

Alternate fruit crops

for sustainable food system

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India is origin of many fruit crops and the most of crops are limited to their growing region only. In spite of their high nutritional and medicinal properties their commercial cultivation is lacking. The tribal areas are full of biodiversity having natural vegetation which is not yet harnessed fully. Owing to which, a wide gap is existing between health and optimal use of natural sources of nutrients, i.e. alternate fruit crops (underutilized fruit crops). These fruits have many advantages like easier to grow and hardy in nature, producing a crop even under adverse soil and climatic conditions. So, exploitation of these fruit crops can be a solution of health and nutrition insecurity, poverty and unemployment. The underutilized crops have the potential to give health and economic security to the people by giving employment and by fetching good returns from their sale in raw form as well as value-added products. There are many temperate fruits hold considerable value and the potential of a veritable treasure of a large number of world's fruits still remains to be explored and their potential is still not utilized which can play major role as alternate crops, ideally suitable for crop diversification, livelihood security to the poor masses dwelling in fragile ecosystem of the world.

Keywords: Alternate crops, Crop diversification, Underutilized fruit crops

FRUITS are undoubtedly known as protective as they are rich in vitamins, phytochemicals and minerals. They are excellent source of soluble dietary fiber, which helps in lowering the cholesterol level and fats from the body, and also helps in smooth bowel movements. Antioxidant properties help in removal of free radicals from the body, and thus provide protection against many chronic and infectious disease. Since time immemorial, edible wild fruits have played a very vital role in supplementing the diet to the poor masses especially tribes of country. Apart from customary use as food, wild edible fruits have various health advantages as they potentially give immunity to many diseases. Most of the important underutilized fruits are indigenous and it is easily available, can play major role for socio-economic upliftment of poor masses of the country in changing climatic scenario. In India, alternate fruit crops for food system are bael (*Aegle marmelos*), chironji (*Buchanania lanzan*), karonda (*Carissa congesta*), ker (*Capparis decidua*), phalsa (*Grewia asiatica*), pilu (*Salvadora oleoides*), jamun (*Syzygium cumini*), kokam (*Garcinia indica*), malabar tamarind (*G. cambogia*), tamarind (*Tamarindus indica*), monkey jack (*Atrocarpus lakoocha*), ber (*Ziziphus mauritiana*), lasoda (*Cordia dichotoma*),

wood apple (*Feronia limonia*), custard apple (*Annona squamosa*), fig (*Ficus carica*), cape gooseberry (*Physalis peruviana*), phalsa (*Grewia subinaequalis*), mulberry (*Morus nigra*), manila tamarind (*Pithecellobium dulce*), timru (*Diospyrus melenoxylon*), mahua (*Madhuca indica*) and palmyra palm (*Borassus flabellifer*), elephant apple (*Dillenia indica*), pummelo (*Citrus grandis*) carambola (*Averrhoa carambola*), loquat (*Eriobotrya japonica*), sugar date palm (*Phoenix sylvestris*), mahua (*Bassia latifolia*), mangosteen (*Garcinia mangostana*), etc. These fruit crops are rich source of vitamins (ascorbic acid, thiamine, niacin, pyridoxine and folacin), minerals, fat, protein, and dietary fiber. These crops can be grown with minimal management under aberrant agro-climatic conditions.

Nutritional significance

Underutilized fruit crops can be “bridge crops,” filling nutritional gaps in the annual dietary cycle. These crops can be continuously harvested over weeks or months and act as a long-term nutritional supplement. A farm or garden diverse in both species and cultivars will produce over an extended period and will provide a diversity of nutrients. Seasonal variation in food supply

affects livelihoods as well. Times of abundance, such as during the harvest and sale of crops, alternate with periods during which savings dwindle. Underutilized fruit crops can improve livelihoods in two ways. First, income can be increased through specialty markets that pay a premium for unusual products or items available somewhat out of season. Second, money can be saved, and thus livelihoods improved, if underutilized crops feed the family during periods when food might otherwise need to be purchased. Specific nutrient deficiency, malnutrition, and underweight of children are significant challenge in rural/tribal areas of India. The intake of nutrients in daily diet is far from satisfactory and largely less than 50% RDA is consumed by over 70% of Indian population. Vitamin A, iron, and zinc deficiency when combined constitute the second largest risk factor in the global burden of diseases; 3,30,000 child deaths are precipitated every year in India due to VAD; 22,000 people, mainly pregnant women, die every year in India from severe anemia; 6.6 million children are born mentally impaired every year in India due to iodine deficiency; intellectual capacity is reduced by 15% across India due to iodine deficiency; and 200,000 babies are born every year with neural tube defects in India due to folic acid deficiency. It increases the risk of premature delivery and low birth weight. The maximum children of tribals are suffering from IDA, retarded growth, impaired cognitive performance, and reduced physical activity. Nutrient deficiency also accelerates the mortality and morbidity rate in women.

Fruits play a significant role in tribal/rural population nutrition, especially as sources of vitamins ascorbic acid (C), carotenoids (A), thiamine (B1), riboflavin (B2), niacin (B3), pyridoxine (B6), and folacin, minerals, fat, protein, and dietary fibre. Other important nutrients supplied by fruits and vegetables include riboflavin (B2), zinc, calcium, potassium, and phosphorus. Most of the food resource is available in plenty during a particular season but all have not been utilized to desired extent due to many reasons. Thus, people residing in tribal areas hardly get considerable advantage from the abundantly available resources. The solution of the problem lies only in evolving the techniques of value addition, providing market, and creating awareness about nutritional quality of underutilized commodities. Processing and value-addition of underutilized fruits into more useful, digestive, tasteful, and convenient products ultimately improves the economic value of underutilized commodities and develop nutritional security to the people of country particularly poor ones.

Medicinal significance

Most of the underutilized indigenous fruit crops used as medicinal formulations throughout India are popular in various indigenous system of medicine like *Unani*, *Ayurveda* and Homoeopathy owing to rich in minerals, vitamins and phytochemicals. These fruits are rich in flavour and aroma. Beside their importance for nutritional, therapeutical and economic value, diversity of these fruits also has cultural and social value,

Table 1. Biological activities of important alternate fruit crops

Crop	Biological activities
Bael	Anticancer, sedative, hypnotic, analgesic, anticonvulsive, hypothermic, antimalarial, antipyretic, antidiuretic, antitumor, cardioactive, antihyperglycemic, antidiislipidemic, antiinflammatory, antiulcer, antiseptic, antiallergic, antidiarrhoea, astringent, antibacterial, antihelminthic, antispasmodic, antiemetic, cytotoxic, antidiabetic
Jamun	Antidiabetic, antihyperglycemic, antifungal, anti-inflammatory, neuropsychopharmacological, antimicrobial, antibacterial, radioprotective, gastroprotective, antifertility, anorexigenic, antidiarrheal, ulcerogenic and anti-HIV.
Custard apple	Antiviral, antioxidant activity, respiratory stimulant, antimalarial, antihelminthic, antiulcer, hepatoprotective, anti-arthritis, antiinflammatory, analgesic, anti-HIV, hypoglycemic
Mulberry	Antidiabetic, hypertension, anaemia, and arthritis, antioxidant, antimicrobial, neuro-protective, anti-inflammatory
Wood apple	Antimutagenic, hypoglycemic, hyperlipidemic, vomiting and hiccups, dysentery, indigestion and induce bowel boils and amoebiosis, diuretic activity, anti-bacterial, antifungal.
Tamarind	Cardioprotective, gastric, jaundice, fever
Khirni	Aphrodisiac, appetizer, arthritis, jaundice, blood purifier
Mahua	Anti-inflammatory, hematoprotective, antitumor, analgesic, rheumatism, ulcer, tonsillitis, ulcers, dyspepsia, opacity of the cornea, bronchitis, urethrorrhea, leprosy
Chironji	Antidiarrhoea, intercostals, rheumatic pains and skin diseases
Phalsa	Astringent, stomachic, demulcent, rheumatism, antiinflammation, administered in respiratory, cardiac and blood disorders, antimicrobial, anti-platelet, antiemetic, anti-cancer properties, antioxidant, radioprotective and antihyperglycemic properties
Karonda	Astringent, appetizer, antipyretic, antidiabetic scabies, intestinal worms, diarrhoea, antipyretic, appetizer, antiscorbutic, antihelminthic
Manila tamarind	Abortifacient, anodyne, astringent, larvicidal, guamachil is a folk remedy for convulsions, dysentery, dyspepsia, earache, leprosy, peptic ulcers, sores, toothache, venereal disease, eczema, sore throat, acne and pimples
Wild noni	Antibacterial, antiviral, antifungal, antitumor, antihelminthic, analgesic, hypotensive, anti-inflammatory and immune enhancing effects.
Fig	Metabolic, cardiovascular, respiratory, antispasmodic, anti-inflammatory, antidiarrhoea, respiratory haemorrhage, diuretic, diabetics, anthelmintic, tuberculosis, anticancer, antidiarrheal
Timru	Antimicrobial, antiparasitic, antidiabetic, antimalaria
Gonda	Antihelminthic, diuretic, demulcent

contributing to the stability of ecosystem. Cultivation and consumption of these crops may be helpful in overcoming the nutritional deficiencies predominant in rural/tribal areas. They also improve socio-economic conditions of poor masses of the country. In addition to socio-economic and ecological advantage, such fruits have numerous medicinal properties as its different plant parts have pharmacological activities. Therefore, these fruits are rich in minerals, vitamins and phyto-chemicals which need to be harvested for commercialization and utilization of wasteland simultaneously. Biological activities of minor fruits are given in Table 1.

Varietal wealth

Selection of plant species and their varieties for production is important. The crop must have one or another characters like deep root system, summer dormancy, high 'bound water' in tissues, reduced leaf area, sunken stomata, thick cuticle, wax coating of pubescence, presence of latex, and ability to adopt shallow, rocky, gravelly and undulated wasteland. Some underutilized crops are widely grown and used in their centers of origin, but are "neglected" by regional and international markets. Crops not suited to long distance transport and commoditization are often ignored by plant breeders and agricultural researchers, which limits the number of named cultivars and the creation of new varieties with traits suited to a broader range of growing conditions. Some highly nutritious plants could play a

larger role in reducing malnutrition if they were eaten over a longer period of the year or if cultivars were available for different growing conditions. At present, research work on collection, characterization, evaluation and conservation of underutilized/alternate fruits have been initiated at several SAUs and ICAR institutes and their regional centre and high yielding quality varieties were developed. Varietal wealth of potential fruit crops is given in Table 2.

Value added products

A large quantity of underutilized fruits produce goes waste due to unavailability of adequate storage facility and lack of knowledge about value added products. Proper storage facility like cool storage, CA and ZECC storage can reduce the post-harvest loss to greater extent and can improve the farm income.

Various processed products are being made by the people utilizing their acquired traditional knowledge like sun drying, pickling etc. However, with the application of modern techniques, the quality of products could be improved considerably. The pre-treatment of many fruits with hormone and harmless chemicals results in better quality end products. Solar drying and electric tray dehydration of fruits and vegetables help to reduce dust load on the product and retain natural colour. Malnutrition in resource poor areas of semi-arid region is a major problem particularly in women and children. Fruits like tamarind, custard apple, bael, khirni, karonda,

Table 2. Different Promising varieties of fruit crops for sustainable food system

Crop	Varieties
Bael	Goma Yashi, Thar Divya, Thar Neelkanth, Thar Srishti, Thar Prakriti, Thar Shivangi, NB-7, NB-9, NB-5, CISHB-1, CISHB-2, Pant Aparna, Pant Shivani, Pant Sujata and Pant Urvashi
Jamun	Goma Priyanka, Thar Kranti, Konkan Bahadoli, Jamwant, Paras, Rajamun, Rajendra Jamun-1, Jamwant
Custard apple	Thar Amrit, Purnndhar, NMK Gold, Island Gem, Bullocks Heart, Pink Mammoth, Balanagar, Mammoth, Red Sitaphal, Yellow Sitaphal, Phule Janki and Sindhan
Mulberry	Thar Lohit, Thar Harit, Saharanpur Local-1, Saharanpur Local-2, S-13, S-34, S-146, S-7999, S-1635, Chak Majra
Karonda	Pant Manohar, Pant Sudarshn, Pant Suverna, Konkan Bold, Thar Kamal
Tamarind	Goma Prateek, Prathisthan, PKM-1, T 263, Urigam, Ajanta, Yogeshwari, DTS 1 and DTS 2, Anant Rudhira
Lasoda	Thar Bold, Paras Gonda, Puskar Local, Maru Samridhi, Karan Lasoda
Khirni	Thar Rituraj
Phalsa	Thar Pragati
Chironji	Thar Priya
Mahua	Thar Madhu, NM-2, NM- 4, NM-7, NM- 9
Manila tamarind	PKM (MT) 1
Fig	Poona Fig, Dianna, Dinkar, Conadria, Excel, Chalisgaon
Wood apple	Thar Gaurav, Thar Prabha

Table 3. Value-added products

Underutilized fruit crop	Value-added products
Bael	Preserve, RTS, nectar, ice cream, slab, squash, cider, canned bael slices, pickles and powder
Chironji	Dried kernels, fruit bar
Karonda	Pickle, candy, jelly, jam, preserve, wine, chutney
Wood apple	Squash, powder, pickle, chutney, jelly, fruit bar
Khirni	Dehydrated fruits, fruit bar, RTS, jam
Jamun	Juice, RTS, squash, syrup, carbonated drink and wine
Phalsa	Juice, squash, syrup
Lasoda	Pickle, culinary
Custard apple	Jam, beverages, ice cream
Tamarind	Tokku (chutney), panipuri masala, Juice concentrate, pulp powder, jam, syrup, candy toffee, tamarind karnel powder
Timru	Bidi, dried fruit
Pilu	Squash, dried <i>peelu</i> , wines
Kair	Pickle, dried fruits
Mulberry	Juice, squash and syrup
Mahua	Biscuits, cakes dried powder, seed oil and wine
Manila tamarind	Biscuits, squash and syrup
Aloe	Candy, jelly, pickle, cold cream, crack cream, moisturizer, gel
Fig	Fig paste, concentrate, powder, nuggets, jam

phalsa, mulberry, wild noni, wood apple etc. are a rich source of vitamins, minerals and dietary fibres. These fruits are highly perishable in nature, the marketing of which is a major problem, e.g. custard apple gets spoiled within 2–3 days of harvesting. Also with the glut in the market, the prices of these fruits drop down drastically making it uneconomical for the farmers to sustain production; the result is that the farmers uproot the trees owing to low price in the market. To avoid the situation, there is a need to extend shelf-life of these fruits and to develop post-harvest value-addition technologies which are simple and adaptable at the farm level. This will not only result in developing small-scale industry but it will also provide employment to the rural masses throughout the year resulting in increased income of both farmers and workers. The value added products of these fruits have expected to catch the national and international markets, if it is properly focused (Table 3).

SUMMARY

India is facing the problems of hidden hunger, nutrient and micronutrient deficiencies, poverty and

unemployment. The fruit crops mentioned above possess tremendous nutritional and medicinal values. So, cultivation of these crops in systematic manner and efficient utilization of marketing systems and channels for fresh fruits and processed products can motivate the growers towards growing these crops and can uplift the economy of country. There is tremendous scope of utilizing these crops in different promising value added products to the food system and nutraceutical industry. Use of these crops often declines due to changes in farming practices, changes in market forces, and cultural erosion that results from modernization, migration, urbanization, and land degradation. For sustainable food system, these alternate fruit crops can play vital role for livelihood and economic security to the people living in the aberrant agro-climatic conditions across the world. India can take lead to promote these fruit crops in the countries having similar isoclimatic regions in the form of crop diversification as alternate horticulture for sustainable food system.

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HANDBOOK OF INTEGRATED PEST MANAGEMENT

To reverse the loss of environmental resources and also to reduce biodiversity loss, the Government of India has Integrated Pest Management (IPM) as part of the National Agricultural Policy. Integrated Pest Management emphasizes the growth of a health crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms. IPM is not new – mechanical, cultural and biological tactics were used by farmers for hundreds of years before chemical pesticides became available. Besides, there are IPM techniques that have been developed more recently and are effective in suppressing pests without adversely affecting the environment.



The task of spreading the message of IPM across is tough due to poor awareness about the subject among people in line-departments as also among the farmers. The information on integrated pest management as a whole is scattered. This *Handbook* comprehensively deals with all the aspects of integrated pest management in field crops, horticultural crops under traditional, protected systems. Information on basic strategies and tactics of different methods of management including mass production of biocontrol agents, IPM policy and pesticide registration is provided in comprehensive form.

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TECHNICAL SPECIFICATIONS

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