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Nutritive values and uses of some important arid zone fruit trees of Madhya Pradesh

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Abstract

India, the centre of origin for many tropical fruit tree species, most of which are not commercially cultivated but provides significant source of livelihood support for many rural communities. Most of the indigenous fruits are underutilized. They are rich in vitamin, minerals, nutrients and has medicinal potential. These fruits have lack of genetic material, loss of germplasm collection and traditional knowledge, lack of knowledge on uses, have constraints and opportunities, limited income generation, market, commercialization and demand limitations, lack of research and development activities and weak national capacities and lack of links across conservation and production. These underutilized fruits popularly known as 'less known fruits' have great values based on their nutritional as well as medicinal properties. However, in spite of rich germplasm existing in the state, development of standard varieties was limited. Having a wide degree of adaptability with high degree of tolerance, they can thrive well under adverse climatic and edaphic conditions. These fruits also serve a potentiality in sustainable agriculture. Hence, research and development work, farmers awareness and feasibility for cultivation of these less known fruits are to be given due consideration.

Keywords: Nutritive values, important arid zone, medicinal potential

Introduction

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. 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^[1]. 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^[1]. 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^[2]. However, they are often undervalued and underutilized. Underutilized crops could also have an important role to play as new promising crops due to their consistent use in lesser common farming situations and subsistence agriculture as practiced by poor farming households. Their adoption on a commercial scale, with crop improvement, standardization of cultural practices and popularization in diverse farming systems are warranted to achieve stability in farm production and food security^[3].

Madhya Pradesh is the second largest state of India by area and is located between latitude 21°N and 27° and longitude 74°02' and 82°49' E, it is a reservoir of biodiversity. The geographical area of the state is 308,144 km² which constitutes 9.38% of the land area of the country. The state has a subtropical climate with hot dry summer (April–June) followed by monsoon rains (July–September) and a cool and relatively dry winter. The average rainfall is about 1,370 mm (53.9 in). It decreases from east to west. The south-eastern districts have the heaviest rainfall, some places receiving as much as 2,150 mm (84.6 in), while the western and north-western districts receive 1,000 mm (39.4 in) or less. The major problems faced by the state are: (i) Most of the part of the state is infertile, stony and barren. (ii) Soil erosion and inadequate moisture are the challenges in some parts of the state. (iii) Erratic and uneven distribution of rainfall is the major constraint for achieving targeted level of production. Due to failure of rains, drought condition also prevails almost every year in one part or the other.

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The state is also bestowed with drought hardy fruits, vegetables, medicinal plants etc. Some of these are Indian jujube (*Ziziphus mauritiana* Lamk.), Aonla (*Emblica officinalis* Gaertn.), Pomegranate (*Punica granatum* L.), Custard apple (*Annona squamosa* L.), Tamarind (*Tamarindus indica* L.), Jamun (*Syzygium cumini* (L.) Skeels.), kair (*Capparis deciduas* (Forsk.) Edgew), Bengal quince or bael (*Aegle marmelos* (L.) Corr. Serr.), henna (*Lawsonia inermis* L.) etc. The tribal inhabitants of the State traditionally rely on non-timber forest products and favoured local fruit species like tamarind, jackfruit (*Artocarpus heterophyllus*), Indian gooseberry (*Emblica officinalis*), ber (*Ziziphus mauritiana*), etc. instead of arable food crops apart from mango and cashew, for establishing agri-horti-forestry for their livelihoods. Most of the underutilized arid zone fruits enriching the state are rich in vitamin, minerals, nutrients and has medicinal potential. Plant and their products are being used as a source of medicine since long. Among the most important constituents of edible plant products, low molecular weight antioxidants are the most important species. It is known that consumption of fruits and vegetables is essential for normal health of human beings. The nutritive values of major arid zone fruits are described in Table-1.

The objective of this review article is to concisely summarize the information about the important underutilized fruit bearing arid region crops of Madhya Pradesh with reference to their nutritional values and uses.

Aonla/Amalaki/Amla (*Emblica officinalis* Gaertn.)

Aonla is a deciduous fruiting plant of family Euphorbiaceae cultivated in India since Vedic Era. The tree has been regarded as sacred, worshipped as the Mother Earth and is believed to nurture humankind by its nourishing taste and also believed to stimulate purity. In Madhya Pradesh it is cultivated in Bhopal, Jabalpur, Chhindwara, Hoshangabad, Sagar, Dhar, Khandwa, Khargone, Ratlam, Mandsaur, Mandla, Dindori. The tree is hardy, prolific bearer and a suitable choice for arid regions^[4] and also in hilly regions terrains^[5]. In Madhya Pradesh it is cultivated in Badwani, Bhopal, Jabalpur, Jhabua, Sagar, Indore, Dhar, Khandwa, Ujjain, Khargone, Burhanpur, Dewas, Mandla, Dindori, Rajgarh, Shajapur, Ratlam, Rewa, Vidisha, Sehore, Sidhi, Ashoknagar, Betul, Hoshangabad, Chhatarpur, Satna, Guna and Chhindwara districts.

Nutritional value

The fruits are recognized for their nutritive, medicinal and therapeutical values. The Calorific value of Aonla is 59 cal/100g with 0.03 mg/100g Vitamin B, 0.2 mg/100g Nicotinic acid and 700 mg/100 g vitamin C. The Vitamin C content found in aonla is easily assimilated by the human body and has been found to have great antioxidant properties^[6]. It also contains proteins and minerals like calcium,

phosphorus and iron. The high vitamin C content of fruit makes its wide use in Ayurvedic medicine.

Medicinal value

The nutritional values of aonla are numerous and is recommended to be included as part of the daily diet. The fruit is the richest source of vitamin C and is a diuretic, aperient and laxative. It has been used for treatment of several disorders such as common cold, scurvy, cancer and heart diseases.^[7-10] The major constituent responsible for these activities is vitamin C (ascorbic acid). Ascorbic acid shows antioxidant, anti-inflammatory and antimutagenic properties^[11-13]. Some studies proved that the antioxidant activities of aonla cannot be attributed to ascorbic acid alone and that the overall effect is due to other polyphenols such as ellagic acid, gallic acid, tannins, etc.^[14-16]. It also cures insomnia, constipation, as well as used as a cooling agent to reduce the effects of sun strokes. It is also useful for haemorrhage, leucorrhoea and discharge of blood from uterus^[17]. As an anti-oxidant, it prevents premature ageing. Aonla stimulate the isolated group of cells that secrete the hormone insulin. Thus it reduces blood sugar in diabetic patient^[18]. Aonla is also used in many hair tonics as it enriches the growth and hair pigmentation. It prevents premature greying and hair fall. It also strengthens roots of hair, maintains colour and shine. It is the main ingredient used in the shampoo and hair dye.

Bael/stone apple/Bengal quince/Bel/Siriphal (*Aegle marmelos*)

It belongs to family Rutaceae and is an indigenous hardy fruit crop grown successfully in dry areas. It is native to India and found throughout southeast Asia. In India this fruit is grown in Indo-Gangetic plains and sub-Himalayan tracts upto and height of 500 m, north-east India and dry and deciduous forests of central and southern India. In Madhya Pradesh it is cultivated in Jabalpur, Sagar, Damoh, Katni, Satna, Panna, Tikamgarh and Chattarpur districts. Being one of the oldest cultivated fruits in India, it has a mythological significance viz. leaves are used for worshipping Lord Shiva.

Nutritional value

Bael fruits consist of moisture (61.5%), protein (1.8%), fat (0.3%), minerals (1.7%), fibre (2.9%) and carbohydrates (31.8%) per 100 g of edible portion. Its vitamin and mineral contents include calcium, phosphorus, iron, carotene, thiamine, riboflavin, niacin and vitamin C [Hasan, 2010]. Various phytoconstituents have been isolated from the various parts of bael plant, namely alkaloids, coumarin and steroid^[19]. The seeds yield an oil (34.4% on dry weight basis). The fatty acid composition of the oil is as follows: palmitic 16.6; stearic 8.8%; Oleic 30.5%; linoleic 36.0%; and linolenic 8.1%.

Table 1: Nutritive value of underutilized fruits

Crop	Energy (Kcals)	Moisture (g)	Protein (g)	Fat (g)	Mineral (g)	Fibre (g)	Carbohydrates (g)	Phosphorus (mg)	Calcium (mg)	Iron (mg)
Aonla	58	82	0	0	0	3	14	50	20	1
Bael	137	61	2	0	2	3	32	85	50	1
Pomegranate	65	78	2	0	1	5	14	10	70	2
Custard Apple	104	70	2	0	1	3	23	17	47	4
Wood apple	134	64	7	4	2	5	18	130	110	0
Indian Jujube/Ber	74	82	1	0	0	0	17	4	9	0

Source:^[20]

Medicinal value

The bael tree is one of the most useful medicinal plants. Part used are fruits, seeds, leaves, bark and root. It is '*Madhura*', palatable, '*Kashaya*', pacifies deranged "*pitta*", beneficial in deranged '*Kapha*', fever diarrhoea, appetizing and gastric stimulant. The medicinal value of Bael fruit is enhanced due to presence of Tannin, the evaporating substance in its rind. The rind contains 20% and the pulp has only 9% of Tannin. Different parts of the tree have their own medicinal importance. The fruit is used as ayurvedic remedy against diarrhea, dryness of the eye and common cold [21]. The fruit's medicinal value is very high when it just begins to ripen [22]. The fruit is aromatic, cooling and laxative. It arrests secretion or bleeding. It is also useful in preventing scurvy and strengthens the stomach and promotes its actions [23]. The unripe fruit is good for digestion and is perhaps the most effective remedy for chronic diarrhoea and dysentery where there is no fever [24]. The ripe fruit of bael contains Marmelosin (C₁₃H₁₂O₃) which has Cardioprotective, Antihelminthic, Antibacterial and Antiulcer properties. Fruits also contains Luvangetin, Marmelide, Psoralen etc. (Fig. 1). Best results are obtained by the use of dried bael or its powder. The fruit is said to act as a tonic for heart and brain. Bael is rich in laxatives which makes it useful in controlling the blood sugar levels. This is because it energizes the pancreas and makes it produce enough amount of insulin which is necessary to control sugar level in the blood. It has been used as a herbal medicine for the management of diabetes mellitus in Ayurvedic, Unani and Siddha systems of medicine in India [25] and Bangladesh [26]. Oxidative stress induced hyperglycemia or diabetes can be reduced to a great extent by extracts of bael leaf isolated [27]. Scopoletin (7-hydroxy-6-methoxy coumarin) from Bael leaves and evaluate for its potential to regulate hyperthyroidism. Due to the presence of one or more antihistaminic constituents present in the alcoholic extract of this plant, therefore supporting its traditional use in asthmatic complaints [28]. Beverages prepared from bael have great healing properties on account of its mucilage content. This form a coating on the stomach mucosa thereby helps ulcers to heal.

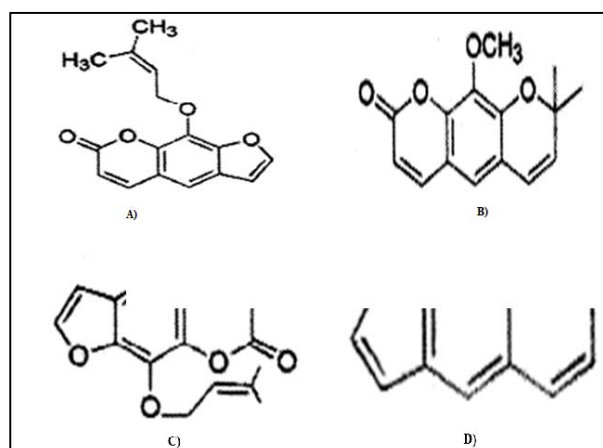


Fig 1: Phytoconstituents isolated from *Aegle marmelos*
A) Marmelosin B) Luvangetin C) Marmelide D) Psoralen

Ber/Indian Jujube (*Zyziphus mauritiana*)

It is also known as desert apple or Indian plum. It belongs to the family Rhamnaceae. It is an ideal fruit tree for arid and semi-arid regions in tropical and subtropical climate where most of the fruit crops cannot be grown either due to lack of

irrigation facilities or adverse climatic and soil conditions. It is regarded as the king of arid zone fruits and also as poor man's apple. 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 [1]. Chinese jujube (*Zyziphus jujuba* Mill.) is grown in temperate regions while Indian jujube (*Zyziphus mauritiana* Lamk.) is cultivated in hot arid regions of India. Both the fruits are rich in nutritive value. Vitamin C content is very high in Chinese jujube and it is fairly high in Indian jujube fruits [29]. Despite its high nutritional value and its biological properties, underlined by various triterpenoid acids, flavonoids, phenolic acids, cytokinins and tannins it is considered as underutilized [30].

Nutritional value

Ber fruits contain fairly high amount of vitamin C, besides vitamin A, B-complex, protein, calcium and phosphorus. More vitamin C was found in the fruit flesh near the seed rather than near the skin of the fruit [31]. In general, the fruit contain 81-83% moisture, 17.0% carbohydrates, 0.8% protein, 0.07% fats, 0.76-1.8% iron, 0.03% each of calcium and phosphorus, 0.02 mg/100g carotene and thiamine, 0.020-0.038 mg/100g riboflavin, 0.7-0.9 mg/100g niacin, 0.2-1.1 mg/100g citric acid, 65-76 mg/100g ascorbic acid, about 22 g/100g sugar, about 1.3 g/100g fiber, about 0.2 g/100g fat with a calorific value of 104/100g [32]. Galactose, fructose and glucose are the major sugars found in ber fruit [33].

Medicinal value

The decoction from root and bark is good for dysentery and diarrhoea and leaf decoction is useful as gargle in sore throat and in bleeding gums. The seed kernels are aphrodisiac. The powder of ber roots has medicinal properties for curing ulcer, fever and wounds. Polysaccharides extracted from plants and fungi have been identified for their anti-oxidative and hepatoprotective effect [34] and also for their immunobiological, anti-viral, anti-tumor and other biological activities [35]. The fruits can also be used for making several products like chutney, dried ber, murabba, jelly, etc. Wines can also be prepared from the fruits.

Pomegranate/Anar (*Punica granatum* L.)

It is a native of Middle East and in ancient Greek mythology, it is known as the "fruit of the dead". Commercial plantations of Pomegranate exist in Maharashtra, Gujarat, Rajasthan, Madhya Pradesh, Andhra Pradesh and Karnataka owing to its preference for arid climate. The recommended areas of plantation of pomegranate in Madhya Pradesh are Bhopal, Betul, Jabalpur, Chhindwara, Hoshangabad, Sagar, Indore, Dhar, Khandwa, Khargone, Bardwani, Jhabua, Burhanpur, Ujjain, Shajapur, Ratlam, Mandsaur, Dewas, Mandla, Dindori, Harda, Gwalior, Guna, Rewa, Neemuch, Satna Chattarpur, Sehore and Ashoknagar. Its xerophytic characteristics and hardy nature makes it suitable crop for dry, rainfed, pasture and undulating land, where other fruit crops cannot grow successfully. Besides, being a favourite table fruit it is also used for preparation of juice and squash. Dried seeds give an important condiment coined as Anardana. It also has medicinal value and rind is being used for dyeing cloths. Pomegranate is a poly-vitamin, a unique fruit plant

producing a wide spectrum of biologically active substances especially important in our present-day polluted environment. It helps in preventing the harmful effects of radioactive substances by producing biologically active substances [36].

Nutritional value

The fruit is moderate in calories, holds about 83 calories per 100 grams; slightly more than that of in the apples. It contains no cholesterol or saturated fats. It contains potassium, carbohydrates, protein, fat, fibre and other vitamins and minerals. Food Value, Minerals and Vitamins per 100 grams of edible portion of pomegranate is Moisture - 78.0%, Calcium - 10 mg, Protein - 1.6%, Phosphorus - 70 mg, Fat - 0.1%, Iron - 0.3 mg, Minerals - 0.7%, Vitamin C - 16 mg, Carbohydrates - 14.5%, Small amount of Vitamin B Complex, Fibre - 5.1% and Calorific Value – 65. It also contains Phenolic compounds like gallic acid, protocatechuic acid, chlorogenic acid, caffeic acid, ferulic acid, o – and p - coumaric acids, catechin, phloridzin and quercetin [36].

Medicinal value

Dietary fibre aid in smooth digestion and bowel movements. Certain ellagitannin compounds such as Granatin B, and Punicalagin are found abundantly in the pomegranate juice. Pomegranate is natural blood thinners it prevents blood clots in the heart and arteries, also urinary retention. The seeds prevent blood platelets from coagulating and forming clots. Studies suggest that punicalagin and tannins can be effective in reducing heart-disease risk factors by scavenging harmful free radicals from the human body. Total antioxidant strength of pomegranate fruit measured regarding its oxygen radical absorbance capacity (ORAC) is 2341 $\mu\text{mol TE}/100\text{ g}$. The fruit is an also good source of antioxidant *vitamin-C*. Consumption of fruits rich in vitamin-C helps the body develop resistance against infectious agents by boosting immunity. Further, it is an also good source of many vital B-complex groups of vitamins such as pantothenic acid (vitamin B-5), folates, pyridoxine and vitamin-K, and minerals like calcium, copper, potassium, and manganese [37].

The rind of the fruit and the bark of the pomegranate tree is used as a traditional remedy against diarrhea, dysentery and intestinal parasites. Pomegranate juice is remarkably rich in antioxidants *viz.* poly phenols, tannins and anthocyanins, thereby acting as scavengers and prevent DNA damage. Drinking pomegranate juice has been shown to have antimicrobial properties against harmful bacteria that can exist in the stomach, such as *Eschericia coli* (*E. coli*) or *Bacillus subtilis*, both of which can cause painful infections and serious stomach conditions. The seeds and juice are considered a tonic for the heart, throat, eyes and for a variety of purposes, such as stopping nose bleeds and gum bleeds, toning skin, firming-up sagging breasts and treating haemorrhoids. Recently research work is being conducted focusing on use of pomegranate in treatment and prevention of cancer, cardiovascular disease, diabetes, dental conditions, erectile dysfunction, bacterial infections and antibiotic resistance, and ultraviolet radiation-induced skin damage. Other potential applications include infant brain ischemia, male infertility, Alzheimer's disease, arthritis, and obesity [36]. Pomegranate hull and/or root extract are used both orally and intra-vaginally in preventing fertility [38, 39], abortion and to ameliorate assorted gynaecological problems [40].

Jamun (*Syzygium cumini*)

It is an important indigenous fruit of commercial value in the country. It belongs to the family Myrtaceae. The tree is ideally suited for windbreak and roadside plantations. In Madhya Pradesh it is recommended for cultivation in Jabalpur, Mandla, Shahdol, Betul, Katni and Chhindwara districts. It is taken as a dessert fruit and is also used in making beverages, squash, jam, jelly and wine. Apart from eating fresh, it can also be used for making delicious beverages, juice, jam, squash, wine, vinegar and pickles. The anthocyanin content in *S. cumini* fruits which attributes to its antioxidant activity can also be a good source of natural food colourants for the food processing industries [41]. The fruits and leaves extract of Jamun showed good efficacy to control nematode infestation in plants. Seed contain an alkaloid jambosin and a glycoside, jambolin or antimallin, which reduces or stop diastatic conversion of starch into sugars.

Nutritional value

The freshly picked fruits per 100 grams of edible portion contains Moisture- 85.8 g, ether extract-0.15 g, crude fiber- 0.3 g, nitrogen- 0.129 g, ash- 0.32 g, calcium- 8.3 mg, phosphorus-16.2 mg, iron-1.62 mg, carotene-0.004 mg, thiamine-0.008 mg, riboflavin-0.009 mg, niacin-0.290 mg and total ascorbic acid- 5.7 mg [Munsell, 1949]. Other reported constituents of the fruit are specific gravity- 1.0184, total acidity (as acetic acid)-5.33 per 100 cc., volatile acidity (as acetic acid)- 5.072 per 100 cc, fixed acidity-0.275% as citric, total solids-4.12 per 100 cc, ash-0.42, alkalinity of ash-32.5 (N/10 alkali), nitrogen- 0.66131, total sugars- 0.995, reducing sugars-0.995, non-volatile reducing sugars- 0.995, alcohol- 0.159% by weight, oxidation value (KMnO₄, 186.4). iodine value- 183.7 and ester value- 40.42.

Medicinal value

Traditionally the jamun fruits, leaves, seeds, and bark are all used in ayurvedic medicine. The bark contains tannins and carbohydrates, accounting for its long-term use as an astringent to combat ailments like dysentery [42]. Jamun fruit reduces the sugar in the blood and is very good in the control of diabetes. Its seeds contain Glucoside, Jamboline and Ellagic acid, which are reported to have the ability to check the conversion of starch into sugar in case of excess production of glucose [43]. All parts of the jambolan can be used medicinally and it has a long tradition in alternative medicine. The plant has been viewed as an antidiabetic plant since it became commercially available several decades ago. The fruits have been used for a wide variety of ailments, including cough, diabetes, dysentery, inflammation and ringworm [44]. In India the juice of the ripe fruit, or a decoction of the fruit or jamun vinegar is used in cases of enlargement of the spleen, chronic diarrhea and urine retention. Water diluted juice is used as a gargle for sore throat and as a lotion for ringworm of the scalp [45, 46]. With regard to the antineoplastic activities studies suggest that Jamun is selective in its action in breast cancer cells. Jamun reduced the tumor incidence, tumor burden and cumulative number of gastric carcinomas. Reports also suggest that ellagic acid, gallic acid, and anthocyanins (Fig. 2) present in Jamun are reported to prevent experimental carcinogenesis in various organs and may have contributed to the anti-carcinogenesis [47].

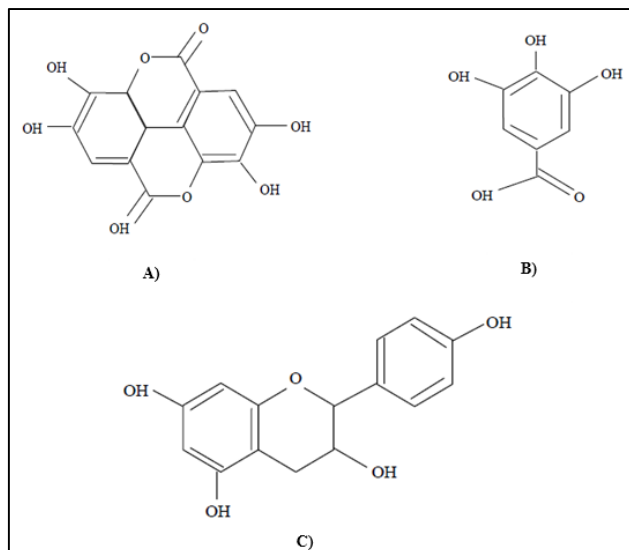


Fig 2: Structures of phytochemicals in Jamun reported to be of use in the treatment of Cancer.

A) Ellagic Acid B) Gallic Acid C) Anthocyanin

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