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Phytochemistry, Ethnomedical Uses and Future Prospects of Mahua (*Madhuca longifolia*) as a Food: A Review

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Abstract

Mahua is a common name used for *Madhuca longifolia*, it belongs to the family Sapotaceae. It is an important economic tree growing throughout India. Mahua is a highly nutritious tree and can also use as an herbal medicine for treatment of various disease. Present paper review the earlier work performed on mahua flower, fruit and seed and highlight the use of mahua flower in value addition. Phytochemistry study of mahua shows that it is rich in sugar, vitamin, protein, alkaloids, phenolic compounds etc. A lot of therapeutic research was carried out on mahua which shows its ethnomedical properties like antibacterial, anticancer, hepatoprotective, antiulcer, antihyperglycemic, analgesic activities etc. Mahua flower is not only used in preparation of liquor but can also utilized as a food ingredient for preparation of biscuit, cake, laddu, candy, bar, jam jelly, sauces etc. This review paper focusing on employment and income generation through commercial use of mahua flower, fruit and seed in medicine and food industry.

Keywords: *Madhuca longifolia;* Ethnomedical; Phytochemistry; Hepatoprotective; Analgesic

Introduction

Some of the food plants are believed to be an important source of nutrition as well as chemical substances having potential of therapeutic effects. These plants are effective source of both traditional and modern medicines and are genuinely useful for primary healthcare. Plants have been rich source of medicine because they produce wide range array of bioactive molecule [1]. Since long, the ayurvedic period, the herbal drugs were the sole source of medication for majority of population pertaining to the holistic approaches consisting of easier method of uses and better results. Despite vast continuous developments in the drug therapy, herbal sources are still of great importance and nearly 60% of the world's population continuously using such drugs. These are not only used for primary healthcare in rural areas in developing countries, but also in developed countries as well where modern medicines are predominantly available. The use of plants as a source of medicine has been inherited and is an important component of the health care system in India and abroad even in the present era. The ayurvedic treatments of several ailments have focused on the need of investigating newer but potent and safer herbal medicines for use various afflictions of the public in general [2].

In the last few years there has been an exponential growth in the field of herbal medicine and these drugs are gaining popularity both in developing and developed countries because of their origin and less side effects. Banerji and Mitra [3] studied that mahua (*Madhuca longifolia*) belonging to the family Sapotaceae, is one of those multipurpose forest tree species that provide an answer for the three major F's i.e., food, fodder and fuel. It is widely distributed in the South Asian countries. This tree known under the name of Mahua, produces edible flowers and fruits with high medicinal value. It is highly regarded as a universal panacea in the ayurvedic medicine and large evergreen tree distributed in India, Sri Lanka and Nepal [4]. Madhuca commonly known as mahua or butternut tree, 17 m high with a large top [5].

Taxonomy

Botanical profile of mahua *(Madhuca longifolia)* [4].

Botanical Name:	*Madhuca longifolia*
Family:	Sapotaceae
Subfamily:	Caesalpinioideae
Tribes:	Caesalpinieae
Genus:	*Madhuca*
Species:	*longifolia*
Order:	Ericaleae

Description

A deciduous tree, 10-15 m tall and with a spreading, dense, round, shady canopy. Bark: Is rough, brown in color, slightly cracked and fissured, inner bark red, exudes white, milky sap when cut. Leaves: elliptic, 15-25 cm × 8-15 cm, tip pointed, base angled, texture thick, hairy beneath, nerves strong, about 12 pairs, tertiary nerves oblique, and margin entire but may be wavy. Stalk 2-4 cm, reddish. Flowers: In bunches at the end of the branches, white, 2 cm long, pointed, sweat scented, fleshy. Fruits: ovoid, fleshy, 2-4 cm across, greenish, 1-4 seeded. Seeds: elongate, 2 cm long, brown, shining [2].

Synonyms of mahua

English:	South Indian Mahua
Hindi:	Mahva, Mohva
Kannada:	Erappe
Telegu:	Ippa

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Tamil:	Iluppai
Sanskrit:	Madhukah
Malayam:	Irippa [6]

Distribution and Habitat

The species is distributed in northern, central and southern part of peninsular India, Sri Lanka and Burma. Southern India extending northwards to Maharashtra and Gujarat. *Madhuca longifolia* is found in some parts of central and north India and Burma. It is common in dry mixed deciduous forests, dry forest and dry teak forests. The tree grows on a wide variety of soils but thrives best on sandy soil. It also grows on shallow, boulder, clayey and calcareous soils. It is found up to an altitude of 1200 m, mean annual maximum temperature 28-50°C, minimum 2-12°C; annual rainfall from 550-1500 mm. The species is drought-resistant, strong light demander and readily suppressed under shade. It is not frost-hardy [7].

Phytochemistry of Different Parts of Mahua

Phytochemistry has undergone significant development in recent years as a distinct discipline. It is concerned with enormous variety of compounds that are synthesized and accumulated by plants and also deals with the structural characterization of these molecules [8,9].

Flower

Vitamins A and C.

Fruits

α- and β-amyrin acetates.

Seeds

Arachidic, linolelic, oleic, myrisic, palmitic and stearic acids, α-alanine, aspartic acid, cystine, glycine, isoleucine and leucine, lysine, methionine, proline, serine, threonine, myricetin, quercetin, Mi-saponin A and B.

Phytochemical Properties of Mahua

Phytochemical constituents are responsible for definite physiological action of the human body [10]. Phytochemicals are basically divided into two groups, i.e., primary and secondary constituents; according to their functions in plant metabolism [11]. Primary constituents comprise common sugars, amino acid, proteins and chlorophyll while secondary constituents consists of alkaloids, terpenoids, saponins, phenolic compounds, flavonoids, tannins and so on.

The phytochemical screening of plants gives the general idea about the class of compounds present in those plants [12]. In recent years, many plants are screened and newer bioactive compounds being isolated every day. Though the utility of plants basically depends on therapeutically effective active principles and therefore chemical tests are essential to identify the various constituents or groups present in the plants. These tests are either general or specific. The utility of medicinal plants has been organized by almost all societies of the earth and hence the plants are screened for phytochemicals [13,14].

Preliminary phytochemical studies were performed for methanolic extract of *Madhuca longifolia*. The results longifoliate the presence of alkaloids, tannins, proteins and carbohydrates (Table 1).

Constitutes	Observation
Alkaloids	+
Tannins	+
Proteins	+
Flavonoids	-
Carbohydrates	+
Ammino acids	-
Volatile oils	-

Table 1: Preliminary phytochemical screening of *Madhuca longifolia* [16].

Use of Mahuain Traditional Medicine

Flower

Flowers are used as tonic, analgesic and diuretic. Flowers have been traditionally used as cooling agent, tonic, aphrodisiac, and astringent, demulcent and for the treatment of helminths, acute and chronic tonsillitis, pharyngitis as well as bronchitis [15]. Also used as anthelmintic, demulcent, laxative, stimulant and tonic, fomentation with dried ones produces relief in orchids', decoction used as expectorant; beneficial in impotence due to general debility when administered with milk.

Fruits

Fruits are astringent and used in chronic tonsillitis and pharyngitis [16].

Seed

Fat obtained from mahua seeds has many medicinal applications. The seeds fat has emuluscent property, used in skin disease, rheumatism, headache, laxative, piles and sometimes as galactogogue. Also used as laxative in habitual constipation and piles, gummy juice applied in rheumatism and skin affection, oil used in skin disease.

Ethnomedical Uses of Different Parts of Mahua

Flower

In Indian system of medicine (The Ayurveda), the flowers of Mahua are reported to be cooling, aphrodisiac, galactagogue and carminative. They are also reported to be beneficial in heart diseases, burning sensation and ear complaints. The flowers fried in ghee (clarified butter) are eaten by people suffering from piles. Mahua flowers are also well known for their high reducing sugar and nutrient content. They are edible and used as a sweetener in preparation of many local dishes like halwa, kheer, puri and burfi in the Mahua production belt of India [17]. Mahua flowers have great potential as an alternative source of food in many parts of the world. However, the nutrient content of the flower deteriorates during postharvest storage, and hence, the true value of this natural product is not fully utilized. Das et al. [18] were quantified the reducing and non-reducing sugars, amino acids, proteins, lipids, ascorbic acid and ash contents every month for 1 year. LPS (laboratory processed samples) showed no change in biochemical constituents throughout the year and NPS (normally practiced samples) were distinct for deterioration of the tested components (Table 2).

In skin diseases, the juice of flowers is rubbed for oleation. It is also beneficial as a nasya (nasal drops) in diseases of the head due to pitta, like sinusitis. The decoction of the flowers is a valuable remedy for pitta diseases. As a general tonic, the powder of flowers works well with ghee and honey. The decoction of flowers quenches the thirst effectively. Because of its astringent property Mahua used in diarrhoea and colitis. In raktapitta, the fresh juice of flowers is used with great benefit to arrest the bleeding. The flowers play an important role in augmention

Constituents	Percentage (%)
Moisture	19.8
Protein	6.37
Fat	0.5
Reducing Sugar	50.62
Total Inverts	54.24
Cane Sugar	3..43
Total Sugar	54.06
Ash	4.36
Calcium	8
Phosphorus	2

Table 2: Nutritional properties of *Madhuca longifolia* flower [19].

the breast milk in lactating mothers and in boosting the quantity of seminal fluids also [7].

Physico-chemical and organoleptic properties of Mahua flower

Physico-chemical values such as the percentage of total ash, water soluble ash, and loss on drying, water soluble extractive and alcohol soluble extractive values were calculated as per the Indian Pharmacopoeia (Table 3) [19,20].

Organoleptic study of *Madhuca longifolia* flowers were performed on color, Odour, taste, surface and corolla (Table 4) [21].

Phytochemical screening of mahua flowers

Ethanolic and methanolic extract of *Madhuca longifolia* flowers were subjected to preliminary phytochemical study following the methodology of Kokate, Purohit and Gokhale [22]. In Table 5, ethanolic extract of *Madhuca longifolia* showed the presence of alkaloids, tannins, proteins, carbohydrates. Methanolic extract showed the presence of alkaloids, tannins, carbohydrates. Some of these phytoconstituents may be responsible for a potent anthelmintic activity.

Verma et al. [9], also reported the presence of phytochemical compounds in flower of *Madhuca longifolia*. Aqueous, ether, acetone and methanolic extracts of fresh flowers of *Madhuca longifolia* were investigated for eight principle bioactive compounds. Table 6 shows that out of all, carbohydrates, proteins, flavonoids and tannins were found to be positive in all four extracts while alkaloids were positive in aqueous and ether extract, saponins were positive only in methanolic extract. Sterol is positive in ether, acetone and methanol extract whereas lipid was found to be positive in aqueous, ether and methanolic extracts.

Health benefits of mahua flower

Anthelmintic activity: Katiyar et al. [23] 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). In Table 7 both extracts shows significant anthelmintic activity but methanolic extract demonstrated the best anthelmintic activity in both the parameters. Mebendazole was included in the assay as standard reference drug.

Antibacterial activity: Verma et al. [9] 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 (Table 8).

The flower has an antibacterial activity against the *Escherichia coli* and resist against rice pest disease [18].

Analgesic activity: The both aqueous and alcoholic extract of flowers of *Madhuca longifolia* posse's analgesic effect. The analgesic effect were screened through tail flick, hot plate and chemical graded doses of both aqueous and alcoholic extract of *Madhuca longifolia* (4.0 to 64.0 mg/kg, i.m. for 3 days) produced dose dependent analgesic effect in all the three nociceptive methods carried out either on rats or mice [15].

Hepatoprotective activity: The methanolic extract of flowers of *Madhuca longifolia* shows the hepatoprotective activity against paracetamol induced hepatotoxicity. Two doses of methanolic extract of *Madhuca longifolia* (100 and 200 mg/kg) were administered orally to the animals with hepatotoxicity induced by paracetamol (2 g/kg). The methanolic extract showed significant protective effect by lowering serum levels of various biochemical parameters such as serum glutamic oxaloacetictransaminase (SGOT), serum glutamic pyruvic transaminase (SGPT), serum alkaline phosphatase (ALP) and total bilirubin, and by increasing serum levels of total protein and albumin in the selected model [24].

Used in preparation of drug: Weerasooriya and Yatawara [25], reported that enzyme Invertase (*β-D-fructofuranosidase, EC 3.2.1.26)*, present in the flowers of *Madhuca longifolia* plays an important role during the preparation of fermented Ayurvedic drugs known as 'Arishta'. This enzyme was partially purified with a yield of 11.6%, using $(NH_4)_2SO_4$ fractionation, followed by gel filtration through Sepharose 4B and DEAE cellulose chromatography at pH 6.5 and 4.2.

Fruit

The fruits of *Madhuca longifolia* was reported to contain a number of triterpenoids including α- and β-amyrin acetates, 3β-monocaprylic ester of erythrodiol, 3β-capryloxyoleanolic acid and an acetate The

Parameters	Values obtained (%w/w)
Loss on drying	18%
Total ash value	0.184%
Water soluble ash	0.080%
Crude fibre content	15.5%
Alcohol soluble extractive	0.680%
Water soluble extractive	0.664%

Table 3: Physicochemical parameters of flowers of *Madhuca longifolia.*

Morphological characters	Result
Color	Brown
Odour	Sweet
Taste	Sweet
Surface	Longitudinal
Corollas	Fleshy

Table 4: Organoleptic properties of mahua flower.

Phytoconstituents	Test	Ethanolic extract	Methanolic extract
Alkaloids	Tannic acid test	+ve	+ve
Tannin	Lactic acid test	+ve	+ve
Proteins	Biuret test	+ve	-ve
Flavonoids	Alkaline reagent test	-ve	-ve
Carbohydrates	Molisch's test	+ve	+ve
Amino acids	Ninhydrin reagent test	-ve	-ve
Volatile oil	Sudan red III test	-ve	-ve
(+ve): Present, (-ve): Absent			

Table 5: Qualitative phytochemical analysis of the extracts of *Madhuca longifolia (Gmel)* flowers [23].

Test	Aqueous	Ether	Acetone	Methanolic
Alkaloids				
Mayers test	+	-	-	-
Dragendroff test	+	+	-	-
Wagners test	+	+	-	-
Carbohydrate				
Benedict test	+	-	+	+
Fehling test	-	+	+	+
Tollens test	-	-	-	-
SAPONIN				
Foam test	-	-	-	+
Proteins				
Xanthoprotein test	-	-	-	-
Biuret test	+	+	+	+
Flavanoids				
Flavanoid test	+	+	+	+
Tanins				
Ferric chloride test	-	-	+	-
Lead acetate test	+	+	+	+
Resin				
Resin test	-	-	-	-
Sterol				
Salkowaski test	-	+	+	+

Table 6: Results of phytochemical analysis of *Madhua longifolia* flowers.

Treatment	Concentration in mg/ml	Time taken for Paralysis (P) and Death (D) of *Pheritima posthuma* worms in min (Mean ± SEM)	
		P	D
Ethanolic Extract	20 mg/ml	66 ± 0.61	90 ± 0.28
	40 mg/ml	40 ± 0.40*	63 ± 0.40*
	60 mg/ml	22 ± 0.81**	45 ± 0.20**
Methanolic Extract	20 mg/ml	90 ± 0.61	110 ± 0.76
	40 mg/ml	74 ± 0.81**	95 ± 0.40**
	60 mg/ml	30 ± 0.76**	61 ± 0.61**
Mebendazole	20 mg/ml	62 ± 0.61	85 ± 0.28
	40 mg/ml	35 ± 0.36	50 ± 0. 24
	60 mg/ml	20 ± 0.20	46 ± 0.26
Control (Normal Saline)	-	-	-

All values are Mean ± SEM; n=6 in each group. Values are significantly different from reference standard (Piperazine citrate), *p<0.05; **p<0.01.

Table 7: Anthelmintic activity of ethanolic and methanolic extracts of *Madhuca longifolia Gmel* flowers.

other constituents isolated and characterized are n-hexacosanol, β-glucoside of β-sitosterol and free β-sitosterol. The nut-shell contains β-glucoside of β-sitosterol, quercetin and hydroquercetin [26].

Phytochemical compounds

Verma et al. [9] reported the presence of phytochemical compounds in fruits of *Madhuca longifolia*. Aqueous, ether, acetone and methanolic extracts of fresh fruits of *Madhuca longifolia* were investigated for eight principle bioactive compounds. Table 9 shows that out of all, proteins were found positive while alkaloids and resins were found negative in all four extracts. Carbohydrate was found positive in aqueous, acetone and methanolic while saponins and sterol were positive only in methanolic extract.

Health benefits of mahua fruit

Antibacterial activity: Antibacterial activity of fruits of *Madhuca longifolia* tested against *Bacillus subtilis* and *Klebsiella pneumonia in a*queous and methanolic extract. It was found that aqueous extract of fruit showed more activity than methanolic extract for both bacteria [9].

Seed

Heath benefits of Mahuaseed

Anti-inflammatory activity: Ramchandra et al. [27] evaluated the ethanol 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.

Antihyperglycemicactivity: 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 [16].

Antiulcer activity: The crude alkaloid extract and ethanolic extract of seeds of *Madhuca longifolia* were evaluated for anti-ulcer activity. The result shows that ethanolic extract was significantly effective in protecting pylorus ligation-induced gastric ulcers. The ethanolic extract at a dose level of 10 mg/kg showed a significant decrease in the

Test organism	Solvent	Zone of Inhibition			Average
Bacillus subtilis	Aqu	8	8	8	8
	Meth	-	-	-	-
Klebsiella pneumonia	Aqu	9	10	9	9.33
	Meth	7	6	7	6.77

Table 8: Antibacterial activity of flowers.

Test	Aqueous	Ether	Acetone	Methanolic
Alkaloids				
Mayers test	-	-	-	-
Dragendroff test	-	-	-	-
Wagners test	-	-	-	-
Carbohydrate				
Benedict test	+	-	+	+
Fehling test	-	-	+	+
Tollens test	-	-	-	-
Saponin				
Foam test	-	-	-	+
Proteins				
Xanthoprotein test	-	-	-	-
Biuret test	+	+	+	+
Flavanoids				
Flavanoid test	-	+	+	+
Tanins				
Ferric chloride test	+	-	+	-
Lead acetate test	-	-	+	+
Resin				
Resin test	-	-	-	-
Sterol				
Salkowaski test	-	-	-	+

Table 9: Results of phytochemical analysis of *Madhuca longifolia* fruits.

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 [16].

Anticancer activity: Bhaumik et al. [28] 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.

Use of Mahuaas a Food

Raw consumption of Mahua

In spite of being a rich source of nutrition and easy availability in the rural areas these flowers are not very popular as food. Only a small quantity of flowers is consumed raw, cooked or fried in different parts of India [29].

Utilization of mahua for processing of different food products

Sugar syrup: Abhyankar and Narayana [30]**,** reports on preparation of sugar syrup from dry mahua flowers, which can be further use as a sweeting agent in different food products.

Jam, Jelly, marmalade, pickle: Reuther, Webber and Batcher [31], reported that mature (full grown) but still unripe fruits are made into jam with addition of citric acid. The pulp is also converted into marmalade or syrup, which is used as food material. Jelly is also made from the pulp alone or combined with guava to modify the astringent flavour. The pulp is also pickled. Major quantity of flowers is used in the preparation of distilled liquors [29]. In 2008, Patel prepared the mahua jam and jelly by using fresh flowers [32]. The developed products were tested for their colour, flavour, taste, texture and overall acceptability, using hedonic test. According to the findings of hedonic test all the developed Mahua products were found to be highly acceptable.

Test organism	Solvent	Zone of Inhibition			Average
Bacillus subtilis	Aqu	7	8	7	7.33
	Meth	6	6	6	6
Klebsiella pneumonia	Aqu	8	8	7	7.67
	Meth	-	-	-	-

Table 10: Antibacterial activity of fruits.

Concentration of the Extracts (µg/mL)	Absorbance	Inhibition of Cell Growth (%)
10	1.519	62.61%
5	1.56	60.56%
2.5	1.62	57.54%
1.25	1.63	57.04%
Control	1.91	0

Table 11: For percentage (%) of cell growth inhibition of methanolic extract (E1) of fruit-seeds of *Madhuca longifolia* on He La cells by MTT assay.

Concentration of the Extracts (µg/mL)	Absorbance	Inhibition of Cell Growth (%)
10	1.518	64.61%
5	1.558	61.56%
2.5	1.59	59.94%
1.25	1.57	58.04%
Control	1.91	0

Table 12: For percentage (%) of cell growth inhibition of ethanolic extract (E2) of fruit-seeds of *Madhuca longifolia* on He La cells by MTT assay.

Concentration of the Extracts (µg/mL)	Absorbance	Inhibition of Cell Growth (%)
10	1.658	55.62%
5	1.745	51.56%
2.5	1.77	49.94%
1.25	1.811	45.04%
Control	1.91	0

Table 13: For percentage (%) of cell growth inhibition of acetone extract (E3) of fruit-seeds of *Madhuca longifolia* on He La cells by MTT assay.

Concentration of the Extracts (µg/mL)	Absorbance	Inhibition of Cell Growth (%)
10	1.560	60.1%
5	1.657	56.56%
2.5	1.745	51.94%
1.25	1.751	49.04%
Control	1.91	0

Table 14: For percentage (%) of cell growth inhibition of chloroform extract (E4) of fruit-seeds of *Madhuca longifolia* on He La cells by MTT assay.

Bakery and confectionary: Candy, biscuits and cake were prepared using the mahua concentrate as a liquid sweetener.

Puree and sauce: In 2008, Patel used fresh flowers and crushed it into puree (after manually removing the stamens) and processed it into sauce [32].

Fermented products: Dried Mahua flowers are an attractive source of fermented products due to the high sugar content. Preparation of mahua wine from fresh flowers has also been reported [33]. Malavade and Jadhav [34] mentioned that various products like alcohol, brandy, acetone, ethanol, lactic acid and other fermented product have been prepared from the dry mahua flowers.

In our experimental study we selected fresh Mahua flowers for value addition. The samples were procured from the local area of Gyanpur, Bhadohi. First dried the mahua flower and grind it into coarse powder then prepared laddu from it. We prepared mahua biscuit and cup-cake also by using mahua flower syrup as a sweeting agent. Mahua bar was also prepared by using mahua flower pulp. All the developed products were tested for their colour, flavour, taste, texture and overall acceptability, using hedonic test. According to the findings of hedonic test all the developed Mahua products were found to be highly acceptable.

On the basis of review of literature and experimental findings, a flow chart of using mahua flowers in different types of food products has been prepared and shown in Figure 1.

Other Uses

Recently, bacterial synthesis of poly (hydroxybutyrate-co-hydroxyvalerate) using Mahua flowers has been reported [35]. In 1930, Fowler and Gilbert prepared organic manure by adding Mahua flowers to the waste organic matter [36]. Study of Saha and Singh [37] reports the development of a new anti-bacterial mahua flower agar medium. Use of spent flowers (produced after fermentation and distillation) as cattle feed gave on whole favourable results as far as the health and milk production are concerned [38].

Conclusion

On the basis of review of literature it concluded that mahua (*Madhuca longifolia*) is a highly nutritious tree with lots of ethnomedical properties like antibacterial, anticancer, hepatoprotective,

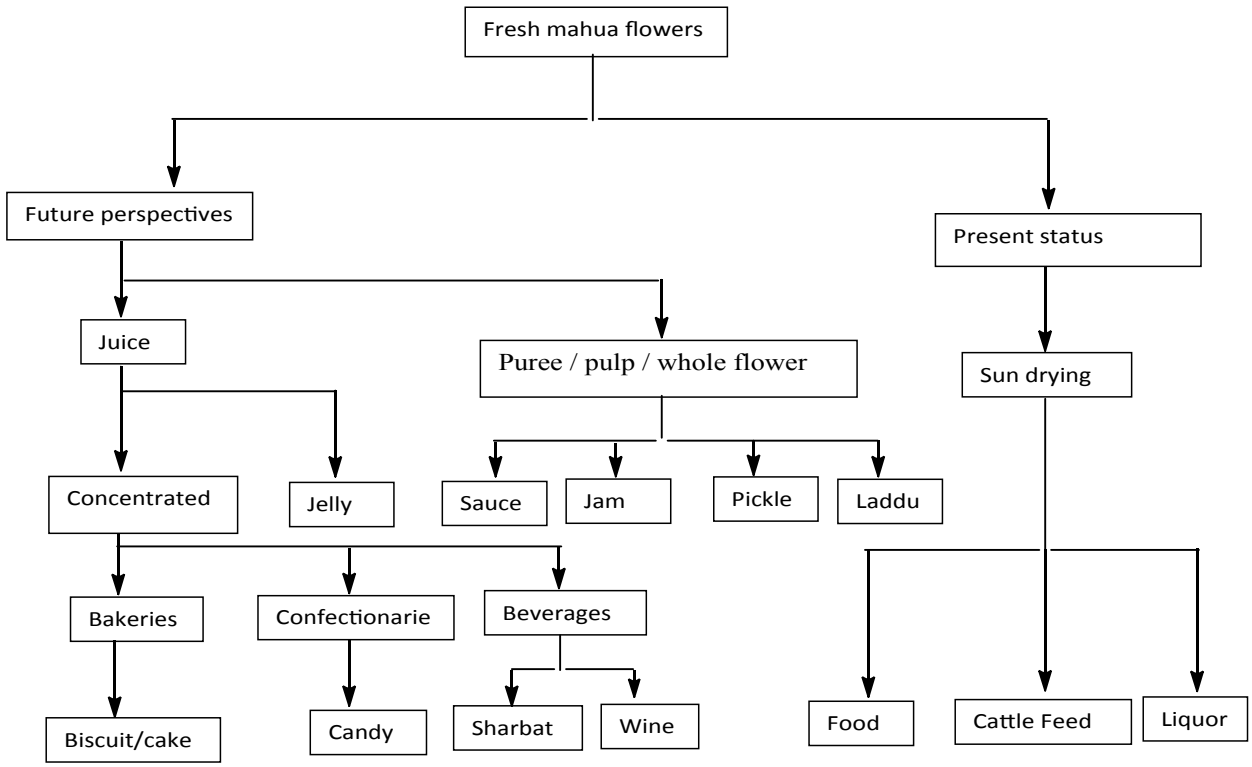

Figure 1: Uses of mahua flowers in different types of food products.

antihyperglycemic, analgesic activities etc. No. of research performed on flower, fruit and seed of mahua to highlight its medicinal properties, but only few experimental research performed for utilizing it as a food or food ingredient. Review shows that only mahua flower commercially used widely in manufacturing of liquor rather than preparation of food or medicine. Yet due to lack of appropriate knowledge and processing practices this highly nutritious and useful tree considered as underutilized. So now the time of diversion for commercial utilization of mahua flowers in different types of food products and fruit, seed will also be used in preparation of medicines. This effort may increase the employment and income generation potential of the nation.

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