

MAHUA PROCESSING



AATMANIRBHAR BHARAT

**PM Formalisation of Micro Food Processing
Enterprises Scheme (PM FME Scheme)**

Mahua (*Madhuca longifolia*) belongs to family *sapotaceae* and finds origin in different regions of India, Sri Lanka, Myanmar and Nepal. It is a multipurpose tree which fulfils three fundamental needs of tribal individuals i.e. Food, Fodder and Fuel. is known for its sweet flowers which possess a lot of ethnic values among the tribal people for the development of various fermented and non-fermented food products.



I



II
(a)



III



I



II
(b)



III

The two major species of genus *Madhuca* found in India are *Madhuca Indica* (syn. *Bassia latifoliai*) and *Madhuca longifolia* (syn. *Bassia longifoliai*). Mahua is widely accepted as a local name. The regional names in some of the potential states are:

State	Regional name
Andhra Pradesh	Ippe, Yappa
Gujarat	Mahuda
Karnataka	Hippe
Kerala	Ponnam, Ilupa
Maharashtra	Mahwa, Mohwra
Orissa	Mahula, Moha, Madgi
Tamil Nadu	Illupei, elupa
West Bengal	Mahwa, Maul, Mahula
English	Butter tree
Sanskrit	Madhuka
Hindi	Mahua, Mohwa, Mauwa

Kingdom	Plantae
Division	Magnoliophyta
Class	Magnoliopsida
Order	Ericales
Family	Sapotaceae
Genus	Madhuca
Species	Indica (syn. <i>Bassia latifoliai</i> <i>longifolia</i> (syn. <i>Bassia longifolia</i>) ³

Mahua is deciduous tree of dry region and native of India. A multipurpose tree, mostly grown on wastelands in North and Central part of the country where generally tropical and subtropical climates prevail. It grows in Eastern Uttar Pradesh, Chhattisgarh, Maharashtra, Bihar, Jharkhand, Orissa and Andhra Pradesh.

Madhuca latifolia is a medium sized to huge deciduous tree, distributed in Andhra Pradesh, Gujarat, Madhya Pradesh, Orissa, Bihar and Uttar Pradesh.

Madhuca longijolia is a large evergreen tree found in South India, and in the evergreen forests of the Western Ghats from Konkan Southwards.



Fig. 1: Distribution of *mahua* tree in India

The Mahua tree has a large spreading root system, through many of them are superficial. Wood is hard/to very hard with large sapwood. Its is a large and deliciuou tree with a short Bole and rounded crown. Its bark thick grey to black with vertical cracks, wrinkled.



Fig 2: Parts of *Madhuca longifolia*

- Leaves oblong-shaped, rigid, clustered at the end of branches, 6-9 cm x 13-23 cm, thick and firm, exuding a milky sap when broken. Young leaves are pinkish and woolly underneath.
- Flowers are cream colored, corollas fleshy, juicy, clustered at the end of branches. Fruits are ovoid, fleshy, greenish, 3-5 cm long containing, 1-4 shiny brown seeds. The Seed is large, 3-4 cm long, elliptical, flattened on one side.
- Fruits are 2-6 cm long, fleshy and greenish. Bark dark color, cracked

Most of the leaves fall from february to April, and during that time the musky-scented flowers appear. Through small eyelet holes at the top, the yellow anthers can be seen. The stamens are very short and adhere to the inner surface of the corolla, the pistil is a long, protruding green tongue.

- It is at night that the tree blooms and at dawn each short-lived flower falls to the ground. A couple of months after the flowering period, the fruit opens. The fruit is a kind of berry, egg-shaped, mature seeds can be obtained during June to July

CLIMATE AND SOIL

It prefers tropical and subtropical climate.

It withstands drought admirably. Mahua grows upto an altitude of 1200m, mean annual temperature 2-46°C and Mean annual

rainfall ranging from 550-1500 mm. The mean relative humidity in its natural habitat varies from about 40 to 80 percent in January and from 60 to 90 percent in July .

- Mahua grows well on a wide variety of soils specially on alluvial soil in Indo-gangetic plain. Mahua being hardy, thrives well on rocky, gravelly red soils and also on saline and sodic soils

There is no improved variety of Mahua for an organized plantation. A large variability exists in its fruits. Recently, selections have been made possessing about 45 % oil content which are being evaluated for yield and other characteristics.



Fig 3: Leves of *Madhuca longifolia*

- **Seed Propagation**

- Collect the seeds between June-August. The seeds after maturity dispersed from the tree and germinate rapidly in wild conditions. The same seeds may be picked for sowing in the nursery. Such seeds are collected when the pre-monsoon rains begin. The seeds thus collected are to be spread on seed beds or planted in polybags in the nursery & covered with soil to prevent any damage to the germinating seeds either by soil borne fungi or insects.

old seedlings raised commence putting on new growth of light green colour, these are ready for soft wood grafting. This method was proved better for establishing *in situ* Mahua orchard in gravelly soils and drier tracts where mortality of nursery raised is very high. Freshly extracted seeds are sown in polythene bags for germination. After attaining a height of 5-10 cm, it should be directly planted in field at desired distance. Such plants grow very fast and attain stature in a few years.

of Mahua on one year

rootstock. Shoots are taken from spring flush and operation was done in July and August. July is the ideal time for Veneer Grafting. Plants become ready for planting in September, just 2 months after grafting.

Air Layering

It was also reported that one year old shoots on Mahua trees were ringed and upper end of cuts treated with IBA (1000ppm). Ringed portion after hormonal operation was wrapped with moist moss grass. Rooted shoots were removed from mother plant 60 days after treatment and planted in polythene bags having size of 15cm x30 cm and filled with soil and FYM mixture in 1: 1ratio



Before undertaking plantation, a pit of distance of 7m x 7m should be dug in summer. Pit size 60 cm is best for planting of mahua in lateritic soil. However, pit sizes of 30cm³ or 45 cm' can also be used depending on the nature & soil thickness of the site. Filled with a mixture of top soil + 25 kg farmyard manure upto a level of 60cm from ground level . Water pits are taken to settle soil. Planting is done in the centre of pit during July-September

A dose of 10 kg farmyard manure, 50g P₂O₅ and 75g K₂O plant should be given to one-year-old plant. It should be increased every year in same proportion up to 10 years. Fully grown up trees require 100 kg farmyard manure, 1 kg N₂, 0.5kg K₂O Farmyard manure should be applied during July-August. Half dose of N₂ and full dose of P₂O₅ and K₂O should be applied in July, remaining half dose of N₂ should be applied by end of August under rainfed conditions. Manure and mixture of fertilizer should be spread under canopy of plants and incorporated in soil.



Flowers appear just after leaf fall (first week of April) in different agro climatic zones of country. Time taken for complete development of flower bud from its visible initiation to anthesis varies from 20 to 30 days. Average number of flowers/fascicle varies from 10 to 60, Young plantation of grafted Mahua (7 year old) shows heavy flowering with very poor fruit set (1.6-4.0%). Dropping of young fruitlets was observed and only 8-13 % of set fruits reached maturity. Cause of poor fruit set may be due to poor pollination or self-incompatibility. Seedling trees of higher age have better fruit set than trees of lower age group.

- Fruits are ready for harvest by 3rd week of May to 3rd week of June.
- Maturity standards in different genotypes of Mahua under different conditions were observed that fruit growth was faster initially and slowed down while reaching towards maturity. Total soluble solids, total and reducing sugars increased as fruits reached towards maturity. Titratable acidity increased during initial period of fruit development, then declined

Flowers are rich source of responsible for its sweet taste and can be used in indigenous or modern alcoholic beverages. *Mahua* flowers contains good amount of Vitamin-C which is responsible for its antioxidant activity⁹. *Mahua* flower contains carotene which is precursor of Vitamin-A. Flowers also contain good amount of minerals like Calcium and Phosphorus. Few amounts of proteins and fats are also present in *mahua* flowers. Brief composition of *mahua* flower is given in Table 1. Various researches have been done to find out medicinal properties of *mahua* flowers like antihelmenthic, antibacterial, analgesic, hepatoprotective, antioxidant, and anticancer

Parameters		Fresh Flowers	
1	Moisture	73.6-79.82 (%, d.b.)	
2	pH	4.6
3	Ash (%)	1.5	1.4-4.36
4	Total sugars (g/100 g)	47.35-54.06	41.62
5	Total Inverts (%)	54.24
6	Cane sugars (%)	3.43
7	Reducing sugars (g/100 g)	36.3-50.62	28.12
8	Proteins (%)	6.05-6.37	5.62
9	Fats (%)	1.6	0.09-0.06
10	Fibers (%)	10.8
11	Calcium (mg/100 g)	45	0.14-8
12	Phosphorus (mg/100 g)	22	0.14-2
13	Carotene (µg/100 g)	307
14	Vitamin-C (mg/100 g)	40	7

The flowers of Mahua tree are fermented to form an alcoholic drink called Mahua, country liquor. Tribals of Bastar in Chattisgarh and Orissa, Santhals of Santhal Paraganas (Jharkhand) and Tribals of North Maharashtra, consider the tree and the Mahua drink as part of their cultural heritage. Tribal people, men and women, consume this drink and it is an obligatory item during celebrations and evening activities. The main ingredients used for making Mahua are the Chhowa Gud (Mollasses in granular form) and dried Mahua flowers

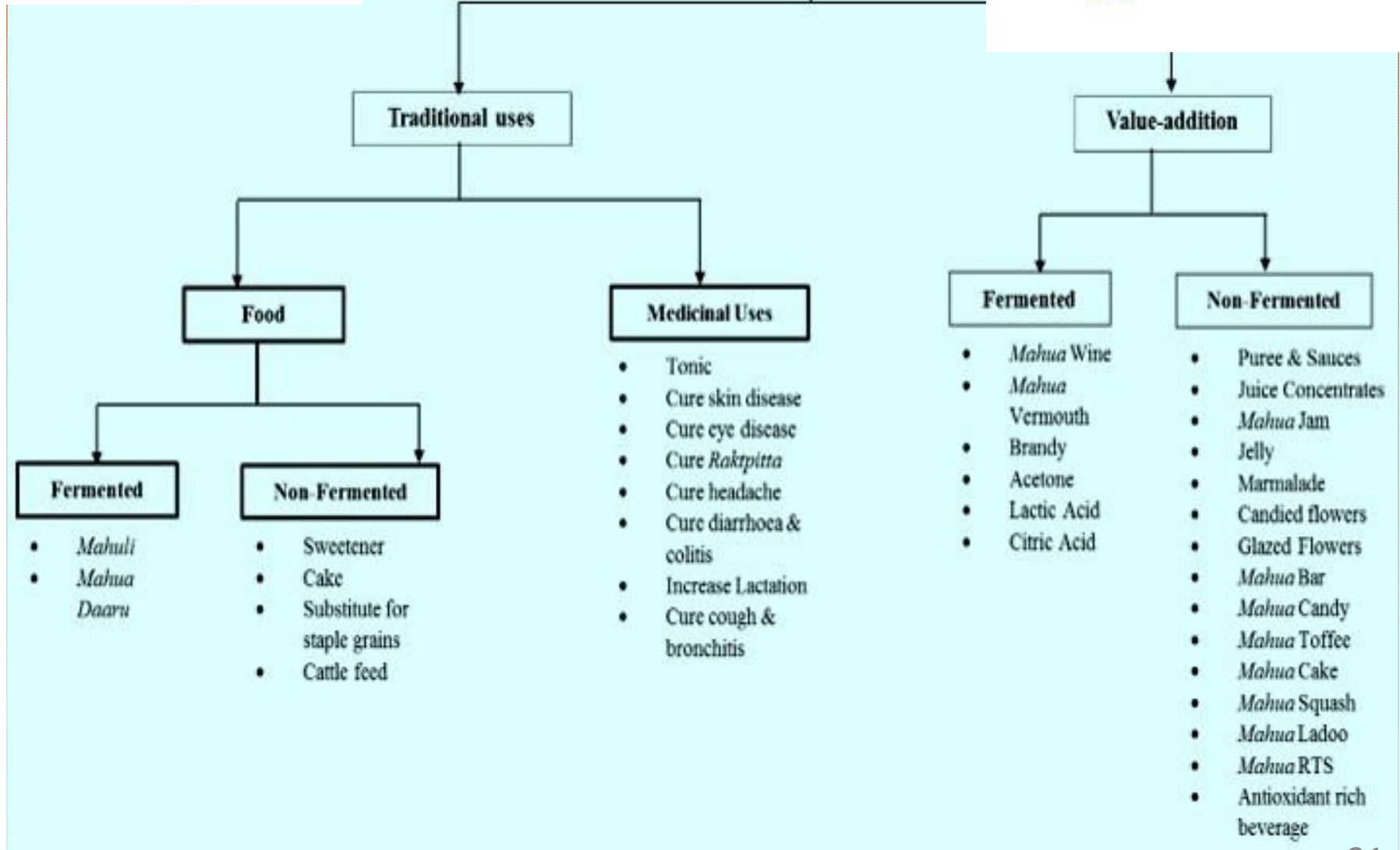


Mahua flowers

seeds contain about 40 % pale yellow seed oil is commercially known as 'Mahua' content of the seed varies from 33 to 43 % of the weight of the kernel.

1	Refractive index	1.452-1.462
2.	Saponification value	187-197
3.	Iodine value	55-70
4.	Unsaponifiable matter (%)	1-3
5.	Palmitic C 16:0(%)	24.5
6.	Stearic Acid C 18: 0(%)	22.7
7.	Oleic acid C18:0(%)	37.0
8.	Lionolic acid C 18: 2(%)	14.3

The oil solidifies to a buttery consistency, and hence the Mahua tree is also known as "The Indian Butter Tree". **used for edible and cooking purposes. It is one of the ingredients of hydrogenated vanaspati. It is also used mainly in the manufacture of soaps, particularly laundry chips**



key points

1 2	As a sweetener Preparation of	<i>Mahua</i> flower used as a sweetener in many dishes like halwa, meethi puri, barfi. It is made from <i>mahua</i>	Due to p amount of sugars (sucrose, fructose, arabinose, maltose, rhamnase. Pre-soaked rice and mahua
3	cake As a substitute for	flowers rice or other cereals or root crops. It is generally used by	flowers are mixed and grinded, paste is covered with Sal leaves and burned on fire to make cake. Sundried flowers are boiled with
4	staple grains As a cattle feed	poor tribal people. Spent flowers (Flowers	seeds of tamarind and Sal and stored. Spent flowers are fed to cattle,
		left after fermentation and distillation) are used.	reported improvement in cattle health and increase in milk production.

uses

key points

Preparation of "mahua daaru" "Mahuli" preparation	Produced from dried mahua flowers by Traditionally made by
	local people of Orissa.

- Flower bearing period of mahua is March-April, as it is an annual bearing tree. Flower sheds when it gets mature at dawn. Fresh *mahua* Flowers are sweet in taste and contain different phytochemicals. Traditionally, the fresh flowers are collected and dried under direct sunlight for 2-3 days and stored in gunny bags in normal environment

S.no.	Tree part(s)	Ethno medical U
1.	Seeds cake	Anti-inflammatory, anti ulcer, and hypoglycaemic activity
2.	Bark	Antidiabetic activity
3.	Flower	Analgesic activity
4.	Leaves & bark	Woundhealing activity
5.	Leaves	Nephro and hepato protective avtivity, antioxidant and cytotoxic activity
6.	Leaves and stem	Antimicrobial activity
7.	Seeds	Effective to alleviate pain

In diarrhoea a cup of infusion of bark is taken every 3-4 hours a day by the tribals. Besides the stem bark is used in chronic tonsillitis, leprosy and fever . It is commonly used for the treatment of snakebite as antidote for southern part of Tamilnadu, India . Decoction of stem bark is used to cure skin disease, hydrocoel and skin disease . Powdered bark is employed for the treatment of scabies. *Madhuca longifolia* leaves are expectorant and also used for chronic bronchitis and Cushing's disease . The leaves are applied as a poultice to relieve eczema.

	way of consumption	remarks
Used as tonic	Flower juice	Flower juice
		amount of protein so it
		is used as tonic
Cure skin		Flower juice rubbed on skin
diseases		for oleation to relieve
		from itching
Cure eye		Flower juice is used for
diseases		treatment of eye diseases.
Cure Raktapitta		Flower juice is used to
		arrest bleeding
Cure headache		Flower juice is used
due to "pitta"		as nasal drops

	Flower powder	Flower act as a cooling agent
		to cure diarrhoea
Increases	Raw flowers	Flowers act as a galactagogue
lactation		which can help in augmentation
		of breast milk.
Cure cough	Roasted flowers
and bronchitis		
Cure impotency	Flower mixed with milk
and general debility		
Cure piles	Flowers fried in ghee	<i>Mahua</i> flower act as a cooling agent

Mahua are of very high nutriti for cattle, goat and sheeps. Trees are lopped for fodder in almost every states, where ever it is grown specially during summer when there is scarcity of fodder. The chemical constituents of Mahua leaves are given in following table

1	Crude protein		9.4-10.02
2.	Digestible crude	protein	0.03
3.	Total digestible	nutrients	37.04
4.	Crude fibre		19.5-0.35
5.	Calcium		1.66
6.	Phosphorus		0.1-0.2

Leaves of Mahua are also used for cups and donnas on which food is served during festival and other social gatherings in rural and tribal areas of Eastern UP, Vindhyan Zone and Bundelkhand of Uttar Pradesh and MP. In Vindhyan Zone of Eastern UP, Bundelkhand of UP and Jharkhand, mahua leaves are used as a substitute of palash for making plates.



Mahua leaves

hwa are also utilized for human consumption. Unripe fruits are used for vegetable following way: Flesh of mahua fruit covering hard seeds are first peeled off to remove outer thin portion and then remaining portion are cut into pieces and fried in small amount of mustard oil along with onion and garlic paste. Take appropriate amount of mixed spices powder and cook till complete softening of fruit pieces and also to prepare a concentrated curry of mixed spices. In the rural areas of Eastern UP, this vegetable is sometime used as substitute of jack fruit. Fruits contain 55 to 65 percent husk, 10 to 15 percent sugar, 1.8 to 2.4 percent minerals, 51 to 74 mg vitamin C and 586 to 890 IU vitamin A per 100 gram. Because of these above mentioned qualities of fruits these are eaten afresh after ripening in tribal areas and poor of rural areas.

After the extraction of oil from oil bearing major portion of the raw materials is left over as the oilseed cake. Oilseed cakes are good and cheap source of proteins and the market value of the cake is governed by its protein contents and quality of its proteins.

- Mahua seed meal is the product left after extracting oil from Mahua seeds. Seeds yield 30-40 % oil and hence 60-70 of total seed production yields is Mahua seeds meals. Two types of meals are available in the market, Mahua seed meal is used as a detergent and fertilizer. It is also used as manure either alone or in mixture with other cakes and ammonium sulphate.

- The Foaming' stability of Mahua saponin at alkaline pH ranges thus suggesting their potential application in the preparation of detergents, shampoo, toiletry etc.
- Apart from these uses, in tribal and adivasi areas, small quantities of Mahua seed meal are also used for feeding their animals.
- Mahua seed-meal was found to be a better source of proteins as well as essential amino acids compared to Sal seed meal

- Recently Orissa University of Food Technology, Bhubaneswar have developed many value-added products from dry *mahua* flowers like candy, cake, RTS, toffee, squash and ladoo.
- Other value-added products like candied flower, glazed flower and *mahua* bar are also developed from dried mahua flowers.
- Because of having high amount of fermentable sugars, *mahua* flowers are utilized for making wine by various researchers scientifically using *Saccharomyces cerevisiae*.



Value addition of m



Ministry of Food Processing Industries
Government of India

- Recently prepared mahua wine has been enhanced with traditional Indian herbs (Black pepper, cinnamon, clove, cumin, fenugreek, nutmeg, fennel and Indian cassia) for development of new value-added product, called *mahua* vermouth
- Dry flowers are also utilized to make fermented products like brandy, acetone, and lactic acid. Beside that all *mahua* flowers can be successfully used as a substrate for surface fermentation using *Aspergillus niger* for production of citric acid .
- The complete detail of the utilization of *mahua* flower recently by various researchers for preparation of value added products is given in table 5 along with their specific remarks

1	Puree & Sauces	Fresh flowers	Fresh flowers are crushed into puree after removal of stamens manually and processed to make puree. Used as a sweetener in bakery and confectionary.
2	Juice	Fresh flower	
3	Concentrates	juice	Jam is made with addition of citric acid. Combined with guava to reduce astringency of mahua flower. By addition of citrus peels.
	Mahua Jam	Pulp of ripe flowers	
4	Jelly		
5	Marmalade		
6	Candied flowers	
7	Glazed flowers		
8	<i>Mahua</i> bar		
9	<i>Mahua</i> candy		
10	<i>Mahua</i> toffee		

11	<i>Mahua</i> cake	Dry flowers	
12	<i>Mahua</i> squash		
13	<i>Mahua</i> laddoo		
14 15	<i>Mahua</i> RTS Antioxidant rich	<i>Mahua</i> flower and	RTS blended with ginger extract @ 10 (%) have TSS of 18° Brix and with fennel extract @ 5 (%) have TSS of 14.8° Brix. The blend showed TPC of 15.94
	Beverage	Amla juice	(mg GAE/ml) and 91.22 (%) DPPH radical scavenging activity.

16	<i>Mahua</i> wine	Fermentation of flower juice	Fermentation at 16° C favours wine quality and increase alcohol content (up to 9.9 %). Sensory evolution reported that addition of yeast during fermentation is acceptable but tannin addition is not required.
----	-------------------	------------------------------	---

Anthelmintic activity: Katiyar et al. were investigated ethanol and methanol extract of the flowers of *Madhuca longifolia* J. F. Gmel (Sapotaceae) for its possible anthelmintic activity in *Pheretimaposthuma* (Indian Earth Worm).

Antibacterial activity: Verma et al. reported the antibacterial activity of flower of *Madhuca longifolia* against *Bacillus subtilis* and *Klebsiella pneumonia*. Aqueous and methanolic extract of flowers were used for analysis. Aqueous extract showed more activity than methanolic extract for both bacteria

Anti-inflammatory activity: Ramchandra et al. extract and saponin mixture of seeds of *Madhuca longifolia* for anti-inflammatory activity using acute (carrageenan-induced inflammation), sub-acute (formaldehyde-induced inflammation), and chronic (cotton pellet granuloma) models of inflammation in rats. The ethanol extract and saponin mixture at a dose level of 10 and 15 mg/ kg and 1.5 and 3 mg/kg significantly reduced the edema induced by carrageenan in acute model of inflammation, inhibiting both phases of inflammation. Both the extracts had a more effective response than the reference drug diclofenac sodium in the sub-acute inflammation model. Results longifoliated a significant anti-inflammatory activity by *Madhuca longifolia* saponins in cotton pellet granuloma.

Antihyperglycemic activity: The ethanolic extract of seeds of *Madhuca longifolia* was effective in reducing the plasma glucose level in normal albino rats in a dose dependent manner, producing hypoglycemic effect by stimulating the release of insulin from the β -cells and or increasing the uptake of glucose from the plasma .

Antibacterial activity: Antibacterial activity of *Madhuca longifolia* tested against *Bacillus subtilis* and *Klebsiella pneumonia* in ulcer index compared to vehicle, and was near to that of lansoprazole used at a dose level of 40 mg/kg, while crude alkaloid extract exhibited no significant gastroprotective effect

Anticancer activity: Bhaumik et al. studied the *in-vitro* anticancer activity of different extract of fruit seed of *Madhuca longifolia* against human cancer cell line (HeLa) and used MTT assay to analyze the cell growth inhibition. Results of Tables 10-14 showed that the various extracts of fruit-seeds of *Madhuca longifolia* have a very good to moderate anticancer activity

- ing essentially a forest crop of organized marketing process. In these areas the proportion of flowers and seed collection is much less than the areas around villages. However local middlemen purchase the dehulled kernels of mahua from villagers and supply it to wholesale markets. It ultimately reached to expellers from wholesale market.
- About 75 % of farmers sell their produce at farm level to the village merchants, retailers, big producers or to pre harvest contractors. They cannot afford to transport their produce to distant markets on account of non availability of transport facilities, expensive transport, and malpractices in market. Information regarding demand, supply, price, market outlook, knowledge of consumer's preference, marketing channels are important for marketing of produce.



M O F P I

LIST OF CULTIVA



Ministry of Food Processing Industries
Government of India

- In mahua plantation (7m x 7m spacing) approximately 200 trees per hectare will be planted. Mahua will start yield from 15 years onwards 1Skg of kernel per tree. Flowers are used for local consumption and return from them has not been taken into consideration for economic forecast of the scheme. Even if planted pure the internal rate of return (IRR) would work out to about 12 percent from flowers and seeds only. Other benefit gained out of woods, and leaves are additional. The estimated cost-economics of mahua cultivation is given in the table below.

NO. of plants per ha. 200
Plants for yeild calculation 160 (80% of plant)
Yield/income/cost/Stabilisation

Particulars	1'h	2'h	3th	4th	Years	6th	7th	8th	9'h	10th	11th	12th	13'h	14lh
					5'h									
Cost of plantation.	8756	3960	3080	3080	3410	3410	3410	3410	1210	1980	2750	4070	4730	5830
maintenance & harvesting (Rs.)														
Seed yeild (kg/tree)									3	5	9	15	18	22.50
Seed yield (kg/tree)									480	800	1440	2400	2680	3600
Gross income Selling price @ Rs. 125/kg)									3360	5600	10080	16800	20160	25200
Net Income	-8756	-3960	-3080	-3080	-3410	-3410	-3410	-3410	2150	3620	7330	12730	15430	19370

NB : The cost - economics may vary depending upon various agro-climatic conditions, wage rate, input cost etc.

gives significantly high quantity

rich in PUFA and has desirable level of oil

to be used as cocoa substitute in confectionary products and production of margarine, cosmetic and pharmaceutical industries.

- The mahua oil also has potential for alternative fuel options for diesel. The flowers are used as vegetable, for making cake, liquor etc. mahua is used to cure Bronchitis, Rheumatism, Diabetes, Piles, Eczema, Gums, Burns etc and flower juice is used in the treatment of various disease and ailments.
- The seeds are thus valuable in meeting demands for food and food supplements with functional, health-promoting properties in addition to industrial uses. As for the better potential, good quality of mahua tree should be cultivated through plant tissue culture by means of micro propagation. effect

tribal workers have to come along tribal community, so they may have more and valuable knowledge. In coming next generation the importance of plant and mahua tree is going to be increase because of their effectiveness, easy availability, low cost and comparatively being devoid of toxic.

- Plants are the important economical source of a number of well established drugs looking upon wide prospects and potential of *Madhuca Indica* for various purposes; it is worthwhile to cultivate this plant on large scale especially on unproductive and wasteland. This will help in financial full support of poor and landless families. Generally this plant *Madhuca Indica* is known only for its liquor making purpose, but one have to come forward to change the thinking of unaware people

- The Mahua tree is hidden from the public eyes as its medicinal point of view. As for the better potential, good quality of mahua tree should be cultivated through plant tissue culture by means of micro propagation. The research workers have to come along with the people of rulers' area so they may have more and valuable knowledge.
- In coming next generation the importance of plant and mahua tree is going to be increase because of their effectiveness, easy availability, low cost and comparatively being devoid of toxic effect. *Madhuca Indica* has found several of pharmacological activity, yet several other activities have to be finding out.



National Institute of Food Technology and Entrepreneurship and Management

Ministry of Food Processing Industries

Plot No. 97, Sector-56, HSIIDC, Industrial Estate, Kundli, Sonipat, Haryana-
131028

🌐 Website: <http://www.niftem.ac.in>

✉ Email: pmfmecell@niftem.ac.in

☎ Call: 0130-2281089