



E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; 7(2): 3414-3418
Received: 17-01-2018
Accepted: 18-02-2018

Vinita Bisht
Mewar University, Chittorgarh,
Rajasthan, India

Neeraj
Mewar University, Chittorgarh,
Rajasthan, India

Vishnu Kanwar Solanki
Mewar University, Chittorgarh,
Rajasthan, India

Nidhi Dalal
Mewar University, Chittorgarh,
Rajasthan, India

Correspondence
Vinita Bisht
Mewar University, Chittorgarh,
Rajasthan, India

Mahua an important Indian species: A review

Vinita Bisht, Neeraj, Vishnu Kanwar Solanki and Nidhi Dalal

Abstract

Madhuca latifolia or *Madhuca indica* commonly called as Mahua is such a kind of tree involved in day to day activity of tribal people. It belongs to the family Sapotaceae, an important economic tree growing throughout India. The Mahua tree is medium sized to large deciduous tree, usually with a short bole and a large rounded crown. Mahua flower are used as a food as well as used as an exchanger in tribal and rural areas. It is also used by wild animals as food. Mahua seeds are rich in edible oil so they have economic importance. Mahua fruits are used as vegetable. *Madhuca longifolia* is also considered as medicinal tree and is useful for external application in treating skin diseases, rheumatism, headache, chronic constipation, piles, haemorrhoids and ethno medical 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. Mahua oil is used for manufacturer of laundry soaps and detergent, and also used as cooking oil in various tribal region of India. *Madhuca longifolia* is reported by various scientist that it contain sapogenins, triterpenoids, steroids, saponins, flavonoids and glycosides. The tree is considered a boon by the tribal's who are forest dwellers and keenly conserve this tree. The tribes consider the mahua tree and the mahua drink as part of their cultural heritage. So it is very much necessary to create awareness among the people to conserve the forest.

Keywords: flavonoids, mahua, skin diseases, sapotaceae, tree, vegetable

Introduction

Mahua is one of the most important trees of Central India. The Mahua trees have 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. It is large and deciduous trees with a short Bole and rounded crown. Mahua has a special status among NTFPs as it is linked to the tribal livelihood systems in different ways. Apart from meeting food and other requirements, it is also an important source of seasonal income. Its flowers are used to brew country liquor which is very popular in the tribal areas of the country. The tree has religious and aesthetic value in tribal culture. Mahua flowers and seeds, which have medicinal and nutritional properties, are collected and dried. One single mature tree can provide an income of about Rs. 1500 from its flowers and seeds, in addition to various other tangible and intangible benefits (Kulkarni *et al.*, 2013) [16]. Mahua provides livelihood security to poor households who collect it both for self consumption and for sale the income is used to purchase daily household items. However, in most tribal areas, Mahua gatherers rarely get the true value of produce, which they usually barter for daily grocery items (FGLG, 2008) [12].

Mahua, the Indian Butter Tree (*Madhuca longifolia* (Koenig) J.F. Macbride) is an important tree having vital socioeconomic value and growing throughout the tropical and subtropical region of the Indian subcontinent. It is a deciduous tree that grows widely under dry tropical and subtropical climatic conditions. It is very hardy and thrives well on rocky, gravely, saline and sodic soils, even in pockets of soil between crevices of barren rock (Singh, 1998) [34]. Mahua (*Madhuca indica* J.F. Gmel. syn. *Madhuca latifolia* Macb.) belonging to the family Sapotaceae (Banerji and Mitra., 1996) [8]. It is one of those multipurpose forest tree species that provide an answer for the three major Fs i.e food, fodder and fuel (Patel *et al.*, 2011) [25]. Fruits are eaten as raw or cooked. The fruit pulp may be utilized as source of sugar, whereas the dry husk makes a good source of alcoholic fermentation. Seeds are good source of oil (Singh *et al.*, 2005). The tree, known under the name of mahua, produces edible flowers and fruits (Jayasree *et al.*, 1998). The leaves of Mahua tree contain saponin, an alkaloid glucoside. Sapogenin and other basic acid have been found in the seeds. Mahua flowers are well known for their high reducing sugar and nutrient content. Flowers of the plant are edible. The corolla commonly called as mahua flowers is a rich source of sugar containing appreciable amount of vitamins and minerals (Singh and Singh, 2005) [35, 36]. The flowers are also used in preparation

of distilled liquor, portable spirits, vinegar and feed for livestock (Adhikary and Adhikary, 1989) [2]. Midya and Brahmachary (1996) [19] reported that the fresh flowers of Mahua (*B. latifolia* Roxb.), that emit fragrance contain 2acetylpyrroline (2AP), the compound responsible for pleasant aroma in basmati and other scented rice. It was found that 2AP gets synthesized only in fleshy corolla of mature flowers (Wakte *et al.*, 2011) [41]. They are edible and used as a sweetener in preparation of many local dishes like halwa, kheer, puri and burfi (Patel and Naik, 2008) [25] in the mahua production belt of India. However, due to the lack of proper scientific investigation and post harvest processing technologies, they are collected and subjected to open yard sun drying till about 80% moisture is lost, before storage (Patel and Naik, 2008) [25].

Climate and soil: Mahua prefers tropical climate. It can withstand drought admirably. This tree does not survive under waterlogged conditions. Since it is a very hardy tree, it can grow even in pockets of soil between crevices of barren rocks. Trees even grow on degraded rocky areas including salt-affected soils. However, for its better growth and productivity, well drained, deep loam soil is ideal.



Fig 1: Parts of *Madhuca longifolia*

Used in tribal medicine: In diarrhoea a cup of infusion of bark is taken orally twice a day by the tribals. Besides the stem bark is used in chronic tonsillitis, leprosy and fever (Kirtikar and Basu, 2001) [15]. It is commonly used for the treatment of snakebite as antidote for southern part of Tamilnadu, India (Ramar *et al.*, 2008) [28]. Decoction of stem bark is used to cure skin disease, hydrocoel and skin disease (Ayyanar and Ignacimuttu, 2005; Joseph, 2008) [7, 14]. Powdered bark is employed for the treatment of scabies. *Madhuca longifolia* leaves are expectorant and also used for chronic bronchitis and Cushing's disease (Prajapati *et al.*, 2008). The leaves are applied as a poultice to relieve eczema.

Phytochemical: The therapeutic value of the plant depends on the active constituents present inside the different part of the plant, which may be present in the small or large quantity (Sardana and Sharma, 2009) [30]. The secondary metabolites are the important substance responsible for the main medicinal properties in the crude drugs (Sengar and Agarwal, 2009) [31]. The leaves of Mahua tree contain saponin, an alkaloid, and glucoside. Sapogenin and other basic acid are found in the seeds. Various Photochemical studies on Mahua include characterization of Sapogenin, triterpenoids, steroids, saponin, flavonoids and glycosides. In view of the aides and attributed medicinal properties new components including

Cultivation and Collection - This plant can be cultivated or self sown (Behl and Sriwasrawa, 2002) [9]. Flowering of this medium sized tree take place during the season of March to April, in every years.

Botanical Description and Identification Features - A medium sized to large deciduous tree, usually with a short, hole and large rounded crown found throughout the green forest part of India up to an altitude of 1,200 meter and of 12 to 15 meter height, bark thick dark colored cracked, inner bark dark red, milk, trunk short, branches numerous (Behl and Sriwasrawa, 2002) [9]. Leaves are 10-30 centimeter long, are thick and leathery most of leaves pointed at the tip, clustescnt glabred near end of branches, epileptic or elliptic oblong 7.5 to 23 cm into 3.8 to 11.5 cm. coriaceous pubeand when young almost. Flowers are small and fleshy, dull or pale white in color and in define fascicles near end of branches. Corolla tubular, freshly pale, yellow aromatic and caduceus (Variers and Vaidyarathanam, 1995) [40]. Fruits are 2-6 cm long, fleshy and greenish. Bark dark color, cracked (CSIR, 2006) [4].

madhucic acid (penta cyclic triterpenoids), madhushazone, four new oleanane type triterpene glycosides and madhucosides A and B (Siddiqui *et al.*, 2010) [10]. The fresh flower of Mahua contains 2 acetyl 1 pyrroline, the aroma molecule. They also contain polysacheride which on hydrolysis give D-galactose, Dglucose, L-araninose, L-rhamose, D- xylose and D-glucuronic acid (Miller, L.G. 2005) [20]. To establish the pharmacological activity of particular crude drug is known as the pharmacological screening, and it is important for prediction of activity (Ansari, S.H. 2007) [6].

Active Constituent Present in Different Parts of *Madhuca indica* (Source-Wealth of India, 2007)

Plant Part	Phytoconstituents
Bark	Flavonoids, Triterpene, Sterol
Latex	Soluble Resin, Insoluble Resin
Leaf	Moisture, Organic Matter, Minerals, Potas (K ₂ O) Phosphoric Acid (P ₂ O ₅) Silica, Alkaloids, Flavonoids, Protobasic Acid
Flower	Carotene, Ascobic Acid, Thiamine, Riboflavine, Niacine, Folic Acid, Biotine, Inositol
Ripe seed	Moisture, Protein, Fat, Carbohydrates, Minerals, Calcium, Phosphoras, iron, Carotene, Ascorbic Acid, Tannins

Table 1: Traditional uses of *Madhuca longifolia* in India

S.no.	Tree part(s)	Ethno medical Uses	Reference(s)
1.	Seeds cake	Anti-inflammatory, anti ulcer, and hypoglycaemic activity	Seshagiri M. <i>et al</i> 2007
2.	Bark	Antidiabetic activity	K Pavan Kumar <i>et al.</i> 2011 [17]
3.	Flower	Analgesic activity	Dinesh Chandra <i>et al.</i> 2001
4.	Leaves & bark	Wound healing activity	Smita Sharma <i>et al.</i> 2010 [37]
5.	Leaves	Nephro and hepato protective activity, antioxidant and cytotoxic activity	S. Palani <i>et al.</i> 2010
6.	Leaves and stem	Antimicrobial activity	Mangesh Khond <i>et al.</i> 2009
7.	Seeds	Effective to alleviate pain	Srirangam Prashanth <i>et al</i> 2010

Utilization

Sugar syrup: There are several reports on preparation of sugar syrup from dry Mahua flowers, as its sweet property is utilized in the fermentation process (Benerji *et al.*, 2010, Shriwastaea *et al.*, 1970, Madhumita and Naik, 2010) [33, 24]. The water extract of dried flower is decolorized with different de coloring agent like slacked lime and activated charcoal before concentrating it to the desired concentration. Activated charcoal at a concentration of 3.5-5.0 % was found to be the best agent for the preparation of the Mahua sugar syrup Madhumita and Naik, 2010 [24]. The syrup thus obtained from the flower of Mahua is employed in the different purpose, either in the manufacturing of chocolate or as a sweetening agent (CSIR, 2006) [4].

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. (Yadav *et al.*, 2009) [42]. Various products like alcohol, brandy, acetone, ethanol, lactic acid and other fermented products have been prepared from the dry mahua (Fowler *et al.*, 1920) [13].

Use of Mahua as 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 (Wealth of India, 1962) [3].

Utilization of mahua for processing of different food products **Sugar syrup:** Abhyankar and Narayana, 1942 reports on preparation of sugar syrup from dry mahua flowers, which can be further use as a sweetening agent in different food products.

Jam, Jelly, marmalade, pickle: Reuther *et al.*, 1967 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 flavor. The pulp is also pickled. Major quantity of flowers is used in the preparation of distilled liquors (Wealth of India, 1962) [3]. Patel, 2008 prepared the mahua jam and jelly by using fresh flowers. The developed products were tested for their colour, flavor, 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.

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

Puree and sauce: Patel, 2008 [25] used fresh flowers and crushed it into puree (after manually removing the stamens) and processed it into sauce.

Nutritional and Medicinal Use: The Mahua tree is having lots of nutritional value in it. It produces fruit which is valued for its seed which yield high quantity of fat commercially known as Mahua butter or mowrah butter, many edible and medicinal applications and it is also used as a biodiesel. Its fat has been used as substitute for cocoa butter and ghee. It is one of the single largest sources of natural hard fat. The fat which is thus obtained from Mahua fruit oil is used in cooking, frying and manufacturing chocolates. The seed fat has emulsion property so it mostly used as an emulsifying agents in few pharmaceutical industries. It is generally applied as massage oil in many part of the country, as it is very good to moisturize skin. Besides edible and medicinal uses, Mahua has industrial application as it can be utilized in the manufacture of laundry soaps and lubricants. Moreover, the seed cake is reported to have insecticidal and pesticide property and used as organic manure in crops like rice, sugarcane etc. The medicinal properties which are seen in this plant are stimulant, demulcent, emollient, heating. Skin disease, rheumatism, headache, laxative, piles, and sometimes as galactagogue astringent and many more. Review of literature based on chemical composition of mahua flower reveals its high nutritional value. Apart from being a rich sours of sugar and protein, the flowers also contain essential minerals like Ca, p, Fe, and K. Calcium is a major component of the bone and assists in teeth development phosphorus is next in importance to calcium as utilization of Ca is closely related to it. Most of the Calcium in the body is deposited as the calcium Phosphate.

Nutritional Properties of Mahua flower (Source: Kureel *et al.*, 2009)

Constituents	Flower
Moisture (%)	19.8
Protein (%)	6.37
Fat (%)	0.50
Total Sugar (%)	54.06
Calcium (%)	8.00
Phosphorus (%) 2.00	2.00
Ash (%)	4.36

Tree-Borne Oilseed Mahua: Seeds of many tree species contain high levels of oil and their use for bioenergy generation has been a topic of interest for long (Raina, 1986). Mahua oil is also edible and is used by tribal communities. All the TBOS are multipurpose in their utility, making them what is desired for agroforestry systems. However, caution is necessary in assessing whether all the uses will be realized at the same time.

Mahua seed oil: Mahua seeds contain about 40% pale yellow semi-solid fat. The seed oil is commonly known as "Mahua Butter". The oil content of the seed varied from 33 to 43% weight of the kernel. For the tribals of India, Mahua oil is by

far the most important tree seed oils. Fresh Mahua oil from properly stored seeds is yellow in colour with a not unpleasant taste. The oil is used as cooking oil by most of the tribes in Odisha, Chhattisgarh, and Maharashtra etc.

Nutritional Properties of Mahua Seed (Source: Kureel R.S et al, 2009)

Properties	Oil Percent (%)
Refractive index	1.452-1.462
Saponification value	187-197
Iodine value	55-70
Unsaponifiable matter (%)	1-3
Palmitic C 16:0 (%)	24.5
Stearic Acid C 18:0 (%)	22.7
Oleic Acid C 18:0 (%)	37.0
Linolic Acid C18:2 (%)	14.3

Conclusion

Mahua tree gives significantly high quantity of oil. The oil is rich in PUFA and has desirable level of oleic and stearic acid to be used as cocoa substitute in confectionary products and production of margarines, 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. The research workers have to come along with the people of 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 effect. 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.

References

1. Abhyankar VS, Narayana N. Reports on preparation of sugar syrup from dry mahua flowers which can be further use as a sweetening preliminary note on the preparation of syrup from mahua flowers. Poona Agric Coll Mage. 1942; 33:168-172.

2. Adhikary S, Adhikary J. Sal olein and Mahua olein for direct edible use. J Am. Oil Chem. Soc. 1989; 66(11):1625-1630.
3. Anonymous. Wealth of India a dictionary of Indian raw materials and industrial products-raw materials publications and information, Directorate Council of Scientific and Industrial Research. LM. CSIR, New Delhi, 1962; VI:207-215.
4. Anonymous. The Useful Plants of India, Publication and Information Directorate, CSIR, New Delhi, 2006.
5. Anonymous. The wealth of India, Raw Material, Council of Scientific and Industrial Research, New Delhi, 2008, 6.
6. Ansari SH. Essential of Pharmacognosy, Birla Publication, New Delhi, Edition. 2007-08; 2:575-76.
7. Ayyanar, Ignacimuthu S. Traditional knowledge of Kani tribals in Kouthalai of Tirunelveli hills, Tamil Nadu, India. J Ethnopharmacol. 2005; 102:246-255.
8. Banerji R, Mitra R. Mahua (*Madhuca species*): uses and potential in India. Appl Bot, 1996, 260-77
9. Behl PN, Sriwasrawa GS. Herbs Useful In Dermatological Therapy, CBS Publishers and Distributors, New Delhi, Edition. 2002; 2:94-95.
10. Bina S Siddiqui, Shazia Khan, Nadeem Kardar M. A New Isoflavone from the *Madhuca latifolia*. Natural Product Research. 2010; 24:76-80.
11. Chandra Dinesh. Analgesic Effect of Aqueous and Alcohol Extract of *Madhuca Indica* Longifolia. Indian Journal of Pharmacology 2001; 33:108-111.
12. FGLG India NTFP Enterprises and Forest Governance: Mahua, FGLG India, Centre for People, 2008.
13. Fowler GJ, Behram JDE, Bhate SR, Hassan HK, Mahdihassan S, Inuganti NN. Biochemistry of Mahua flower, J Indian Inst Sci. 1920; 3:81-118.
14. Joseph J, Siddha. Medicine background and principles and their application for skin diseases. Clin Dermatol. 2008; 26:62-78.
15. Kirtikar KR, Basu BD. Indian Medicinal Plants. Oriental enterprises. 2001; VII:2058-2061.
16. Kulkarni PS, Dr. SG, Dr. RMR. Mahua (*Madhuca indica*) as a source of biodiesel in India. Internl. J Sci. & Eng. Res. 2013; 4(7):2319-2329.
17. Kumar Pavan K, Vidyasagar G. Screening of *Madhuca Indica* for Antidiabetic Activity in Streptozotocin and Streptozotocin Nicotinamide Induced Diabetic Rat. International Journal of Pharma Tech Research. 2011; 3:1073-1077.
18. Kureel RS, Kishor R, Dev Dutt, Ashutos P. Mahua—a potential tree born oilseed. National oilseed and development Board. Ministry of Agriculture Govt. of India, Gurgaon, 2009, 1-27
19. Midya S, Brahmachary R. The aroma of Bassia flower. Curr. Sci. 1996; 71:430.
20. Miller Lucinda G, Herbal Medicinal. A Clinicians guide, Viva Book private Limited, New Delhi, Edition 2005; 1(2-3).
21. Palani S, Raja S, Karthi S, Selvi Archana, Sendhil Kumar B. *In vivo* analysis of nephro and hepato protective effects and antioxidant activity of *Madhuca longifolia* against acetaminopheninduced toxicity and oxidative stress. Journal of Pharmacy research. 2010; 3(1):9-16.
22. Patel M. Biochemical investigations of fresh mahua (*Madhuca indica*) flowers for nutraceuticals, 2008.
23. Patel M, Naik SN. Biochemical investigations of fresh mahua (*Madhuca indica*) flowers for nutraceutical. PhD.

- Thesis, Centre for Rural Development and Technology, Indian Institute of Technology, New Delhi, India, 2008.
24. Patel Madhumita, Naik SN. Flowers of *Madhuca Indica* J.F. Gmel: Present Status and Future Perspectives. Indian journal of Natural Products and Resources. 2010; 1:438-443.
 25. Patel M, Pradhan RC, Naik SN. Physical properties of fresh mahua. Int. Agrophys. 2011; 25:303-306.
 26. Prajapati V, Tripathi AK, Khanuja SPS, Kumar S. Anti-insect screening of medicinal plants from Kukrail Forest, Lucknow, India Pharma. Biol. 2003; 4:166-70.
 27. Raina AK. A critical appraisal of the potential petro-plantations for tomorrow. In: Plantation Crops - Opportunities and Constraints. Proceedings of the Symposium on Plantation Opportunities in India. Srivastava HC, Vatsya B and Menon KKG (ed), Oxford and IBH Publishing Co, New Delhi, India, 1986, 1.
 28. Ramar PS, Thwina MM, Gopalakrishnakone P, Ignacimuthu S. Ethnobotanical survey of folk plants for the treatment of snakebites in southern part of Tamilnadu, India. J Ethnopharmacol. 2008; 115:302-312.
 29. Reuther W, Webber HJ, Batcher LD. The Citrus Industry. University of California, USA, 1967, 407-409.
 30. Sardana S, Sharma OP. Fundamentals of Pharmacognosy, Birla Publication, Delhi, Edition. 2009-10; 1:40-42.
 31. Sengar NPS, Agarwal Ritesh Singh. A Text Book of Pharmacognosy, Pharmamed press, Hyderabad, Edition. 2009; 1:44-45.
 32. Seshagiri M, Gaikwad RD. Anti Inflammatory, Anti ulcer And Hypoglycemic Activities of Ethanolic And Crudealkaloid Extracts of *Madhuca Indica* Gmein Seed Cake: Oriental Pharmacy And Experimental Medicine, 2007; 7:141-149.
 33. Shriwastaea RK, Sawarkar SK, Bhutey PG. Decolourization and Deodorizations studies on mahua extract, Res India. 1970; 15:114-117.
 34. Singh IS. Mahua An oil bearing tree. Technical Bulletin, ND University of Agriculture and Technology, Kumarganj, Faizabad, Uttar Pradesh, India, 1998, 3-11,
 35. Singh S, Singh AK. Genetic diversity in mahua (*Bassia latifolia*) under semi arid ecosystem of Gujarat. Indian J Agric. Sci. 2005; 75(8):519-523.
 36. Singh S, Singh AK, Apparao VV, Bagle BG, Dhandar DG. Genetic Divergence in Mahua (*Bassia latifolia*) under SemiArid Ecosystem of Gujarat. Indian J. Plant Genetic Res., 2005; 18(3):244-249.
 37. Smita Sharma, Mukesh Chandra Sharma, Kohli DV. Wound healing activity and formulation of ether-benzene – 95% ethanol extract of herbal drug *Madhuca longifolia* leaves in albino rats. Journal of optoelectronics and Biomedical materials. 2010; 19(1):13-15.
 38. Srirangam Prashanth, Annampelli Anil Kumar, Burra Madhu, Yennamaneni Pradeep Kumar. Antihyperglycemic and antioxidant activity of ethanolic extract of *Madhuca longifolia* Bark. International Journal of Pharmaceutical Sciences Review and Research. 2010; 5(3):89-94.
 39. Srirangam prashanth, Annampelli Anil Kumar. Anti hyperglycemic and Antioxidant Activity of Ethanolic Extract of *Madhuca Indica* Bark, International Journal of Pharmaceutical Science Review and Research. 2010; 5:89-94.
 40. Variers PS. Vaidyarathanam: Indian Medicinal Plants, Orient Longman Publication, New Delhi, Edition. 1995; 1(III):362-366.
 41. Wakte KV, Kad TD, Zanan RL, Nadaf AB. Mechanism of 2acetyl1 pyrroline biosynthesis in *Bassia latifolia* Roxb. flowers. Physiol Mol Biol Plants. 2011; 17(3):231-237.
 42. Yadav P, Garg N, Diwedi DH. Effect of location of Cultivar, Fermentation temperature and additives in the physic-chemical and sensory qualities of mahua (*Madhuca indica* J.F. Gmel) Wine preparation. Natural product radiance. 2009; 8:406-418.