

UNDERUTILISED FRUITS AND BIOTECHNOLOGICAL INTERVENTIONS FOR THEIR PROMOTION

Abstract

Global population is increasing; on the other hand the natural resources are shrinking and degrading. To meet increasing demand for food and other primary production, maximum production has to be obtained from minimum natural and non-renewable resources. Despite meeting food requirements there is need to produce nutritionally rich crops to combat malnourishment. India is super abundant with variety of underutilized fruits. These are versed with the high medicinal and nutritional properties. Therefore, increased in production of underutilized fruits as well as extending their growing season, self life with the help of various tools, biotechnology offers a great opportunity to country and world, to cope up the nutritional security for the growing population.

Keywords: Underutilised fruits, medicinal and nutritional properties, biotechnological tools.

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Global population is likely to reach nine hundred billion by the 2050. About 30 per cent people of the world are undernourishment and facing various health related problems in some or other ways. Due to a lack of food that is nutritionally sufficient, 159 million children worldwide are reported to be stunted and have low BMIs. It is also estimated that globally, about 2 billion people are having the deficiency of one or more than one micro nutrients. The food basket that includes limited crop derivatives has proved prime reason behind the surging malnutrition among the human being. It is critical to diversify food baskets in order to address this issue. Neglected and underutilised fruits, vegetables, which were the vital sources of food for human before civilization, seem to play a significant part for resolving the malnutrition issue. Nowadays these fruit crops are having good market demand due to their rare availability in market because of lack of planned cultivation and referred as Underutilized fruits. Underutilized fruit crops, plant species that are less exposed by marketing as well as research industry, but they are very well adapted to the marginal, stress soil conditions. Underutilized fruits have a huge potential to alleviate malnutrition in the challenging environmental conditions. Because they can withstand both biotic and abiotic pressures, these fruit species can flourish even in unfavourable agro-climatic conditions. Exploitation of these underutilized fruits can become a viable solution to overcome thenutrition insecurity, poverty and unemployment. This chapter aims to describe the importance of major underutilised fruit crops and scope of their improvement through biotechnological interventions.

Aonla: Aonla (*Phyllanthus emblica*, family Euphorbiaceae) is a significant fruit crop that is grown in India's tropical and subtropical regions. It is a excellent source for vitamin and tannins, hence considered as wonder fruit for health. Aonla is a deciduous fruiting plant and the known richest natural source of vitamin C (500-1500 mg/100gm of pulp), which causes its highly valued wider use in Ayurvedic medicine system. Its fruit contains potent anti-oxidant, anti-tumor, anti-microbial, anti-ulcerogenic, adaptogenic, and hepatoprotective qualities. Hence, it is used for the treatment of chronic dysentery, diarrhea, bronchitis, dyspepsia, jaundice, diabetes, coughs and fever etc. It is referred to as Amrit Phal and is prominently included in ancient Indian mythological literature such as the Vedas, Shivpuran, Askandhpuran, Ramayana, Kadambari, Padma-puran, Charak Shanghita, and Sushrut Shanghita due to its great medicinal and nutritional benefits.

Bael: Bael (*Aegle marmelas*, family Rutaceae) is an important underutilised fruit crop from Indian origin. In Ayurveda, it is more commonly known as Bilva, its name in Sanskrit language. Bael has great medicinal, spiritual and religious significance. Bael is being researched extensively due to its well-known excellent blood sugar-controlling abilities. Additionally, it promotes healthy intestines and is excellent for digestion. Among the fruits it is considered the richest source of riboflavin. Every part of beal is utilised in various ways. Due to its medical and nutritional benefits, which include being highly effective in treating diarrhoea and dysentery, it is particularly well-liked. Bael fruit's therapeutic benefits make the tree one of India's most valuable medicinal plants and contribute to its significance.

Ber: Ber or Indian Jujube (*Zyziphus mauritiana*, family Rhamnaceae) is a native of plant of the India. Popular as poor man's fruit, it is one of the richest nutrition sources for the venerable section of society. Fruits of ber contain fair quantity of different vitamin like A, C and B Complex as well as minerals such as Ca, Br, K, Rb, La. Its fruits are used for preparing various value added products like dried ber, murabba, jelly, chutney, wine etc. Decoction

from the root and bark of ber is used for treating diarrhea and dysentery. Gargling with leaf decoction provides relief from a sore throat and gums bleeding. The powder of ber roots is beneficial for curing ulcer, wounds and fever. Secondary metabolites found in the ber fruits like saponins, lignins, glycosides, phenols, sterols and flavonoids are reportedly effective against various pathogens. Different parts of the ber plant, including the seeds, root, leaves, blossoms and bark are used to treat numerous diseases. Fruits are used as appetizer and blood purifier.

Bullock's heart: *Annona reticulata* a member of the Annonaceae family, is traditionally a important plant which is having curative properties for various ailments. Sweet, astringent, heart shape fruits with smooth rind and yellowish red colour, are useful for treating blood related complaints. It has smooth seed, black in colour. This plant is traditionally used for curing cardiac problem, dysentery, epilepsy, worm and parasitic infestations; dysuria, haemorrhage, bacterial infection, fever, constipation and ulcer. Its leaves contain insecticidal properties thus widely used for insect control in plants as well as animals. Bark of this plant is considered as a prevailing astringent thus used as an energizer, whereas foliage are used to treat helminthiasis.

Chironji: Chironji (*Buchanania lanzan*, family Anacardiaceae) is native species of the Indian subcontinent. Seed's nutritional composition depicts it as an excellent source of fat, protein, energy and roughage. Chironji contains a good amount of calcium, magnesium, iron and phosphorus. This fruit crop has great potential for adoption as a commercial fruit crop. Sweet and juicy fruits are utilised for manufacturing of various value added items such as ready to serve (R.T.S.) drinks, squash and nectar following juice extraction. Chironji kernels have an oil content of about 52% and are mostly utilised as a substitute for olive and almond oils in the cosmetics sector. Different fatty acids, polyphenols, phytosterols and stigmasteryl contained in seed extract have long been recognised for their therapeutic and nutritional benefits.

Custard apple: In India, custard apple (*Annona reticulata* family Annonaceae) is a neglected exotic fruit crop with great possibilities for commercial exploration. It contains good amount of minerals, natural antioxidants, phenolics compounds. Custard apple is moderate source of copper as well as manganese which protects us from cardiac disease and control our blood pressure. Fruits size medium, flobular, green skin, conspicuous reticulation on surface, helps in curing indigestion problems and it is considered good for eyes. Inclusion of this fruit in routine diet gives relief from constipation. Copper content of custard apple helps in the treatment of diarrhea and dysentery.

Fig: Fig (*Ficus carica*, family Moraceae) is a highly nutritious fruit crop. In ancient civilisation, it was a significant food crop. Fruit contains iron, calcium, protein, thiamine and vitamin A at varying concentrations and highest fiber as well as high calories. Nutritive index of fig is 11 whereas for apple, raisin and dates it is 9, 8 and 6 respectively. Fig is a multiple fruit that develops from an entire inflorescence. It can be eaten raw, dried, candied, preserved, or canned. For desserts or to make jam, jelly, cakes, pudding, and other dishes, fresh custard apple fruits are often utilised.

Grape fruit: In various cultures, the grape fruit (*Citrus paradise*, family Rutaceae), also known as forbidden fruit, has been utilised as a preservative, astringent, antioxidant,

antifungal, antibacterial, anti-inflammatory, and antiviral agent. Fruits bear in clusters with pink to red flesh rich in vitamin C, potassium and folic acid. In traditional medicine grape fruit has been utilised for cancer prevention, cholesterol lowering, cellular regeneration, detoxification, lupus nephritis disorder, maintenance of heart health, body weight loss and relief from rheumatoid arthritis.

Jack fruit: Jack fruit (*Artocarpus heterophyllus*, family Moraceae) indigenous crop of India, have a distinctive, sweet and fruity aroma. The largest edible fruit in the world is produced by its evergreen tree. The seeds, when roasted or boiled, are consumed as snacks or used in recipes. Despite its uses as a table fruit as well as vegetable purpose, jackfruit is popularly used in preparation of pickles, papad, syrup, sweets jam, jelly and candy. The fruit, in various concentrations contains fair amount of carbohydrate, dietary fibre, protein and fat. Jack fruit is good source of minerals like calcium, phosphorus, iron and vitamin such as carotene, thiamine, riboflavin, niacin and vitamin C. In traditional medicine system whole fruit tree is used for treatment of various diseases. Secondary metabolites present in jack fruits have biological activity; hence, after consumption it instantly restores energy and revives the body. Rich dietary fibre content in fruits make it excellent bulk laxative. The vitamin A in jackfruit is helpful for preserving the integrity of the skin's mucosa and for preventing wrinkles and achieving a radiant complexion and wrinkle-free skin. Jack seed promotes healthy blood circulation, provide healthy digestion and considered very beneficial in hair growth. Traditionally, jackfruit is used in healing ulcers when charred ash of jackfruit leaves, corn, and coconut shells, is used either alone or applied after mixing in coconut oil.

Jamun: Jamun or Java Plum (*Syzygium cumini*, family Myrtaceae) is significant underutilized fruit crop that can be found in roadside plantations, forests, marshy fields, and neglected places in most of the states. The jamun fruit has an extremely high nutritional value. By turning starch into sugar, the gallic and ellagic acid content of seeds lowers blood glucose levels. Diarrhea, ulcers, and inflammation are also successfully treated with it. High anthocyanin content of fruit pulp might be a valuable resource for food processing industry as natural colorants. Vinegar from slightly unripe fruit juice is diuretic, stomachic and carminative.

Jujube: Jujube or Ber (*Ziziphus jujube*, family Rhamnaceae) is a suitable fruit plant for arid and semi-arid regions with exceptional medicinal and nutritional value. Vitamin C, A, and B-complex are abundant in its fruits. Ber has excellent therapeutic effects due to presence of secondary metabolites as well as phenolic components such as alkaloids, flavonoids, terpenoids, pectin, triterpenoic acid, saponin, and lipids. Fruits have haematological, anxiolytic, sedative and sweetness-inhibiting effects. Additionally, ber fruits can be utilised to prepare chutney, dried ber, murabba, jam, wines etc. The bark and root decoction used for treatment of dysentery as well as diarrhoea. Gargling with leaf decoction helps with sore throats and also gum bleeding. The seeds have aphrodisiac properties.

Karonda: Karonda (*Carissa carandas*, family Apocynaceae) is Indian native fruit of socio-economically importance with astringent and sour taste. It is highly affluent source of iron also contains fair amount of protein, vitamin C, fat, carbohydrates, calcium and fibre. Karonda fruits are processed for preparation of sauce, Carissa cream or jellied salad, jelly, chutney and pickles. Dried karonda fruits are cheap substitute of raisins. Antiscorbutic karonda fruit is considered useful for curing anaemia and stomach ache. This plant's root

preparations are used for venereal illnesses, chest complaints, and lumbago. Karonda fruits have historically been used to cure leprosy, malaria, nerve disorders, headaches, fever, and pain relief.

Khirni: Khirni or Rayan (*Manilkara hexandra*, family Sapotaceae) with Indian origin is significant underutilized fruit crop of western- central part of India. It is key source of sustenance and livelihood for the tribal inhabitants in many areas. Mature khirni fruits have good economic and nutritive value due to sweet taste and fair content of vitamin A, protein, carbohydrate, minerals and sugar. Bark and fruits are used for treatment of many diseases like ulcers, cornea opacity, dyspepsia, leprosy etc.

Kokam: Kokam (*Garcinia indica*, family Guttiferae) mostly found in western coast of country, and also in the forest areas of eastern India. Citric, acetic, malic and ascorbic acids are fairly found in the fruits along with hydroxyl and garcinol. Bioactive compounds present in Kokam fruit contain antioxidant, and antimicrobial properties. It is considered effective against various types of cancer like leukaemia, breast and liver cancer. Since ancient times, kokam has also been used as a medication to cure skin infections, diarrhoea, and wounds. Fruit rinds of kokam after drying are used for adding sweetish-tangy flavour to the food.

Lasoda: Lasoda or Indian cherry, (*Cordia mixa*, family Boraginaceae), is grown all over plain and plateau regions of India. Immature fruits of Lasoda are used as vegetable and for preparing pickle. Fruit pulp is fine source of lipid, protein, crude fiber, carbohydrates and ascorbic acid. Lasoda is naturally loaded source of antioxidants, minerals, ascorbic acid, ash and vitamins too. It enhances digestion, functions as an expectorant, diuretic, demulcent, anti-tumor, and anti-helmentic, and promotes hair development.

Mahua: Mahua (*Madhuca longifolia*, family Sapotaceae), a versatile tree, it is useful to accomplish fundamental needs of tribal culture i.e. food, fuel and fodder. Edible flowers of the plant have high nutritive value as well as economic importance. It is a good source of proteins, vitamins, minerals, and lipids in addition to being a rich sugar source. High sugar content in flower makes it suitable to act as sweetening agent for preparation of various traditional dishes. According to Ayurveda, mahua flowers have cooling, carminative, galactagogues, and astringent properties. In addition, it helps with skin, eye, and cardiac problems.

Tamarind: Tamarind (*Tamarindus indica*, family Leguminosae) is considered appropriate for agro-forestry systems and avenue plantation due to its wide adaptation range. It bears terminal and lateral drooping bisexual flowers and forms fruit as pendulous pods. Tamarind fruit pulp and seeds are rich source of tartaric acid and have good amount of reducing sugar, pectin, tannin, cellulose, phosphorous, potassium, calcium etc minerals. The fruit pulp is a wonderful delicacy that is used to flavour beverages, chutneys, sauces, and other meals. The food, feed, wood, fuel, textile, nutritional, and medicinal industries use different parts of the tamarind plant. It is used as a refrigerant, carminative, antiscorbutic and laxative.

Passion fruit: Passion fruit (*Passiflora edulis*, family Passifloraceae) is berry having tropical American origin. It is a perennial climbing woody vine with vigorous growing habit, produces round to ovoid shape fruits. It produces waxy smooth fruits with dark purple or and yellow rind. The rind has fine, faint, white specks on it. Orange pulpy juice and numerous

hard, tiny, gloomy brown to black bumpy seeds are found in fruit. Fruit juice having exceptional aroma and flavour suitable for fresh consumption and processing with high nutritional and medicinal properties. Passion fruits have a high mineral content, including salt, magnesium, sulphur, and chloride, and they are a fair to good source of provitamin A, ascorbic acid, riboflavin, and niacin. Fruit pulp used to make fruit salads, fruit juice, ice cream, and other processed goods like squash, jam, jelly, and juice.

Phalsa: Phalsa (*Grewia asiatica*, family Tiliaceae) is a highly perishable summer season fruit crop originated in India. The fruit of phalsa is mostly used to eat fresh as dessert or processed into ready to serve drink, squash, syrup as well as pickles. Phalsa is considered as good source of vitamins, minerals, protein and carbohydrates. This fruit is having various medicinal properties and it is useful in curing respiratory and heart problems, blood related disorders, fever, nausea, vomiting, morning sickness, inflammation, motion sickness, pustules and eruptions, etc.

Star fruit: Star fruit or carambola (*Averrhoa carambola*, family) is native to Sri Lanka and also referred as five corner fruit. The colour of fruit varies from yellow to greenish yellow and it taste crisp, tart due to presence of oxalic acid. This fruit provide very low-calories it is good source of dietary fibre, reducing sugar, ascorbic acid and minerals. It contains significant amounts of polyphenolic substances, gallic acid, epicatechin and quercetin as antioxidants. Sweet type of fruits can be eaten fresh and sour type used for pickle, tamarind substitute or refreshing drinks. Fruits are also used for preparing good quality squash, jelly, preserve and candy.

Sour soup: Sour soup (*Annona muricata*, family Annonaceae), is evergreen fruit plant that is typically found in India's tropical as well as subtropical climate. Fruits of this plant are very large, dark green, surface outlined in rhomboidal areas with short fleshy spine and juicy, white, woolly pulp. Fruit pulp is frequently used in the production of syrups, candies, drinks, shakes and ice creams. It serves as a natural remedy in arthritic pain, diarrhea, dysentery, neuralgia, fever, rheumatism, skin rushes parasites as well as worms. Fruits are also consumed to improve a mother's postpartum milk production. The leaves are used to cure diabetes, headaches, cystitis, and sleeplessness. The foliage is used to cure diabetes, headaches, cystitis, and sleeplessness.

Wood apple: Wood apple (*Feronia limonia*, family Rutaceae) also referred as curd fruit, monkey fruit, and keth bel. It is native to dry plains of India and Sri Lanka. The ripe fruits contain sweet aromatic pulp rich in protein, carbohydrates, riboflavin, vitamin C and minerals, which is used for making fruit bar, powder, syrup and chutney.

Sea Buckthor: Sea Buckthorn (*Hippophae rhamnoides*, family Elaeagnaceae) is storehouse of several plant medicines. Fruits of sea buckthorn have strong anti-oxidant, anti-stress and anti ageing properties. It promotes wound healing and effective in treatment of coronary heart diseases. It is one of the only fruit contains omega-7 fatty acid assisted with growth and development as well as responsible for treatment of arthritis, heart diseases, hypertension etc.

Biotechnological interventions required for promotion of underutilised fruit crops

- 1. Micropropagation:** The use of micropropagation technology assures that plants multiply quickly, disease-free, and true to type. It also made the movement of the germplasm safer and more controlled. Commercialisation of protocols for multiplication of underutilised fruit crops will help in rapid area expansion of these crops.
- 2. Genetic diversity assessment:** For analysing genetic diversity and the relationships between genotypes, molecular markers are valuable tools. DNA finger printing has made considerable use of random amplified polymorphic (RAPD) DNA markers based on polymerase chain reaction (PCR). The genetic diversity of the available genotypes of underutilised fruits can be estimated using RAPD analysis, which will also be helpful in improving these crops.
- 3. Marker assisted selection:** In underutilised fruit crops with a naturally long juvenile period, when the trait under study is controlled by a recessive gene, and when the trait incorporates multiple genes for disease resistance or any other particular characteristic, the use of molecular markers can significantly speed up the pace of selection.
- 4. Genetic transformation:** It is the process by which transgenes are transferred, integrated, and expressed in the host cells. Through genetic modification, it is now feasible to produce organisms that are resistant to biotic stress, have a higher tolerance for abiotic stresses (such as salt, flood, and drought), shorten the juvenile growth phase, and improve quality attributes like shelf life. This intervention can improve the availability of underutilised fruit crops to larger area and distant markets.
- 5. Identification of quantitative trait loci (QTLs):** The combined effects of multiple genes result in a number of significant heritable traits. Identification of these can help in enhancing productivity, quality and stress resistance in underutilised fruit crops.

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