Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.7486

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **7 (3):** 86-103 (2019)

Review Article

An Overview on Inherent Potential of Underutilized Fruits

Yogendra Singh[1*] and Prerak Bhatnagar[2]

[1]Ph.D. Scholar, (Fruit Science), [2]Assistant Professor (Fruit Science),

College of Horticulture & Forestry, Jhalawar- 326023, AU, Kota (Rajasthan)

*Corresponding Author E-mail: yogendrasinghphd938@gmail.com

Received: 9.04.2019 | Revised: 13.05.2019 | Accepted: 18.05.2019

ABSTRACT

The lesser known fruit crops comprising aonla, bael, ber, chironji, jamun, karonda, lasora, phalsa and wood apple belong to Indian subcontinent origin and pomegranate is native to Persian Iran. The overview on these fruit crops revealed that limited area is under cultivation on these fruit crops in Rajasthan state. In spite of their high nutritional and medicinal values, their commercial cultivation is lacking and needs to be popularized for commercial acceptance and orchard establishment under arid and semi-arid zones of Rajasthan. The most promising under-utilized fruits which having plethora of nutrition are Aonla (Emblica officinalis), Bael (Aegle marmelos), Ber (Ziziphus mauritiana), Chironji (Buchanania lanzan), Jamun (Syzygium cumini), Karonda (Carissa carandas) Lasora (Cordia myxa L.), Phalsa (Grewia subinaequalis), Pomegranate (Punica granatum L.) and Wood Apple (Feronia limonia) etc. These fruits are potential source of food, nutritional and medicinal values. The value added products of these fruits need surge to catch the national and international markets if it is properly focussed under nutritional care of inputs along with plant protection measures. The present overview on these fruit crops is manly emphasis on nutritional, food and medicinal value of these minor fruits and its impact on betterment of human health wellness through intake of vitamins, minerals, total sugars and ascorbic acid content present in different components of these fruits by the people inhabiting in arid and semi- arid regions.

Key words: *Nutritional, Medicinal, Uses, Vitamins, Processed products, Underutilized fruit crops.*

INTRODUCTION

Fruits are also known as protective food as they are rich sources of vitamins, phytochemicals and minerals. Fruits are potential source of soluble dietary fiber, which helps in reducing the cholesterol level and fats from the body, helps in smooth bowel movements and helps in boosting the immune system. Commercially, if fruits are compared with vegetables, pulses and cereals, they are having very high anti-oxidant values. An antioxidant property helps in removal of free radicals from the body, and thus provides protection against many chronic and infectious diseases as reported by Kumar[41].

Cite this article: Singh, Y. and Bhatnagar, P., An Overview on Inherent Potential of Underutilized Fruits, *Int. J. Pure App. Biosci.* **7(3):** 86-103 (2019). doi: http://dx.doi.org/10.18782/2320-7051.7486

Underutilized fruits are equally important and nutritional sound vis a vis commercially grown fruit crops under the present scenario. The term 'underutilized' crop has been defined in various ways in world literature, most of these have been given importance to ethno-botanical features, among others pertaining with the ancient cultural heritage of the locality, multiple uses, traditional crops in localized areas lesser known and neglected by agricultural research and development agencies as reported by Thakur[76]. Since time immemorial, edible wild fruits have played a very crucial role in supplementing the diet of the people of Indian Subcontinent. Apart from customary use as food, wild underutilized edible fruits have various health advantages as it potentially imparts immunity to many diseases. Prevention and cure of digestive disorders through the use of medicinal plants as reported by Sidhu[64]. According, Ayurveda to the Indian Folk medicine was developed from wild fruits and plants. Major fruit crops like Mango, Banana, Papaya Litchi, Guava etc. are commercially cultivated while the wild edible fruits refer to species that are neither cultivated nor domesticated but naturally come from their wild natural habitat and used as one of the sources of food as demonstrated by Beluhan *et al.*[9] and Urvashi *et al.*[81]. Most of the underutilized indigenous fruit crops are being utilized as medicinal plants throughout India and popular in various indigenous system of medicine like Unani, Ayurveda and Homoeopathy. It was recognized that a high consumption of fruits and vegetables can help to prevent several non-communicable diseases such as cardiovascular diseases, the diabetes type 2 and some cancer as reported by Ganry[26]. Most of the important underutilized fruits are indigenous and it is easily available in natural niches of forests. In India most common underutilized fruits are Aonla (*Emblica officinalis*), Bael (*Aegle marmelos*), Ber (*Ziziphus mauritiana*), Chironji (*Buchanania lanzan*), Jamun (*Syzygium cumini*), Karonda (*Carissa carandas*) Lasora (*Cordia myxa* L), Phalsa *(Grawia subinaequalis),* Pomegranate (*Punica granatum* L) and Wood Apple (*Feronia limonia*) etc. So, the review paper is mainly emphasizing on insights of nutritional, medicinal and other values of these fruit crops.

Nutritional and Medicinal Uses of Underutilized Fruits:

AONLA

Aonla (*Emblica officinalis* Gaertn.) belongs to the family of Euphorbiaceae. It is also known as Indian gooseberry. It has medicinal and therapeutic properties from the ancient time in India. Aonla is one of the indigenous fruit crops of Indian subcontinent and widely used in Indian System of Medicine. The aonla fruits are round, ribbed in shape and pale green. The fruit is divided into six segments through pale liner grooves. The surface of the fruit is shiny and the size varies from small marble to a large plum. It is quite hard with a thin and translucent skin. The raw fruit, due to its high acidic nature and astringent taste, is unacceptable to consumers. The average fruit weight and seed weight varies from 22.29 to 25.20 and 1.54 to 1.82 g, respectively, among Krishna, NA7 and Chakaiya cultivars as reported by Goyal[30]. The seed pulp ratio is reported to vary from 1:15 to 1:22 as reported by Kalra[34].

Importance of Aonla Fruit: Aonla fruit is highly nutritive with a great medicinal use and the richest source of vitamin C. The fruits are potential source of ascorbic acid and tannins. The chemical composition of aonla fruits is influenced by environmental factors. Aonla is particularly rich in vitamin C. The pulp of fresh fruit contains 200 to 900 mg of vitamin C, as reported by Kalra[34] and Singh *et al*.[70]. It contains 500-1500 mg of ascorbic acid per 100 g of pulp as reported by Chauhan[19], which is much more than the vitamin C content of guava, citrus and tomato fruits. The fruit juice contains nearly 20 times as much vitamin C as in orange juice.

The Chemical Composition of Aonla Fruit:

Nutrients	Nutrient value per 100g edible portion
Moisture (%)	80.22 to 89.36
TSS (°B)	10.32 to 16.00
Acidity (% citric acid)	1.25 to 3.24
Ascorbic acid (mg/100g)	200 to 1500
Reducing sugar (%)	1.04 to 4.09
Non-reducing sugar (%)	3.05 to 7.23
Total sugar (%)	2.11 to 8.68
pH	2.20 to 3.21
Tannin (% gallotannic acid)	0.35 to 0.64
Protein (%)	0.65 to 0.98
Pectin (% Ca pectate)	0.44 to 0.78
Total sugars (%)	7 to 9.6
Reducing sugars (%)	1.04 to 4.09
Non-reducing sugars (%)	3.05 to 7.23

Source: Singh *et al.* [70]

Processed Products of Aonla Fruit:

The various value added products prepared from aonla fruit like appetite, murabba, chawanparash and trifala as reported by Tripathi[78]. However, now a days several new products have been developed by value addition namely aonla candy, jam, herbal jam, chutney, pickle, squash, juice, sharbat, vinegar etc. Fruit powder is also used in preparation of toiletries and cosmetics. Several other processing methods are being developed and research is continuing at various institutes in India to popularize and increase the consumption of aonla as demonstrated by Lim[43]. The nutritional values of aonla are multifaceted and is recommended to be included as part of the daily diet. It is also useful for haemorrhage, leucorrhoea and discharge of blood from uterus as reported by Hasan[31].

Medicinal Uses of Aonla: Aonla are rich source of phenols and tannins containing gallic acid, elegiac acid and glucose which prevent oxidation of vitamin C as reported by Calixo. A tablespoonful each of fresh aonla juice and honey mixed together forms a very valuable medicine for the treatment of several ailments like tuberculosis of lungs, asthma, bronchitis, scurvy, diabetes, anemia, weakness of memory, cancer, tension, influenza, cold, loss and greyness of hair etc as reported by Chatterjee and Sil[17]. Because of its highly acidic and astringent nature, the consumers do not relish this fruit in fresh form due to its astringent nature and consequently it is used in the preparation of various ayurvedic tonics like Chayvanprash, Triphala, etc. It has also been reported that pellets of dried aonla powder was served to soldier during world war for the treatment of scurvy as reported by Kalra[34]. Medicinal products chyavaprash, Triphla, Amrit Kalash, Amol Ki Rasayan etc. and cosmetics (Chair oil, shampoo, hair dyes etc) are prepared from it as revealed by Gopalan[29] and Brand[11]. The fresh aonla fruits are not popular as a table fruit due to their bitter taste owing to high astringency and its storability after harvesting is also limited due to its high perishable nature. It has got great potential in processed forms, which has great demand in national as well as international market. The presence of hypolipidaemic effect in fruit juice of *Emblica officinalis* in cholesterol fed as reported by Mathur[46].

BAEL

Bael (*Aegle marmelos* Linn), belongs to the family of Rutaceae. Bael is one of the most important wonder tree species used in various indigenous systems of medicine in India, China, Burma and Sri Lanka as reported by Kirtikar *et al.*[37]. It is also known as Bale fruit tree, it is moderate sized, slender, aromatic tree, 6.0 -7.5 m in height and range between 90 to 120 cm in girth, with a somewhat fluted

bole of 3.0-4.5 meter growing wild throughout the scattered forests niches of India.

Importance of Bael Fruit: Bael (*Aegle marmelos*) is also known as Bengal quince, golden apple, Japanese bitter orange, stone apple, etc. It is also known as various names such as Kaitha, Maredu Pandu, Vilam Palam, Belada Hannu, Koovalam, Kothu, Koth Bel, etc. It's one of the potential sources of Ayurvedic plants whose entire parts from root, leaves and fruits are used for various treatments of diseases. The fruits are also useful to control of Kaph and Vata doshas. Bael is the only member of the monotypic genus *Aegle* as reported by C. S. I. R.[13]. Every part of the plant likes stems, barks, roots, leaves, flowers and fruits at all stages of maturity have medicinal values and have been used in different ayurvedic medicines since long time for the treatment of specific disorders such as respiratory disorders, constipation, ulcer, diarrhoea, dysentery and many others. Bael fruits contains vitamin and mineral contents include calcium, phosphorus, iron, carotene, thiamine, riboflavin, niacin and vitamin C as reported by Hasan[31].

The Chemical Composition of Bael Fruit:

Nutrients	Nutrient value per 100g edible portion
Water (g)	57.46
Protein (g)	2.13
Fat (g)	0.3
Carbohydrates (g)	29.07
Ash (g)	1.3
Carotene (mg)	54.5
Thiamine (mg)	0.10
Riboflavin (mg)	1.03
Niacin (mg)	0.9
Ascorbic Acid (mg)	75
Tartaric Acid (mg)	1.98

Fibers	**Pulp**	**Seed**
Acid detergent fiber	12.0	4.0
Hemicellulose	0.00	8.0
Cellulose	2.0	6.0
Lignin	8.0	6.0
Pectin	8.0	5.8

Source: Singh[69]

Processed Products of Bael Fruit

The fruit is converted into different products viz. the green bael fruit slices are sundried for further use, pulp is converted to prepare sherbet and syrup, marmalade prepared from its fruits. Fruits are also used for the preparation of powder, preserve, nectar and toffee as reported by Dashora[23].

Medicinal Uses of Bael Fruit:

All parts of the plant are economical and possess different medicinal values viz. leaves, roots, seed, bark and fruit etc contain a large number of coumarins, alkaloids, steroids and essential oils hence, possess analgesic, anti-inflammatory, antipyretic, anti-microfilaria, antifungal, hypoglycemic, antidyslipidemic, immunomodulatory, antiproliferative, wound healing, anti-fertility, and insecticidal abilities as reported by Neeraj[50]. The fruit is considered as one of the potential sources of riboflavin. *Marmelosin* present in fruit has therapeutically active factor which is remedy of the stomach ailments. The fresh leaf juice of bael fruit is very useful in doses of 8 to 16 gm is given with honey as a mild laxative in fever, catarrh and asthama. Fresh leaves and fruits are very

useful as a remedy for Beriberi as demonstrated by Kumar[39,40]. Half ripe fruits are mostly used in medicine and the fruit has characteristic aromatic, cooling and laxative properties. Fruit are also useful in controlling scurvy and strengthen the stomach and promotes its actions as reported by Joshi[33]. Bael fruit is especially used in the treatment of chronic diarrhea, dysentery, and peptic ulcers, as a laxative and to recuperate from respiratory affections as revealed Bakhru[7]. *Aegeline* is a well-known constituent of the bael leaf and consumed as a dietary supplement with the purpose to produce weight loss as reported by Avula *et al*.[6].

BER

Ber or Indian Jujube (*Zyziphus mauritiana*) belongs to the family of Rhamnaceae. It is a native of Indo-China and India. It is also known as a poor man‘s fruit, and one of the rich sources of nutrition. Ber fruit is normally eaten fresh are highly nutritious, rich sources of ascorbic acid, carbohydrates and contain fairly good amount of vitamin A, B complex, minerals like calcium, phosphorus and iron. Predominant phenolics found in ber relates to its major antioxidant activity, reducing power activity and scavenging of free radical activity. Fruit has great medicinal value, considered to purify blood and aid digestion. Ber fruits are mainly eaten fresh and dehydrated form as demonstrated by Dar[22].

Importance of Ber Fruit:

The fruits can also be used for preparation of various products like chutney, dried ber, murabba, jelly, wine etc. The decoction from root and bark is well for dysentery and diarrhea and leaf decoction is very useful as gargle in sore throat and in bleeding gums. The powder of ber roots has medicinal properties for curing ulcer, fever and wounds as revealed by Diengngan *et al*.[24]. Ber fruits are loaded with calcium, phosphorus and iron which helps improves bone strength. The ones who are suffering from osteoporosis and other bone degrading conditions must consume sweet and tart fruit to reserve the effect or manage the condition better. Ber increase blood circulation and also ensures smoother blood circulation it is a rich source of iron and phosphorus.

Chemical Composition Fresh Fruit of Ber

Nutrients	Nutrient value per 100g edible portion
Moisture (%)	82.01
Carbohydrate (g)	5.4 - 10.5
Protein (g)	0.8
Fat (g)	0.07
Fibre (g)	0.60
Calcium (mg)	25.5
Phosphorus (mg)	26.8
Iron (mg)	0.76-1.8
Vitamin B3 (mg)	0.02-0.024
Vitamin C (mg)	65.8-76.0
Vitamin A (carotene) mg	0.021

Source: Morton[48].

Processed Products of Ber Fruit:

Various products are made from ber fruit like ber jam, ber candy, ber preserve, ber powder, ber murabba, ber beverages, ber wine, ber pickle and ber ready to serve (RTS).

Medicinal Uses of Ber Fruit:

Ber being rich in Vitamin A and C extend good protection against cough and cold. Ber fruit is a good source of energy too. It works in nervous system very effectively thus reducing fatigue and helps in regaining energy. The dried ripe fruit is a mild laxative. The seeds are sedative and are taken sometimes with buttermilk, to halt nausea, vomiting, and abdominal pains in pregnancy. They inhibit diarrhea and are poulticed on wounds. Mixed

with oil, they are rubbed on rheumatic areas. The leaves are applied as poultices and are very helpful in liver troubles, asthma and fever and, together with catechu, are administered when an astringent is needed, as on wounds. The bitter, astringent bark decoction is taken to halt diarrhea and dysentery and relieve gingivitis. The bark paste is applied on sores. The root is purgative. A root decoction is given as a febrifuge, taenicide and emmenagogue, and the powdered root is dusted on wounds. Juice of the root bark is said to alleviate gout and rheumatism. Strong doses of the bark or root may be toxic. An infusion of the flowers serves as an eye lotion. It is good rich source carotenes and phenolics as reported by Tanmay[75]. The secondary metabolites were present in ber fruits like flavonoids, glycosides, saponins, lignins, sterols and phenols are very effective function against pathogens. The different parts of plant like root, bark, leaves, flowers, seeds are used for treatment and also used as blood purifier and appetizer as demonstrated by Bolada[10] and Rathore[56]. Ber is a rich source of flavonoids like Epicatechin, quercetin-3-0 rutinoside, Quercetin-3-0- galaetoside, Kaempferol-glucosyl- rhamnoside, Procyanidins B2 and two unidentified compounds. The flavonoids present in good amounts in ber fruits create cell signalling pathways and antioxidant effects.

CHIRONJI

Chironji (*Buchanania lanzan*) belong to family of Anacardiaceae. Nutritional composition of the seeds shows that it as a potential source of protein, fat, dietary fiber, and energy. It is very good source of Phosphorus, Calcium, Magnesium and Iron.

Importance of Chironji Fruit:

The fruit has high socioeconomic value providing livelihood to tribal population of the Baran district of Hadoti region and has high potential as commercial fruit species. Chironji found culinary uses both in sweet acid as a delicacy. Chironji is low in calories but extremely such in protein and dietary, fibre which keeps your hunger pangs at body, leading to satiety and eliminating the need to eat more often.

Chemical Composition of Chironji Fruit

Nutrients	Nutrient value per 100g edible portion
Moisture (g)	3.0
Protein (g)	19.0
Fat (g)	59.1
Fire (g)	3.8
Carbohydrate (g)	12.1
Calcium (mg)	279
Phosphorus (mg)	528.0
Iron (mg)	8.5
Thiamine (mg)	0.69
Riboflavin (mg)	0.53
Niacin (mg)	1.5
Vitamin (mg)	5.0

Source: Anon (1990)

Processed Products of Chironji Fruit:

The fruit is juicy and sweet in taste and used for preparation of various value added products like squash, ready to serve (R.T.S.) drinks and nectar after juice extraction. Chironji kernel contains about 52% oil as reported by Kumar[39,40]. Kernel oil is used mostly in cosmetic manufacturing and substitute for olive and almond oils as reported by Siddiqui[63].

Medicinal Uses of Chironji Fruit:

Chironji is a widely used plant with a history of traditional medicinal use for the treatment of various diseases. Chironji is used in the form of decoction to treat intrinsic haemorrhage, diarrhoea with blood and as

tonic. Grown up child who has left the breast milk should be given sweet bolus prepared of Chironji kernels, madhuka (*Glycyrrhiza glabra*) honey, parched paddy and sugar candy. Kernels made into a powder and used with milk as aphrodisiac and in case of fever and burning sensation. Powder of the bark mixed with honey is useful in blood dysentery as reported by Warokar *et al.*[82]. The plant has a long history of folk mostly used in tribal societies across tropical regions of the world. At present, in this era of herbal science, in depth research is being carried out in every such plant to discover pharmaceutically active novel magic drugs. The comprehensive account of the global effort already undertaken to explore the phytomedicinal wealth of *Buchanania lanzan* as demonstrated by Khare *et al.*[35]. The polyphenols have been proven for its disease fighting power and possess good antioxidant activities. The fatty acids, polyphenols, phytosterols and stigmasterol in seed extract have both medicinal and nutritional value as demonstrated by Khatoon[36]. Chironji acts as natural coolant and must be used in dishes prepared during summer because it has cooling effect in the body. Chironji seeds make excellent face packs and the oil extracted from these seeds keeps the skin moisturized and helps to remove dark spots and blemishes. Chironji has many essential vitamins and minerals including Vitamin C, B1 and B2 as well as niacin.

JAMUN

Jamun (*Syzygium cumini* skeels) belongs to family Myrtaceae. It is important well known underutilized fruit crop and it is an important indigenous fruit of commercial value in the country. The tree is suitable for windbreak and roadside plantations. The fruit found in most of the states in neglected areas, forest niches, marshy lands and roadside plantations as staggered trees.

Importance of Jamun Fruit: Jamun is an important medicinal plant used in various traditional systems of medicine. It is very effective in the treatment of diabetes mellitus, inflammation, ulcers and diarrhea and preclinical. It is rich in compounds containing anthocyanins, glucoside, ellagic acid, isoquercetin, kaempferol and myrecetin. Fruits contain various kinds of anti-oxidant compounds, including flavonoids, phenolics, carotenoids and vitamins, which are all considered beneficial to human health, for reducing the risk of degenerative diseases by reduction of oxidative stress, and for the prevention of macromolecular oxidation as reported by Kubola *et al.*[38]. The seeds are containing alkaloid, jambosine, and glycoside jambolin or antimellin, which halts the diastatic conversion of starch into sugar.

The Chemical Composition of Jamun Fruit

Nutrients	Nutrient value per 100g edible portion	
	Fruit	Seed
Moisture (%)	82.19	16.34
Crude protein (%)	2.15	1.97
Crude fat (%)	0.83	0.65
Crude fiber (%)	1.76	4.19
Ash (%)	2.04	2.18

Source: Choptra[21] and Raza[57]

Valuable Products of Jamun Fruit: The ripe fruits are used for refreshing health drinks, making preserves, squashes, jellies and wine as reported by Warrier *et al.*[83]. Jamun are a potential source for preparation of good quality wine, resembling Port. Brandy and distilled liquor called "jambava" have also been made from the fermented juice of jamun fruit. Good quality vinegar is also made from jamun fruit, it has an attractive, clear purple, with a pleasant aroma and mild flavor. The juice of ripe jamun fruit is used for making sauces as well as beverages.

Medicinal Uses of Jamun:

The bark, fruits, leaves and seeds of jamun are used for medical purposes. The leaves and bark are used for controlling blood pressure and bleeding gums. Seed powder of jamun which able to reduces the sugar content in urine. Intake of Jamun is considered beneficial and cheaper way to control diabetes. The glucoside presence in jamun inhibits conversion of starch into glucose and thereby helps in reducing blood-sugar in the body. The seeds are used to treat a wide range of ailments, the most important being diabetes mellitus as reported by Sagrawat *et al*.[60]. Various local and foreign researchers have confirmed it through clinical trials. Practitioners of medicines report that jamun pulp lowers blood-sugar level in about 30 minutes, while its seed lowers blood-sugar level in about 24 hours. Over a period of several weeks it can reduces the thirst associated with diabetes and decrease the quantity of urine output and in some cases can help reduce the use of insulin. All parts of the tree and basically the seeds are used to treat a range of ailments, the most important being diabetes mellitus as demonstrated by Sagrawat[60]. Jamun seed has gastro-protective properties. In case of peptic ulcer jamun is very effective as it helps in promotion of mucosal defensive factors and antioxidant status and decreasing lipid peroxidation. Jamun also has anti-cancer and anti-viral properties. Jamun fruit extract controls growth and increase apoptosis of breast cancer. However, jamun juice has carminative, mild astringent, stomachic, diuretic and provides a soothing effect on human digestive system. The seeds of jamun fruit is also have hypoglycemia, anti-inflammatory, anti-bacterial, anti-HIV and anti-diarrhoea effects. The powder of bark is applied externally to effectively reduce bleeding. The oil medicated with jamun leaves, is salutary in dermatoses. The fruits are also used in blood purifier and are effective in treatment of skin eruptions like freckles. The gallic acid and ellagic acid present in seed plays crucial an important role in conversion of starch into sugar and minimize blood glucose level in the human body as revealed by Noomrio *et al*.[51]. It is found most effective in the treatment of inflammation, ulcers and diarrhea. Fruit pulp contains very high amount of anthocyanin and can be a potential source of natural food colourants for the food processing industries as reported by Chaudhary *et al*.[18]. The pigment is known for their strong antioxidant capacity and health-protecting effects and reduces the risk of various diseases as reported by Singh[67].

KARONDA

Karonda (*Carissa carandas* L.) belongs to the family of Apocynaceae and native fruit of India. It produces berry-sized fruits that are mostly used as a condiment or additive to pickles and spices. It is a very hardy, drought-tolerant fruit plant that thrives well in a wide range of soils. Fruits have a sour taste and astringent. Fruits contain very high amount of iron and good sources of vitamin C, protein, carbohydrates, fat, fibre and calcium.

Importance of Karonda fruit:

The plant is mostly used as a condiment or additive to Indian, spices and cold beverages. It is also sometimes substituted for apples to make an apple tart, with cloves and sugar to flavor the fruit. In many part of India fruits are commonly caring with green chilies to make a tasty dish taken with chapattis as demonstrated by Chandra[16] and Siddiqui *et al*.[62]. In Konkan, India, root is pulverized with horse urine, lime-juice and camphor as a remedy for the itch as reported by Khare *et al*[35].

Chemical Composition of Karonda Fruit:

Nutrients	Nutrient value per 100g edible portion	
	Fresh Fruit	Dried Fruit
Energy (Calorie)	42	364
Moisture (%)	91	18.4
Protein (%)	1.1	2.3
Carbohydrate (%)	2.9	67.1
Fat (%)	2.9	9.6
Mineral (%)	-	2.8
Calcium (mg)	2.1	160
Phosphorus (mg)	28	60
Iron (mg)	-	39.1
Vitamin –C (mg)	200-500	1

Source: Tripathi *et al*.[77].

Processed Products of Karonda Fruit:

The fruits are commonly used to prepare jelly, sauce, carissa cream or jellied salad, pickles, sauces and chutney. The dried fruits may act as a substitute for raisins as demonstrated by Cheema *et al*.[20] and Nalawadi *et al*.[49]. The ripe fruit emits gummy latex when it is cooked, but yields a rich red juice which becomes clear when it is cooled, so this is used as a refreshing cooling drink in summer.

Medicinal Uses of Karonda Fruit:

The fruits are traditionally used for medicinal treatments of malaria, epilepsy, nerve disorder, relieve of pain and headache, fever, blood purifier, itches and leprosy as reported by Rahmatulla[54]. The major bioactive constituents which impart medicinal value to the herb are alkaloids, flavonoids, saponins and large amounts of cardiac glycosides, triterpenoids, phenolic compounds and tannins. Fruits have been reported to contain carisol, β-caryophyllene, carissone, carissic acid, carindone, carinol, ascorbic acid, lupeol, and β-sitosterol. These chemicals are mostly effective in the treatment of scabies, intestinal worms, pruritus and biliousness and also used as antiscorbutic, anthelmintic as reported by Reshu[58]. The sweeter types may be eaten raw but the more acid ones are best stewed with plenty of sugar. Unripe fruit is good appetizer; astringent, antiscorbutic, cooling, acidic, stomachic, anthelmintic and leaf decoctions are given in the commitment of remittent fever as reported by Trivedi *et al.*[80]. Leaf extract is externally applied for curing leprosy. Two drops of plant oil is given with half cup of honey for controlling worms of minors as revealed by Trivedi *et al*.[79]. Traditional healers of Chhattisgarh use the different plant parts to cover the cancerous wounds and to kill the maggots as reported by Z Naim *et al.*[84].

LASORA

Lasora (*Cordia myxa* L.) belongs to family of Boraginaceae. Lasora also known as Gonda, Lasora or lehsua. Lasora can be grown throughout India except in high hills and temperate climates. It is a perennial, medium sized tree with crooked stem. Lassoda bears small sized fruits in bunches, used as traditional vegetable and pickles.

Importance of Lasora Fruit:

Fruits are potential sources of minerals, fiber and vitamins, which gives essential nutrients for the human health as reported by Mala[44]. The most important nutrients present in plants are: carbohydrates, such as the starch and free sugars, oils, proteins, minerals, ascorbic acid, and the antioxidant phenols, such as chlorogenic acid and its polymers as reported by Spiller[73]. Fruits are considered as one of rich sources of natural antioxidants i.e. carotenoides, ascorbic acid, phenols etc. Very high sucrose (29.09 %) has been in ripe fruits as reported by Aberoumand and Deokule. Comparing the fruits mineral contents with recommended dietary allowances, *Cordia myxa* fruits could be a well supplement for some nutrients such as protein, carbohydrates, K, and Na. The seed kernel of *Cordia dichotoma* contains a high proportion of fatty oils and proteins (46 and 31 %, respectively) which have potential as cattle feed as reported by Orwa *et al.*[52]. Being a multipurpose plant it has long been associated with health, nutrition and other diversified uses in curing certain human ailments as revealed by Chandra and Pareek[14].

The Chemical Composition of Lasora:

Nutrients	Nutrient value per 100g edible portion
Carbohydrate (%)	57.08
Crude protein (%)	8.32
Crude lipid (%)	2.2 %
Crude fibre (%)	25.7 %
Potassium (mg)	7.83
Sodium (mg)	(1.62),
Calcium (mg)	0.46
Iron (mg)	0.51

Source: Aberoumand[1].

Processed Products of Lasora Fruit:

Unripe green fruits are mostly used as vegetable and pickles. Sometime fruits are dehydrated after blanching for used as vegetable during off season reported by Singh[66]. The sticky pulp from ripe fruits is commonly used to make glue. Unripe fresh fruits are acrid and mostly used for vegetable and pickle since time when availability of conventional vegetables is scarce (April–May). It provides food (pickle and vegetable), fuel wood and timber, thus play a crucial important role in the rural economy of arid regions reported by Chandra *et al*.[15].

Medicinal Uses of Lasora Fruit:

Lasora (*Cordia myxa* L) is an important constituent of traditional medicine systems. The leaves of *Cordia myxa*, as well as those of many other species of the same genus, have been used in the traditional medicine of many countries for the treatment of various diseases as revealed by Rapisarda *et al*.[55]. The presence of the secondary metabolites like alkaloids, saponin, steroid and polyphenols has contributed to its medicinal value as well as physiological activity as reported by Bruneton[12]. Presence of polyphenols in the Lasora fruit have been shown to have antibacterial, anti-inflammatory, anti-allergic, antiviral and anti-neoplastic activity as reported by Sofowora[71]. Many of these alleged effects have been linked to their known functions as strong antioxidant, free radical scavenger and metal chelators. The presence of steroidal compounds in the lasora (*Cordia myxa* L*)* is very useful in pharmacy because of their relationship with some compounds as sex hormones as reported by Sofowora[71]. Significant liver recoveries was noticed when rats treated with chemical such as carbon tetrachloride and thioacetamide were fed with Lasora (*Cordia myxa* L) extract as reported by Afzal *et al*.[3]. Therefore presence of these phytochemicals may be used in the management of various ailments viz skin diseases, dropsy, dysentery, dyspepsia, cholera and headache by local population of the region.

PHALSA

Phalsa *(Grewia subinaequalis)* belongs to family of Tiliaceae. It is a shrub or small tree of Indian origin. It has been used since Vedic period. The ripe fruits are consumed fresh or processed into refreshing fruit and soft drinks during summer. Phalsa fruit has a short shelf life suitable for only local marketing. It is cultivated on a commercial scale mainly in the northern and the western states of India. Phalsa is found wildly growing in UP, Rajasthan, Punjab, Haryana, MP, West Bengal and many parts of south India. The cultivation of phalsa is limited to very small scale in Punjab, Haryana, Rajasthan, Gujarat and Uttar Pradesh.

Importance of Phalsa Fruit:

The fruits are potential sources of vitamins and mineral. The citric acid predominant acid present in the phalsa fruit along with traces amount of malic acid. It contains high amount of vitamin A and high antioxidant value. The phalsa fruits are rich sources of flavonoids, carotenoids and anthocyanins. The phalsa fruits are potential sources of potassium which plays crucial important role in energy metabolism and normalizing blood pressure. Fruits are a potential source of nutrients such as proteins, amino acids, vitamins, and minerals and contain various bioactive compounds like anthocyanins, tannins, phenolics and flavonoids. Different parts of this plant possess different pharmacological properties.

The Chemical Composition of phalsa fruit:

Nutrients	Nutrient value per 100g edible portion
Moisture (%)	80.8
Carbohydrate (%)	21.1
Protein (%)	1.5
Fat (%)	0.9
Fibre (%)	1.2
Calcium (mg)	129
Phosphorus (mg)	39
Potassium (mg)	375
Iron (mg)	3.1
Vitamin B3 (mg)	0.3
Vitamin C (mg)	22
Vitamin A (carotene) ug	419

Source: Gopalan[29].

Other Uses:

The fresh leaves are used as animal fodder. The bark is used as a soap substitute in some areas. The mucilaginous extract of the bark is used in clarifying sugar and jiggery. Fiber extracted from the bark is used for rope making. The wood is yellowish white, fine-grained, strong, and flexible. The pruned branches are used for basket making, support sticks and fuel wood purpose. The flower contains grewinol, a long chain keto alcohol as reported by Laxmi and Chauhan (1976). The seed of phalsa contains 5 percent oil, which is bright yellow in colour and contains 65 % linoleic acid, 13.5% oleic acid and 11% stearic acid as demonstrated by Morton[48].

Processed Products of Phalsa Fruit:

Ripe fruits are consumed fresh in desserts, or processed into refreshing soft drinks like squash, RTS, Sherbet etc. which are enjoyed during hot summer months in India.

Medicinal Uses of Phalsa Fruit:

The unripe fruits of phalsa are revealed to alleviate inflammation and are administered in and blood disorders as well as in fever reduction[48]. Ripe fruits of Phalsa are consumed fresh, as desserts, or processed into refreshing fruit and soft drinks enjoyed in India during hot summer months as it has cooling tonic and aphrodisiac effects which overcomes thirst and sensation. Leaves have antimicrobial, anticancer, antiplatelet and antiemetic activities; fruit possess anticancer, antioxidant, radioprotective and antihyperglycemic properties; while stem bark possesses analgesic and anti-inflammatory activities. The bark is used as a soap substitute in Burma. A mucilaginous extract of the bark is useful in clarifying sugar. An infusion of the bark is given as a demulcent, febrifuge, and treatment for diarrhoea. Flavonoids have known antioxidant activities while anthocyanins help to lower the risk of heart disease by prevention of formation cholesterol in the body. The ripe fruits provide a cooling effect on body when eat it. They have tonic and aphrodisiac properties. The fruits cures thirst and burning sensation remove and cure inflammations. These are useful for heart and blood disorders, fevers and diarrhoea. It is very suited for the troubles of throat. The unripe fruits and bark of phalsa fruit plant cures biliousness and Vata and Kapha. It also cures urinary troubles and the burning sensation of reproductive system. The root is used in strangury, gleet and gonorrhea. The root bark is used for rheumatism by Santhal tribe. The leaves are used as an application to pustular eruptions. Some physicians also prescribe buds of phalsa for cure of diseases. In the experiment with small mammals, it has found that phalsa provides protective role against gamma irradiation.

POMEGRANATE

Pomegranate (*Punica granatum* L) belongs to the family of Punicaceae. It is good source of antioxidant compounds such as tannins and flavonoids. These phenolic compounds are responsible for its exceptional healing qualities as demonstrated by Parashar *et al*.[53]. The antimicrobial activity of various extracts prepared from pomegranate fruit peels were evaluated and it was found that 80% methanolic extract of peels was a potent inhibitor for *Yersinia enterocolitica*, *Listeria monocytogenes*, *Staphylococcus aureus* and *Escherichia coli*. This is due to the presence of active inhibitors in peels including phenolics and flavonoids as potent constituents as demonstrated by Adhami *et al.*[2] and Al-Zoreky *et al.*[4].

Importance of Pomegranate Fruit:

Pomegranate is one of the most important fruit crops in India because of its adaptable nature, high profitability and being cultivated on a commercial scale in India. In Rajasthan its cultivation is gaining momentum in Jodhpur and Barmer districts. The fruits are well known source of nutrients and bioactive compounds mainly anthocyanins which exhibit strong chemo preventive activities such as anti-mutagenicity, anti-hypertension, anti-oxidative potential and reduction of liver injury.

The Chemical Composition of Pomegranate Fruit

Nutrients	Nutrient value per 100g edible portion
Moisture (%)	78
Protein (%)	1.6
Total Sugars (%)	14.6
Ascorbic acid (mg)	16
Ash (%)	0.7
Calcium (mg)	10
Phosphorous (mg)	70
Magnesium (mg)	44
Potassium (mg)	133
Sodium (mg)	0.9
Iron (mg)	1.79
Zinc (mg)	0.82
Manganese (mg)	0.77
Copper (mg)	0.34

Source: Sood *et al.*[72].

Processed Products of Pomegranate Fruit:

Various value added products made from pomegranate fruit like processed pomegranate seeds, jams, marmalades, single strength juices, jellies, juice concentrates, frozen seeds, refrigerated seeds, seeds in syrup, candied arils, arils in brandy and in vinegar, carbonated beverages, pomegranate wine, pomegranate syrup. The processed products such as anardana, juice, concentrate syrup and jelly were highly acceptable because of their nutritive and dessert qualities and palatability. Pomegranate juice can be used in beverages, for jellies, for preparation of pomegranate juice concentrate, as flavouring and colouring agents as well as for dietetic and prophylactic treatment purposes.

Medicinal Uses of Pomegranate:

Pomegranate is a very effective and emerging crop for its refreshing arils, juice and its chemo preventive properties having medicinal value revealed by Hertog *et al.*[32]. The pomegranate has potential sources as a food medicine for therapeutic purposes like colic, colitis-diarrhea, dysentery, leucorrhea, paralysis and headache as reported by Schubert *et al.*[61] and Sadeghi *et al.*[59]. It is mostly used in the traditional Asian medicines both in Ayurvedic and Unani systems. Therapeutic properties of pomegranate due to presence of betulic and urosolic acids and different alkaloids such as pseudo pelletierine, pelletierine and some other various basic compounds as demonstrated by Singh *et al.*[68]. Pomegranate cultivation is on increase in the commercial farming community of the global world as it has potential health benefits. The fruit has high antioxidant, anti-mutagenic, anti-hypertension activities and the ability to control liver injury as reported by Du *et al.*[25] and Gil *et al.*[27]. Pomegranate anthocyanins have been reported scavenging activities. The pomegranate polyphenolic compounds are able to elevate the antioxidant capacity of the human body. Pomegranate fruit has anti-inflammatory and anti-atherosclerotic activity against osteoarthritis, prostate cancer, heart disease and HIV-I as demonstrated by Malik *et al.*[45] and Summer *et al.*[74]. The juice from the pomegranates is one of the nature's great powerful antioxidants tool. The antioxidant activity of pomegranate and compared to those of red wine and a green tea infusion showing that the usually pomegranate juices had three times highest antioxidant activity than those of red wine and green tea as demonstrated by Gil, *et al.*[28]. Pomegranate juice is the most powerful tool to increases the body's resistance against infections, acts as cooling beverage and tones up the function of kidney,

liver and heart. All the parts of pomegranate tree like roots, reddish brown bark, leaves, flowers, rinds and seeds have featured in medicine for thousands of years as they are potential source of various chemical constituents. The sweet varieties of pomegranate are considered a well laxative while those which are intermediate between sweet and sour are regarded as valuable in stomach inflammations and heart pain. The pomegranates have recently been found to boost activity of an enzyme which protects the cardiovascular risks. The fruit helps to sharpen one's memory power. It has a toning effect on the skin and is used in the preparation of skin tonics. It also aids in digestion and is good for heart patients. Its iron and pectin contents are considerable. It enriches haemoglobin content in the blood. People suffering from piles will benefit from pomegranates. The sweet juice makes the bones grow firm in children. In northeastern regions, the juice is even used to knead flour. This provides strength without inducing fat in the body. It is rich in phosphorous, calcium, and iron. The rind of the fruit is useful for children. For loose motion, two spoons of rind paste in juice extract with jiggery will control the dysentery. Fruit juice is tonic for intestine and the liver. For eye irritation and common eye pain, pomegranate leaf paste will provide relief when applied on eyelids. Hair oil prepared from fruit juice (1kg), leaf paste (100g) in mustard oil massaging the hair gives healthy growth of hair. Rind powder is the main constituent of ayurvedic preparations 'Dadimastaka choorna' and 'bhaskara lavana choorna'.

WOOD APPLE

Wood Apple (*Feronia limonia)* belongs to the family of Rutaceae. The wood apple tree is native to India but is also found in Sri Lanka, Thailand, and other regions in the southern part of Asia. The tree can grow up to 30 feet in height and the edible fruits are 5-9 cm in diameter. Their shells are tough, and the inside consists of a brownish pulp and small white seeds. It is also known as curd fruit, kathbel, elephant apple, and monkey fruit. In some parts of the world, this fruit is called elephant apple because it is a favorite food of elephants, while in other areas, it gets the name wood apple because of its hard wooden shell. It is considered sacred by Hindus and is widely cultivated and eaten in India.

Importance of Wood Apple Fruit:

The fruits contain phytochemicals (polyphenols, phytosterols, saponins, tannins, coumarins, and triterpenoids), vitamins and amino acids as reported by Dar[22]. It has curative value for various diseases of bones and joints, bilious diseases, controlling of capillary bleeding, cold, influenza, piles, dysentery, habitual constipation and scurvy.

The Chemical Composition of Wood Apple Fruit:

Nutrients	Nutrient value per 100g edible portion
Moisture (%)	74.00
Protein (%)	7.30
Carbohydrates (g)	15.50
Riboflavin(mg)	170
Vitamin C (mg)	2 .00
Calcium (%)	0.17
Phosphorus (%)	0.08
Iron (%)	0.07

Source: Morton[48]

Processed Products of Wood Apple:

The fruit pulp can be used for the preventing of various value added products like preserve, candy, sherbet, juice, chutneys, jam, jelly and squash. The pulp can be eaten raw, but it is popularly scooped out and frozen or made into jam. It can also be mixed with coconut milk for a delicious, healthy beverage or frozen into an ice cream. Wood apple is well for digestion because it helps to destroy worms

in the intestine and is a good for digestive disorders. It is widely used now a days in chutneys used with Katchouri in Hadoti region.

Medicinal Uses of Wood Apple Fruit:

It is also recommended as a remedy for chronic dysentery. The trunk and branches of wood apple trees contain a gum-like substance called 'Feronia gum'. It is mostly used in curing diarrhea and dysentery. It is also recommended for people with peptic ulcer or piles since wood apple tree leaves contain tannin, which is known to reduce inflammation. The laxative property of wood apple also helps to avoid constipation and the subsequent, pain, discomfort and associated health risks of that condition. These attributes combined with the antifungal and antiphrastic activities make this fruit ideal for enhancing the digestive health. The fruit especially used as a liver and cardiac tonic, diarrhoea and dysentery curer is already as demonstrated by Diengngan *et al*.[24].

CONCLUSION

The fruit crops reviewed under the present investigations revealed that these underutilized fruit possesses various enriched medicinal values beside the nutritional one. These crops are present around us in staggered manner. So cultivation of these crops in systematic manner to promote commercial orcharding as well as efficient utilization of marketing systems and channels for fresh fruits during glut periods and processed products can motivate the growers towards growing these crops and can uplift the economy of country. There is tremendous scope of utilization as table purpose and value addition of transformed nutritionally enriched products to the public domain through attractive outlets. The value added product can meet the dearth of new product in the market and serve the purpose of nutritional security along with healthy and safe life. By this we can prove what Hippocrates said, "Let food be thy medicine and medicine be thy food". Not only in fresh form but these underutilized fruit can also be utilized in dehydrated forms especially ber, lasora, wood apple, aonla, and chironji for making their availability year round to be common people. There is a dire need to collect, preserve, and multiply these potential underutilized fruit for betterment of farming community to harness the inherent nutritional and medicinal potential of these fruit crops as a way to move forward the popularization and survivability of these lesser known fruit species for sustainable livelihood of tribal people as well as nutritional security for the common masses.

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