

***Balanites aegyptiaca* (L.) Del.: A Multipurpose and Potential Biodiesel Tree Species of the Arid Regions**

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Abstract: *Balanites aegyptiaca* (L.) Del., commonly known as hingota or desert date is an evergreen xerophyte. This plant can survive in a wide range of climatic conditions. It can withstand high temperature, high light intensity, high wind velocity and severe drought. The fruits and roots of this plant contain diosgenin, which can be used in pharmaceutical industry in production of oral contraceptive and steroids. The seeds of this plant contain 30-60% oil, which is edible and used as cooking oil. The seed oil can also be used as biofuel as combustion energy of oil is comparable to that of diesel. Fruits are also being used in detergent industry. This plant also has been reported to have Bristol and larvicidal activity against some mosquitoes. The stem of the tree contains steroidal saponins, which have been shown to have an insect anti-feedant and molluscicidal properties. Beside this the leaves of this plant is a one of the favorite fodder among goats, so it can play an important role of fodder tree in the desert in severe drought. This plant can be listed among the plants, which are used as famine foods. The yield of this marvelous tree is about 125 Kg/tree/annum. So looking at the importance and nature of the plant, this plant species must be promoted as planting material in combating desertification programme and in stabilization of sand dunes. This plant can play significant role especially against soil erosion as it produces root sucker in nearby area, the clump of the root sucker can hold the soil for a long.

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1. Introduction

The plant *Balanites aegyptiaca* (L.) Del. belongs to family balanitaceae. It is an evergreen woody plant of fragile ecosystem of the Great Indian Thar Desert. It is a thorny species with 2.5-3.5 cm long thorns (Fig. 1A). Flowering and fruiting occurs during October (Bhandari, 1990). Flowers are 5-6 mm in diameter, greenish white fragrant, axillary in few flowers cyme or fascicles. Seeds are pendulous and ex-albuminous. Seeds can be stored with insecticides. One tree produces 100 - 150 kg/ year (Rathore *et al*, 2005). The woody fruit is ovoid in shape and 3-6 X 2-3 cm in size. It is drupe and having five grooves (Fig.1B). *Balanites* is distributed all over the drier parts of India, Kanpur to Sikkim, Bihar, Gujarat, Khandeish and the deccan plateau. Globally it is found in Tropical and Northern Africa, Syria, W. Asia and Sudan. It is also found growing in neighboring parts of East and West Africa, particularly Nigeria and also in Arabia and Burma.

2. Medicinal Importance

This plant has got tremendous importance and being used in treatment of several diseases and disorders since ages. The roots and fruits of this plant contain diosgenin (Fig.1D), which is used in production of oral contraceptive, sex hormone and anabolic steroids. Diosgenin is used as precursor of progesterone hormone. The quantity of diosgenin

varies in various plant parts. According to Desai *et al* (1978) diosgenin content in Indian samples in fruit pericarp, seed kernels, and oil is 0.994%, 0.94%, 0.45% respectively. According to Abu-Al -Futuh (1983) potential earning from diosgenin alone could be as high as US\$ 36 million per annum in Sudan.

Ethanol extract of leaves was found to be best effective against *Bacillus subtilis*, *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa* and *Candida albicans* than the same extract of stem bark, root bark and fruits (Karuppusamy *et al*, 2002).

Decoction of root is used to cure Malaria by Bhils. Roots are used as emetic. Roots are boiled and root soup is used against oedema and stomach pain. This plant is also used as a source of antidiabetic medicines in Egypt (Kamel *et al*, 1991). Bark has hepato-protective activity in rats (Jaiprakash *et al*, 2003). The stem of the tree contains steroidal saponin, which have been shown to have an insect anti-feedant and molluscicide properties (Jain, 1987). The root extract of *Balanites aegyptiaca* exhibits moderate biological activity against *Leishmania major* (Fatima *et al*, 2005). An aqueous extract of kernel exhibited anthelmintic activity against *Coenorhabditis elegance*. Larvicidal activity against larvae of *Anopheles arabiensis*, *Culex quinquefasciatus* and *Aedes aegypti* (Zarroug, 1990) make it a potentially important plant for managing

mosquitoes and thereby controlling malaria, which is already a menace in our country.

3. Potential Biodiesel Resource

Resently Chapagain *et al.*, (2009) have reported *Balanites aegyptiaca* as an arid lands sustainable bioresource as an oil crop in arid lands for large-scale sustainable industrial biodiesel production. The study reports that using proper cultivation practices with emphasis on low quality irrigation water, trees can be extremely well developed in hyper-arid conditions of the Israeli Arava desert and yield oil-rich fruits. Best selected trees can yield date fruits up to 52 kg/trees. Kernels oil content may reach up to 46.7% (based on dry weight). The study further concludes that the oil is consisted on four major fatty acids: palmitic (16:0), stearic (18:0), oleic (18:1), and linoleic (18:2), constituting 98-100% of the total fatty acids in the oil of all tested genotypes. Linoleic acid was found to be the most prevalent fatty acid, ranging from 31% to 51% of the fatty acids profile, very similar to soybean oil profile. *In situ* biodiesel production directly from oil-enriched powder was successfully developed according to this study. Yield efficiency for both conventional and *in situ* biodiesel production was about 90%. The qualities of the produced biodiesel well meet the international biodiesel standards.

4. Other Uses as a Multipurpose Tree Species

Besides its medicinal value and importance as a source of biodiesel plant species, the plant is also well known for its non-medicinal importance. These values are described in following sections.

a. Famine Food: The plant is very important in days of drought. The fruits are used as famine food. As the yield is quite high so this plant ensures food security in the drought prone regions.

Seed weights reported (Maydell, 1986) of 500-1500 seeds/kg are for cleaned, extracted and air dried (15% moisture content) seeds. The kernels contain oil from 30-60% (Hall and Walker, 1991), which is a quite higher percentage and economic for oil extraction. The oil remains very stable when heated, has a high smoking point and an acceptable scent and taste. Oil is edible and can be used for cooking purpose. Kernel also contains 20-30% crude protein. It is an article of diet among many groups, for example Madi, Acholi and Nilotic tribes of Sudan (Abu-Al -Futuh, 1983). The meal left after oil extraction is also edible and contains vitamins such as thiamine (1.68 ppm), riboflavin (0.073 ppm) and niacine (1.37 ppm) (Hall and Walker, 1991).

b. Fodder: Leaves of this plant serve the purpose of fodder for livestock especially for goat. The leaves contain 26.3% protein (Rathore and Meena, 2004).

Oil cake is also used as an animal feed. This has two proteins balanine and aegyptine, which make it a valuable as a concentrate ration (Maydell, 1986). It is widely used in Senegal, Sudan and Uganda (FAO., 1967). The plant contributed 38% of dry matter intake in dry season rations for goats in an experiment in Burkina Faso (Hall and Walker, 1991).

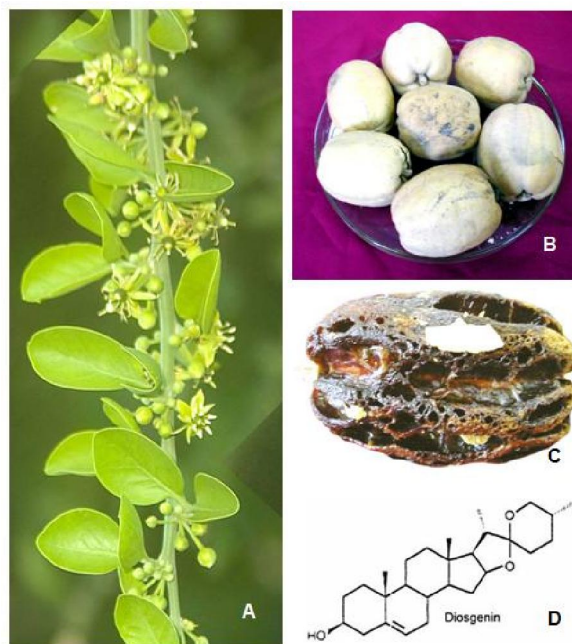


Figure 1. *Balanites aegyptiaca*: (A) Flowering twig with immature fruits, (B) mature fruit, (C) Fruit showing pulp and (D) Chemical structure of diosgenin (active principle of the plant)

c. Fuel wood: The wood is used for fire. Its wood gives good quality charcoal (NRC, 1983). The empty fruit coats are filled with gun powder and used in fireworks and blasted bellow water for food and fun. Heating value of oil is 40.8 kJ/g and that of diesel is 45.6 kJ/g (Hall and Walker, 1991) so the oil can be used as bio-fuel also.

d. Timber: The wood is hard and durable. The tribals of desert use it for making agricultural implements, house hold articles, handles of mechanical tools, legs and frames of cots and gates of huts etc.

e. Chemical extract: It is used in treatment of drinking water due to its pesticide-properties; it is very toxic to cold-blooded animals but apparently not to mammals (Maydell, 1986). The potency of the emulsion deteriorates quickly so water is entirely safe to drink shortly after treatment (IPGR, 1984). According to Palgrave (1977) one fruit will kill all the snails in 30 liter of water. The plantation along streams and canals has been shown to reduce the incidence of bilharzia (bilharzia is a human disease

caused by parasitic worms called Schistosomes, transmitted through bilharzia-transmitting snails) (Snolnozi, 1985).

f. Detergent: The tribes of Indian desert use the pulp of fruit (Fig.1C) as a detergent and a substitute for soap to wash their hair and cloths. It is worth noting that this is a biodegradable and eco-friendly soap that doesn't pollute the environment. This can also be used in production of shampoo and other detergents also.

Besides, above all discussed medicinal and non-medicinal values the plant has got a wide range of adaptability, which makes it very important species for afforestation in desert and barren land. It is well adapted to various agro-climatic regions, especially with arid region. It can withstand flood for two months (IPGRI, 1984). It can tolerate Na^+ concentration up to 3840 ppm in soil (Firmin, 1971). This plant attains maturity within 5-7 years and gives fruits. The plant requires a special attention/care in early stage of its establishment in field and later it grows well without any notable casualty.

5. Conclusion

Thus this multipurpose plant has economic potential for the people of desert. The plant has a great potential as a source of biodiesel plant as well as a famine food and a fodder species besides a multipurpose tree species. Plantation of this species should be promoted in arid regions as shelterbelts and in saline soil for reclamation of soil, it will be helpful in conservation of biodiversity and desert development programme. It can play an important role in combating desertification and sand dune stabilization as root suckers and roots of this plant can hold the soil very well.

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