PROSPECTS
IN PHARMACEUTICAL SCIENCES

Prospects in Pharmaceutical Sciences, 21(2), 30-36
https://prospects.wum.edu.pl/

Review

CRITICAL REVIEW ON POTENTIALS OF ETHNOPHARMACOLOGICAL, ETHNOMEDICINAL AND TRADITIONAL PRACTICES OF *MADHUCA LONGIFOLIA* (J. KOENIG EX L.) J. F. MACBR. (FAMILY: SAPOTACEAE)

Dibyajyoti Saha[1*], Satish Kumar Sarankar[1]

[1] *Faculty of Pharmacy, Mansarovar Global University, Billkisganj, Sehore, Madhya Pradesh-466001, India.*

* Correspondence, e-mail: djsmgupharmacy@gmail.com

Received: 20.02.2023 / Accepted: 20.04.2023 / Published: 22.05.2023

ABSTRACT

The importance of medicinal plants in traditional medicinal practices and their contribution to biodiversity preservation is now widely acknowledged. It is well recognized that the traditional application of medicinal plants in medicinal operations offers guidance for brand-new study areas. Ethnopharmacological studies are very helpful in the creation of herbal medications. One of the primary goals of these studies, which provide scientific documentation for medicinal plants used for specific therapeutic purposes, is the development of superior preparations for use by peoples. It is now commonly recognized how crucial the traditional medicinal uses of plants are for opening up new research areas. It is essential to preserve the traditional knowledge of ethnomedicine. Economic factors are significant, but traditional techniques also have appeal for social, cultural, and medicinal reasons. *Madhuca longifolia* has pharmaceutical, ethnomedicinal and ethnopharmacological values. The parts used include flowers, fruits, seeds, leaves, barks etc. This medicinal plant is effective against various diseases, e.g. cancer, ulcers, as well as snakebite. So, the aim and rationale of the study were to explore the ethnopharmacological, ethnomedicinal and traditional practices of *Madhuca longifolia* (J. Koenig Ex L.) J. F. Macbr. (Family: Sapotaceae).

KEYWORDS: Ethnopharmacology, Ethnomedicine, Practice, Traditional, *Madhuca longifolia*.

1. Introduction

Researchers from a variety of fields, primarily pharmacology, chemistry, and botany, collaborate to conduct ethnopharmacological investigations [1]. The literature on ethnobotany and ethnomedicine is the source of primary data for a variety of investigations [2]. Ethnomedicine deals with the study of ancient claims. Different in vitro or in vivo models may be used to research biological processes [3]. Both strategies have a number of benefits and drawbacks. After weighing a variety of parameters, the choice of an in vivo or in vitro assay is determined [4]. For instance, an in vivo test may be preferred if there are no ethical concerns at stake and a large sample size and financial resources are available [5]. These tests will provide a clearer understanding of the plant's therapeutic potential [6]. An in vitro assay might be a superior option, though, if there are time constraints, insufficient resources, or a small sample size [7]. The medicinal plant enters the drug development process once several different assays have been successfully completed and evidence of significant biological activity has been revealed [8]. Tribes own intellectual property in the field of ethnomedicine [9-11]. Their ethnomedicinal practices have been significantly impacted by the relocation of tribal communities to different locations and the extinction of medicinal plant and animal species [12-14]. Every tribe has a distinctive understanding of ethnomedicinal techniques that sets them apart from other tribes [15]. Ethnomedicine is a form of research of old methods of treatment; alternative medicine is a type of treatment which is not in line with the evidence based medicine [16-17] and in this respect we decided doing review about *Madhuca longifolia*.

Madhuca longifolia is a medium to big deciduous tree with a short bole, spreading branches, and a wide spherical crown that grows up to 18 meters tall. The bark is grey to black in colour, with vertical fractures and thin scales that exfoliate. Leaves are elliptic or elliptic-oblong, 7.5-23 cm x 3.8-11.5 cm, coriaceous, hairy when young, virtually glabrous when mature and clustered near the ends of branches. Flowers occur in thick fascicles towards branch ends, many and small; calyx is coriaceous; corolla is tubular, fleshy, cream-coloured, 1.5 cm long, perfumed, caduceus. The species can be found in northern, central, and southern peninsular India, as well as Sri Lanka and Burma. Var. *longifolia* is found in Sri Lanka and southern India, expanding northwards to Maharashtra and Gujarat; var. *latifolia* is found in central and northern India, as well as Burma. Dry mixed deciduous forests, dry forests and dry teak forests are all

places where it can be find. The tree may grow in a range of conditions, but it prefers sandy soil. It thrives in shallow, clayey and calcareous soils as well. It can be found up to 1200 m altitude, with mean annual maximum temperatures of 28°C-50°C, minimum temperatures of 2°C-12°C, and annual rainfall of 550-1500 mm. *Madhuca longifolia* can be found in the plains and woods of Central and North India, as well as in some portions of Eastern India, including West Bengal, Odisha, Bihar, and Jharkhand.

2. Ethnopharmacology, Ethnomedicine and Traditional Practice with its Significance

Ethnopharmacology has made a comeback as an important strategy for drug discovery. Botanicals are the focus of the majority of ethnopharmacology studies because they provide a natural library of various chemical scaffolds and structures [18]. Each plant is made up of many molecules and bioactive substances. Each bioactive substance may be able to affect one or more targets [19]. Each target has the potential to impact one or more genes and metabolic pathways, what can contribute to healing one or more diseases [20].

When traditional knowledge is lacking, random screening and a phytochemical approach have been found to be quite helpful in finding new leads [21]. These prevent several plants from being disregarded because of a lack of supporting evidence [22]. However, because a significant number of resources are lost during the trial-and-error process, the two approaches prove to be more expensive than the ethnopharmacological strategy [23].

More ethnic and less scientific is ethnomedicinal practice [24]. It is a study of personal experiences with disease and illness as well as cultural healing techniques [25]. Ethnomedicine permits the use of medicinal plants and animal products to treat illness [26]. Ethnopharmacology is the modern medicinal system that uses bio-products to cure serious chronic disorders as well as generalized fevers, colds, and coughs. [27] Ethnomedicine cannot treat life-threatening conditions including cancer, diabetes, or high blood pressure. It may be used for general colds and coughs, issues with the stomach or liver, joint pain, etc. [28]. Since the beginning of human culture on earth, people have developed a man-made environment to meet their numerous fundamental, derived and integrative bio-psychic wants, including those for food, water, shelter, sex, love, care, and affection, as well as political, social, and economic requirements [29]. This has led to the development of medicinal knowledge for health care and physical fitness [30]. The earliest known medicinal system is Ayurveda, which was created between 1000 and 800 BCE in the Vedic period, roughly between 4500 and 500 BCE. Numerous therapeutic herbs [31], God's function as both a healer and restorer of health, and devils who cause disease are all mentioned in Ayurveda [32]. According to some researchers, it predates the development of the Mesopotamian medicinal system. In India, herbal medicine is used to treat more than 70% of the population and herbal doctors have employed more than 6,000 of the 15,000 species of natural plants as herbal treatments or medicines [33-34]. People from tribal groups typically reside in forested settings, where they get to know species range of animals and plants which are used for medicine and foods [35]. Their culture and economics are greatly impacted by deforestation and migration, and their ethnomedicinal practises are greatly impacted by the extinction of medicinal plant and animal species, such as those used in the treatment of general illnesses, fever, gynecological issues, etc. [36]. More than 50,000 plant species are known to have medicinal benefits worldwide, according to a study. Much of the population living in lightly urbanized areas still relies solely on traditional health care remedies, despite globalization and modernization [37]. Due to their cultural viability, affordability, and the fact that current modern health care services are expensive in comparison to traditional medicine, the dependence on traditional medicinal herbs and their function in the health care system will only grow in the future [38]. Before modern medicine came along, the only way to take care of health and prevent, diagnose, and treat mental, physical and social illness had been through traditional medicine.

Oral tradition among the general population still perpetuates the use of plants in the conventional treatment of illnesses. Our understanding of the transmission of traditional knowledge and cultural heritage, which are in danger due to the global development of popular culture and the emphasis on science, is aided by ethnobotanical studies [39]. The use of traditional knowledge holders as study participants aids in the creation of innovative natural resource conservation initiatives [40]. Plants have been used to discover numerous bioactive principles and useful medicinal compounds. Plant-based alternative therapies have been recognized as a significant option and are being investigated more and more. This strategy is based on ethnobotanical knowledge and ethnoveterinary practises, and it may provide details on plant species of interest for more research to recommend sustainable therapy based on local uses and resource availability [41]. Despite the impressive growth of research in ethnobiology and ethnopharmacology over the past few decades, folklore healthcare practises using locally available resources have been passed down orally across a generation of folklore healthcare practitioners in order to treat a number of human disorders that are closely tied to the spiritual ideas and practises of the native population [42]. Indigenous and local ethnic groups have absorbed traditional knowledge into their cultures and medicinal practises since the dawn of humanity. It was also seen as a crucial element of sustainable resource management [43]. Due to the limitations of contemporary medicine in the prevention and/or treatment of diseases, ethnobotanical research has become increasingly important in recent years. Herbal products are becoming increasingly popular among a large part of the world's population [44], which led us to evaluate the ethnopharmacological, ethnomedicinal and traditional practice of *Madhuca longifolia* (J. Koenig Ex L.) J. F. Macbr. (Family: Sapotaceae).

3. Evidence Based Systematic Literature

Jodh et al. [45], investigating the therapeutic potential of *Madhuca longifolia*, showed that the plant has therapeutic effects that include antibacterial,

anxiolytic, anticancer, hepatoprotective, anti-ulcer, anti-hyperglycemic and pain-relieving activities. Skin infections, stiffness, migraines, chronic congestion and piles and hemorrhoids, bone fractures and burns are also treated with the help of this plant. The leaves act as an expectorant and are used to treat persistent bronchitis, Cushing's disease and diabetes, while the flowers are used as a tonic, analgesic and diuretic. Dalvi et al. [46] found that *Madhuca longifolia* compounds have several activities, such as antibacterial, antipyretic, antioxidant, anticonvulsant, analgesic, and antitumor effects, and Keri [47] further demonstrated that the bark and leaves of this plant exhibit antidepressant, sedative, aphrodisiac, astringent, anti-inflammatory, antiproliferative, antibacterial, antidiabetic and antiulcer activities, as well as can be used as a therapeutic approach to treat Alzheimer's disease.

Khutade et al. [48] stated that traditionally the plant flowers are collected by tribal groups and used for making liquor. It is practiced in many states in India, in different regions of Andhra Pradesh, Maharashtra, Chhattisgarh, where some tribal communities cultivate and harvest mahua flowers for alcoholic beverages.

Naveena et al. [49] reported that *Madhuca longifolia* seed has potential anti-oxidant and anticancer activities in methanolic extract of 18.9 % yield. Sawant et al. [50] noticed that pharmacological studies proved that *M. longifolia* flowers act as antiulcer, anti-inflammatory, antioxidant, anti-diabetic and also have non-toxic effect even after consumption of larger doses. They prepared Mahua candies which are the cough drops/hard candies that can be consumed by any age group. Saif et al. [51] explored the ethnopharmacological usage of *Madhuca longifolia*. This plant has antimicrobial, antioxidant, antipyretic, anti-inflammatory, antiulcer, cardioprotective, anti-carcinogenic, immunomodulant, antirheumatic, oxytocic, anti-estrogenic, uterotonic, antiepileptic, demulcent, and many other pharmacological actions and traditional uses such as anti-inflammatory, antipyretic, antihyperglycemic, antifertile and antiulcer properties and *Madhuca longifolia* seeds are a rich source of edible fats, making it economically valuable. Manikandan et al. [52] evaluated how to make *Madhuca longifolia* seed extracts to be rich in compounds that have anti-foot ulcers properties as well as have pharmacological actions and potential therapeutic activities.

Mishra and Usha [53] explored that *Madhuca longifolia* has pharmacological properties for the treatment of numerous liver ailments. The ethanolic extract showed hepatoprotective action against paracetamol-induced hepatotoxicity in albino rats via inducing hepatocyte repair and regeneration. Mishra and Poonia [54] determined that Mahua flowers used by tribal groups for the production of liquor and medicine have been used to treat raktapitta (bleeding disorders), diarrhoea, and skin problems for centuries, as well as have been used as an aphrodisiac, galactagogue, carminative, anthelminthic, antibacterial, and antioxidant agent. Chavan et al. [55] employed ethanolic extract of *Madhuca longifolia* flowers as a test drug at doses of 100, 200, and 400 mg/kg on mice weighing 20-25 g for CNS depressant action on the Actophotometer. The locomotor activity was reduced in the presence of all extracts, which could be owed to the drug's CNS depressive properties. Chinnadhurai et al. [56] evaluated the pre-treatment with *Madhuca longifolia* leaves on 7, 12-Dimethylbenz(a)anthracene (DMBA)-induced mammary carcinoma in Sprague Dawley rat. The leaves of *Madhuca longifolia* may be used in the treatment of mammary carcinoma. Bisht et al. [57] further demonstrated that Mahua is a type of tree that is involved in tribal people's day-to-day activities. In tribal and rural communities, the mahua flower is used as a food as well as an exchanger. This plant has antibacterial, anticancer, hepatoprotective, antiulcer, antihyperglycemic, and analgesic properties that can be used externally to treat skin diseases, rheumatism, headaches, chronic constipation, piles, and haemorrhoids, as well as ethnomedicinal properties like antibacterial, anticancer, hepatoprotective, antiulcer, antihyperglycemic. The mahua tree and mahua drink are considered part of the tribes' traditional legacy. As a result, raising public awareness about the need of forest conservation is critical.

An ulcer is a frequent, chronic condition that can be caused by a variety of reasons such as stress, diet, bacteria, and the use of medicines that irritate the gastrointestinal tract. The findings of the investigation of Sangeetha et al. [58] revealed that a hydroalcoholic extract of *M. longifolia* leaves may have promising gastro-protective and treating ulcers activity.

The antioxidant and cytotoxic activities of ethanol bark extract was investigated by Godfrey et al. [59]. To summarise, the ethanol bark extract of *Madhuca longifolia* imparts target specific cytotoxicity in MCF-7 cell lines, and there is a significant link between the presence of antioxidant chemicals and cancer cell cytotoxicity.

According to Jha and Mazumder [60], *Madhuca longifolia* is widely utilised in traditional and folklore medicine with its many pharmacological qualities, such as in snake bites and diabetes. Pharmacological research has shown that it has a wide range of biological actions, including antiulcer, anti-inflammatory, antioxidant, and antidiabetic properties. The study of Subanithi and Swarnalatha [61] was designed to evaluate antibacterial activity of species that originated in India. *Madhuca longifolia* showed antibacterial activity, pharmacological and therapeutic activity. Jaydeep et al. [62] stated that the plant has been traditionally used as a medication for a variety of ailments, including headache, diarrhoea, skin, and eye disorders, due to its various phytochemical properties. Their review investigates the composition of dry and fresh flowers & its uses, therapeutic and nutritive value which can enhance the livelihood of tribal people by increasing work opportunities. Khare et al. [63] showed that *Madhuca longifolia* has therapeutic effects in treating conditions such as eczema, rheumatism, burns and can serve as an emollient. The flowers are used as a tonic, analgesic, and diuretic, while the bark is used to treat rheumatism, chronic bronchitis, and diabetes mellitus, and the leaves are used as an expectorant and to treat chronic bronchitis and Cushing's disease. Khare et al. [64] stated that the plant has anthelmintic, antiulcer, anticancer, antibacterial, antidiabetic, anti-inflammatory, antigoitrogenic, and hepatoprotective activity. Sarkar et al. [65] explored that to overcome the problem of breast cancer, silver nanoparticles (AgNPs) synthesized using Indian medicinal plant *Madhuca longifolia* can be used as an alternative anticancer

medicine. According to Arun et al. [66], *Madhuca longifolia* is a traditional medicinal plant used in the treatment of a variety of diseases, including cancer, and also used in herbal formulations. The plant has antioxidant properties. Sinha et al. [67] demonstrated that this plant has been used as an herbal medicine to treat a variety of ailments. They summarised previous research on mahua flower, fruit, and seed, with a focus on the application of mahua flower in value addition. Mahua has undergone extensive therapeutic investigation, demonstrating antibacterial, anticancer, hepatoprotective, anti-ulcer, antihyperglycemic, and analgesic characteristics, among others. Furthermore, Devi and Sangeetha [68] stated that the plant has potent herbal medicine and has traditionally been used to treat infections, wounds, rheumatism, heart disease, diabetes, and a variety of other conditions. The findings of these investigations have highlighted current pharmacological profile and offered compelling evidence for its future clinical usage in modern medicine. Kamal [69] concluded that *Madhuca longifolia* is one of the most widely used medicinal plants and also have traditional therapeutic use, but to investigate their possible therapeutic properties, more biological research is required. In vitro anticancer investigations were conducted by Bhaumik et al. [70] against the human cancer cell line (HeLa), and the MTT assay was utilised to assess cell growth suppression. The findings revealed that several extracts of *Madhuca longifolia* fruit-seeds exhibit very good to moderate anticancer efficacy. Akshatha et al. [71] focused on the *Madhuca longifolia* which is used in tribal people's day-to-day activities. Ethnomedicinal uses included antipyretic, hepatoprotective, anti-inflammatory, analgesic, antitumor, antiprogestational, antiestrogenic, and wound healing properties. *M. longifolia* bark has traditionally been used to treat rheumatism, ulcers, bleeding, and tonsillitis. Mishra and Pradhan [72] explored that in tribal and rural communities, the mahua flower is used as a food. *Madhuca longifolia* is occasionally used as an emetic. Yadav et al. [73] stated that *Madhuca longifolia* has spasmogenic, oxytocic, uterotonic, antibacterial, anti-implantation, anti-tumor, anti-progestational, antiestrogenic, anti-cancer activity.

Chakma and Patel [74] tested the antimicrobial activity of *M. longifolia* acetone and aqueous extracts against a variety of pathogenic microorganisms. The acetone extract was shown to have strong antibacterial action. The research backs up its use in traditional medicine. Gaikwad et al. [75] investigated the anti-inflammatory activity of the ethanolic extract and seed saponin mixture of *Madhuca longifolia* L. (Sapotaceae) in rats with acute carrageenan-induced inflammation.

4. Conclusion

The practising of conventional system of medicine is one of the oldest professions. This system was postulated and then created by humans through empirical observation and trial-and-error experimentation, particularly the use of conventional medicinal plants. Even in the current era of computational pharmacology techniques, traditional medicinal plants still serve a vital role in the treatment of many ailments in developing countries. Chloroquine and artemisinin, two of the most effective antimalarials currently on the market, are gifts from our treasured traditional knowledge and practise of using conventional medicinal plants. The recent success of developing medications from medicinal plants has encouraged and inspired many researchers to investigate and validate the use of traditional medicinal plants [76]. There are many challenging issues and formidable barriers that must be swiftly and efficiently overcome in order to promote traditional medicinal herbs. Combining the efforts of ethnobotanists, anthropologists, pharmacists, and medicinal experts may be a useful strategy for evaluating and confirming traditional medicinal plant use practises using up-to-date scientific techniques and cutting-edge methodologies. So, from the above review it has been established that *Madhuca longifolia* (J. Koenig Ex L.) J. F. Macbr. (Family: Sapotaceae) have high ethnopharmacological, ethnomedicinal and traditional value.

Authors contribution

DS: Conception and design, acquisition of data, analysis of data, revising critically.

SKS: Conception and design, input important intellectual content.

Conflict of interest

The authors(s) declare no conflict of interest.

References

1. Cordell, G.A.; Colvard, M.D. Some thoughts on the future of ethnopharmacology. *J. Ethnopharmacol*. **2005,** *100(1-2)*,5–14.https://doi.org/10.1016/j.jep.2005.05.027
2. Ghorbani, A.; Naghibi, F. Mosaddegh M. Ethnobotany, ethnopharmacology and drug discovery. *Iran. J. Pharm. Sci*. **2006**, *2(2)*, 109–118.
3. Heinrich, M.; Gibbons, S. Ethnopharmacology in drug discovery: an analysis of its role and potential contribution. *J. Pharm. Pharmacol*. **2001**, *53(4)*, 425–432. https://doi.org/10.1211/0022357011775712
4. Heinrich, M.; Kufer, J; Leonti, M.; Pardo-de-Santayana M. Ethnobotany and ethnopharmacology—Interdisciplinary links with the historical sciences. *J. Ethnopharmacol*. **2006**, *107(2)*, 157–160. https://doi.org/10.1016/j.jep.2006.05.035
5. Holmstedt, B.; Bruhn, J.G. Ethnopharmacology-A challenge. *J. Ethnopharmacol*. **1983**, *8(3)*, 251–256. https://doi.org/10.1016/0378-8741(83)90062-4
6. Houghton, P.J.; Howes, M.J.; Lee C.C; Steventon, G. Uses and abuses of in vitro tests in ethnopharmacology, Visualizing an elephant. *J. Ethnopharmacol*. **2007**, *110 (3)*, 391–400. https://doi.org/10.1016/j.jep.2007.01.032
7. Redžić S. The ecological aspect of ethnobotany and ethnopharmacology of population in Bosnia and Herzegovina. *Coll. Antropol*. **2007**, *31(3)*, 869–890.
8. Rout, S.; Choudary, K; Kar, D; Das, L; Avijeet, J. Plants in traditional medicinal system - Future source of new drugs. *Int. J. Pharm. Pharm. Sci*. **2009**, *1(1)*, 1–23.
9. Waller, D.P. Methods in ethnopharmacology. *J. Ethnopharmacol*. **1993**, *38(2-3)*, 181–188. https://doi.org/10.1016/0378-8741(93)90015-w.
10. Dodd, K.C. Health and Illness. An Introduction for Health

Professionals. *Sociol. Health Illn.***1991**, *13(2)*, 283–284.

11. Souza, E.N.F.; Williamson, E.M.; Hawkins, J.A. Which Plants Used in Ethnomedicine Are Characterized? Phylogenetic Patterns in Traditional Use Related to Research Effort. *Front. Plant Sci.* **2018**, *9,* Art. No. 834. https://doi.org/10.3389/fpls.2018.00834
12. Tripathi, S.; Panigrahi, N. Changing Sacred Status of Village Pond in the Context of People-Pond-Spirit Complex, An Empirical Study. *The Oriental Anthropologist*. **2017**, *17(1)*, 149–161. https://doi.org/10.1177/0976343020170110
13. Rekka, R.; Murugesh, S.; Prabakaran, R. Plants used by Malayali Tribes in Ethnogynaecological disorders in Yercaud hill, Southern Eastern Ghats, Salem District, Tamil Nadu. *Sci. Res. Reporter*. **2013**, *3(1)*, 190–192.
14. Romeu, R.; Ierecê, L.R. Animals in traditional folk medicine, implications for conservation. *Heidelberg Springer*. **2013**, *5(2)*, 60–64. https://doi.org/10.1007/978-3-642-29026-8
15. Kanetkar, P.; Singhal, R; Kamat, M. Recent Advances in Indian Herbal Drug Research. *J. Clin. Biochem. Nutr*. **2007**, *41(1)*, 77–81. https://doi.org/10.3164/jcbn.2007010
16. Dhamija, H.; Parashar, B.; Singh, J. Anti-depression potential of Herbal drugs, An overview. *J. Chem. Pharm. Res*. **2011**, *3(5)*, 725–735.
17. Maregesi, S.M.; Kauke, B.; Kagashe, G.; Kaali, R. Traditional eye medicines in Tanzania, Products, health risk awareness and safety evaluation. *Herb Med.* **2016**, *2(12)*, 1-11. https://doi.org/10.21767/2472-0151.10008
18. Alves, R.R.N.; Rosa, I.L.; Santana, G.G. The Role of Animal-derived Remedies as Complementary Medicine in Brazil. *BioScience*. **2007**, *57(11)*, 949–955. https://doi.org/10.1641/B571107
19. Ferreira, F.S.; Brito, S.V.; Ribeiro, S.C.; Saraiva, A.A.; Almeida, W.O.; Alves, R.R. Animal-based folk remedies sold in public markets in Crato and Juazeiro do Norte, Ceará, Brazil. *BMC Complement. Altern. Med.* **2009**, *9(17)*, 1-8. https://doi.org/10.1186/1472-6882-9-17
20. Souto, W.M.S.; Mourão, J.S.; Barboza, R.R.D.; Alves, R.R.N. Parallels between zootherapeutic practices in ethnoveterinary and human complementary medicine in northeastern Brazil. *J. Ethnopharmacol*. **2011**, *134(3)*, 753–767. https://doi.org/10.1016/j.jep.2011.01.041
21. Radha, P.; Udhayavani, C.; Nagaraj, R.; Sivaranjani, K. Ethno-gynaecological knowledge on medicinal plants among the rural communities of Tiruppur district, Tamil Nadu, India. *Med. Plant. – Intn. Jour. Phytomed. Rel. Ind.* **2020**, *12(4)*, 656–665. https://doi.org/10.5958/0975-6892.2020.00079.9
22. Mishra, D; Singh, R.K.; Srivastava, R.K.; Dubey, S.R. Ethnomedicinal plants used to cure the gynaecological disorders by ethnic populace of Sitapur district, Uttar Pradesh, India. *Med. Plant. – Intn. Jour. Phytomed. Rel. Ind.* **2013**, *5(4)*, 238-245. https://doi.org/10.5958/j.0975-6892.5.4.038
23. Sadeghi, Z; Mahmood, A. Ethno-gynecological knowledge of medicinal plants used by Baluch tribes, southeast of Baluchistan, Iran. *Revista Brasileira de Farmacognosia*. **2014**, *24(6)*, 706–715. https://doi.org/10.1016/j.bjp.2014.11.006
24. Kigen, G; Kamuren, Z; Njiru, E; Wanjohi, B; Kipkore, W. Ethnomedicinal Survey of the Plants Used by Traditional Healers in Narok County, Kenya. *Evid. Based Compl. & Altr. Med.* **2019**, *8,* Art. No. 8976937. https://doi.org/10.1155/2019/8976937
25. Alves, R; Souto W; Barboza R. Primates in traditional folk medicine: world overview. *Mammal Review*. **2010**, *40(2)*,155–180.https://doi.org/10.1111/j.1365-2907.2010.00158.x
26. Hardy, K. Paleomedicine and the Evolutionary Context of Medicinal Plant Use. *Rev. Bras. Farmacogn.* **2020**, *31*, 1–15. https://doi.org/10.1007/s43450-020-00107-4
27. Gallego-Jara, J; Lozano-Terol, G; Sola-Martínez, R.A.; Cánovas-Díaz, M, de Diego Puente, T. A Compressive Review about Taxol®, History and Future Challenges. *Molecules*. **2020**, *25(24)*, Art. No. 5986. https://doi.org/10.3390/molecules25245986
28. Najmi, A; Javed; S.A.; Al, Bratty. M; Alhazmi, H.A. Modern Approaches in the Discovery and Development of Plant-Based Natural Products and Their Analogues as Potential Therapeutic Agents. *Molecules*. **2022**, *27(2)*, Art. No. 349. https//www.mdpi.com/1420-3049/27/2/349/htm
29. Murugan, N.A.; Podobas, A.; Gadioli, D.; Vitali, E.; Palermo, G.; Markidis, S. A Review on Parallel Virtual Screening Softwares for High-Performance Computers. *Pharmaceuticals*. **2022**, *15*, Art. No. 63. https://doi.org/10.3390/ph15010063
30. Zaman, W.; Ye, J; Saqib, S; Liu, Y; Shan, Z; Hao, D. Predicting potential medicinal plants with phylogenetic topology, Inspiration from the research of traditional Chinese medicine. *J Ethnopharmacol*. **2021**, *281*, Art. No. 114515. https://doi.org/10.1016/j.jep.2021.114515
31. Zaman, W; Ye, J; Ahmad, M; Saqib, S; Shinwari, Z.K., Chen, Z. Phylogenetic exploration of traditional Chinese medicinal plants, a case study on Lamiaceae (angiosperms). *Pak. J. Bot.* **2022**, *54(3)*, 1033-1040. http://dx.doi.org/10.30848/PJB2022-3(19)
32. Zhao, Z; Li, Y; Zhou, L; Zhou, X; Xie, B; Zhang, W. Prevention and treatment of COVID-19 using Traditional Chinese Medicine, A review. *Phytomedicine*. **2021**, *85*, 1-7, https://doi.org/10.1016/j.phymed.2020.153308
33. Thomford, N.; Senthebane, D; Rowe, A; Munro, D; Seele, P; Maroyi, A. Natural Products for Drug Discovery in the 21st Century, Innovations for Novel Drug Discovery. *Int. J. Mol. Sci.* **2018**, *19(6)*, 1-29. https://doi.org/ 10.3390/ijms19061578
34. Pirintsos, S.A.; Bariotakis, M.; Kampa, M.; Sourvinos, G.; Lionis, C., Castanas, E. The Therapeutic Potential of the Essential Oil of Thymbra capitata (L.) Cav., *Origanum dictamnus* L. and *Salvia fruticosa* Mill. and a case of plant-based pharmaceutical development. *Front Pharmacol*. **2020**, *11*, 1-16. https://doi.org/10.3389/fphar.2020.522213
35. Lai, X; Wang, X; Hu, Y; Su, S; Li, W; Li, S. Editorial, Network Pharmacology and Traditional Medicine. *Front. Pharmacol.* **2020**, *11*, 1-4. https://doi.org/

10.3389/fphar.2020.01194

36. Yeung, A.W.K.; Heinrich, M.; Kijjoa, A.; Tzvetkov, N.T.; Atanasov, A.G. The ethnopharmacological literature, An analysis of the scientific landscape. *J. Ethnopharmacol*. **2020**, *250*, Art. No. 112414. https://doi.org/ 10.1016/j.jep.2019.112414.

37. Górniak, I; Bartoszewski, R; Króliczewski, J. Comprehensive review of antimicrobial activities of plant flavonoids. *Phytochem. Rev*. **2018**, *18*, 241–272. https//link.springer.com/article/10.1007/s11101-018-9591-z

38. Adamski, Z; Blythe, L.L.; Milella, L.; Bufo, S.A. Biological Activities of Alkaloids, From Toxicology to Pharmacology. *Toxins*. **2020**, *12(4)*, Art. No. 210. https://doi.org/ 10.3390/toxins12040210

39. Pizzi, A. Tannins medicinal / pharmacological and related applications, A critical review. *Sust. Chem. Pharm*. 2021, *22(1)*, Art. No. 100481. https://doi.org/ 10.1016/j.scp.2021.100481

40. Metwaly, A.M.; Lianlian, Z; Luqi, H, Deqiang, D. Black Ginseng and Its Saponins, Preparation, Phytochemistry and Pharmacological Effects. *Molecules* **2019**, *24(10)*, Art. No. 1856. https://doi.org/10.3390/molecules24101856

41. Sevindik, M. Investigation of Antioxidant/Oxidant Status and Antimicrobial Activities of *Lentinus tigrinus*. *Adv. Pharmacol. Scs*. **2018**, *1*, Art. No. 1718025. https://doi.org/10.1155/2018/1718025

42. Hinkson, I.V.; Madej, B.; Stahlberg, E.A. Accelerating Therapeutics for Opportunities in Medicine, A Paradigm Shift in Drug Discovery. *Front. Pharmacol*. **2020**, *11*, Art. No. 770. https://doi.org/10.3389/fphar.2020.00770

43. Hao, D.C.; Xiao, P.G. Pharmaceutical resource discovery from traditional medicinal plants, Pharmacophylogeny and pharmacophylogenomics. *Chin. Herb Med*. **2020,** *12(2)*, 104-117. https://doi.org/10.1016/j.chmed.2020.03.002

44. Kalyvianaki, K.; Malamos, P.; Mastrodimou, N. Toxicity evaluation of an essential oil mixture from the Cretan herbs thyme, Greek sage and Cretan dittany. *Npj Sci. Food*. **2020**, *4*, Art. No. *20*. https//doi.org/10.1038/s41538-020-00080-1

45. Jodh, R; Tawar, M; Kachewar, A; Mahanur, V; Sureka, Y; Atole, V. Pharmacological Review on *Madhuca longifolia*. *Asian Jour. of Res. in Pharm. Scs*. **2022**, *12(1)*, 29–36. https//doi.org/ 10.52711/2231-5659.2022.00006

46. Dalvi, T.S.; Kumbhar, U.J.; Shah, N. *Madhuca longifolia*, Ethnobotanical, phytochemical studies, pharmacological aspects with future prospects. *Interdisc. J. Appl. & Basic Sub*. **2022**, *2(7)*, 1-9.

47. Keri, R.S. *Madhuca longifolia* – bark and leaves, An outlook for natural therapeutic approach for Alzheimer's disease. *Research Square*. **2022**, *1*, Art. No. PPR506829. https://doi.org/10.21203/rs.3.rs-1524591/v1

48. Khutade, K.; Shah, H.; Joshi, V.; Chanda, S. Traditional Brewing Techniques for Production of Bioethanol from *Madhuca longifolia* Flowers using Isolated Strain VIMS 1, Saccharomyces cerevisiae ATCC-9763 and Study of Parameters. *Int. J. Adv. Res. Biol. Sci*. **2022**, *9(10)*, 60-67. http://dx.doi.org/10.22192/ijarbs.2022.09.10.007

49. Naveena, R. ; Metta, S; Swamy, M.V.; Raja, S.S.D.B.; Nagadani, S,L,, Reddy, M.N. Isolation, Characterization and Biological Evaluation of Biomolecules from *Madhuca longifolia* Seeds, *World Jour. of Pharm. Res*. **2022**, *11 (13)*, 1537-1559.

50. Sawant, S.H.; Vishwakarma, J.R.; Kulavoor, S.S. Preparation of Hard Cough Candy by using Dry Mahua Flowers, *J. Emerg. Technol. Innov. Res*. **2020**, *7(7)*, 843-848.

51. Saif, M; Varma, R; Kant, R; Gupta, R.K. *Madhuca longifolia* (Mahua), A comprehensive ethno pharmacological review. *Intn. J. Chem. Studies*. **2020**, *8(2)*, 172–175.

52. Manikandan, D; Parveen, S; Periasamy, P.A. Examination of Phytochemical Constituents – Using Seed Extract of *Madhuca longifolia*. *Asian. J. Pharm. Clin. Res*. **2020**,*13(6)*, 35–37. https://doi.org/ 10.22159/ajpcr.2020.v13i6.37113

53. Mishra, B.; Usha, T. A Review on Pharmacological Approach of the Therapeutic Property of *Madhuca longifolia* (J.Koenig ex L.) J. f. Macbr. Flower. *J. Res. Sid. Med*. **2019**, *2*, 61–68.

54. Mishra, A.; Poonia, A. Mahua *(Madhuca longifolia*) flowers, review on processing and biological properties. *Nut. & Food Sc*. **2019**, 11; *49(6)*, 1153-1163. https://doi.org/10.1108/NFS-12-2018-0358

55. Chavan, G.M.; Vasaikar, R.S.; Patil, J.K.; Hamid, H.S.; Akash, J.; Jain, V.H. Study of CNS Depressant activity of Ethanolic extract of *Madhuca longifolia* Flower. *Res. Jour. Pharmacol. Pharmacodynamics*. **2019**, *11(4)*, 127–131. https://doi.org/10.5958/2321-5836.2019.00022.3

56. Chinnadhurai, M.; Al-Otaibi, F.; Nelson, K.; Kandasamy, G.; Shanmugam, M.; Venkatnarayanan R. Protective Effect of *Madhuca longifolia* leaves in 7, 12-Dimethylbenz(a)anthracene Induced Mammary Carcinoma in Sprague Dawley Rat model. *Pharmacog. Mag*. **2019**, *15(66)*, 396-401.

57. Bisht, V.; Neeraj, V.; Solanki, K.; Dalal, N. Mahua an important Indian species, A review. *J. Pharmacog. Phytochem*. **2018**, *7(2)*, 3414–8.

58. Sangeetha, R.; Kripa, K.; Devi, N. In vitro proton pump inhibitory activity of the leaves of *Madhuca longifolia*. *Int. J. Res. Pharm. Sci*. **2018**, 9(3), 935–9. https//doi.org/ 10.26452/ijrps.v9i3.1611

59. Godfrey, A.; Jose, R.; Govindarajulu, B.; Abirami, T.; Kavitha, V.; Saritha, G. In vitro antioxidant and cytotoxic activity of ethanol bark extract of *Madhuca longifolia* on MCF-7 and Vero cell lines. *Jour. of Pharmacog. Phytochem*. **2018**, *7(6)*, 1368–1371.

60. Jha, D.; Mazumder, P. Biological, chemical and pharmacological aspects of *Madhuca longifolia*. *Asian Pac. Jour. Trop. Med*. **2018**; *11(1)*, 9–14. https://doi.org/10.4103/1995-7645.223528

61. Subanithi, P.; Swarnalatha, M. In vitro Antimicrobial Activity of *Madhuca longifolia* Leaf Extract. *Int. J. Eng. Sci*. **2018**, *7(4)*, 9–12. https://doi.org/10.9790/18130704020912

62. Jaydeep, P. D.; Kumar, V.; Kumar, A; Gat, Y; Suri, S.;

Sharma, K. Mahua: A boon for Pharmacy and Food Industry. *Curr Res Nutr Food Sci*. **2018**, *6(2)*, 371–381. https://dx.doi.org/10.12944/CRNFSJ.6.2.12

63. Khare, P.; Kishore, K.; Sharma, D.K. Medicinal uses, Phytochemistry and Pharmacological profile of *Madhuca longifolia*. *Asian Journ. Pharm. Pharmacol*. **2018**, 4(5), 570–581. https://doi.org/10.31024/ajpp.2018.4.5.5

64. Khare, P.; Kishore, K.; Sharma, D.K. A Study on the Standardization Parameters of *Madhuca longifolia*. *Asian Jour of Pharm. Clinical Res*. **2017**, *10(7)*, 318-321. https://doi.org/10.22159/ajpcr.2017.v10i7.18414

65. Sarkar, M.K.; Vadivel, V.; Raja, M.R.C.; Mahapatra, S.R. Potential anti-proliferative activity of AgNPs synthesized using M. longifolia in 4T1 cell line through ROS generation and cell membrane damage, *J. Photochem. Photobiol. B: Biol*. **2018**, *186*, 160-168. https://doi.org/10.1016/j.jphotobiol.2018.07.014

66. Arun, S.; Ajay, S.; Vadivel, V. Effect of Extraction Conditions on the Total Phenolic Yield of *Madhuca longifolia* Leaves and Evaluation of Its Physico-chemical and Antioxidant Properties. *J. Pharm. Sci. Res*. **2017**, *9(7)*, 1188–1194.

67. Sinha, J.; Singh, V.; Singh, J. Phytochemistry, Ethnomedicinal Uses and Future Prospects of Mahua (*Madhuca longifolia*) as a Food, A Review. *J. Nutr. Food Sci*. **2017**, *7(1)*, 25-38. https://doi.org/10.4172/2155-9600.1000573

68. Devi, N.; Sangeetha, R. *Madhuca longifolia* (Sapotaceae): A Review of its Phytochemical and Pharmacological Profile. *Int. J. Pharm. Bio. Sci*. **2016**, 7(4), 108-114. https://doi.org/10.22376/ijpbs.2016.7.4.b106-114

69. Kamal, A. Qualitative Phytochemical Analysis of *Madhuca longifolia*. *Indian J. Plant Scs*. **2014**, *3(4)*, 38–41.

70. Bhaumik, A.; Kumar, M.U.; Khan, K.A.; Srinivas, C. The Bioactive Compounds Obtained from the Fruit-Seeds of *Madhuca longifolia (L)* Act as Potential Anticancer Agents. *Sch J App Med Sci*. **2014**, *2(4A)*, 1235–1238.

71. Akshatha, K.N.; Murthy, S.M.; Lakshmidevi, N. Ethnomedicinal Uses of *Madhuca longifolia* – A Review. *Intn. Jour. of Life Sc. Pharm. Res*. **2013**, *3(1)*, 44–53.

72. Mishra, S.; Pradhan, S. *Madhuca longifolia* (Sapotaceae), A Review of Its Traditional Uses and Nutritional Properties. *Intern. Journ. Hum. Social Sci. Inv*. **2013**, *2(5)*, 30–36.

73. Yadav, P.; Singh, D.; Mallik, A.; Nayak, S. Review *Madhuca longifolia* (Sapotaceae), A review of its traditional uses, Phytochemistry and pharmacology. *Intern. Jour. Biomed. Res*. **2012**, *3(7)*, 291–295.

74. Chakma, C.S.; Patel, M.P. Antimicrobial Activity of The Fruit-Seeds *Madhuca longifolia* (Koenig). *Intn. Res. Journ. of Pharm*. **2011**, *2(9)*, 192–193.

75. Gaikwad, R.D.; Ahmed, M.L.; Khalid, M.S.; Swamy, P. Anti-inflammatory activity of *Madhuca longifolia* seed saponin mixture. *Pharmaceutical Biol*. **2009**, *47(7)*, 592–597. https://doi.org/10.1080/13880200902902513

76. Tiezzi A. Medicinal Plants from Different Planet Regions, Traditional and Present Uses. *Current Traditional Medicine*. **2018**, *4(3)*, 156–156.