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Balanites aegyptiaca (L.): A MULTIPURPOSE FRUIT TREE IN SAVANNA ZONE OF WESTERN SUDAN

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Abstract

Underutilized fruit trees play a vital role in food security and economy of the rural population in a number of African countries. Beside the significant important of the underutilized fruit trees in food security and livelihood of the local population many applications can be summarized such as using of leaves for fodder, branches for fencing materials, fire wood and charcoal making, timber for furniture and constructing huts, controlling soil erosion and competing desert encroachments . In spite of their great potential little attention has been given to this species. *Balanites aegyptiaca "soap* berry tree; thorn tree, desert date" is an important multipurpose trees species in dry land Africa. The tree is a potential source of medicines, pesticides, edible oil, animal feed, nuts, soap, and fuel wood. The edible fruits are rich in saturated fatty acids which are used as cooking oil. The fruit also contains Stereoids (Saponins, Sapogenins, and Disogenins) which are used as row materials for industrial production of contraceptive pills and other sexual hormones. The excessive uses of the tree for fruit production and for other uses combined with scarcity of natural regeneration lead to drastic depletion of this species. The desert date tree is adapted to dry and hot climatic environment which are characterized by increasing of land and water resources. However, little information is available about propagation and domestication of this valuable tree species; therefore, studies are needed for sustainable use of underutilized fruit trees in general and for *Balanites aegyptiaca* in particular. This article aims at highlighting and summarizing information on different aspect of *B. aegyptiaca* to stimulate the scientist interest in this valuable tree species which is of economical importance for rural inhabitants of western Sudan and other African countries.

Key words: underutilized fruit trees, Desert date, *Balanites aegyptiaca*, western Sudan.

Introduction

Indigenous fruit trees play a very important role in the livelihoods of rural people, especially for those living in the dry land areas (Von Maydell, 1983), where crop failure often resulted in a poor nutrition of the local population (Maxwell, 1991).FAO (1999) indicated that a number of 18,000- 25,000 wild-collected species are used as food. In many part of Sudan wild plant are common in the normal diet (Gebauer *et al.*, 2002). However, the potentiality and their contribution to farmer livelihood and poverty elevation are not acknowledged. With the massive increase in human population, drought and desertification, low and erratic rainfall development of alternative crops to improve the range of commodities is needed (El-Siddig *et al.*, 1999). An example of such species is *B. aegeyptiaca* (L.)Del. Commonly known as desert date and locally known as "Heglig". The species grow naturally on the arid and semi arid area in East, Central and North part of Africa (Von Maydell, 1983). In Sudan the species was found in different soil types ranging from sand soil, heavy clay soil, to the rivers soil along the water streams. The tree is growing in rainfall ranging from 200-800 mm\annum (Vgot, 1995). Bunderson *et al.*, (1990)in his investigation on agro forestry practices and potential in Western Sudan reported that *B. aegyptiaca* has attracted attention as a potentially source of medicines, pesticides, edible oil, animal feed, nuts, soap, and fuel, as well as hard currency export revenue. In western Sudan the species was used as fuel wood, charcoal, timber, ornamental, shade, insecticide, drugs, sand dune fixation, shelter belt and fodder for livestock (Vgot, 1995).

Table1: Variation among *B. ageyptiaca* geographic sources in seed morphological and chemical characteristics

Province	Seed length (cm)	Seed diameter (cm)	Size index ratio	Shape index ratio	Oil content %	Protein content %	Carbohydrate%
El Dinder	3.66a	2.30a	8.45a	1.61d	44.5d	28.7	85
El-Damazin	3.55b	2.07c	7.36b	1.74c	21.1g	33.1	33
Umm abdalla	3.31c	2.16b	7.16c	1.55e	40.4e	38.3	34
Arwashda	3.52b	1.97d	6.95d	1.80b	47.4bc	36.2	46
Abu Gubeiha	3.03e	2.06c	6.22e	1.49f	41.3e	34.8	41
Abu Zabad	2.90f	2.09c	6.08ef	1.39g	23.6f	31.5	34
Kass	2.46h	2.18b	5.38g	1.13i	49.4ab	28.7	31
Abassiya	2.64g	2.07c	5.48g	1.28h	41.5e	36.6	75
Boat	3.23d	2.18b	5.99f	1.76c	49.8a	41.2	30
Kassala	3.18d	1.72f	5.50g	1.86a	46.4cd	33.1	39
Id Elfrssan	2.30i	1.99d	4.59h	1.16i	19.8g	30.5	38
P=	0.0001	0.0001	0.000	0.000			
C.V. %	10.37	10.55	15.49	15.13	2.48		

Means with different latter in the same columns are significantly different at ($P \leq 0.05$) level of significant according to DMRTs (El Feel and Warrag, 2006)

Many authors have reported a great genetic variation on seeds of tropical tree species such as *Acacia senegal* (El Feel and Warag, 2004), *Faidherbia albida* (Ibrahim, 2002), *Acacia nilotica* (Chhillar et al, 2002), *Azadirachta indica* (Sidhu et al, 2003). El feel and Warag, (2006) studied the variation among eleven *B. aegeyptiaca* geographical seed sources in seed morphological and chemical characteristic they reported a great variation among different seed sources on seed length, seed diameter, size index ratio, shape index ratio, oil content, protein content and the carbohydrates (Table 1). This study aimed to summarizing information on different aspects of *Balanites aegeyptiaca* to stimulate the interest in this valuable tree species.

Botanical description

According to El Amin (1990) *Balanites aegeyptiaca* belong to the family Balanitaceae and it is an armed tree 8-10 m high, often with a fluted bole. Bark grey to dark brown with deep vertical fissures exposing the new yellow bark; spines straight, stout, rigid, up to 8 cm long, inflorescence supraxillary or subracemose; flowers yellow-green, about 1.3 cm long. Flowers November – April; fruits December to July.

Ecology and distribution

B. aegeyptiaca has wide ecological distribution. The tree grown successfully in different soil type ranged from alluvial soil, sandy soil, dark cracking clay soil, gardud soil, river bank soil and to the food slopes of rocky soil (Elamin, 1990). According to Vgot, (1995) and Von Maydell, (1983) the tree is distributed in arid and semi arid zone of tropical Africa it is native to Algeria, Angola, Benin, Burkina Faso, Burundi, Cameroon, Chad, Democratic Republic of Congo, Djibouti, Egypt, Eritrea, Ethiopia, Libyan, Morocco, Myanmar, Nigeria, Saudi Arabia, Somalia, Tanzania, Uganda, Yemen, Republic of, Zambia, Zimbabwe. In Sudan the species is commonly found on dark cracking clays soils of central Sudan and on the sandy soils in Kordofan and Darfur, often associated with *Acacia seyal* on short grass savanna (El Amin, 1990). El- ElKhalifa*et al.*, (1989) reported that *Balanites aegeyptiaca* was found in *Acacia seyal* Balanites savanna alternating with grass areas. This sub zone is found in Blue Nile State South of Wad El Nail around El damazine and east of it. Virgin stands of the tree were encountered in South Kordofan, in Siragyia and Habila areas.

Propagation methods

Blanites aegeyptiaca is commonly propagated by seeds. The seed germination is hypogeal germination in which the hypocotyls do not elongate or its elongation is significant so the cotyledons remain in the soil Naim*et al.*, (1970). *Balanites aegyeptiaca* seeds were recommended to be sown horizontally (El-nour and Massimo 1995). The seeds may be collected directly from the trees or from the ground, and then soaked in water for some hours

to separates the stones from the pulp. Seed germination can be improved by immerse the seeds in boiling water for 7-10 min then cooling slowly. Germination occurs in 1-4 weeks and the seedlings are kept in the nursery for about 12 weeks (DANIDA 2000). Recently, natural regeneration is lacking due to a high demand for fruit, which have higher economic value; therefore, little fruit and thus few seeds are left for natural regeneration of the species.

Chemical composition of the fruit

Balanites aegyptiaca fruits locally known as "Lalob" are the most promising because it could be used as row materials for edible oil, protein concentrate, alcohol and steroids (figure 2). The fruits consist of epicarp (5-9%), mesocarp (28-33%), endocarp (49-54%) and kernel (8-12%). The kernel is very rich in oil (Mohammed *et al.*, 2002).Hussain *et al.*, (1949) reported that the kernel of *B. aegyptiaca* fruit contain 46% oil, amounts to 9 to 10% by weight of the whole fruit. Suliman and Jackson, (1959) reported a 40% sugars and 40 to 58% oil, Abut-Al Futuh (1983) found 64% to 72% total carbohydrates, 44 to 51% oil and 26 to 30 protein and El nour *et al.*, (1985) reported that the edible mesocarp contained 1.2- 1.5 % protein and 35 to 37% total sugar of which 81.3- 91.1% is present of reducing sugars.The kernels contained 45 to 46% oil. Extraction of the kernels yields light yellow oil, having a composition calculated to be 43.8% linolein, 30.5% olein, 23.7% saturated acid glycosides. In general, thecontent of the pulp and kernel is saponin, which is a source of diosgennin a precursor for steroidal drugs such as cortisteriods, contraceptives and sex hormones (FAO, 1985; Von maydell, 1986; Pettit *et al.*, 1991; Farid*et al.*, 2002).

Main uses

The fruits of *B. aegeyptiaca* locally known as "Lalob" are an edible fruit. The fleshy pulp of the ripe and unripe fruit is eaten dried or fresh. In western and central Sudan the fruits are collected by women, children's and sold in the local market to provide additional income for the family especially during the dry season after crop harvesting. *B. aegeyptiaca* is one of the most important fodder trees in western Sudan which often have a higher crude protein, minerals content and higher digestible dry matter particularly during the dry season (Anon, 2004). Lazim (2007) in his investigation on composition of some fodder trees in South Kordofan State reported that crude protein of *B. ageyptiaca* and *Ziziphus spina- Christi* could be adequate to meet the requirements of the ruminants in the late dry season. However, *B. aegeyptiaca* leaves and twigs seemed to be useful as protein supply to poor grass range.

The antibacterial effect of *B. aegeyptiaca* was reported by Dougharie*t al.*, (2007). He reported that organic leaves extracts of *B. aegeyptiaca* and *Moringa oleifera* can be used against *Salmonella typhi* which causes the typhoid fever. The antibacterial activity of the extracts on *S. typhi* was reasonably stable when treated at 4, 30, 60 and 100 C ^{o} for one hour. The tree crashed fruit is used as a source for the bio diesel in USA Mordechay *et al.*, (2008).

The wood is hard, durable, worked easily and made wooden spoons, pestles, mortars, handles, stools and combs. In Sudan the wood is used for different use such as furniture,

charcoal making, fencing material, ornamental; shad for domestic livestock, insecticides, drugs, sand dune fixation, shelter belts and life fences. Young leaves and tender shoots are used as a vegetable, which is boiled, pounded, then fried or fat added to prepare it. Flowers are sucked to obtain nectar. In Burkina Faso, *B. aegeyptiaca* contributed up to 38% of the dry-matter intake of goats in the dry season. The oil remains stable when heated and has a high smoking point, and therefore its free fatty acid content is low. Its scent and taste are acceptable. Wood gum mixed with maize meal porridge is used to treat chest pains.

Seeds and seed biology

Seed storage behavior is orthodox; viability can be maintained for 2 years in air-dry storage at cool temperatures or for several years in hermetic storage at 3^{o}C with 6-10% mc. One kilogram of cleaned, extracted seeds, air-dried to 15% mc, contains 500-1500 seeds (ICRAF, 1992).

Tree improvement and germeplasm conservation

In Sudan stands of *B. aegyptiaca* are endangered as a consequence of intensive grazing, excessive lopping and cutting, fire out break and desert encroachment, thus, there is a need for germplasm collection of the existing local types as well as improvement through selection and breeding programs.

During the last decades, the important forest trees species were grouped according to product produced by Warrag *et al*. (1998). More than 100 species were reported to produce non-woody products (Badi, 1993), these ranges from honey bees keeping, fiber, food, fodder, medicinal materials, dyes to tannins.

Tree improvement activities and germplasm conservation effort for the forest trees in Sudan are very limited. The tree improvement was started by introduction of the exotic species, mainly *Eucalyptusspp* in 1915 the other few attempts include; identification of high-gum yielding trees of *Acacia senegal* in 1967 from the gum belt areas and planting their provenances at the gum Arabic research site at El-Demokeya Forest Reserve in North Kordofan State. Beside *Acacia sengal* the provenance trials and studies are concentrated on a very limited species such as *A. senegal, A. seyal, A. nilotica and Faidherbia albida* (Gorashi, 1998). Very limited research was done concerning *Blanites aegeyptiaca* provenance trails (Elfeel and Warag, 2004).

Future research work

Future efforts should start by planning for the conservation of the priority species and the endangered ones and then implementation of conservational plans. This requires inter-country collaboration especially in view of the uniqueness of the vulnerable dry land zone and that the important and endangered species are shared in the Sahelian and North - Sudanian Africa (FAO 2001).

References

Abu-Al-Futuh, I.M., 1983. *Balanitesaeyptiaca*: An unutilized raw material potential ready for agro-industrial exploitation. UNIDO Document no. 12419 project TF\INT\77|021. UNIDO of the United Nations.

Anon, Y.M., 2004. Final report, South Kordofan range management strategy study,Yam consultancy and Development. Co. ltd. Sudan, Khartoum.Volume1. Pp 38.

Badi, K.H., 1993. Study on consumption of forest products: an exhaustive list of forest species bearing non-wood forest products. GCP/SUD/049/NET, Khartoum, Sudan.

Bunderson,W.T., Elwakeel,A.,Saad,Z.A. and Hashim,I.M., 1990. Agroforestry practices and potential in Western Sudan. In: planning for Agroforestry. ELSEVER (1990) Amesterdam.

Chhillar, S., Hooda, M. and Chopra,D., 2002.Variability studies on pods and seed characteristic of *Acacia nilotica* (L.)Willd.*Journals ofArid zone*, 4 (1): 69-74.

DANIDA, 2000. *Balanites aegyptiaca* (L.) Del seed leaflet in: www.dfsc.dk.

Doughari, J.H., Pukuma, M.S. and De, N., 2007. Antibacterial effects of *Balanites ageyptiaca* (L) Dell and *Moringa oleifera* Lam on Salmonella typhi. *African Journal of Biotechnology* Vol 6 (19).Pp 2212-2215.

El Amin, H.M., 1990. Trees and Shrubs of the Sudan. Ithaca Press Exeter 1990, England.

El nour, A.M., Ahmed, A.H.R. and Gayoum, A.G.A., 1985.A chemical study of Balanites aegyptiaca L. (Lalob) fruits grown in Sudan, *Journal ofscience of food and agriculture*. 36: 125, 1254-1258.

El nour, M. and Massimo, K., 1995.Effect of pulp and positioning on seed germination and juvenile development of Heglig (*Balanites ageyptiaca* (L) Dell).

Elfeel, A.A. and Warrag, El., 2004. Genetic variation in seed parameters and germination of *Acacia senegal* (L) Willd at the geographical source and individual tree levels, *Journal of Science and Technology*, 5 (1): 2004pp 216.

Elfeell, A.A. and Warrag, El., 2006. Variation in Morphological and Chemical Characteristic of Fruits and Seeds among eleven geographical sources of *Balanites aegyptiaca* (L) Dell. *Journal of Sudan Silva*, pp29-40.

ElKhalifa, M.D., El Samani, M.O., Abdel Nour, H.O., Pearee, D.W., Barbier, F.B.,Markang, A. and Burgess, J.C., 1989.Gum Arabic Belt Rehabilitation in the Republic of the Sudan. Stage I Report Volume 3: Endsleigh Street. London WC, HODD. England. Institute of Environmental Studies. University of Khartoum, Sudan.

FAO, 1999.Uses and potential of wild plants in farm house-holds.FAO Information Division, Rome, Italy, Available from *http:// www.fao.org*.

FAO, 1985. An all purpose tree for Africa offers food and income. Ceres 18: 6-7.

FAO, 2001.State of Forest Genetic Resources in the Sahelian and North-Sudanian Africa & Regional Action Plan for their conservation and Sustainable Use. Forest Genetic Resources Working papers, working paper No.2.

Farid, Haslinger E., Kunert, O., Wegner, C. and Hamburger, M., 2002.New *steroidal glycosides from Balanitesaegyptiaca, Helvetica chi mica Acta*. 88 (4): 1019-1026.

Gebauer, J., El-Siddig, K.and Ebert, G., 2002. Baobab (*Adansoniadigitat* L.): a review on a multipurpose tree with promising future in the Sudan. *Eur J HorticSci* 4: 155-160.

Gorashi, A., 1998. State of forest Genetic resources in Sudan. Paper presented in the sub-regional workshop FAO, IPGRI, ICRAF on the conservation, management, sustainable utilization and enhancement of forest genetic resources in Sahelian and north Sudanian Africa, Ouagadougo, Burkina Faso, 22-24 Sept, 1998.

Hussain, A.A., Dollear, F.G. and Connor, R.F.O., 1949. Oil from the kernels of Lalob fruit, *Balanitesaegyptiaca*.*Journal of the American OilChemists Society*, Volume number 12.

ICRAF, 1992. A selection of useful trees and shrubs for Kenya: Notes on their identification, propagation and management for use by farming and pastoral communities. ICRAF.

Lazim, A. M., 2007. Proximate composition of some fodder trees in the South Kordofan State. Ministry of Science and Technology Agricultural Research Corporation, Proceedings the 41 and 42 meetings of the national crop husbandry committee, Wad Medani, 2007.

Maxwell, S., 1991. To cure all hunger: food policy and food security in Sudan. Short Run Press, UK.

Mohammed, A.M.,Wolf, W. and Spiep, W.E.L., 2002. Physical, morphological and chemical characteristic oil recovery and fatty acid composition of *Balanitesaegyptiaca* Dell, kernels.*Journal of plant food for human nutrition* 57: 179-189. Khuwer Academic publisher.Printed in Netherlands.

Mordechay, H.,Zeev, W. and Sarina, G., 2008.Production of Biodiesel from *Blanitesageyptiaca*.Browdy and Neimarry, P.L.L.C; 624, Washington, Dc, US.

Naim, S., Elshafey,M., Sharoubeem, H. and El Bayoumi, A., 1970. Botany published by the Anglo-Egyptian Book-shop-Cairo.

Pettit, G., Doubek, Dl., Herald, Dl., Numata, A., Takahasi, C., Fujik, R. and Miyamoto, T., 1991. Structure of cytostatic saponins from the African medicinal plant *Balanitesageyptiaca*.*Journal of Natural Products*. 54 (6): 1491-1502

Sidhu, O., Kumar, V. and Behl, H., 2003.Variability in Neem (*Azadrichtaindica*) with respect to azdirchtin content. *Journal of Agricultural and Food Chemistry* 51 (4): 910-915.

Suliman, A. M. and Jackson, J. K., 1959. The Heglig Tree, *Sudan Silva*, 9 (1): 1-4.

Vgot, K., 1995. "Field workers guide to the identification, propagation and uses of common trees and shrubs of dry land Sudan" SOS Sahel international, London, U.K.

Warrag, E.I., Elmahi, A.G. A., Ibrahim, M. and Elsheiksh, E.A., 1998.Status of forest genetic resources in the Sudan. October, 1998.