, Serum alkaline phosphatase, , total protein, albumin, globulin, total, conjugated and unconjugated bilirubins tested at an oral dose of ethanol extract of *Balanites aegyptiaca* (100 and 200mg/kg).

The ethanolic extract of the plant was also found to show the significant antioxidant effect with increase in the



levels of superoxide dismutase, catalase, glutathione peroxidase and glutathione reductase (GRD) by means of reducing the malondialdehyde (MDA) levels. The presence of flavonoids and phenolics compounds in the plants has been studied by the preliminary phytochemical analysis. They were known to exhibit both antioxidant and hepatoprotective studies. The plant was also reported to contain saponins in the ethanol extract that acts as an antioxidant for the prevention of oxidative hepatic damage. Flavonoids and saponins in combination helps in stabilizing the reactive oxygen species by reacting with them and oxidizing subsequently to more stable and less reactive radicals¹⁷.

Chemical Analysis and the Chemotherapeutics

The stem-bark of *Balanites aegyptiaca* was analyzed spectrophotometrically for the presence of the mineral constituents such as calcium, copper, iron, potassium, magnesium, manganese, sodium, phosphorous and zinc. The extracts of the plant obtained by maceration with different solvents was evaluated for their phytochemical and antimicrobial activity by using the disc-diffusion method. The higher levels of calcium and potassium with the lower level of copper and zinc were found in the stem-bark of the plant. Phytochemistry results in the indication of the presence of tannins, carbohydrates and glycosides as being present. The ethanol extract was found to be more efficient against entire spectrum of organisms. The microbe was found to develop resistance against the chloroform extract. Thus, the bioactive compounds of the plant could be used for the drug development purposes and in the treatment of various bacterial and fungal diseases¹⁸.

Anti-asthmatic and Anti-anaphylactic Activity

The n-butanol fraction (NBF) obtained from the fruit pulp of *Balanites aegyptiaca* was investigated for their antiasthmatic and antianaphylactic activity various experimental models.

Treatment with NBF of *Balanites aegyptiaca* was found to exhibit a dose dependent (at 50, 100 and 200 mg/kg p.o.) beneficial effect on the degranulation rate of actively and passively sensitized mesenteric mast cells of albino rats on challenging with antigen (horse serum). NBF of *Balanites aegyptiaca* was found to reduce the serum IgE level and the number of eosinophil cell count in rats significantly on comparison with the untreated control. They also showed significant protection against acetylcholine and histamine aerosol induced bronchospasm in guinea pigs. They exhibited dose dependent inhibition of ileal contractions that was induced by histamine and acetylcholine. The fraction has showed significant antihistaminic activity in histamine induced contraction in goat tracheal chain preparation¹⁹.

Molluscicidal Activity

Molluscicidal property of *B. aegyptiaca* has been investigated against the snails *Lymnaea acuminata*. The toxicity of different preparation of the leaf extracts for

molluscs was found to be both time and dose dependent. But, the exact mechanism by which these leaf extract killed snails is not known and will require further biochemical studies for elucidation²⁰.

Larvicidal Activity

The saponins fraction obtained from the fruit mesocarp of *Balanites aegyptiaca* Del. Was investigated for their larvicidal activity against the common dengue vector *Aedes aegypti* mosquito. A series of concentrations of fruit mesocarp extract of *B. aegyptiaca* fruit, its crude saponin extract and pure saponin fraction were compared and tested for their activity against the laboratory-reared third instars larvae and compared with their LC50 values. The pure saponin fraction was found to exhibit most active larvicidal, followed by crude saponin extract and mesocarp extract. The LC50 values of pure saponin extract, crude saponin extract and mesocarp extract were found to be 145, 315 and 935 ppm respectively²¹.

CONCLUSION

Medicinal plants are the major targets of present research due to their potent biological activities and also their active compounds. The compounds obtained from the extracts were used in many pharmacological products due to the absence of the side effects and the immense curation potential. The drugs obtained from the plants were pure and do not contain any chemical additives. Even though, the toxic compounds obtained from the plants were applied in the research and drug development purposes. In the above review, the biological activities of *Balanites aegyptiaca* were briefly summarized. They exhibit many biological activities and contains phytochemical compounds such as flavonoids, phenolics, tannins, saponins etc. The plant can be investigated further to reveal the hidden compounds of potent nature.

REFERENCES

1. Hammer K. Antimicrobial activity of essential oils and other plant extracts. *J. Appl. Microbiol.* 86, 1999, 985-990.
2. Srivastava, J, Lambert J, Vietmeyer N. Medicinal plants: An expanding role in development. World Bank Technical paper, 320, 1996.
3. Clark AM. Natural Products as a source for new drugs. *Pharm. Res.* 13, 1996, 94-96.
4. Yadav JP, Panghal M. *Balanites aegyptiaca* (L.) del. A review of its traditional uses, phytochemistry and pharmacological properties. *Int. J. Green Pharm.* 4, 2010, 140-146.
5. Ojo OO, Nadro MS, Tella IO. Protection of rats by extracts of some common Nigerian trees against acetaminophen-induced hepatotoxicity. *Afr.J. Biotechnol.*, 5, 2006, 755-760.
6. Barley S, Watt JM, Breyer- Brandwijk MG. *Zygophyllaceae*. In: ed.The Medicinal and poisonous plants of Southern and Eastern Africa. Livingstone Ltd. London. 1962, 1064.
7. Croach P, Watt JM, Breyer- Brandwijk MG. *Zygophyllaceae*.In: ed.The Medicinal and poisonous plants



- of Southern and Eastern Africa. Livingstone Ltd. London. 1962, 1064.
8. Bashir AK, Ahmed GHM, Suliman SM, EIKheir YM. Molluscicidal and other Biological activities of *B.aegyptiaca*. The first Arab Conference on Medicinal plants, Cairo, Egypt, 1984.
 9. Zarroug IMA, Nugud AD, Bashir AK, Mageed AA. Evaluation of Sudanese plant extracts as mosquito larvicides. *Int. Sci. Crust. Drug. Res.* 71, 1988, 71-76.
 10. Kirtikar KR, Basu BD. Dehradun: International book distributors. Book sellers & publishers, 5th ed. 1998, 513-515.
 11. Orwa C, Mutua A, Kindt R, Jamnadass R, Anthony S. *Agroforestry Database 4*. Agroforestry Database:a tree reference and selection guideversion 4.0. www.worldagroforestry.org/sites/treedbs/treedatabases.asp).
 12. Mayba Gnana Suky T, Parthipan B, Kingston C, Mohan VR. Anti-Inflammatory Activity of Aerial part of *Balanites aegyptiaca* (L.) Del against Carrageenan induced Paw Oedema. *Int. J. Pharm. Tech. Res.* 3, 2010, 639-643.
 13. Wilson Obidah, Margaret Samuel Nadro, Godfrey Obadiah Tiyafo, Abdullahi Usman Wurochekke. Toxicity of Crude *Balanites aegyptiaca* Seed Oil in Rats. *J Amer. Sci.* 5, 2009, 13-16.
 14. Samir AM, Zaakkouk, Somaia ZA, Rashi, Mattar AF. Anti – diabetic properties of water and ethanolic extracts of *Balanites aegyptiaca* fruits flesh in senile diabetic rats. *Egypt. J. Hosp. Med.* 10, 2003, 90 – 108.
 15. Shashi Bidawat, Ruchi Nag, NaG, TN. Antimicrobial principles from tissue cultures of *Balanites aegyptiaca*. *Roman. Biotechnol. Lett.* 16, 2011, 2.
 16. Preeti Shukla, Satyawati Sharma, Effect of *Balanites aegyptiaca* on Bran Bugs. International Conference on Biotechnology and Environment Management, IPCBEE, 18, 2011, IACSIT Press, Singapore.
 17. Mayba Gnana Suky T, Parthipan B, Kingston C, Mohan VR, Tresina Soris P. Hepatoprotective and Antioxidant Effect Of *Balanites Aegyptiaca* (L.) Del against CCl₄ Induced Hepatotoxicity In Rats. *Int. J. Pharm. Sci. Res.* 2, 2011, 887-892.
 18. Khan ME, Abdu KB, Aga T, Lawan ZU. Chemical Analysis and the Chemotherapeutics of Stem-Bark of *Balanites aegyptiaca*. *Conti. J. Appl. Sci.* 3, 2008, 95 – 102.
 19. Savita Patil D, Sameer Ahale V, Sanjay Surana J. Evaluation of Anti-asthmatic and Anti-anaphylactic Activity of *Balanites aegyptiaca* (delile), *Asian. J. Pharm. Clin. Res.* 4, 2011, 52-55.
 20. Priyanka Vijay. Evaluation of Molluccidal Activity of Some Indian Medicinal Plants Against *Lymnaea acuminata*. I, *Int. J. Appl. Biol. Pharm. Technol.* 21, 2010, 308-311.
 21. Bishnu Chapagain P, Zeev Wiesman. Larvicidal Activity of the Fruit Mesocarp Extract of *Balanites aegyptiaca* and its Saponin Fractions against Aedes aegypti. *Dengue. Bulletin.* 29, 2005, 203-207.

Source of Support: Nil, **Conflict of Interest:** None.

