

Mahua Flower (*Madhuca Indica*): Approach Of Functional, Nutritional Characteristics And An Accompaniment To Food Products

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DOI: 10.47750/pnr.2022.13.S09.1064

Abstract

Mahua trees play an important role in tribal people's economy and cultural values. Mahua (*Madhuca latifolia*) belongs to the Sapotaceae family. A tree grown in almost all parts of India, it includes the Chota Nagpur plateau area covering Jharkhand, Chhattisgarh, Bihar, West Bengal, Karnataka, Odisha and further west towards Madhya Pradesh, Maharashtra, and Gujarat. The Mahua tree is considered a butter tree in Indian forests and gives multiple benefits like food, fodder, and fuel. Mahua has medical, nutraceutical and economical properties. Every part of the Mahua tree is used for medicinal purposes, liquor production, biodiesel production or to develop food products. Mahua flowers are rich in nutritional attributes. Mahua flower is a rich source of nutrients like reducing and non-reducing sugar, polysaccharide, dietary fibres, protein, fat, minerals, vitamins, enzymes, and different organic acids. After the collection of mahua flowers, it is very much important to reduce the moisture of flowers to make them more stable for a long time. Few primitive value-added products are prepared by the tribal people who are used by them during the rainy season as well as during the scarcity of food grains. Mahua flowers are consumed traditionally as raw flowers, roasted flowers, mahua energy drinks, traditional liquor (suguda), sweet dishes, pancake (pitha) Biryani and Meat etc. The value-added products prepared by researchers such as confectionery and bakery products at home or pilot scale level. It is very much necessary to create industrial replication of syrups or products.

Keywords: Mahua Flower, Value addition, Reducing Sugar, Syrup

Introduction

In India, the mahua tree is considered a natural reward to the tribal community. Mahua has several undiscovered valuable properties. In India, more than 50% of forest revenue comes from NTFP (Non-timber forest products). NTFP is considered as the backbone of the Indian forest economy. Mahua is a seasonal flowering tree in an Indian forest. Except for the extreme northern part, the tree grows in almost all parts of India. It is found in the Chota Nagpur plateau area covering Jharkhand, Chhattisgarh, Bihar, West Bengal, Karnataka, Odisha and further west towards Madhya Pradesh, Maharashtra, and Gujarat. In the tribal economy, Mahua flower collection and selling is one of the most important sources of income [1]. Mahua trees give various tangible and intangible benefits to tribal people. In the forest, approximately 1500 INR income is generated from a single mahua tree by collecting and selling of flowers and seeds [2]. Research conducted by FGLG in 2008, shows income generated by selling Mahua flowers and seeds is very low which will not barter for daily needy items of tribal people due to the low market value of the product [3]. The mahua tree is a deciduous tree grown throughout the tropical and subtropical regions of the Indian subcontinent. This tree has vital socioeconomic values for tribal peoples. The income of the tribal also depends on the season. The season for the Mahua flower is very short. The flower is available from the month of March to May. Mahua ripens fruits available from June to August. One other reason some of the trees are inaccessible in the forest, so it is not possible to collect flowers. Middlemen or traders purchase dried flowers from tribal peoples in season at very minimal prices. As per Das's study in 2010, due to the lack of storage facilities,

selling flowers without value addition negative economic impact causes on the tribal. Low income gives perennial problems like hunger and malnutrition [4]. Research by Patel and Naik, 2010 research shows that value addition and processing help to generate more income, and employment for tribal and help to provide an affordable nutritional source to other people in society. To get all these results training and knowledge transfer about processing and value addition to tribal people are most important [5]. In India, most of the population considers Mahua has been used to make country liquor only which gives unwanted social consequences and promotes health usage of the plant. According to Panchayat Extension Scheduled Area (1996) Act, in India, all states have their own policies about Mahua. Recent policies show states have regulated transactional exchanges in Mahua and started to focus more on alternate uses of Mahua.

Vernacular Names

Mahua is also known as Atavimaduka in Sanskrit; Mungli in Hindi; Ippa, Madhukamu in Telugu; Iluppai, Kattillupi in Tamil; Mohuka, Mohulo in Odia; Illuppa, Iruppapu in Malayalam; Doddippa, Halippa in Kannada; Mahuva in Urdu; Moha, Mhowra in Marathi; Mahudo in Gujarati; Mahula, Kochra in Bengali. Mahua is a frost-resistant species that can grow in marginal areas of dry tropical and subtropical forests up to an altitude of 1200-1800 m, in India. It requires an annual temperature of 02-46°C, annual rainfall ranging from 550-1500 mm and annual humidity from 40-90%. Mahua trees are distributed from India to other Asian countries like The Philippines, Pakistan, and Sri Lanka to Australia.

Cultivation And Collection

Mahua flower is one of the most important non-timber forests produced (NTFP), playing a major role in the tribal economy of the country. The economic importance of mahua can be gauged from the fact that nearly three-fourths of entire tribal households in the country are involved in the collection of mahua flowers, which indicates approximately 7.5 million individuals are in this livelihood activity. The collection and trade of mahua flowers provide employment to 28,600 persons per year, whereas, the potential is 163,000 persons per year. The mahua flowers hold a special place in the lives of tribal communities. It is their source of livelihood, and their food and drink also come from it. And it is a crop for which they do not have to spend any money (as most of it grows naturally in the forests). Tribal generally barter mahua for daily grocery items, the value of which is considerably more than the actual value of mahua traded. On average, each person can collect about 70 kilograms (kg) of dry flowers in a good flowering season. Flowering occurs over four to six weeks (March to May). However, the collection period is for 15-20 days when maximum flowering takes place. The average annual yield of a mahua tree is 50.756 kg per tree.

Taxonomy of Mahua Tree

Mahua Kingdom-Plantae, Family-Sapotaceae, Subfamily-Sapotaceae, Tribes-Caesalpinieae, Genus- Madhuca, Species -Madhuca longifolia [6]. Mahua tree will grow in all kinds of soil as well as between crevices of barren rock. It will grow in rocky, gravelly, saline, sodic soil [7]. The mahua tree considered a butter tree in Indian forests gives multiple benefits like food, fodder, and fuel [8]. Mahua is one of the most important trees of Central India. The Mahua trees have a large spreading root system, though many of them are superficial. Wood is hard to very hard with large sapwood. Hardwood is reddish brown in colour. The height of the mahua tree is approximately 20 meters. Long, thick, pointed leaves found near the end of branches approximately 10 to 30 cm in length. Elephants attracted and ate Mahua branches in the forest region which contain a characteristic smell and higher sugar content in the flower [1]. Flowers bloom at night and fall on the ground before dawn. The flowers don't remain for a long time on the tree. It seems like a yellow carpet under the mahua tree after flower fall on the ground. The tribal community that collects flowers from the forest is called Gonds. Gonds sell flowers freshly or after drying to local traders. Lots of peoples not having a license for the direct selling of flowers so the middleman who has a licence collect flowers from the tribal and sells them further. The shelf-life of the mahua flower depends on drying and moisture content in the final flowers. Over time dried flowers absorb atmospheric moisture and spill because they are hygroscopic in nature. Mahua drink considered part of the cultural heritage in

Bastar in Chhattisgarh, Odisha, Santhals (Jharkhand) and North Maharashtra. Both men and women consume liquor or drink prepared from Mahua and consider them obligatory item during all type of celebration and evening activities. As research shown by Patel and Naik in 2008, shows difficulties faced by tribal because of a lack of post-harvesting processing technologies, and a lack of scientific support on value addition. Still, sun drying in the open yard is used as a common drying technique for drying flowers. Flower gets stored after sun drying and is used for selling in the local market [25].

Mahua Flower

Tribal peoples used the mahua flower as a sweetener in common dishes because of its sweetness. Sweetness is because of the high content of reduced sugar. Flowers are used as sweeteners in many local dishes like halwa, kheer, desserts, puri, burfi etc. [9]. Position of flowers in definite fascicle near the ends of tree branches. It was found drooping on the pedicels. The flowers look tiny approximately 2 cm in length. The colour of the flower varies from pale white to dull, and the texture looks like fleshy. Mahua corolla looks fleshy, tubular, and pale yellow. It gives a characteristic aroma so used as a flavouring agent in food dishes as well as in pickle preparation [9]. Addition of fresh mahua flowers while cooking rice gives a pleasant aroma or fragrances containing 2acetylpyrroline (2AP) [10]. The matured flower is used in cooking because once the flower gets mature, and the corolla becomes fleshy then only 2AP get synthesized [11]. The calyx is covered with rusty tomentum [12]. Mahua flower collection and sales consider an alternative economical practice for the tribal of Bihar, Madhya Pradesh, Himachal Pradesh, Orissa and Maharashtra [13].

Nutritional Characteristics of Mahua Flower

The mahua Tree is considered a powerhouse of nutrition in NTFP. Every part of the mahua tree is used for medicinal purposes, liquor production, biodiesel production or to develop food products. Mahua fat is the largest source of natural hard fat used as a substitute for cocoa butter or ghee and used in chocolate production. Mahua seed fat has emulsifying properties, so it is used in the manufacturing of laundry soaps and lubricants. Research and literature survey shows Mahua flower is a rich source of nutrients like reducing and non-reducing sugar, polysaccharide, dietary fibres, protein, fat, minerals, vitamins, enzymes, and different organic acids.

Particular	Mahua Flower (Ripe)	Mahua Flower (Dried)
Energy (Kcal/100g)	111.00	125.00
Moisture (g/100g)	86.40	11.61
Protein (g/100g)	1.40	6.67
Fat (g/100g)	1.60	0.50
Fiber (g/100g)		1.90
Total Sugar (g/100f)		54.06
Carbohydrate (g/100g)	22.70	68.00
Calcium (mg/100g)	45.00	139.00
Phosphorus (mg/100g)	22.00	137.00
Iron (mg/100g)	0.23	
Thiamine (mg/100g)		0.03
Riboflavin (mg/100g)		0.87
Niacin (mg/100g)		4.80

Table No. 01 Nutritional composting of Mahua Flower

The sugar content of dried Mahua flower was found 40-70%. The sugar content of flowers depends on geographical region, collection of flowers and variety of Mahua [16-19]. Research shows reducing sugar and non-reducing sugar content also varies from 48-57% and 3-18 respectively [17-20]. To extract different polysaccharides, the hydrolysed and unhydrolyzed extraction method was used for the mahua flower. Research shows maltose, sucrose, glucose, arabinose, fructose and rhamnose found in unhydrolyzed extraction and analysed by paper chromatographic analysis. Galacturonic acid along with maltose, glucose, arabinose, fructose and rhamnose found in the hydrolysed extract [17]. In hydrolysed extract sucrose was absent. Polysaccharide

structures were also studied after extraction and isolation from the mahua flower [21-23]. Fresh juice prepared from mahua flower. After the concentration of fresh juice, it was found rich in sugar and a rich source of natural sweeteners i.e., 1:2.1:2.3 sucrose, glucose, and fructose[24]. Protein and nitrogen content varies on stages of maturity of flowers. Tender flowers found more nitrogen than matured flowers [25]. The percentage of nitrogen and protein was found 0.65 – 1.1% and 4.4 – 7% respectively. It shows that the mahua flower is a rich source of protein [26,18,19]. Mahua flower shows rich in essential amino acids [17-19].

Mahua Flower Micronutrient Profiling

Amino Acids	g/100g
Isoleucine	7.91
Leucine	12.98
Lysine	4.67
Phenylalanine	6.4
Tyrosine	3.94
Cystine	3.35
Threonine	5.86
Methionine	1.8
Valine	7.25

Table No. 02 Amino Acid Profile of Mahua Flowers [22]

Mahua kernel oil [27] have much more fat content than flowers [14,17-19]. Research shows dried Mahua flower content 0.09 – 1.3% fat content. The mahua flower called as Corolla of the plant is a rich source of vitamins and minerals [28-29]. Research shows, Mahua flower analysis on loss on drying, total ash, water-soluble ash and crude fibre content 18%, 0.184%, 0.080% and 15.5% respectively. As per Indian Pharmacopoeia, results show 0.680% and 0.664% water-soluble extractive and alcohol-soluble extractive respectively [37-38].

<p>Mahua flower - Minerals Profile [17-18,30-31]</p> <ol style="list-style-type: none"> 1. Calcium 0.14 – 0.25% 2. Phosphorous 0.13 – 0.14% 3. Iron 0.015 – 0.03% 4. Potassium 1.2% 5. Sodium 0.02% 6. Magnesium 0.21% 	<p>Mahua flower - Vitamin Profile [14,18,19,30]</p> <ol style="list-style-type: none"> 1. Thiamine 2. Riboflavin 3. Niacin 4. Folic acid 5. Ascorbic acid
<p>Mahua flower - Enzyme Profile [25]</p> <ol style="list-style-type: none"> 1. Amylase 2. Maltase 3. Invertase 4. Catalase 5. Oxidase <p>Ascorbic acid oxidase [</p>	<p>Mahua flower – Specific Compositional Profile [30]</p> <ol style="list-style-type: none"> 1. Succinic acid 2. Betaine 3. Malic acid 4. Crude pigment 5. Tannin 6. Essential oil [25] 7. Anthocyanins 8. Salts [32-34] 9. Alkaloids, Phenolic compounds, Flavonoids, Tannins, Sterols, and saponins [35]

Table No. 03 Micronutrient Profile of Mahua Flowers

Constituents	Tests	Ethanollic Extract	Methanolic Extract
Alkaloids	Tannic Acid Test	+ve (Present)	+ve (Present)
Tannins	Lactic Acid Test	+ve (Present)	-ve (absent)
Proteins	Biuret Test	+ve (Present)	-ve (absent)
Flavonoids	Alkaline reagent test	-ve (absent)	-ve (absent)
Carbohydrates	Molisch's test	+ve (Present)	+ve (Present)
Amino Acids	Ninhydrin reagent test	-ve (absent)	-ve (absent)
Volatile oils	Sudan red III test	-ve (absent)	-ve (absent)

Table No. 04 Phytochemical Analysis of Mahua Flowers [36]

Ethanollic Extraction	Methanolic Extraction
alkaloids, tannins, proteins, carbohydrates	alkaloids, tannins, carbohydrates
Some of these Phyto-constituents may be responsible for a potent anthelmintic activity.	

Table No. 05 Phytochemical screening of mahua flowers [40]

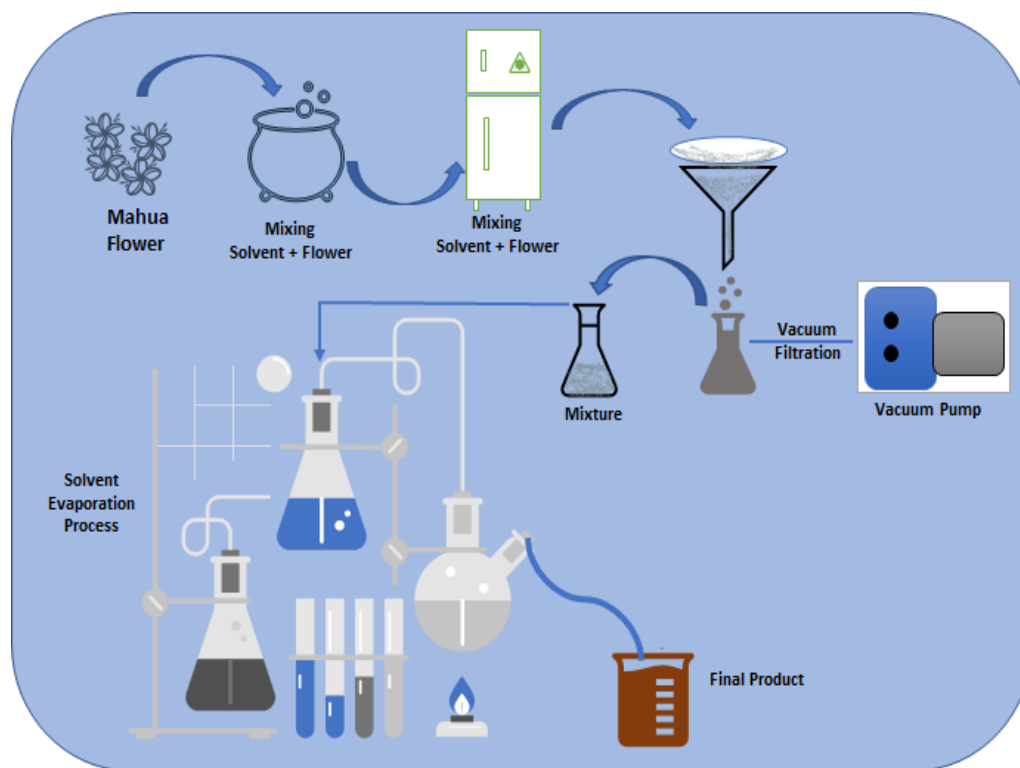


Figure No. 01 Alcoholic Extraction of Mahua Flowers

Four extraction methods used for the analysis of fresh mahua flowers i.e., aqueous, ether, acetone and methanolic extraction and it was eight principle bioactive compounds found after analysis.

<p><u>Aqueous Extraction</u> Found the following component present -</p> <ol style="list-style-type: none"> 1. Alkaloids 2. Carbohydrates 3. Protein 4. Flavonoids 5. Tannins 	<p><u>Ether Extraction</u> Found the following component present</p> <ol style="list-style-type: none"> 1. Alkaloids 2. Carbohydrates 3. Protein 4. Flavonoids 5. Tannins 6. Sterol
<p><u>Acetone Extraction</u> Found the following component present -</p> <ol style="list-style-type: none"> 1. Carbohydrates 2. Protein 3. Flavonoids 4. Tannins 5. Sterol 	<p><u>Methanolic Extraction</u> Found the following component present -</p> <ol style="list-style-type: none"> 1. Carbohydrates 2. Protein 3. Flavonoids 4. Tannins 5. Sterol

Table No. 06 Extraction Methods and Components of Mahua Flowers

Organoleptic Study

An organoleptic study of *Madhuca longifolia* flowers was performed on colour, Odour, taste, surface, and corolla. It was found flowers are brown in colour, sweet in odour & taste, and corollas are fleshy and have a surface area in longitudinal dimension [39].

Pharmacological and Medicinal Characteristics of the Mahua Flower

As per research conducted by Dinesh Chandra in 2001, aqueous and alcoholic extracts of the Mahua flower are used in analgesic activities [41]. It also shows hepatoprotective activities [42]. The juice of flowers is used for recovering from skin diseases [43]. Flowers are also used as a Tonic, analgesic, and diuretic [44]. Roasted flowers are used for curing cough [45]. Mahua is used for recovering skin diseases. The Flower decoction is used as a traditional remedy for recovering from pitta disease, this also helps in quenching the thirst. Akshatha KN in 2013, research shows mahua flower plays a very helpful role in improving breast milk in lactating mothers and acts as a booster for seminal fluids [46]. In Ayurveda, the mahua tree is considered an important medicinal plant. It is used as a cooling, aphrodisiac, galactagogue and carminative. It is also used for recovering from heart diseases, burning sensations and ear complaints. A person who suffers from piles problem suggests eating ghee-fried mahua flower. Mahua has medical, nutraceutical and economical properties. Mahua is used as a medicinal remedy in hepatoprotective, wound healing, anti-burns, emollient, skin disease, rheumatism, headache, laxative, anti-haemorrhoids, bronchitis, anti-ulcer, astringent, tonsillitis, swelling gum, diabetes, stomach-ache, anti-snake bite, increase milk production in lactating women, diuretic etc. Mahua helps to increase immunity, facilitate digestion, and act as an antioxidant, and stimulant, used as a tonic and act as an energetic agent, it boosts glucose level [47-49].

Macroscopic Characteristics

Part	Active Ingredients	Properties
Leaves	B-carotene, xanthophylls, erthrodiol, palmitic acid, myricetin and its 3-O-arabionoside and 3-O-L-rhamnoside, quercetin, 3-galactoside, 3 β -palmitoxy-olean-12-en-28-ol, oleanolic acid, β -sitosterol and its 3-O- β -D-glucoside, stigmasterol, β -sitosterol- β -D-glucoside, n-hecacosanol, 3- β -caproxyolcan-12-en-28-ol, n-octacosanol, sitosterol.	Wound healing, hepatoprotective, antioxidant, antimicrobial, astringent, stimulant, emollient, demulcent, rheumatism, piles, nutritive, verminosis, gastropathy, dipsia, bronchitis, dermatopathy, cephalgia, haemorrhoids and Cushing's disease
Root	Amino Acids, Organic Acids, Enzymes	Antipyretic, anti-inflammatory, antioxidant, phthisis and scrofula, diarrhoea and chronic fluxes
Flower	Vitamin A and Vitamin C	Tonic, analgesic diuretic, cooling agent, aphrodisiac, astringent, demulcent, helminths, acute and chronic tonsillitis, pharyngitis as well as bronchitis
Fruit	n-hexacosanol, quercetin and dihydroquercetin, β -sitosterol and its 3 β -D-glucoside, α and β - amyryn acetates.	Astringent, lotion in chronic ulcers, acute and chronic tonsillitis and pharyngitis.
Seeds	Arachidic, linoleic, oleic, myristic, palmitic and stearic acids, α -alanine, aspartic acid, cystine, glycine, isoleucine and leucine, lysine, methionine, proline, serine, threonine, myricetin, quercetin, Misaponin A and B.	Emuluscent, skin disease, rheumatism, headache, laxative, piles and galactagogue
Bark	Ethylcinnamate, sesquiterene alcohol, α -tocopherol, 3 β -monocaprylic ester of eythrodiol and 3 β -capryloxy oleanolic acid, α and β -amyryn acetates.	Itch, swelling, fractures, rheumatism, bleeding spongy gums, ulcer and tonsillitis, skin diseases, epilepsy, pneumonia and piles.

Table No.07 Microscopic characterises of Mahua Plant Parts[41-49]

Food Applications - An Accompaniment To Food Products

After collecting mahua flowers it is very important to reduce the moisture of the flowers to make them more stable for a long time. After collection flowers should be spread in an open space to avoid spoilage of flowers. For drying, it takes up to 5 days. Over-drying will cause weight reduction and deterioration of the quality of the flowers. Tribal people not having adequate facilities for drying so peoples use the front and back of houses prepared from mud and cow dung. Problems like lack of scientific knowledge, inadequate market linkage for getting proper prices, exploitation from middlemen and trades faced by tribal peoples.

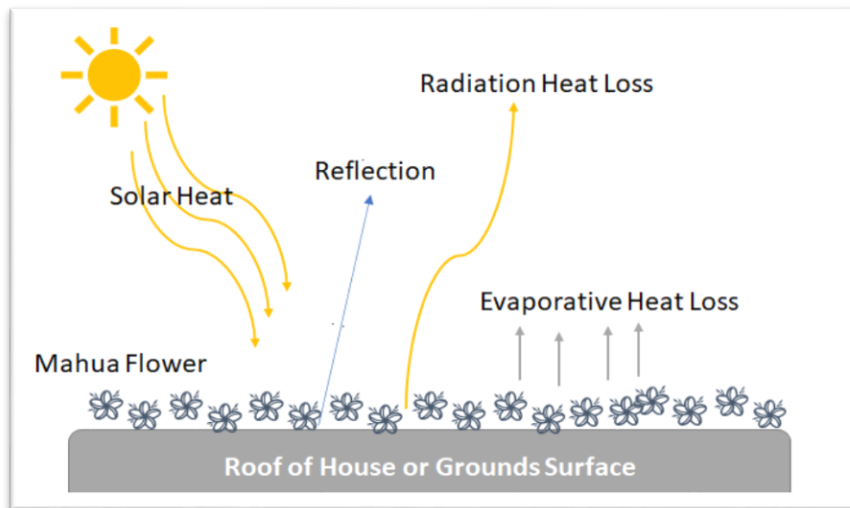


Figure No. 02 Traditional Drying method of Mahua Flowers

Use Of Mahua As A Food

Mahua tree and flower have great spiritual, cultural, medicinal, and ornamental and multiple utilities. Forest departments of different states of India realised the cultural, health and economical importance of mahua and tried to promote the utilization of flowers in commercial-scope products like jams, squashes, biscuits, Pickles, laddoo, and jellies. Initiatives taken by the forest department aim at diversification of the application of mahua flowers. It will help to build rich cultural capital who dependent on modest forest wealth.

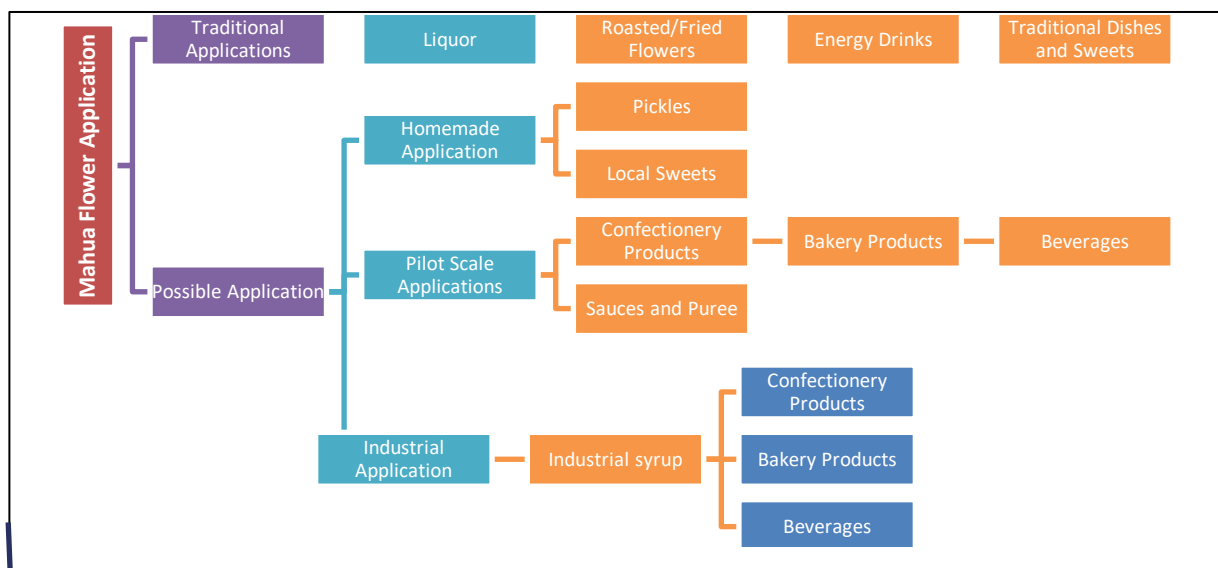


Figure No.03 Application of Mahua Flowers

Traditional Preparation of Mahua Products

Few primitive value-added products are prepared by the tribal people who are used by them during the rainy season as well as during the scarcity of food grains such as:

Raw Consumption of Mahua

A Wealth of India, 1962, research shows tribal peoples consume raw, cooked or fried mahua flower to satisfy hunger [50]

Roasted Mahua Flower

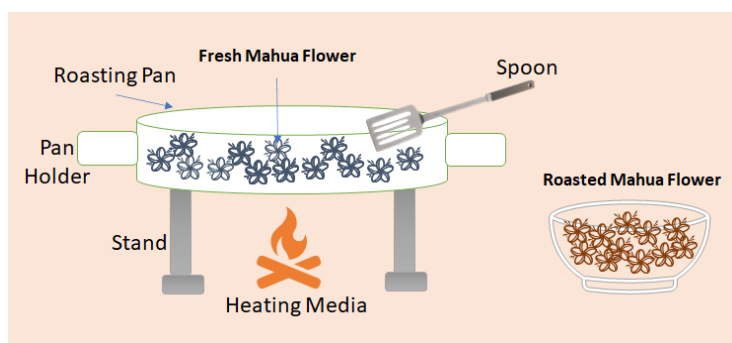


Figure No. 04 Roasting of Mahua Flowers

Tribal people traditionally used dried, clean without stamen Mahua flower for the preparation of roasted snacks. Flowers roasted in an earthen pan. Continuous stirring is required for uniform roasting. Roasted snacks become ready by adding garlic and chilli powder. It is used for treatment of chronic bronchitis problem and also used in the treatment of cough, throat infection.

Boiled Mahua Flower

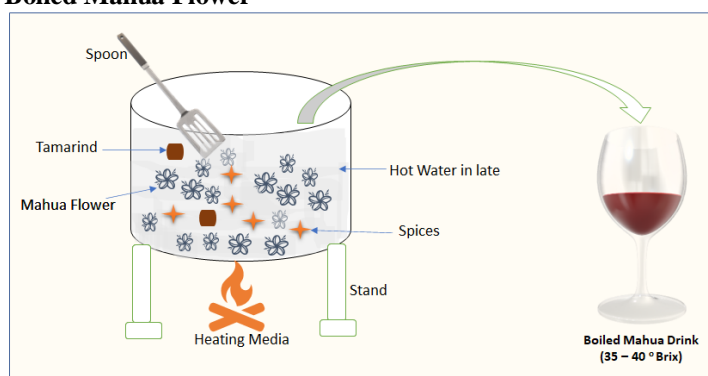


Figure No. 05 Drink Preparation of Mahua Flowers

Traditional drinks are also made by the addition of spices in boiled flowers. The concentration of boiled drink is up to 35 – 40%. Tamarind seed is also added for improving the taste of the drink. It was officially given "heritage liquor" status in 2021. Dried mahua flowers are used to produce fermented products and country liquor. The marginalised Adivasis are historically known to have distilled alcoholic beverage from mahua flowers since centuries. Making mahua liquor has been a part of Adivasi culture from time immemorial, with traditional distillation methods used for the distinctive white flowers.

Preparation of Traditional Liquor (Suguda) by the Tribal:

Suguda is traditional fermented liquor made by fermenting mahua flower with tablets prepared from different herbs. Fermentation happens after 7 to 10 days. After fermentation mixture is strained and the liquid is used as a drink.

Preparation of Sweet Dishes

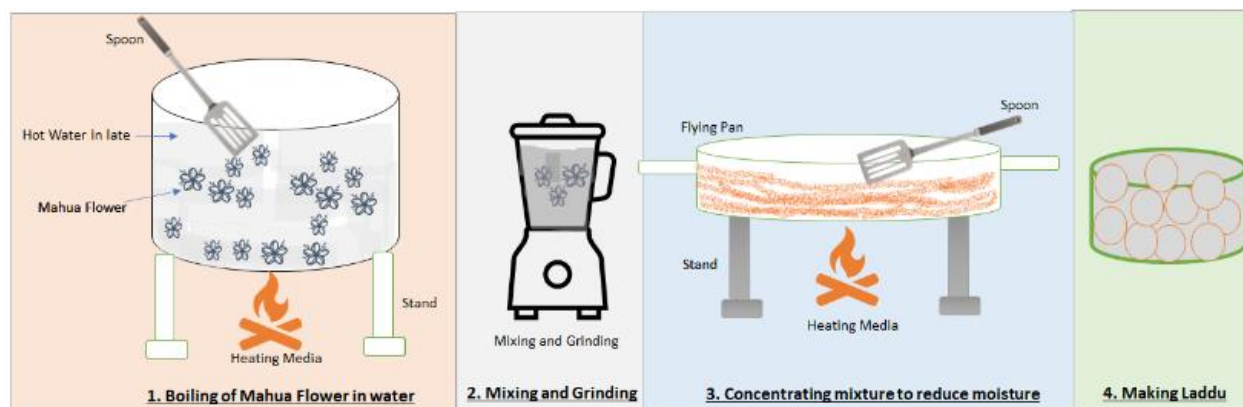


Figure No. 06 Sweet Dish Preparation of Mahua Flowers

Pulp prepared by boiling and grinding cleaned Mahua flower. After straining, the liquid portion was collected and concentrated to desired consistency. Add mahua pulp and heat with continuous stirring. Laddu stored in an airtight earthen container will remain a shelf life of more than a year. Due to the high content of sugar in the mahua flower, it is used in many regional sweet dishes in India like halwa, kheer, puri and burfi [51]. A sweet dish prepared in the Chhattisgarh state of India by frying clean Mahua flowers in desi ghee or butter. To make it sweeter may add extra sugar but the flower has sugar. This dish helps to get more milk in lactating mothers [52-55].

Pancake (Mahua Pitha):

The fruits of the mahua ripen several weeks after the flowers fall, around June. The rind and flesh of the fruit are coveted seasonal ingredients to cook with in rural kitchens. In Odisha, where it is called, the fleshy fruit is thoroughly cleaned, deseeded, cut into slices and parboiled before being stir-fried with mustard, garlic, chillies and cumin, ground up into a paste. The top is also cooked into piquant curries or tossed into a chat with black gram and a few spices. Alternatively, the fruit is smashed lightly, dredged in rice flour spiked with cumin seeds and chillies, and shallow fried on a griddle to make pithau bhaja.

Biryani And Meat

Rice cooked in mahua liquor, and chicken cooked on a leisurely flame with fresh mahua flowers and finished with a drizzle of mahua liquor. The second recipe originally used game meat, perhaps in the mahua-strewn forests of the region.

Value Added Products

Mahua Syrup

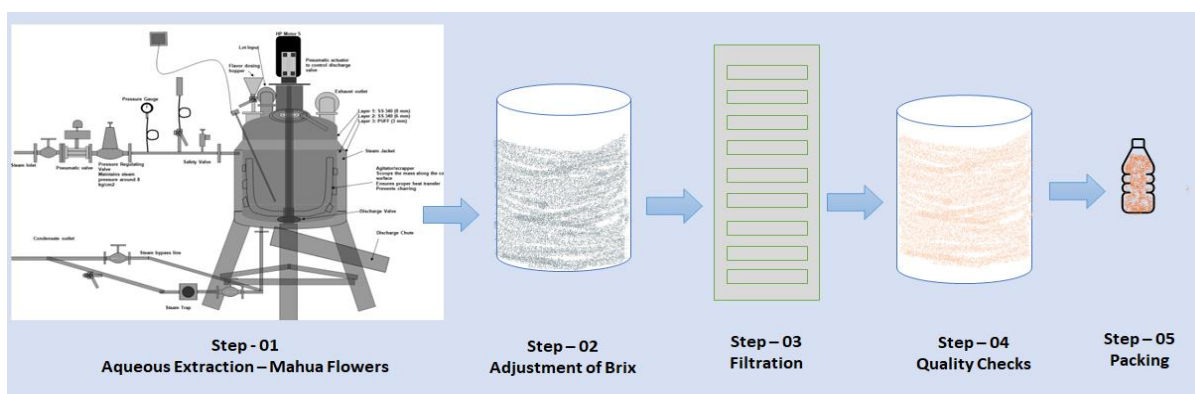


Figure No. 07 Syrup Preparation of Mahua Flowers

Different research shows the preparation of syrup is possible from dried Mahua flowers. This is used in the fermentation process due to its sweetness. The water extraction method is used for the preparation of syrup. The aqueous extracted syrup gives a dark colour syrup. Slacked lime and activated charcoal (3.5 – 5.0%) used as the best were clarifying agents for Mahua syrup. CSIR, 2006 report shows, Mahua syrup is used as a sweetening agent in confectionery products [56], and syrup is also in other food products [57]. Preparation of syrup is easy technology by making aqueous extraction of dried flower. The concentration of syrup increases by evaporation of water from syrup [52,54,58].

Fermented Products

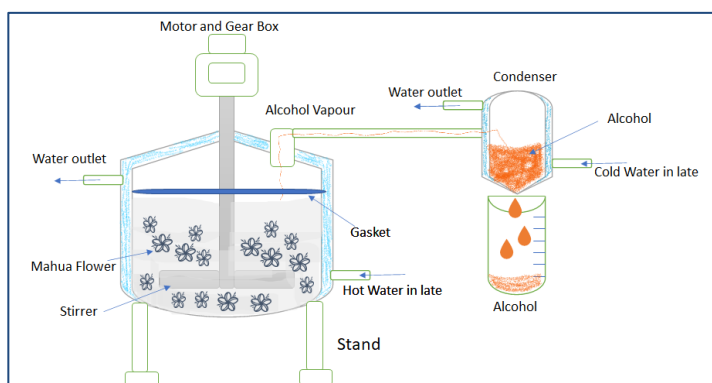


Figure No. 08 Liquor Preparation - Mahua Flowers

Most common product is distilled liquor from Mahua flower. Among the non-alcoholic beverages which they consume as cooling or refreshment drinks generally in summers are prepared from various plant species [59]. As per Adhikary Mahua flower used for various applications like distilled liquor, portable spirits, vinegar and feed for livestock production [60]. Freshly collected Mahua flower used for wine [61] dried used for production of fermented products like alcohol, brandy, acetone, ethanol, lactic acid, etc. [62].

Jam, Jelly, Marmalade, Pickle

It was found Mahua food products were highly acceptable in all sensory attributes like colour, flavour, taste, texture, mouthfeel, overall acceptability etc. As research showed by Reuther in 1967, the utilization of mature unripe Mahua fruit in jam preparation along with citric acid [63]. The fruit pulp is used in marmalade, syrup, Pickles, and jelly and is used to mask the astringent flavour of guava. Fresh flowers are also used in the preparation of Jam and Jelly [64]. The mahua jam and jelly by using fresh flowers. The developed products were tested for their colour, flavour, taste, texture, and overall acceptability, using the hedonic test. According to the findings of the hedonic test all the developed Mahua products were found to be highly acceptable. For the preparation of Jelly clean Mahua flower soaked in water overnight. Soaked flower heated and mashed properly in fruit masher. Pectin and sugar are added to form jelly properly [52-55].

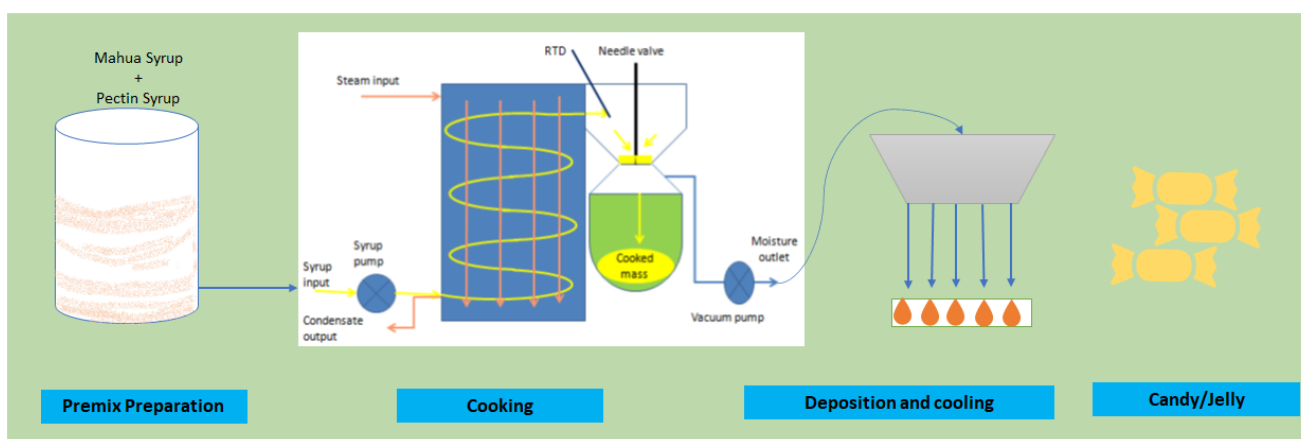


Figure No. 09 Jelly Preparation - Mahua Flowers

Bakery and Confectionary

Candy, biscuits, and cake were prepared using the mahua concentrate as a liquid sweetener. Commercial application of Mahua flower in bakery and confectionery application was not found in research. On small scale, Freshly baked cookies made of millet and mahua are popular with customers.

Puree and Sauce

Fresh flowers are used for the preparation of puree and Puree further processed into the sauce by removing the stamens of Mahua flowers.

Discussion

The mahua tree is a powerhouse of nutrients and benefits. Various research, online data, books, and survey related to its nutritional attributes and application in the food product are compiled in this review article. After reviewing all data, it is easy to conclude that the industrial application of Mahua flower-based products is not available in the market. Most of the value-added products are not yet commercialized at a large scale. Mahua flower is a rich source of different sugars. If it is possible to convert Mahua flower to industrial syrup and demonstrate its application in confectionery products as an alternative to industrial raw materials such as liquid glucose or high maltose corn syrup will help the sweet industry. This syrup will add nutritional attributes to confectionery products.

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