

## Review Article

# Some Important Fruit Trees and Shrubs of Hot Arid Regions of Rajasthan State in India, Their Uses and Nutritive Values

Tewari VP\*

Himalayan Forest Research Institute, Shimla, India

\*Corresponding author: V.P. Tewari, Himalayan Forest Research Institute, Shimla, India

Received: February 16, 2016; Accepted: April 12, 2016;

Published: April 13, 2016

**Abstract**

The wild plants assume significance as alternative food sources, predominantly in the areas receiving frequent droughts and famine. In many Indian states, majority of forest dwellers depend on forests for their annual food requirements. *Cordia myxa*, *Zizyphus mauritiana*, *Salvadora oleoides* are some of the important fruit bearing plant species found in hot arid region in India that provide food supplement and means of survival during time of hardships. Rural people in Rajasthan state of India have extensive knowledge about use of famine foods. The fruits of many plants are rich sources of protein and energy. For example, *Zizyphus mauritiana* is richer than apple in protein, phosphorous, calcium, carotene and vitamin C. However, they are often undervalued and underutilized. This article highlights the importance of some of these plants, their various end uses and nutritive values of their seeds and fruits.

**Keywords:** Alternative food plants; Nutritive values; Arid region; Rajasthan; India

**Introduction**

Non-Wood Forest Products (NWFP) are goods of biological origin other than wood, derived from forests, other wooded land and trees outside forests. Non-Timber Forest Products (NTFP), another term frequently used to cover this vast array of animal and plant products, also include small wood and fuel wood [1]. NWFPs constitute an integral component of food for the communities dependent on forests. The role of NWFPs becomes more significant for less agriculture-dependent communities with small landholdings residing in remote forest villages.

Since time immemorial people have been dependent on the forests for various valuable biological resources such as timber, fuel wood, food resources, medicines and other extracts, many of which have no replacement by modern cultivation options. NWFPs play an important biological and social role in local food systems for the people living in and around forests as they depend heavily on forest resources to meet their day-to-day requirements. The communities living in the close vicinity of forests are especially dependent for their livelihood needs and food security. NWFPs are most extensively used to meet dietary shortfalls and to supplement the household income during particularly lean seasons.

Many agricultural communities suffer from seasonal food shortages, generally known as “hunger periods”. These commonly occur at the time of the year when stored food supplies have dwindled and new crops are only just arriving. During this period the consumption of NWFPs increases. In many Indian states, especially Bihar, Orissa, Madhya Pradesh and Himachal Pradesh, 80 percent of forest dwellers depend on forests for 25 to 50 percent of their annual food requirements. Out of the total NWFPs consumed, 49 percent are

consumed as fruits, 26 percent as leaves, 16 percent as rhizomes and 5 percent as the entire plant [2].

The importance of wild plants in subsistence agriculture in the developing world as a food supplement and as a means of survival during times of drought and famine has been overlooked. Generally, the consumption of these ‘alternative-food’ has been under-estimated [3]. Rural people in India are endowed with a deep knowledge concerning the use of alternative plants when the staple food is in short supply and alternative food consumption is still very common in rural areas in Rajasthan.

There are about 30 plant species in arid zone known for their edible use and of these about 20 plant species are known for their edible fruits either raw or use as vegetable [4]. However, they are often undervalued and underutilized.

The objective of this article is to briefly summarize the information about the important and underutilized fruit bearing species from arid region of Rajasthan with reference to their uses and nutritional values.

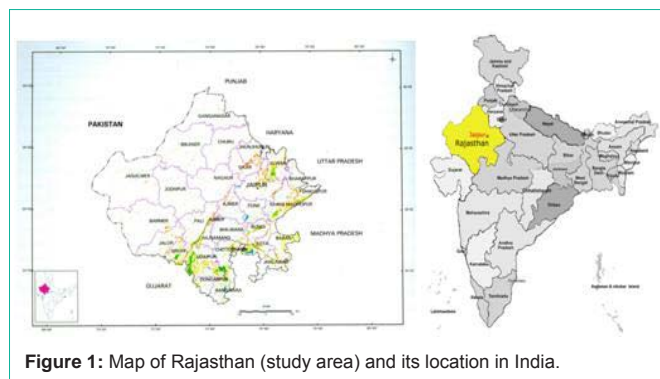


Figure 1: Map of Rajasthan (study area) and its location in India.

**Table 1:** Some Important Fruit Trees and Shrubs of Hot Arid Regions of Rajasthan State India and Nutritive Value.

Species	Sugar (%)	Protein (%)	Carbohydrate (%)	Fat (%)	Fibre (%)	Vit. A (mg/100g)	Vit. B2 (mg/100g)	Vit. C (mg/100g)	Ca (mg/100g)	P (mg/100g)	Fe (mg/100g)	Energy (Kcal/100gm)
<i>Balanites aegyptiaca</i>	34.9	4.9	69.9	0.1	3.5		0.07	46	147	58	4	300.1
<i>Calligonum polygonoides</i>	46	18	71.1	64	9.1	0.764	0.7	-	670	420	12.7	-
<i>Cordia myxa</i>	-	2	92	2	2	-	-	-	55	275	6	394
<i>Salvadora oleoides</i>	-	6	76	2	2	-	-	-	630	167	8	346
<i>Ziziphus mauritiana</i>	4.9-10	0.8	17	0.3	-	0.02	0.02	76	4	9	1.8	73.9

Source: Nour [5], Duhan, *et al.* [7], Chandra, *et al.* [8], Anon [6], Rathore [4].

**Figure 2:** *Balanites aegyptiaca* tree.**Figure 3:** *Cordia myxa*.

## Methodology

The information presented in this article was collected from literature review and interactions with the local people including women during field visits and surveys in arid districts of Rajasthan (Figure 1). The plant species were identified with the help of plant taxonomist and herbarium sheets. No independent lab work was done to determine nutritional value. The nutritional values reported in this paper (Table 1) have been taken from already published papers and, accordingly, references have been cited.

### Some Important Underutilized Fruit Bearing Trees and Shrubs of Hot Arid Region of Rajasthan State in India

***Balanites aegyptiaca* (Linn.) Del.:** The species belongs to family 'Zygophyllaceae'. It is distributed in open sandy plains of Pali and Jodhpur districts. It is a slow growing, small, not very spreading, spiny and medium size tree or shrub (Figure 2). Its edible Parts are Fruit, Young shoots and leaves. Yield is 100 to 150 fruits/mature tree. Flowering is observed during December-March while fruiting is in March-July.

Ripe fruits are eaten raw/sun-dried and stored like dates, made into sweetmeats or fruit juice (mixed with water) and mixed with cereals, or fermented to alcoholic beverages. Young shoots and leaves are used as vegetable, added to soups, melon seeds/peanut pastes and used as a relish. Nutritional value of the fruits is [5]: Protein (4.9%), carbohydrate (69.9%), sugar (34.9%), fat (0.1%), fibre (3.5%), vitamin B2 (0.07mg/100g), vitamin C (46mg/100g), phosphorous

(58mg/100g), calcium (147mg/100g), iron (4mg/100g) and energy (300.1Kcal/100g).

***Calligonum polygonoides* Linn.:** It is a member of family 'Polygonaceae'. It is a typical sand dune plant, found in whole of arid zone viz., Jodhpur, Barmer and Jaisalmer. It is a rigid, much branched, leafless shrub. Its edible Parts are flowers. Flower buds abort and drop off in substantial quantities in May which are collected. The flower buds are used as salad with curd (*Raita*) or fried and eaten. Flowering and fruiting is in April-May. Unripe fruits of *C. polygonoides* have a vast nutritive value [6] such as protein (18%), carbohydrate (71.1%), sugar (46%), fat (64%), fibre (9.1%), Vitamin B2 (0.7mg/100g), calcium (670mg/100g), phosphorus (420mg/100g) and iron (12.7mg/100g).

***Cordia myxa* Roxb.:** *Cordia myxa* (family Boraginaceae) is widely distributed in arid zone, mostly cultivated. It is a small to moderate-sized deciduous tree with a short bole and spreading dense crown (Figure. 3). Edible Parts are Fruit and Flowers. Fruits are harvested at tender green immature stage for vegetable and are also used in pickles. Ripe fruits are also consumed. The floral buds and flowers are cooked as vegetable. Nutritional value of fruits is [7,8]: Protein (2%), carbohydrates (92%), fat (2%), fibre (2%), phosphorous (275mg/100g), calcium (55mg/100g), iron (6mg/100g), zinc (2mg/100g), manganese (2mg/100g) and energy (394Kcal/100g).

***Salvadora oleoides* Linn.:** *Salvadora oleoides* (family Salvadoraceae) forms dominant part of vegetation in Barmer,



Figure 4: Salvadora oleoides tree.

Jodhpur, Jaisalmer, Bikaner, Churu, Nagaur and Jalore districts. It is a large shrub or a small tree with short twisted trunk and drooping branches (Figure 4). Fruit yield is 10-15Kg fresh fruits per mature tree. Flowering is observed in March-April while fruiting in May-June. Fruits are plucked or felled by shaking the trees vigorously. Ripe fruits are sweet and are eaten raw. Nutritional value of fruits is [7]: Protein (6%), carbohydrate (76%), fat (2%), fibre (2%), zinc (2mg/100g), phosphorous (167mg/100g), calcium (630mg/100g), manganese (2mg/100g), iron (8mg/100g) and energy (346Kcal/100g).

**Ziziphus mauritiana Linn.:** It belongs to the family 'Rhamnaceae' and is distributed in whole of arid zone and is locally known as 'Ber'. It is a small evergreen, much branched tree or often a large bushy shrub. Its edible Parts are Fruit and seed cotyledons. During prime bearing age of 10-20 years, the yield of different cultivars ranges between 50-80Kg fruit /tree in dry areas under rainfed conditions. Flowering and fruiting time is September-March.

Fully ripe fruits are gathered in the beginning of the winter months, dried, ground and sieved. The powdered form is eaten either alone or mixed with molasses or bajra flour. Products such as squash, jam, candy and ber powder have been prepared from the fruits. Honey can be obtained from the flower nectar. It is also reported that the cotyledons are removed from the seeds, fried and eaten separately or mixed with bajra. Nutritional value of fruits is [8]: Protein (0.8%), carbohydrate (17%), fat (0.3%), sugar (4.9-10%), phosphorous (9mg/100g), calcium (4mg/100g), iron (1.8mg/100g), vitamin A (0.02mg/100g), vitamin B2 (0.02 mg/100g), vitamin C (76mg/100g) and energy (73.9Kcal/100g).

**Leptadenia pyrotechnica Forssk. Decne:** Commonly known as Kheep, it belongs to family 'Apocynaceae'. It is distributed throughout the arid zone viz. Jodhpur, Bikaner, Jaisalmer. It is a much branched often leafless erect shrub (Figure 5). Its edible Part is Tender fruit. Flowering time is August-December and fruiting time is November-March. Fruit is collected and cooked as vegetable.

**Commiphora wightii (Arnott) Bhandari:** Commonly known as guggul (Burseraceae family), it is a much branched spinous shrub or a small tree (Figure 6). In Indian sub-continent, *Commiphora* species



Figure 5: Leptadenia pyrotechnica.

occur in India and Pakistan. In Rajasthan, it occurs in the districts of Jaisalmer, Jodhpur, Barmer, Sirohi, Pali, Nagour, Sikar, Churu, Bikaner and Jhunjhunu. Plants in low density are also found in Jalore, Siwana, Jaswantpura, Bhinmal, Jassi, Bisala, Chohatan, Udaipur, Alwar, Ajmer, Sawai Madhopur, Bundi, Kota and Jaipur.

Guggul grows in a wide range of habitats. The plant grows wild in the arid, rocky tracts of North-western region of India as well as in the ravines of Chamber and Mahi rivers in Rajasthan and Gujarat, respectively. It occurs not only in the extremely arid areas such as Jaisalmer, Barmer etc. ( $\pm 100$  mm average rainfall) but also in sub-humid regions along deciduous/ scrub forests such as Ajmer, Falna, and other area (400-500mm average annual rainfall).

Guggul gum is a mixture of 61% resins, 29.3% gum, 6.1% water, 0.6% volatile oil and 3.2% foreign matter [9]. The important biologically active principles of C21 or C27 steroids are: guggulsterol-I, guggulsterol-II, guggulsterol-III, guggulsterol-IV, guggulsterol-V, E-guggulsterone, Z-guggulsterone and related ketones.

It has been used as an inactive pharmaceutical ingredient, binding agent, anti-obesity agent, and cholesterol-reducing agent. Therapeutic uses include treatment of nervous diseases, leprosy, muscle spasms, ophthalmia, skin disorders, ulcerative pharyngitis, hypertension, ischaemia, and urinary disorders. It is also used in incense, lacquers, varnishes, and ointments, as a fixative and in perfumes.

The demand and supply gap of gum guggul is increasing very fast. According to an estimate, the domestic demand of gum guggul is to the tune of 300tons while the supply is only 75tons. To meet the domestic demand, presently India is importing substantial quantities of guggul. As a result of increasing exploitation, in the year 1994, the Ministry of Environment, Forests & Climate Change, Govt. of India banned the export of this high valued medicinal plant species.

Guggul, once a luxuriantly growing species in the arid and semi arid areas, has become an endangered species because of its slow growing nature, poor seed setting, lack of cultivation, poor seed germination rate and excessive tapping for gum extraction. The growing importance of Guggul gum in organized sector of pharmaceutical industries in India has led to ruthless exploitation by the drug collectors and contractors. Due to lack of cultivation and unscientific & excessive tapping for extraction of gum, it is included



Figure 6: *Commiphora wightii*.



Figure 7: *Cassia angustifolia*.

in the Red Data Book of IUCN.

***Cassia angustifolia* Vahl.:** Locally known as Senna (family Caesalpinaceae), it is an important medicinal shrub which has successfully been grown in hot arid areas. Senna is a reputed drug in Unani medicine, which has also been adopted by the pharmacopoeias of the world. It is a multi branched, erect and bushy shrub, growing up to one meter in height (Figure 7). It is perennial in nature and can be harvested up to 2-3 years if cultivated once.

Leaves are pinnate, flowers are bright yellow in colour, and pods are green when young and dark brown to black when mature. It is valued as a medicine for its cathartic properties and is especially useful in habitual constiveness. Its leaves and pods are traditionally used as purgatives.

The main purgative constituents in the leaves are anthraquinone derivatives and their glucosides. Leaves contain glycosides, sennoside A, sennoside B, sennoside C and sennoside D [10]. Leaves are also used as a safe laxative.

It can be cultivated on all types of soils including salt affected soils. However, optimum growth was observed in well drained sandy loam to loam soil at pH 7-8.5. It does not come under waterlogged and frosty conditions. It grows well under rainfed conditions and requires one weeding. *C. angustifolia* performs well on marginal soils



Figure 8: *Aloe vera*.

and yielded good harvest of leaves with least cultivation efforts.

It gives good economic returns to the farmers and local people even in severe drought conditions when agricultural crops fail which ultimately helps in the poverty alleviation of rural poor.

About 6000 tons of *C. angustifolia* dried leaves and pods are exported from India to other countries every year. The market value of dried leaves is ranging from Rs. 15 to Rs. 60 per kg depending on the leaf quality.

***Aloe vera:*** The scientific name of Aloe Vera is *Aloe Barbadosensis* Miller. The word 'aloe' has its roots in the Arabic word 'alloe', which means 'radiance'. A native plant of Somalia, *Aloe Vera* (family Liliaceae) also figures prominently in Egyptian, Chinese, Greek, Indian and Christian literature. *Aloe Vera* is a succulent plant. It is one of the 250 known species of aloes. It is stem-less plant which can produce up to a height of about 80cm to 100cm that spreads for root sprouts and balancing.

***Aloe Vera*** leaf is fleshy, lance-shaped and thick. It is forever gray - green and green in color (Figure 8). Flowers are made on a spine about 90cm tall that includes tubular corolla in yellow shade which is up to 2 to 3cm tall [11]. The sap of the Aloe is a thick, mucilaginous gel, which is used medicinally.

The gel found in the leaves is used for soothing minor burns, wounds, and various skin conditions like eczema and ringworm. The gel's effect is nearly immediate, plus it also said to reduce the chance of any infection. It contains amino acids, vitamins, calcium, enzymes, sodium, nitrogen and more.

It can be cultivated on all types of soils including salt affected soils. The water requirement of this spp. is low and grows well on non-irrigated lands. It grows in arid climates. However, it is most suited to tropical dry to moist habitats. It can also be grown indoors and is frost sensitive. It is propagated through root suckers in July-August. The plant takes approx. four years to reach maturity and has a life span of about twelve years. After one year of planting, leaves can be harvested every 3 months leaving 3-4 leaves on the plants. The yield is 50 tons/ha fresh leaves which is being sold in market @ Rs. 3/ Kg.

***Jatropha curcas* Linn.:** It belongs to family 'Euphorbiaceae' and is native to Mexico and Central America, but has adapted well to Indian conditions (Figure 9). It is a fast growing and long-lived plant,



Figure 9: *Jatropha curcas*.

easy to propagate, found to be growing in many parts of the country, can grow and survive with minimum inputs in marginal land and not browsed by animals and seeds not eaten away by birds. Time taken for nut yield is between 2 to 5 years based on soil and rainfall conditions and yield varies from 0.5 to 3t/yr.

Seed contains moisture (6.2%), protein (18%), fat (38%), carbohydrates (17%), fibre (15.5%) and ash (5.3%) [12,13]. The oil content is 35-40% in the seeds and 50-55% in the kernal. Oil contains 21% saturated fatty acids and 79% unsaturated fatty acids. *Jatropha* oil mainly consists of triglycerides of oleic acid (34-45%), linoleic acid (31-43%) and palmitic acid (14-15%) [14]. It is unsuitable for human consumption. Its latex contains an alkaloid Known as "Jatrophine". Oil is used for skin diseases and rheumatism. Roots are reported to be as an antidote for snake bite. Seeds are considered anthelmintic in Brazil [15]. The ether extract shows antibiotic activity against *Styphylococcus aureus* and *E. coli*.

***Citrullus colocynthes* Linn.:** Belonging to family 'cucurbitaceae' and common on sandy tracts in the desert zone, it is perennial, tender climbing monoecious plant with 2-3tendrils. Leaves are deeply 3-5 lobate and both, the male & female flowers are yellow.

Fruits are globular, variegated, dark green with yellowish blotches. When ripe, it is filled with a dry spongy very bitter pulp. Fruits are bitter, pungent, cooling purgative, antipyretic, antihelminthic and are also used in flatulence (gas problems). It may be toxic if taken in large doses. Root powder is effective in jaundice, urinary diseases and rheumatism. Root extract is antidote to scorpion bite. Commercial drug "Colocynth" from dry pulp of fruit is cathartic.

## Concluding Remarks

Sample survey in species occurring zones needs to be done for

updating and cross-validation of data. Economics should be worked out based on the existing information of distribution, production and market rates. The existing markets, marketing network for various products and possible linkage must be explored to help farmers. Studies on value addition, long-term storage and shelf-life of the products required to be taken up on priority. Finally, focus should be on the quality control and certification of organically produced material.

## References

1. FAO. Towards a harmonized definition of non-wood forest products. *Unasylya*. 1999; 50: 63-64.
2. Bhattacharya AK. NWFPs as food in India. *FAO Non-Wood News* 11, Rome: FAO. 2004; 9-10.
3. Tewari VP. Some important wild plants yielding alternative foods for nutritional security in arid region of Rajasthan. In: R.K. Behl and A.K. Chhabra (eds.), *Enhancing Production and Food Value of Plants: Genetic Options*, Hissar: Society of Sustainable Agriculture and Resource Management. 2003; 146-150.
4. Rathore M. Nutrient content of important fruit trees from arid zone of Rajasthan. *Journal of Horticulture and Forestry*. 2009; 1: 103-108.
5. Nour AAM, Ahmed AR, Abdel-Gayoum AA. A chemical study of *Balanites aegyptiaca* L. (Lalob) fruits grown in Sudan. *Journal of the Science of Food and Agriculture*. 1985; 36: 1254-1258.
6. Anon. *Food from Forests in Arid Zone*. Technical Brochure. Arid Forest Research Institute, Jodhpur. 2006; 12.
7. Duhan A, Chauhan BM, Punia D. Nutritional value of some non-conventional plant foods of India. *Plant Foods Hum Nutr*. 1992; 42: 193-200.
8. Chandra A, Chandra A, Gupta IC. *Arid Fruit Research*. Jodhpur: Scientific Publishers. 1994; 302.
9. Wickens GE. *Ecophysiology of Economic Plants in Arid and Semi-Arid Lands*. Berlin, New York: Springer Science & Business media. 2013; 343.
10. Panda H. *Medicinal Plants Cultivation & Their Uses*. New Delhi: Asia Pacific Business Press Inc. 2002; 598.
11. Yates A. *Yates Garden Guide*. Sydney, Australia: Harper Collins. 2002; 466.
12. Pramanik T, Tripathi S. Biodiesel: Clean fuel of the future. *Hydrocarbon Processing*. 2005; 84: 50.
13. Gonsalves JB. An Assessment of the Biofuels Industry in Thailand. *United Nations Conference on Trade and Development*. 2006; 29.
14. Mittelbach M, Remschmidt C. *Biodiesel: The Comprehensive Handbook*. Graz, Australia: Martin Mittelbach Publisher. 2004; 332.
15. Monteiro MV, Bevilaqua CM, Morais SM, Machado LK, Camurça-Vasconcelos AL, Campello CC, et al. Anthelmintic activity of *Jatropha curcas* L. seeds on *Haemonchus contortus*. *Veterinary parasitology*. 2011; 182: 259-263.