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TAMARIND: ITS ECONOMIC USE AND INDUSTRIAL EXPLOITATION

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ABSTRACT

An account is presented in this paper of the occurrence, distribution and nativity of Tamarind Tree together with the economics and statistics and commerce of this useful species in India. Industrial exploitations of Tamarind Kernel Powder (T.K.P.), Tamarind Seed Jelly (T.S.J.) and Tamarind Seed Pectin (T.S.P.) are given in some detail.

Tamarind (*Tamarindus indica* Linn.) is one of the important economic trees of India. Among the earlier literature of the 17th and later centuries having a bearing on Tamarind, the more significant are those of Bauhin (1671: 403), van Rheede (1678: 39), Ray (1688: 1748), Sloane (1696: 147), Tournefort (1719: t. 445), Boerhaave (1720: 59), Linnaeus (1747: 14; 1748: 15), De Candolle (1825: 488), Roxburgh (1832: 215), Wight and Arnott (1834: 285), Baillon (1869: 182), Hooker (1879: 273), Hooker (1891: t. 4563) and others. The species is known to be a native of the Tropics and is considered as probably indigenous to Tropical Africa (*Fawcett & Rendle,* 1920; *Hegi,* 1958; *Britton,* 1918), although Britton (*l.c.*) was not quite specific of its native home. Stephenson & Churchill (1831), however, refer to Tamarind as native of Egypt, Arabia and E. Indies.

SPREAD AND DISTRIBUTION

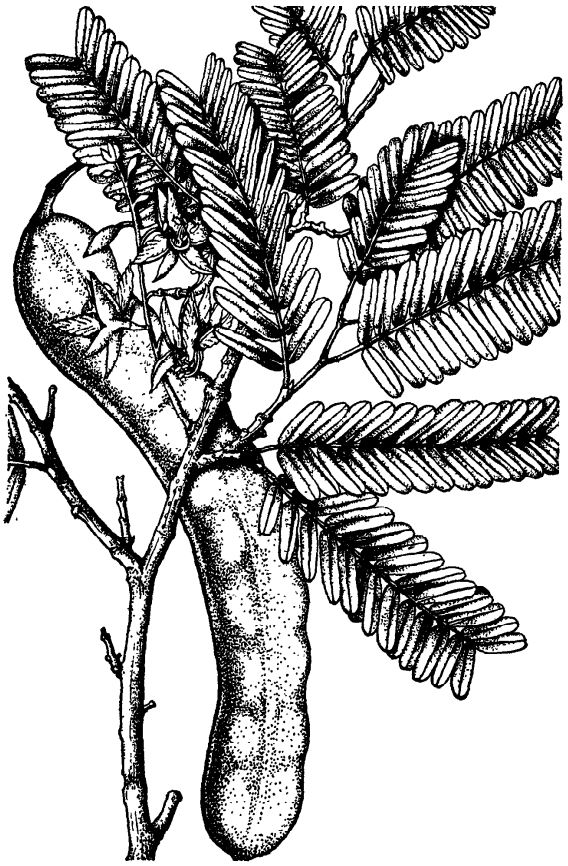
In Tropical Africa, Tamarind is spread over Upper Guinea, Nile Island, Lower Guinea, South and Central Bakota country, Mozambique and Zambesi valley (*Oliver,* 1871; *Welwitsch,* 1901). In West Tropical Africa, it is seen all over the Central Sahara, Senegal, French Guinea, Gold Coast, Togo, North Nigeria, South Nigeria, S. Leone and French Sudan (*Dalziel & Hutchinson,* 1937). It is also found in Madagascar in various localities as Kilelo, Kily, Madiro, Voamatory and Madilo (*Heckel,* 1910). It is found in Mauritius and Rodriguez in a semi-wild condition (*Baker,* 1877).

Tamarind has also become naturalised in several other Tropical countries as in Peninsular Florida and on the Keys (*Britton & Shafer,* 1908), Costa Rica (*Pittier,* 1908), Netherland, W. Indies, St. Eustatus, Saha, St. Martin, Cura Cao, Aruba, Benan (*Bolding,* 1913), Mid-Europe, E. Indies, Cambodia, Assam, Siam, Jamaica, Hainan in China etc. It is also known widely cultivated in Tropical and Sub-Tropical regions of America and Asia (*Fawcett & Rendle,* 1920), in Malaysian regions (*van Steenis,* 1948-54), in tropics of old world extending to N. Australia (*Forbes & Hemsley,* 1886-88). Among the widely cultivated areas may be mentioned Jamaica, Porus, Berwick, Bendor Hill, and at the two latter localities at 610 m and 365 m altitudes respectively (*Fawcett & Rendle,* 1920). In Malay Peninsula, it is chiefly cultivated in the North at Penang and Province of Wellesley and it has also come up in Singapore, Rocky Islands in Johort Straits as escapes. It is also cultivated in many Pacific Islands (*Merrill,* 1951). In East Indies, in the western Islands, Tamarind is cultivated for its shade and fruits and for its medicinal and commercial importance. In Burma, it is largely cultivated, but not found wild in any place. Tamarind is known to have been first planted in Acapulio by the Spaniards and from whence it has widely spread over West Indies (*Guppy,* 1917).

In India, although there is no exclusive area of Tamarind cultivation, it is generally and constantly planted in avenues throughout South India, in parts of Assam and in the plains. In Bijapur in Deccan, Tamarind is famous for its fine varieties and is cultivated extensively. In some places in India, Tamarind is also grown as an ornamental tree in gardens. It is also known to be grown self-sown in several areas, as in many parts of South India, in waste lands and forest lands. Tamarind is also frequently met with in forest tracts and in old deserted village sites and about ruins. In some areas, Tamarind has naturalised among granite rocks.

According to M'Fadyen (cf. *Hooker,* 1891), most authors make two species of *Tamarindus.* The Indian kind with long pods and the W. Indian with short pods. . . India is probably the aboriginal country of both whence the species was introduced

to Western India. The Arabs called the tree *Tamar hindee* or Indian Date, from which the generic



Tamarindus indica Linn.

name *Tamarindus* derived. Wight & Arnott (1834), however, record that Gaertner and Roxburgh consider the West Indian species as distinct from that of the East; but as both kinds of pods are seen in Indian Peninsula, Wight & Arnott (1834) are inclined to regard them mere as varieties from cultivation than as naturally distinct. The Tamarind must be of very ancient introduction, as it has two Sanskritic names, *Tintidi* and *Amlika* in ancient Sanskrit literature.

CULTIVATION STATISTICS IN INDIA

Tamarind does not appear to have been cultivated in Kashmir State. In Gujarat and elsewhere in Rajasthan, the trees are not cultivated on any appreciable scale; no data is available on the acreage under wild or cultivated state, although Tamarind grows here and there as avenue trees in E. Rajasthan. In Maharashtra, it is not known as a forest tree and is scattered all over private lands, but no data is available as to the acreage. In Madhya Pradesh, cultivation is not done as for other fruit crops, but Tamarind is seen scattered here and there on road-sides, on border of fields etc. although here again no statistics are available. In Bengal & Bihar trees are very common in Hughli Dt., Monghyr, Manbhum, Murshidabad, Singhbhum and various other areas. In Assam, Tamarind is cultivated throughout as ornamental trees in gardens and in the plains. In Orissa, the trees are found mostly scattered near villages and in the forests near abandoned villages. Tamarind is found in abundance in the Districts of Koraput, Phulbani, Kalahandi and Parlakemedi. About 480 hectares are known to be under cultivation in Orissa and about 5200 hectares under wild growth; out of the total number of trees, about three-fourth the number in the State is under private management. In Central India, Bijapur in Deccan is famous for Tamarind. In Andhra Pradesh, total area under Tamarind cultivation is estimated at about 8725 hectares. It is grown wild along road sides also, field bunds and similar areas, which are mostly under private management. At Nellore about 176 hectares are under private management on vacant spaces, along bunds and village sites. In Madras it is largely grown along highways, on private lands and in the forests; in forest tracts, the trees are comparatively smaller in number, and plantations are raised under Minor Forest Produce working Circle and in aforestation and soil conservation plots in Farm forestry.

In Mysore, Tamarind grows extensively all over in both cultivated and wild forms. In Kerala, Tamarind is available in large numbers but there appears to be no cultivation under the forest departments. However, about 205 hectares are under cultivation either by the Agricultural Department or under private management with about 34 hectares under wild growth.

SIZE OF TREE AND PRODUCTION STATISTICS

Tamarind is a large and handsome evergreen tree reaching upto 33 m height and a diameter of 2 m or a circumference of about 8 m and more. In Madras State, the average size of trees is estimated at 22 m with a girth of about 1 m. In Kerala, the trees attain a size of about 16-22 m ht.; in Orissa, they reach 12-18 m ht., with 2 m diameter. In

Andhra Pradesh, the trees are comparatively of shorter stature with 6-12 m ht. and at times reaching 23 m though the average height is about 11 m.

In India, the annual production of Tamarind seed is estimated at 25,19,60 tons with Madras yielding 165,000 tons, Andhra 32,960 tons, Bengal and Bombay 15,000 tons each, Orissa 9,000 tons, Kerala 8,000 tons, Hyderabad 5,000 tons, Madhya Pradesh 2,000 tons. In Madras, the fruit yield is about 200 kg/tree per year and a good tree is capable of giving a yield of about 1000 kg/tree per year. In Andhra Pradesh, the average yield of fruits per tree is only about 100 kg/tree. In Orissa, the average yield per tree is about 35-150 kg, and the approximate value of the Tamarind fruits and seeds collected in this State is estimated at Rs. 1,80,792 per year. The total quantity of seeds that, however, enter in the market may not be more than 100,000 tons, because of certain difficulties entailed in the collection of seeds.

PHENOLOGY OF TAMARIND TREE

As Tamarind is an evergreen tree, it bears foliage throughout the year, though in the hottest part of the country, the trees may look without foliage just for a few days. In Kerala, the leaves are shed in December. Fresh and new leaves are put forth in March-April. Flowers are borne in the months of April-June, though in Kerala, by September flowering is also seen. Fruits ripen during December-March. In Rajasthan, fruits may become available by end of June. Harvesting of fruits is generally between April-May, although in Kerala and other parts, fruit collection may be over by February of the year also.

USES

Root: The root of Tamarind is a bitter and used in dysentery (*Nadkarni,* 1954).

Stem bark: The stem bark is astringent and tonic. The bark is also used medicinally for loss of sensation in paralysis (*Kirtikar & Basu,* 1918). The ash of the bark with salt is used as a remedy for colic and indigestion. A gargle of the ash with water is used in sore-throat to heal aphthous sores (*Nadkarni,* 1954). The ash is given in urinary discharges and gonorrhoea (*Kirtikar & Basu,* 1918). The bark of the tree is peeled off for medicinal purposes during the time when the tree is not in flowering stage or when the flowering season ends.

Timber: The wood is hard, close-grained, yellowish white with red streak. The heartwood is small, near the centre of the old trees and is dark purplish brown. It is a most valued timber for making tool-handles, agricultural implements, wheels, mallets, planks, furniture, rice-pounders, oil and sugar crushers. It is also much priced as a fuel as it has high calorific value and chiefly used for making gun-powder charcoal, and in brick-kilns where great heat is required in brick-making.

Leaves: The Tamarind leaves contain Tartaric and Malic acids, the latter being found in excess and increasing with the age of the leaves. They also contain certain enzymes. The leaves are astringent and the tender leaves are cooling and anti-bilious. A poultice of leaves is used as application to inflamatory swellings and in rheumatism to relieve pain. Decoction of leaves is used as gargle and juice is used in dysentery and in bilious fevers and in urinary troubles (*Nadkarni,* 1954).

Flowers: Like leaves, the flowers of Tamarind are also cooling and antibilious. Poultice of flowers is used in inflamatory affections of the conjunctiva. The juice expressed from flowers is used internally in cases of bleeding piles (*Nadkarni,* 1954).

Fruits: The fruits contain 55% pulp, 33.9% seeds and 11.1% shell and fibre. In India, the production of pulp is estimated at about 230,000 tons per year. Dry pulp of fruits yield about 16% of free Tartaric acid and its salts along with Citric, Malic acids. Two kinds of pulp are known, the red coloured and the brown coloured, the former being of superior quality. Bijapur in Deccan is famous for the fine varieties. The pulp is non-proteinaceous and the pulp of tender fruits contains far less nitrogen than the ripe fruits. The pulp consists of crude protein 3.1%, carbohydrate 67.4%, fibre 5.6%, and minerals 2.9%. Chemical analysis of pulp gives Tartaric acid with Potassium bi-tartarate 10-12%, moisture 20-30%, reducing sugars 25-30% and other solubles 3-4%, the rest with insoluble cellulose. In addition, it contains about 3% of good quality pectins, lactic, oxalic, succinic, malic, quinic, and some unsaturated acids of a total of about 3%. Small amounts of citric, nicotinic and ascorbic acids and some amino-acids are also present.

The pulp is edible and largely used for culinary purposes. It is refrigerant, carminative and antibilious. It is also useful in preventing and curing scurvy and in sobering the intoxicating effects of alcohol and *Ganja* (*Cannabis sativa* Linn.). The pulp

with wood-ash is extensively used for cleansing and brightening brass and copper vessels.

Ashes of burnt shells of ripe fruits are used as an alkaline substance with other alkaline ashes in the preparation of the medicine *Abhayalavana* used in cases of enlarged spleen of long standing.

Seeds : The seeds are compressed and flattened with a shallow oblong pit on each flat face. They are of irregular outline, round, ovate or oblong, brown and shiny. The edge is broadly keeled or sightly furrowed. The seeds are ex-albuminous with thick hard cotyledons, each seed weighing on an average about 11.7 grains.

The seeds are used as famine food and for cattle in several districts in Madras, Andhra, Madhya Pradesh and elsewhere. The hard kernel is dried and roasted and powdered into flour and used for making cakes and chappatties, either alone or with flour of other edible kinds. In Ranchi, the poorer classes use the dried and fried and powdered kernels with rice. The Santhals use the seeds with Mahowa flowers as article of food. The annual production of seeds is estimated at 132,000 tons. The seed-powder finds several industrial uses, given below.

Seed testa : The testa yields a dye extract which can be used for imparting fast shades to wool. The testa abounds in tannin, and as such can be used in dyeing, tanning and adhesive industries. It is useful in the preparation of ply-wood adhesives. The tannin in the testa produces a harsh and highly coloured leather, which though not fit for shoe-uppers, is suitable for heavy hides for soles, suitcases etc. with Myrobalans. The seed testa may find use in oil-drilling operations. The annual production of testa is estimated at 39600 tons.

Seed oil : The seeds yield a kind of amber coloured oil having no smell. It is suitable for culinary purposes, and useful in varnishes, paints and for burning in lamps. It is semi-drying and in some respects resemble pea-nut oil. It solidifies at 15°C and has the following values: Acid value, 0.84; Saponin value, 183; Iodine value, 87.1; Fatty acids, 94.9; Melting point, 46°C.

INDUSTRIAL USES

Tamarind Kernel Powder (*T.K.P.*): Tamarind kernel powder is about 50% of the weight of the seeds. Commercial samples of T.K.P. has the composition, Polysaccharides 48.7%, Albuminoids 18.9%, Fatty matters 7.5%, moisture 8.8%, ash 1.6%, soluble matters 3.2%, insoluble matters 11.3%. The kernel powder forms solutions of high viscosity in low concentrations and serves as a good creaming agent for concentration of rubber-latex. It acts also as a soil stabiliser and can be used in manufacture of compact bricks for building purposes. It is also the starting point for the preparation of polysaccharides which like, fruit pectins, possesses excellent jelling properties. Tamarind seed jellose is prepared from Tamarind kernel powder. The seed powder is also medicinal and given in rheumatism. It is used in certain other ailments in the Hindu and Yunani systems of treatments. The powder is regarded as stomachic. Paste applied to skin promotes suppuration in indolent ulcers and used as poultice for boils. It is reported that seeds or powders used alone produce depressing effects and inflammation. The testa of the seeds, if not removed completely are likely to cause irritation in the stomach.

Tamarind Powder Industry is covered by Indian Patent no. 32223, and full right is vested in Government of India. The seeds are commercially used in textile industry, and when powdered and boiled in water makes a tenacious glue.

Tamarind Seed Jelly (*T.S.J.*): Tamarind seed jelly is used in confectionery. It is an excellent substitute for fruit pectins, in jam, jelly and marmalade industries. In cosmetics it is used for preparation of emulsions of essential oils and fatty acids, shaving creams and dentifrices. In Pharmaceuticals, it is used as a binder and in the manufacture of pills and tablets, in the preparation of colloidal Iodine jelly. It can also be used in insecticidal preparations. It finds use in treatment of colitis, diarrhoea, dysentery and other intestinal disorders.

Tamarind Seed Pectin (*T.S.P.*): Tamarind seed has been described as a rich source of pectin; dehusked kernel yielding about 60% of pectin. Later researches conducted, however, have indicated that it is not a pectin, as ordinarily understood. The seed pectin contains 2-Xylose, 1-Galactose and 3-Glucose. It has been suggested that the seed pectin may be termed *polyose* or *hexopentose*. This can be used in sizing of artificial silk, finds extensive application in paper industry and for sizing, and as a finishing material, superior to Maize starch; it has extensive scope in jute industry for sizing. Tamarind seed polyose is used in food industries, and as emulsifying agents for essential oils, as adhesives and dehydrating agents, in cosmetics, as excipient, in the preparation of pills and tablets, in

the preparation of colloidal Iodine jelly, and as nutrient media in bacteriological work. It is used also as a substitute for gum, in the printing and plastic industries, in binding work, and as adulterant with Maize starch.

Commerce and Trade: Nearly 20,000 tons of tamarind seed powder are produced annually in India. An annual production of double this quantity can easily be achieved if proper care is taken to pool all the raw materials for industrial purposes. The annual returns is estimated at Rs. 16 to 17 lakhs, and the price per quintal of seed powder is between Rs. 37 and 43. Raw materials of seeds for T.K.P. are obtained chiefly from South India. Dried fruits are exported to various countries in U.K., U.S.A., Europe, Australia, Africa, Ceylon, Malaysia, Pakistan, etc. The following is a glimpse at the trade returns:

Country	*Quantity in Tons*	*Value Rs.*
Iraq ...	886	385732
Ceylon ...	420	400678
Aden ...	322	296042
Syria ...	318	314278
Saudi Arabia ...	133	128339
Canada ...	121	56416
Germany ...	60	36587
U. K. ...	55	45943
Australia ...	37	39464
U.S.A. ...	12	12733

In recent years interest is shown in Tamarind products and researches on them. Among the Institutions where work is carried on Tamarind products may be mentioned, Ahmedabad Textile Industry Research Association, Ahmedabad ; Chemistry of Forest Products Section, F.R.I., Dehra Dun ; Department of Chemical Technology, University of Bombay ; Central Food and Technological Institute, Mysore ; Indian Jute Mills Association Research Institute, Calcutta and a few others. A plant for the manufacture of Tamarind seed polyose has gone into operation in Bombay. Bombay is also the chief port for export and the Customs and Port Authorities have laid down standardisation methods for effecting the quality controls.

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