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UNTAPPED TROPICAL FRUIT PLANTS FOR MEDICINAL PLANTS INDUSTRY AND THEIR IMPROVEMENT

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A large number of tropical fruits in India are used in Ayurvedic *and* Unani *medicines. Some of these have consistent demand in the country and can be developed into bulk source of raw materials for drugs and allied industries. By and large, these lesser known fruit plants have not received enough research support. Exploitation of genetic variability occurring in natural populations and selective breeding could improve their yield and quality. A wide adaptability of many of these tropical fruit plants make their raising on plantation scale more profitable over inhospitable landscape.*

India has a vast variety and diversity in tropical fruit plants, many of which are evolutionary climaxes in specific nitche. These plants have a close association with local beliefs and rituals and are used in health-care needs in the rich ethnic life of our people. Quest for natural source of medicament is growing all over the world for these products have milder action in various body functions in preference to synthetic drugs. In terms of their therapeutic value, the fruits provide nutrition, strength and vigour to the body and restore loss of minerals, biflavonoids and amino-acids and thus protect the users against many deficiencies/diseases. Studies in chemical analysis of several fruits used by tribals and ethnic groups have shown that these are richer in calcium and several other minerals and have higher bio-medical properties than many other popular fruits.

In this respect, our country has inherited a rich treasure-house of knowledge from ancient medical-men who characterised several tropical species to yield specific drugs and medicaments as recorded in treatise dealing with Ayurvedic, Unani and Siddah Systems of Medicine. However, most of these fruit trees have remained semi-domesticated due to lack of research support for improvement as well as unorganised marketing of the produce. Many species have become rare and endangered due to large scale urbanization or extension of cultivation under high yielding cereals. Nonetheless, the economics of cultivation has brought the focus back on fruit trees. Plantation of fruit trees promises an alternate land use system which is environment-friendly and would yield a host of raw materials

from their different parts. In consideration of these new trends in horticulture and plantation sector, an attempt has been made to enumerate untapped resources of tropical fruit plants for medicinal plants industry. A long term research support through selection, breeding and appropriate management of crop and soil moisture can bring dramatic change in economic yield of these lesser known fruit trees. Taken together the benefits of fruits, fuel, timber and fodder yield and the protection of soil in several inhospitable landscapes, these species would provide good economic return. This strongly calls for developing a regular research programme on biological and chemical screening of the relatively less known tropical fruit plants in India for their use in medicinal plants industry. A list of lesser known tropical fruit plants of India along with distribution and uses is drawn from literature (Table 1) to generate research in their economic utilization.

Medicinal properties of tropical fruits

A glimpse in the old medical literature (Chopra *et al.*, 1956, 1969) provides information on characteristics and uses of fruits and fruit products which has stood the test of time and is verified through chemical and clinical evaluation. Accordingly, fruits possess both restorative and curative principles. These could be aromatic, cooling, digestive, stomachic, stimulant, useful in seasoning, maturation and fermentation of culinary, processed food and drinks. Some others have chemical principles responsible for their astringent, alternative anthelmintic, anodyne, emenagogue and emollient properties. There are a few others which possess specific properties such as diuretic, diaphoretic, sedative or stimulant to nerves, vasodilatory, improver of peristaltic movement of intestine and liver ailments, cardiotonic, relieving cough, cold, bronchitis, asthamatic spasm, high blood pressure etc. Some fruits and their essential oils from peel, foliage or roots have carminative and germicidal properties and are prescribed to expel intestinal worms. Some of these plant-based raw materials are in commercial demand in the medicinal plant industry in our country. However, this presentation is limited to hither-to commercially untapped tropical fruits which could be developed as raw materials for drugs and pharmaceutical Industry in India.

Tropical fruits for traditional medicine

Neem (*Azadirachta indica*), is by far, the most important medicinal plant of India but world's largest neem plantation is established in an area of 10 sq. km in the plains of Arafat, Saudi Arabia. Its berries, leaves, bark, alkaloids and related other products have demand in a wide range of industries like pharmaceuticals, pesticides, slow release fertilizers, soaps and cosmetics. However, its seed has very fugitive viability of 5 to 6 weeks. In this respect, the work carried out at Forest Research Institute, Dehra Dun has shown that seed could be maintained for 6 months if kept in well-

aeriated containers at 15°C against the common belief of storage in sealed containers at a low temperature (5°C). The economics of raising neem plantation vis-a-vis timber species has not been studied in depth. Selections of faster growing genotypes producing longer berry yield for recommendation under commercial plantation are also not available.

Aonla (*Emblica officinalis*) is another important fruit plant of India, and has wide utility because of its being the richest source of Vitamin C. Several new varieties have been developed in the last two decades having increased fruit size and yield. It is to note that Vitamin C content of varieties *Banarasi-aonla* which was developed through selective breeding is much higher (645.5 mg/100 g) over *desi* culture (540.7 mg/100 g) on individual fruit basis.

Bael (*Aegle marmelos*) is another important medicinal fruit of arid regions in India. It has adapted well to soils of poor fertility where yield varying from 200 to 400 fruits per tree could be obtained in fruiting season. The fruit pulp has numerous seeds (74 to 200) which if reduced, will make it a choice fruit for food processing industry. The ripe fruit has high amount of non-reducing sugars, rich in Vitamin C (13.4 to 22.7 mg/100 g) and is considered appetizing, stomachic, cooling and restores vitality. It has substantial amount of phenolics which contribute astringent taste. *Marmelosis* is the therapeutically active compound, which is high in unripe fruit and therefore it is prescribed in treatment of diarrhoea and dysentry. It should be noted that ripe fruit has 17 amino acids and 11 minerals which compares favourable with citrus fruits; it is richer in aspartic acid and iron content is found 21 times more abundant in *bael* than in orange or grape fruit. Similarly Zn, Cl and Na concentration is also found in higher unit. (Barthakur and Arnold, 1989). Acharya Narendara Dev University of Agriculture and Technology, Faizabad has made an impressive collection of cultivars of this species and identified selections for economic plantations.

Papaya (*Carica papaya*) is an age old introduction from south America and is extensively grown all over the country. Its unripe fruit, on incision, yields crude *papain* (dried milky extract) which improves digestion, tenders meat and meat products, clears beer (liquor) and is used in cosmetic, dental paste and textile industry. India is one of the major exporter of *papain* to the world market and there is a growing demand. Recent studies have shown that 90 days fruit-set is to be tapped for this purpose and 4 incisions are given, 3 to 4 times each, at an interval of 2-6 days. The flow of latex is low if temperature is below 10°C. The latex is dried at 50 to 55°C and a yield of 60 to 80 kg/ha of *papain* is obtained without affecting fruit ripening, yield and quality.

Rudraksha (*Eleocarpus saphericus*) is yet another endemic fruit tree which is held in high esteem in India and is tied into necklace worn for

Table 1. Tropical fruit plants used in medicinal plants industry

Name	Botanical name	Distribution	Properties/uses
Aonla	*Emblica officinalis*	Deciduous tree, throughout India	Fr. acidic, cooling, rich in Vit. C. and tannins, useful in bacillary dysentery, diuretic, liver tonic etc.
Nux-vomica (Kuchla)	*Strychnos nux-vomica*	Moist tropical forests, rising upto 1200 m elevation	Seed contains strychine and brucine, neuro-stimulant.
Kokam	*Garcinia indica*	Tall tree, W. Ghat, lower slopes of Nilgiris.	Seed-butter useful in skin ointments
Hardey	*Terminalia chebula*	Throughout deciduous forest.	Fr. astringent, laxative, alterative stomachic, dentrifice.
Neem	*Azadirachta indica*	Tree, throughout sub-tropical India.	Fr. emollient, anthelmintic, purgative stimulant, alterative and useful in skin diseases.
Anardana	*Punica granatum*	Shrub in foot-hills of J & K and H.P.	Fr. acidic, stomachic, larger demand for culinary.
Unnab	*Zizyphus sativa*	Large shrub, drier tracts in Western Himalayas	Dried fruits useful in cough, cold and bronchitis and related disorders.
Nut-meg	*Myristica fragrans*	Small tree, Cultivated.	Unripe fruits yield papain, useful in flatulence and nausea.
Papita	*Carica papaya*	Small tree, introduced into cultivation.	Unripe fruits yield papin, useful in tendering proteins.
Ankola	*Alangium salvifolium*	Small tree, peninsular India	Fr. and tree bark yields alkaloids, useful in hypertention and increase peristaltic movement of intestine.
..a	*Semicarpus anacardium*	Tree, sub-tropical India	Oil of nuts used externally for reheumatism and nervous debility.
Kajuput	*Melaleuca * leucodendron*	Small tree, introduced into gardens avenue tree.	All parts yield ess. oil, used to potentiate insecticides.

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Table 1. Cont....

Name	Botanical name	Distribution	Properties/uses
Amaltas	*Cassia fistula*	Tree, throughout sub-tropics, planted along roadside.	Fr. pulp laxative, prescribed to infants and pregnant women.
Bael	*Aegle marmelos*	Small thorny tree. Dry sub-tropical forests and foot-hills	Fr. cooling, soothing, laxative stomachic, useful in diarrhoea/dysentery.
Baheda	*Terminalia belicica*	Through-out deciduous forests	Fr. purgative, astringent, useful in piles, dropsy; in dyeing and tanning.
Maniphal	*Randia dumetorum*	Small tree, sub-mountaineous tract.	Fr. pulp anodyne anthelmintic, given in colic, expelling intestinal worms.
Mahua	*Madhuca indica*	Large tree, planted on arid poor soils.	Fl. useful in cough and brochitis; it yields alochol on fermentation.
Priyangu	*Aglaia elaegnoides*	Konkon, Western Ghat and peninsular India.	Fr. cooling, astringent, used externally to cure inflamation and leprosy.
Nirmali	*Strychnos potatorum*	Tree in Kerala, Bengal Orissa	Seed used for purifying drinking water, useful in gonorrhoea and conjuctivities.
Indrayan	*Citrulus colocynthesis*	Trailing herb, arid tracts	Fr. pulp is bitter, given in colic pain.
Rudraksha	*Eleocarpus sphaericus*	Tree, Eastern Himalayas	Fr. useful in epilepsy, cardiotonic. Hard tubercled nuts are made into rosaries and necklaces.
Gorakh-imli	*Adansonia digitata*	Tree, West coast of India planted as avenue tree.	Fr. pulp aperient, astringent, diuretic and diaphoretic, food seasoner and for making cooling drink.
Kaith	*Feronia limonia*	Small tree, distributed over arid tracts throughout India.	Fr. astringent, stomachic, stimulant.
Laurel	*Laurus nobilis*	Small tree, Nagaland	Fr. used in diarrhoea, dropsy; leaves used in essential oil perfumery and food flavouring.

Abbrevations used:
Fl = Flower; Fr = Fruit, Vit. = Vitamins, Ess. oil = Essential Oil
* Introduced species

protection against mental and cardiac troubles. Its alcoholic extract has been found to induce sedation and anti-convulsant effects, useful in *grandmal* epilepsy and hypertension. This plant has not received due attention, particularly to identify and propagate mono-carpellary (one sutured) drupe, which is considered sacred in Hindu mythology and commands higher price.

Several allied species of Indian fruit trees occurring in neighbouring countries have shown significant pharmaceutical properties. Such reports provide new leads to us for chemical and clinical investigation to improve economic utilization of the Indian species. For example, glandular hairs on Kamla fruits (*Mallotus philippinensis*) is a popular remedy in jaundice and the dried hairs are commercially marketed as raw materials for manufacture of geleniacls in India. In an allied Japanese species viz. *M. japonicus*, two new phoroglucinol derivatives have been isolated which culture significant cytotoxic activity in K.B. cell culture system (Fujita *et al.*, 1987). Similarly, methanolic extract of *Evodia rutaecarpa* fruits is found to yie*ld evodimine* and *dihydrorutaecarpine* which showed highly significant cardiotonic activity on the isolated guinea pig atria (Shoji *et al.*, 1987).

Some medicinal fruit trees like *Alangium, Terminalia, Madhuca, Azadirachta* and *Pongamia* profusely secrete nectar and pollen for honey bee populations and are closely associated with apiculture (Gupta, 1989). Further studies on mycorrhizal flora around certain tropical trees have shown their utility for atmospheric nitrogen fixation and consequently in improvement of soil texture and fertility. Such studies on tropical fruit trees should be supported in our country. Many of these lesser known fruit plants would find place in forestry and in avenue plantations over eroded lands and riverine tracts where it would improve rural economy and provide green coverage to the inhospitable landscape. There are many tropical fruit plants like **Jamun** (*Syzygium jambolana*), **Chironji** (*Bachanania latifolia*), **Kadliphal** (*Musa paradisica*), **Amara** (*Mangifera indica*), **Indrajau** (*Holarrhena antidysenterica*), **Gular** (*Ficus glomerata*) and **Lishoda** (*Cordia myxa*) which are planted for their bark and roots have poular medicinal properties and are extensively used in home remedies in rural India. A great opportunity therefore awaits in research and development of these lesser known tropical fruit trees. In essence, exploration of available natural genetic variability within a species and development of hybrid lines should be attempted in these species with a view to improve their yield and quality for use in pharmaceutical industry.

Genetic diversity for economic characters and its utility in plant improvement

The native tropical fruit plants have both pantropic and localised distribution. Their long history of evolution through interaction with

environment have given rise to cytotypes and rise in ploidy levels mainly to prepare the species to survive the vagaries of change in climate. This genetic variation in the taxa can be exploited to advantage through selection of populations for plantation purpose. Although very little work has been reported in cytological mapping of populations of these minor fruit plants, many valuable trends have been reported in recent publications. For example, cyto-morphological studies in **Anar** (*Punica granatum*) from Western Himalayas and Punjab plains have revealed that both wild and introduced cultivated taxa have same chromosome number (n=8). B-chromosomes in the populations of *Punica granatum* occurring in N.W. Himalayas have been identified. B-chromosomes have earlier been reported in a tetraploid cultivar of **ber** (*Zizyphys jujuba*). In fact, such occurrence of B-chromosome in a predominantly tropical taxon may be a possible adaptation to colonize over temperate lands. Inter-specific polyploids have been identified in *Syzygium jambolana, Randia dumetorum* and *Morus alba*. They have identified many genotypic variants in natural populations of *cordia dichotoma Schizium jambolana* and *Terminalia belerica*. Gill *et. al* (1989) studied 40 cultivars and their wild growing proginitors in *Zizyphus mauritiana* complex growing in the sub-Himalayan foot-hills and recorded inter-specific hybridization and intra-specific polyploidy. They have identified tetraploids (2n=48) and male sterile fruit trees showing normal fruit setting and proper stone formation in these populations. Abnormal meiosis and partial male sterility are believed to have given rise to variations in number of seeds per stone (1 to 3), average weight of seed, its shape, size and ornamentation suggesting that these changes have got fixed through domestication stress and are perpetuated through vegetative propagation. In this respect, the distribution of an allied medicinal fruit species Unnab (*Z. spina-christ* syn. *Z. sativa*) in north western parts of Punjab is remarkable as it occurs over stony, infertile soil, and has unique winter hardiness to withstand extreme temperatures of western Himalayas; its distribution extends westward to N.W. Frontier Province of Pakistan and further into West Asia. The dry Unnab fruit is considered most nutritious for its high riboflavin content (1.19 mg per cent) and is widely used in medicine to relieve cough, cold and periodic fever combined with laxative action.

Cytological studies on natural populations of *Terminalia chebula* reported occurrence of diploid, tetraploid and hexaploid cytotypes with characteristic pattern of distribution (Ray *et al.*, 1983). The diploids are confined to northern India whereas the other forms occur in central Indian forests. The polyploids with abnormal meiosis appeared to be allopolyploids having effect on their fruiting habit. In an allied species, *T. pallida*, endemic to certain parts of Andhra Pradesh, the analysis of fruits has shown the presence of 20 phenolic compounds whereas only 17 are present in *T. chebula*; eight flavonoids are common to both the species and are quantitatvely higher in the former (Chetty and Rao, 1989). The utilization potential of

these compounds may vary in terms of quality of additional compounds of quantitative availability of total phenols, both of which can be useful index traits for improvement through selection.

Conclusion

The utility of henceforth untapped tropical fruit plants appears worthwhile. These should be explored for their use in medicinal plant industry or raising farm economy. The first step is to prioritise the lesser known native fruit plants for research and identify the region of maximum diversity in population or areas of endemic occurrence including ethnic pockets wherever they exist in semi-wild forms and build-up through selection over a period of time. This may be followed by genetic studies related to growth and fruit bearing. A list of priority taxa and their respective regions for *in-situ* protection in the country can be drawn which may be further raised in plantations for bulk supply to users.

REFERENCES

1. Barthakur N.N. and N.P. Arnold. 1989. The central organic and inorganic constituents in bael. (*Aegle marmelos* Correa). *Trop. Agrl.* 66 (1) : 65-68.
2. Chopra, R.N., S.L. Nair and I.C. Chopra. 1956. Glossary of Indian Medicinal Plants (Counil of Scientific and Industrial Research, New Delhi).
3. Chopra, R.N., I.C. Chopra and B.S. Varma. 1969. Supplement to Glossary of Indian Medicinal Plants. ibid.
4. Cheety, K.M. and K.N. Rao. 1989. Phyto-chemical comparison of endemic *Terminalia pallida* Brandis with *T. chebula* Retz. *Indian Jour. Forestry* 2 (2) : 117-120.
5. Fujita, A., M. Arisawa, T. Hayashi, M. Shimizu and N. Monta. 1987. Studies on cyto-toxic constituents in pericarps of *Mallotus japonicus. Jour. Pharmaceutical Sciences* (Japan) 76 (11) : S-195.
6. Gill, B.S. and V.K. Singhal. 1989. Strategies for selective germplasm evaluation and conservation of north-west Himalayan species. Symposium *on Status of Indian Forestry Problems and Perspectives* (21-23, Dec. Hisar), *Abstr.* p. 35.
7. Gill, B.S.,R.C. Gupta and Suman. 1989. Stone variability in *Zizyphus mauritiaina* complex (Rhamnanceae) ibid, p. 53.
8. Gupta, M. 1989. Forest trees as honey bee pastures for bee-keeping. ibid, *Abstr.* p. 55.
9. Roy, R.P., S. Saran and B. Dutt. 1983. Cytogenetics of other flowering plants. In Genetical Research in India. (Indian Council of Agricultural Research, New Delhi) : 63.
10. Shoji, N,A. Umeyama, A. Iuchi, T. Takemota, A. Mouroyama and Y. Ohizume. 1987. Powerful cardiotonic principles of *Evodia rutaecarpa* Bentham. *Jour. Pharmaceutical Sciences* (Japan) 76 (11) : S-216.