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A Mechanistic Review on Phytochemical, Traditional and Pharmacological action of *Michelia champaca*

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ABSTRACT-

Michelia champaca Linn acknowledged by most as Champa is a medium-sized everblooming tree in the Magnoliaceae family. It is widely dispersed in China, South India, West Bengal, Myanmar, and the eastern Sub-Himalayan region. This plant has both traditional ethnomedical uses so it is used in various ailments like ulcers, nausea, stimulant, astringent, purgative etc.

Preliminary phytochemical screenings have detected the existence of saponins, flavonoids, alkaloids, glycosides, fixed oils, and carbohydrates. Additional active components derived from various portions of this plant include dihydro parthenolide, liriodenine, gallic acid, quercetin, β-sitosterol, parthenolide, starch. Phytochemistry of plant revealed many active chemical constituents like Methyl Linoleate, Cis-Linalool Oxide, Phenyl Acetonitrile, 2-Phenyl Ethyl Alcohol, and Methyl Anthranilate Indole.

For the purpose of analyzing bioactive chemicals, the plant has been exposed to a variety of chromatographic techniques, including Gas chromatography (GC), Gas chromatography with Mass spectroscopy (GCMS), High-performance thin-layer chromatography (HPTLC), Thin-layer chromatography (TLC), High-performance liquid chromatography (HPLC). Procognitive activity, Anti-microbial, Anti-oxidant, Diuretic, Anti-ulcer, Analgesic, Anti-inflammatory, Burn wound healing, Anti-helmintholytic, Anti-diabetic, and antifertility properties are among the pharmacological activities for *M.champaca* that have been described. The goal of this review is to present a comprehensive and complete understanding of the pharmacological, phytochemical, and pharmacognostical activities associated with *M. champaca* in a single piece.

Keywords: *Michelia champaca Linn.*, Pharmacological activity, HPLC, HPTLC, Flavonoids, Phenol

Introduction

Michelia champaca a tree with high therapeutic value belonging to the family *Magnoliaceae* known by many names, including Champa in Hindi, Atigandhaka in Sanskrit, Sambagam in Tamil, Champaka in Bengali.this plant is grown in Indian gardens and close to temples because of its lovely foliage and fragrant blossoms. (Kapoor S, 2004)

Vernacular Names-

M. champaca is also referred to by a number of regional names, as listed below:

Assam - Champa, Champaka,

English - Golden, Yellow Champa,

Gujrati - Pilochampo, Champ, Sonchampo, Konkani, Champa, Champaca, Champac,

Sanskrit - Anjana, Atigandhaka, Hempushpa, Kanchana

Marathi - kudchampa, Sonchampa

Punjabi - Champa, Chamoti

Uriya - Champa, Chamoka

Tamil - Amariyam, Sambagam

Geographical Distribution

Native to India, *M.champaca* grows in humid tropical evergreen woods between 250 and 1500 metres above sea level. It can be found in Java, Sumatra, Malaysia, Indo-China, and southwest China. Because of the widespread human dispersal caused by the use of the trees, it is challenging to ascertain the native distribution of this species outside of India. These areas include Southeast Asia and Indonesia. About 40 species make up the genus Michelia, which is found in southern Japan, Taiwan, Malaysia, and Indonesia in addition to India. In Malaysia, there are three types of chempaka: *Michelia alba* (white), *Michelia figo* (dwarf), and *Michelia champaca* (orange). (Armiyanti, 2010,M.K. HOSSAIN and Indian Diversity Portal).

Botanical Description

The scientific name for the Michelia tree is *M. champaca*, and it can grow as high as thirty metres. The young branches are covered in grey hairs. The greatest length and width of the ovate-shaped leaves are 30.5 cm and 10.2 cm, respectively, and they taper to a fine point at the tip. Stipules are little bracts that are present on the leaf stalks of alternating leaves. With a diameter of 5.1 cm, the flowers are relatively enormous and come in a variety of colours, from pale yellow to orange. When a Michelia tree blooms, they may also be smelled far away due to its potent scent. The blooms feature fifteen tepals that curve upward towards the tips

and several stamens that generate pollen. (NTBG, 2005, M.K. HOSSAIN and Indian Diversity Portal)

M. champaca grows at 2,100 metres above sea level, it can be found sporadically in mountain rain forest to primary lowland. 35–400^0 C is the absolute maximum, while 3–100^0 C is the absolute minimum (Orwa C, 2009). This plant's primary growing season is the monsoon, which lasts from June to September. This plant contains a lot of volatile oil constituents, the concentrations of which change with the seasons. (Lago JHJ, 2009, M.K. HOSSAIN and Indian Diversity Portal)

Taxonomical Classification

Kingdom	Plantae
Subkingdom	Tracheobionta
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Magnoliidae
Order	Magnoliales
Family	Magnoliaceae
Genus	Michelia
Species	champaca

(a) **(b)** **(c)**

Fig.1 Various part of *Michelia champaca* plant (a) Fruit (b) Flower (c) Steam & Flower

Identity, Purity & Strength

The qualities listed below aid in identifying this plant, both in terms of strength and purity.

Table 1: Established Standard Parameters of *M. Champaca Lin.* (The Ministry, 2008)

Standardized Parameters	**Value(%w/w)**	
	Not more than	**Not less than**
Water-soluble extractive value	-	12%
Foreign matter	2%	-
Alcohol-soluble extractive	-	9%
Total Ash	11%	-
Acid-insoluble ash	1.5%	-

Traditional uses-

M. champaca had been used since ancient times so it found a wide range of the traditional uses in variety of health related problems.

Table 2: Traditional Uses of *M. champaca*

Plant part	**Uses**	**Reference**
Dried root & Bark	Abscesses, Purgative	(Kirtikar, 1991)
Flower & flower buds	Ulcers, skin disease wounds	(Nandkarni, 1954)
Flower buds	Herbal preparation for diabetes	(Rajagopalan, 2010)
Flower oil	Cephalagia, opthalmia & gout, Rheumatism	(Sumeet Gupta, 2011)
Flowers	Stimulant, antispasmodic, tonic, stomachic, dyspepsia, Nausea & fever, Antidote to snake & Scorpio venoms, Foetid discharges from nostrils, Vertigo.	(Kirtikar, 1991,Sumeet Gupta, 2011 and (Gupta S., 2011)
Leaves	Colic, fever leprosy, post partam protection	(Sumeet Gupta, 2011 and LM, 1980)
Fruits	Ulcers, Skin disease wounds	(Nandkarni, 1954)
Root Bark	Purgative, inflammation, constipation & dysmenorrhea.	(Khan. M. R., 2002)
Stem bark	Stimulant, gonorrhea, antidote for scorpion and snake venoms, cough, astringent and febrifuge, eye disorders, inflammation	(Varier, 2003,Nandkarni, 1954 and Sobhagini N, 2004)

Phytochemistry-

Researchers have isolated numerous active principles and secondary metabolite from various parts of *M. champaca* and they are tabulated below.

Table 3: Various chemical constituents in different parts of *M. champaca*

Plant Part	Chemical constituents	References
Flower	Alkaloids, A-Ionon, Saponins, Methyl Benzoate, Tannins, Sterols, Flavonoids, Dihydro-B-Ionone, B-Ionone Dihydro-B-Ionol, Triterpenoids, Linalool, Benzyl Acetate, Methyl Linoleate, Cis-Linalool Oxide, Phenyl Acetonitrile, 2-Phenyl Ethyl Alcohol, Methyl Anthranilate Indole,	(Raja S, 2014 and Rout, 2006)
Leaves, Stem, Root	Triterpenoids, B-Caryophyllene, A-Humulene, Steroids, Fatty Acid, Alkaloids, Flavonoids, Tannins And Saponins, Liriodenine, Parthenolide, Sesquiterpene Lactones, Guaianolides, Benzyl Acetate, Linalool, Isoeugenol,Sesquiterpenes B-Elemene, B-Selinene, A-Cadinol.	(Chandrashekhar KS, 2010, Ahmad H S. V., 2011, Monteiro MCM, 2007,WC, 1994, Kazuoito, 1982, PK, 1997, Cheng-Tsung Huang, 2014 and João Henrique G. Lago, 2009)
Stem Bark & Leaves	Quercetin	(Ahmad H M. A., 2011)
Stem bark	Magnograndiolide, Costunolide, Dihydroparthenolide, N-Docosanoic Acid B-Sitosterol, Ushinsunine, Michampanolide, 8 - Acetoxyparthenolide, Stigmasterol, (Polyphenolic) Gallic Acid, Magnoflorine, And Micheliolide	(RK, 2004, SC, 2005, Jacobsson U, 1995, Balugri VC, 1997, Banerjee SK, 1964, Makhija IK, 2010 and Ahmad H M. A., 2011)
Bark	Volatile, Essential, Fixed Oil, Resin, Mucilage, Starch, Sugar, Tannin	(Kirtikar, 1991)
Branches	Anonaine, Asimadoline,Romerine, N-Acetylanonaine, Scopoletin , Vanillin , Nuciferine, Anolobinelignan –Syringaresinol Amide- N Trans-Feruloyltyramine, Vanillic Acid	(Lo WL, 2004, Chen CY, 2008, Yang TH, 1972, CM, 1970, Liu CY, 2008, Céspedes CL, 2006, , Lo WL, 2004, Kapoor S, 2004 and Yeh YT, 2011)

Preliminary Phytochemical Screening-

Michelia champaca is a very precious plant and it contains a markedly significant amount of phytochemical constituents, Researchers had employed a wide range of preliminary tests to confirm the presence of specific chemical constituents and they are tabulated below.

Table 4: Phytochemical screening of *M. champaca*

S. no.	Phytochemical Tests	Extract	References
1.	Reducing Sugar, Flavonoids, Steroids, Tannins, Phlobatannis, Saponins	n-hexane, chloroform, methanol, ethanol, and aqueous extract of leaves and stem	(N. Manhas, 2017)
2.	Alakloids, tannis, glycosides, carbohydrate, amino acids, flavonoids and sterols	Petroleum ether extract of dried flower and leaves	(Shejale Savita R., 2019)
3.	Alkaloids, Amino acid, Flavonoids, Sterols, Saponis, Tannins, Glycosides, Carbohydrate,	Acetone, Aqueous, Benzene, Ethanol, Chloroform, Pet. Ether extract of leaves and flower	(K. N. Geetha, 2011)
4.	Alkaloid, Tannins, Saponins, Flavonoids, Terpenoids, Glycosides, Carbohydrate, Steroids	Pet. Ether, Chloroform, Ethyl acetate, Methanol	(Raja S, 2014)
5.	Carbohydrate, Alkaloids, Terpenoids, Flavonoids, Tannins, Steroids, Proteins, Amino acid, Phenols	Methanolic extract of Flower	(T. ANANTHI, 2013)
6.	Alkaloids, Flavonoids, Terpenes, Glycosides, Phenols, Steroids, Tannins And Saponins	Methanolic extract of leaves	(R. Shankar, 2023)
7.	Terpenoids, Flavonoids, Saponins, Tannins, Alkaloids, Reducing Sugar, Anthraquinones, Cardiac glycoside, Steroids, Phenols, oils and resins	Ethanolic, Methanolic, Chloroform, Aqueous extract of Seed and flower	(Dr. S.Vijayanand, 2016)
8.	Alkaloids, Flavonoids, Steroids And Tannins	Hydroalcoholic extract of leaves	(Seema Taprial, 2013)
9.	Alkaloids, Saponins, Tanins, Glycoside, Carbohydrate, Flavonoids, Sterols, Amino acids	Methanolic, ethanolic& aqueous extract of dried flower	(Iyer Ganesh, 2016)

10.	Steroids, Carbohydrates, Alkaloids, Flavonoids, Tannins, Saponins.	Chlorofrom, Acetone, Ethanolic, aqueous extract of Plant material	(E. Edwin Jarald, 2008)
11.	Carbohydrates, Alkaloids, Terpenoids, Flavonoids, Tannins, Steroids, Proteins, Amino acid, Phenols	Methanolic extract of dried flower	(T. Lavanya, 2017)
12.	Saponins, Alkaloids, Terpens, Sterols, Anthraquinone, Tannins, Phenols	Ethanolic extract of Leaves	(Saqib, 2018)
13.	Alkaloids, Flavonoids, Tannins, Steroids	Pet. Ether, choloroform& Ethanolic extract of Aerial	(Seema Devi, 2024)
14.	alkaloids, flavonoids, glycosides, Carbohydrate, Protein, Sterols,	Aqueous and Ethanolic extract of leaves & Flower	(A. R. Mullaicharam, 2011)
15.	Tannins, Flavonoids, Steroids, Triterpenoids, Anthroquinones, Carbohydrate, Saponins, Cardiac Glycosides, Terpenoids, Alkaloids, Phlobatannins	Methanolic extract of dried flower	(T.Ananthi, 2014)
16.	Steroids, Alkaloids, Saponins	Pet.Ether,Chloroform,Aceton,Ethanolic Extract of leaves	(Gupta S., 2011)
17.	Sterols, Flavonoids, Saponins, Terpenoids, Glycosides And Tannins	ethyl acetate, chloroform:methanol and methanolic extract of Seeds	(Dutta M., 2023)
18.	Alkaloids, Coumarins, Flavonoids, Tannins, Phenols, Sterols, Saponins, Terpenes And Anthraquinone	Ethanolic extract of Leaves	(Saqib, 2018)
19.	Alkaloids, carbohydrate, Glycosides, Phytosterol, Saponins,Tannins, Protein & A.A, Gum & Mucilage etc.	Pet. Ether, Ethanol, Chloroform, Ethyl acetate, and Aqueous extract of Leaves	(Karthikeyan V, 2016)

Chromatographic Techniques-

For the quantitative and qualitative estimation of various compounds various Chromatographic Techniques had been employed by the Researchers and they are tabulated below.

Table 5: Various Chromatographic Techniques of *M. champaca*

S. No.	Chromatographic Techniques	Extract	Solvent system	Phytochemical constituents	References
1.	GCMS	Volatile compounds of dried flower	Carrier gas-Helium	phenyl ethyl alcohol, epoxylinalool, varamol, methyl anthranilate and β–elemene	(Rajnibhas Samakradhamrongthai, 2009)
2.	GC-MS	Oils from leaves	Carrier gas-Helium	n-alkanes	(João Henrique G. Lago, 2009)
3.	GC-MS	Methanolic extract of flower	Carrier gas-Helium	linoleic acid ethyl ester 9,12octadecadienoic acid	(T. ANANTHI, 2013)
4.	GC-MS	Ethanolic extract of dried leaves	Carrier gas-Helium	n-hexadecanoic acid etc.	(Waisul Qarani, 2023)
5.	HPLC	Methanolic extract of flower	Solvent A-Methanol Solvent B-(water: acetic acid;1:1 v/v)	Gallic acid, Caffeic acid, Rutin, Quercitin, Ferulic acid	(T. Ananthi, 2015)
6.	HPLC	Endophytic Chaetomium sp.	Methanol / acetonitrile / water (25:35:40, v/v/v)	taxol	(A. Immaculate Nancy Rebecca, 2012)
7.	HPTLC	Methanolic & aqueous extract of Dried flower	Methanol : Chloroform: acetic acid :formic acid: (15:80: 2.5:2.5)	Saponins, Terpenoids, Tannins, Steroidal Terpens, Phenol, Flavonoids, Phenols &	(Malathi S., 2015)

				Anthraquinons	
8.	HPTLC	n-hexane extract of dried leaves	Toluene: Ethyl acetate : Acetic acid : Methanol (2.5:7:0.25:0.25)	Steroidal, Terpenoids, Fats, Flavonids	(Hafsa Ahmad V. S., 2011)
9.	HPTLC	Methanolic extract of dried leaves & stem bark	Benzene : Methanol (9 : 1)	β- Sitosterol	(Hafsa Ahmad S. S., 2012)
10.	TLC	Methanolic & aqueous extract of Dried flower	Toluene : Chloroform : Methanol	Phenols, Flavonoids, Saponins, Terpenoids	(Malathi S., 2015)
11.	TLC	Methanolic extract of dried leaves & stem bark	Solvent A- Toluene: Ethyl acetate(8:2) Solvent B – Benzene : Methanol (9:1) Solvent C – Toluene : Methanol(9 : 1)	β- Sitosterol	(Hafsa Ahmad S. S., 2012)
12.	TLC	Pet. Ether, Chloroform , Ethylacetat e, methanolic extract of plant	Solvent A- Dioxane : ammonia 25% (9:1) Solvent B- Ethyl acetate : Methanol (60:20) Solvent C- Benzene : Ethyl acetate(95:5) Solvent D- Chloroform Solvent E- Toluene : dioxin : acetic acid(90:25:4) Solvent F- Ethyle acetate : formic acid: Glacial Acetic acid	Alkaloids, Steroids, Flavonoids	(Raja S, 2014)

			: water (100:11:11:26)		
13.	TLC	Endophytic Chaetomium sp.	Solvent A- methanol : Chloroform - 1:7, v/v Solvent B – acetonitrile :Chloroform - 3:7, v/v Solvent C – Ethylacetate : propanol - 95:5, v/v Solvent D – Methylene chloride : tetrahydrofuran- 6:2, v/v Solvent E- Methylenechlorid : methanol : dimethyl formamicle- 90 : 9 : 1, v/v/v.	Taxol	(A. Immaculate Nancy Rebecca, 2012)
14.	TLC	Chloroform Extract, Petroleum ether extract	Solvent A- n-Hexane: Methanol- (9:1) Solvent B- Chloroform: Methanol-(9:1) Solvent C- Ethanol:n-Hexane- (2:8)	Quercetin	(Shejale Savita R., 2019)
15.	GC	Aqueous extract of fresh flower	Carrier gas- Helium (50:1)	Sesquiterpenes, essential oils	(Prasant K. Rout, 2006)
16.	GC	Methanolic extract of Bark	Carrier gas- Helium	Tributylacetylcitrate	(I Gusti Agung Gede Bawa, 2024)
17.	GC	Oils from leaves	Carrier gas- Helium	Monoterpene, hydrocarbons,	(Joao Henrique

				oxygenated sesquiterpenes, aliphatic alcohols	G. Lago, 2009)
18.	GC	Volatile compounds of dried flower	Carrier gas- Helium	phenyl ethyl alcohol, epoxylinalool, varamol, methyl anthranilate and β–elemene	(Rajnibhas Samakradh amrongthai , 2009)
19.	CC	Methanolic extract of Bark	Mobile Phase - Hexane : acetone (3:1) Stationary phase - Silica gel 60	HE1, HE2, HE3, HE4, HE5	(I Gusti Agung Gede Bawa, 2024)

Ethanomedicinal uses:

The flowers of this plant are used orally in the Ayurvedic medical system to treat dyspepsia, stomachaches, and as a carminative (Chanda R, 2007). Joint swelling is treated with *M. champaca* flower oil in the Siddha medical system (Wilson E, 2007).Plant seeds are consumed to increase appetite and treat liver conditions (Shrivastava RC, 2010). Honey-infused leaf infusion is used to cure colic, and fruit and seed paste is used to treat foot cracks. (Lalfakzuala R, 2007).

Pharmacological Activity-

As the *M. champaca* contains high amount of active chemical constituents it possess various reported Pharmacological activities

Diuretic Activity:

In order to assess diuretic action, the study used the conventional Metabolic Cage method, which involves giving the extracts to adult Swiss albino Wister rats with dosage of 250mg/kg and 500 mg/kg and monitoring rat's urine output over a predetermined amount of time. Comparing the extracts from the stem bark and leaves to a control group, the findings showed that both had notable diuretic effects. This may have consequences for the creation of natural diuretic medicines as it implies that *M. champaca Linn.* has promising diuretic characteristics. To clarify the underlying mechanisms and evaluate the safety and effectiveness of these extracts for use in human medicine, more research is necessary. (Ahmad H M. A., 2011)

Anti-microbial activity:

The study employs a method to synthesize (Silver Nitrate nano Particles) AgNPs using the fruit extract as a reducing agent and characterizes the nano-particles using various analytical

techniques. The results demonstrate that the synthesized AgNPs exhibit significant antibacterial properties at various concentration (200, 400, 800 and 1000 µg/ml). This suggests that *Michelia champaca L.* fruit extract can be utilized as a green and sustainable approach for the synthesis of AgNPs with potential applications in medicine and materials science. (Azharuddin Daphedar, 2020)

Anti-diabetic Activity:

In this research the investigator utilized alloxan to induce diabetes in rats, followed by treatment with the extract. Through morphological analysis and biochemical assays, the research revealed that the *M. champaca* leaves extract effectively mitigated hyperglycemia and induced positive morphological changes in the pancreatic beta cells. This suggests a potential anti-hyperglycemic effect of the extract Pet.Ether, Ethanol, Chloroform at a dose of 200mg/kg mediated through its impact on pancreatic beta cells. (Gupta S, 2011)

Wound healing:

In this study the researcher employed *M. champaca* extract in burn wound model as well as Dexamethasone suppressed burn wound model both model in this investigation were treated with *M. champaca* extract. When compared to the control group, oral and topical treatment of *M. champaca* dramatically accelerated wound contraction and shortened the duration of epithelialization in the burn wound model. In the dexamethasone-suppressed burn wound model, topical use of the extract markedly improve the rate of wound contraction. (Tara Shanbhag, 2011)

Anti-inflammatory Activity:

The investigation shows marked anti-inflammatory activity of *M. champaca* leaf extracts. Paw edema, a hallmark of inflammation, was notably reduced following treatment with the Ethanolic, Pet. Ether, chloroform, aqueous extracts at a dose of 200mg/kg. Moreover, granuloma formation, indicative of chronic inflammation, was inhibited. Biochemical analysis showed a decrease in MPO activity and NO levels, suggesting attenuation of inflammatory mediators. Histopathological examination corroborated these findings, demonstrating reduced tissue damage and inflammatory cell infiltration in treated rats compared to controls. (Gupta S., 2011)

Anti-oxidant Activity:

The research revealed promising hypolipidemic effects of *M. champaca Linn.* in hyperlipidemic rats. Elevated levels of antioxidant enzymes like Super Oxide Dismutase (SOD), catalase (CAT), glutathione peroxidase (GPx), and together with decreased lipid peroxidation, confirmed the extract's antioxidant efficacy. Histopathological examination of

the liver showed improvements in hepatic architecture and reduced lipid accumulation in treated rats compared to hyperlipidemic controls. (Pramila Patil, 2021)

Analgesic Activity:

In this study the researcher employed methanolic extract of *M. champaca Linn.* leaves at a dose of 200 and 400 mg/kg in rats with acetic acid induces writhing exhibited the analgesic activity. The activity of extract improves with increasing dose of extract. (Mohamed HM, 2009)

Procognitive Activity:

The hexane extract of *M. champaca* Linn. at dosage of 100mg/kg and 200 mg/kg demonstrated precognitive activity in memory deficit mice utilizing animals using interoceptive behavioural models of the Y maze. As the dosage was increased, the extract's activity surged. A higher dosage improves memory, which in turn causes mice to learn more effectively. (Ahmad H S. V., 2011)

Anti-Cancer:

This important research shows that researcher had utilized the flower and seed extract of the *M. champaca* plant for the exploration of anti-cancer potential of the flower extract and extract of *M. champaca* shows positive results in the research against MCF-7 cells. (Lee Seong Wei, 2011)

Acetyl cholinesterase inhibition activity:

The researcher has extracted eight different extracts (Mc-1, Mc-2, Mc-3, Mc-4, Mc-5, Mc-6, Mc-7, and Mc-8) from *M. champca* that are fungal strains of endophytic fungus (*Xylaria sp., Phomopsisstipata, and C. gleosprioides*). TLC assays that were assessed at 200µg showed a moderate inhibition of AChE. All other drugs were utilized as negative controls, such as Mc-1, which showed minimal action, and galantamine. (Vanessa Mara Chapla, 2014)

Anti-Depressant activity:

The tail suspension test was used to assess the antidepressant activity of EEMC. When compared to the control group, the results demonstrated that all treatment groups had a significant reduction in immobility time, and that the treatment groups at 100 mg/kg and 200 mg/kg were both equivalent and significantly better, respectively, when compared to standard drugs. (Pushpa V. H., 2022)

Anxiolytic activity:

The anxiolytic activity is evaluated using the light and dark box method to evaluate the anxiolytic effect of EEMC, the study found that both doses markedly increased the amount of duration in the light cubicle. On the other hand, treatment with 200 mg/kg of EEMC proved

to be more effective than other treatment doses and outperformed standard medication. Diazepam. (Pushpa V. H., 2022)

Antifungal activity:

According to this study, every extract of the endophytic fungal strain (*Colletotrichum gloeospriodes*) that was separated from *M. champaca* was assessed for its ability to inhibit phytopathogenic fungi. *C. sphaerosperm* and *Cladosporium cladosporioides* Using the TLC diffusion method, the extract Mc-1 showed strong antifungal activity at 5 µg, comparable to that of the positive control (Nystatin), suggesting that it has the potential to be an antifungal agent. The extracts Mc-7 and Mc-8 also showed strong antifungal activity at 100 µg against both fungal strains, but the Mc-6 extract only showed strong antifungal activity against *C. spaerospermum*. (Vanessa Mara Chapla, 2014)

Antifertility activity:

The aerial portions of *M. champaca* were extracted and using an investigational model for estrogenic/anti-estrogenic and anti-implantation effect, Ethyl alcohol (EAEMC), and Chloroform water (AAEMC), Petroleum ether (PEAEMC) were administered to female Wistar rats at dosae of 100 mg/kg and 200 mg/kg. The Ethyl alcohol extract of *M. champaca*, or EAEMC, was found to exhibit dose-dependent anti-fertility action. *M. champaca* may have anti-fertility properties is because of existence of phytochemical like as flavonoids, steroids, and alkaloids that were discovered using photochemical screening. (Seema Devi, 2024)

Anti-ulcer activity:

This study was conducted to assess *M. champaca Linn.* anti-ulcer properties. At dosage of 300 gm/kg, an alcoholic extract and flowers and leaves demonstrate anti-ulcer efficacy in male albino rats. It results in a rise in pH, a drop in ulcer index, overall acidity, and gastric juice. It lessens the production of pepsin and acid, which are necessary to preserve the strength of the stomach mucosa. (Kumar MS, 2011)

Anthelmintic activity:

The purpose of investigation is to assess anthelminthic potency of *M. champaca* leaves using test worms called *Pheretima posthuma*. In the investigation, different quantities of both methanolic and aqueous leaf extracts (70 mg/ml and 30 mg/ml) were utilized. The earth worm's death time (D) and paralysis time (P) were measured as part of the investigation. The extracts demonstrated dose-dependent anthelmintic efficacy. In comparison to the aqueous extract, the methanolic extract at both concentrations displayed shorter P and D time. Both

extracts displayed P and D times that were higher than average. Additionally, compared to Albendazole, the Ayurvedic standard had a longer P and D period. (Dama G., 2011)

Anti-tubercular activity:

In this research the investigator is able to conclude that Inhibition of both chloroform and methanol extract of *M. champaca* with concentration of 1mg/ml against *M. tuberculosis* MDR was under 90%. The increasing concentration of extracts (10 and 100m/ml) gives higher inhibition against *M. tuberculosis* MDR with inhibition above 90%. (Ni Putu Ariantari, 2017)

Table 6: Various Pharmacological activities of *M. champaca*

Pharmacological Activity	**Animal/Specie /Extract Used**	**Type of study**	**Method**	**Extract**	**References**
Diuretic activity	Swiss Albino Wistar Rats	In-vivo	Metabolic cage Method	Aq. Extract of leaves and stem bark	(Ahmad H S. V., 2011)
Anti-microbial Activity	*S.aureus, E.coli, B.subtilis*	In-vitro	Minimum Inhibitory concentration	Methanolic extract of dried flower	(T. Lavanya, 2017)
Anti-microbial Activity	*A.niger, Arubrum, A.versicolor, A.vitis, C.albicans, C.tropicalis, C.cladosporiods, T.mentagrophytes, T. tronsurum*	In-vitro	Minimum inhibitory concentration (MIC) determination	Methanolic extract of stem, root heart-wood, leaves, seed, stem, root bark,	(Khan. M. R., 2002)
Anti-microbial Activity	*E.coli, K. pneumonia, Edwardsiella tarda,Flavobacterium spp.,S.typhi, P. aeruginosa, V. alginolyticus, V. parahaemolyticus, A.hydrophila,*	In-vitro	Minimum inhibitory concentration (MIC) determination	Methanolic extract of Seed and flower	(Lee Seong Wei, 2011)

	V.cholera				
Anti-microbial Activity	*S.aureus, P.aeruginosa, , C.albicans, S.paratyphi B.subtilis, S.typhosa, E.coli*	In-vitro	Minimum inhibitory concentration (MIC) determination	Methanolic, Ethanolic and aqueous extracts of the flowers	(R. Vivek Kumar, 2011)
Anti-microbial Activity	*E.coli, B.coagulans*	In-vitro	Agar Cup Plate Method	Methanolic, ethanolic& aqueous extract of dried flower	(Iyer Ganesh, 2016)
Anti-microbial Activity	*E.coli,S.aureus , P.aeruginosa, B.cereus,*	In-vitro	Disc diffusion method	Silver nanoparticle of aqueous fruit extract	(Azharuddin Daphedar, 2020)
Anti-microbial Activity	*B.subtilis, S. aureus, S. typhi and S. dysentriae*	In-vitro	Minimum inhibitory concentration (MIC) determination	hexane & ethyl acetate extract of Flower	(Umadevi Parimi, 2012)
Anti-microbial Activity	*Salmonella, E. coli, S.aureus, E.coli, Klebsiella, Pseudomonas sp. & Acinetobacter, S. aureus*	In-vitro	Agar Well diffusion method	n-Hexane, chloroform, Methanolic, Ethanolic, & aqueous extract of Leaves and Stem	(N. Manhas, 2017)
Anti-microbial Activity	*Rhizopus species, S. aureus, E. coli, M. luteus, B.subtilis, Y.enterocolitica, S. typhimurium,*	In-vitro	Disc Diffusion Method	Methanolic & Aqueous extract of flower	(K. M. Elizabeth, 2006)
Anti-Fungal Activity	*C.cladosporioides, C.sphaerospermum*	In-vitro	Bio-autography	Endophytic Fungal extract isolated from Leaves, Stems & roots	(Vanessa Mara Chapla, 2014)

Anti-Ulcer Activity	Male albino Wistar	In-vivo	Pylorus Ligation Method	Ethanolic & aqueous extract of Leaf and Flower	(Kumar MS, 2011)
Anti-Ulcer Activity	Male albino rats	In-vivo	Aspirin induced Gastric acid ulcers	Ethanolic extract of Leaves	(M. Surendra Kumar, 2011)
Anti-Ulcer Activity	Male albino wistar Rat	In-vivo	Pylorus Ligation Method	Aqueous and Ethanolic extract of leaves	(A. R. Mullaichar am, 2011)
Anti-Diabetic Activity	Sprague Dawley rats	In-vivo	Alloxan induced Diabetes Rat Model	Petroleum, Chloroform, Ethanolic extract of whole plant	(Gupta S, 2011)
Anti-Diabetic Activity	Wistar rats	In-vivo	Alloxan induced Diabetes Model	Pet ether, Chloroform, Acetone, Ethanolic & aqueous extract of Flower buds	(E. Edwin Jarald, 2008)
Anti-Diabetic Activity	Albino wistar rats	In-Vivo	Streptozotoci ne-nicotinamide induced diabetes mellitus	Ethanolic & aqueous extract of leaves	(Jyoti Nanda, 2022)
Anti-Diabetic Activity	Dried bark extract	In-vitro	α- Amylase Inhibitory Assay, α-Glucosidase inhibitory Assay	Hydroethanoli c extract of dried bark	(Segu Prathyusha, 2021)
Wound healing Activity	Male Wistar rats	In-vivo	Burn wound healing model, Dexamethaso ne suppressed burn model	Ethanolic extract of Flowers	(Tara Shanbhag, 2011)

Anti-inflammatory Activity	Albino wistar rats	In-vivo	Cotton pallet granuloma	Methanolic extract of flower	(Vimala R, 1997)
Anti-inflammatory Activity	Human Red Blood cell Membrane	In-vitro	HRBC Membrane Stabilization Method(HRBC)	Methanolic extract of flower	(T. ANANTHI , 2013)
Anti-inflammatory Activity	Male Albino Wistar rat	In-vivo	Carrageenan Induced Paw oedema	Pet. Ether, Chloroform, Acetone, Ethanolic Extract of leaves	(Gupta S., 2011)
Analgesic Activity	Male Swiss albino mice	In-vivo	Acetic acid-induced writhing test	Methanolic extract of leaves	(Mohamed HM, 2009)
Anti-Oxidant Activity	Methanolic Extract	In-vitro	DPPH radical scavenging activity	Methanolic extract of leaves	(Mohamed HM, 2009)
Anti-Oxidant Activity	Pet. Ether, Benzene, Chloroform, Ethanol, Methanol & aqueous Extract	In-vitro	DPPH radical scavenging activity	Pet. Ether, Benzene, Chloroform, Ethanol, Methanol & aqueous Extract of Flower	(R. Vivek Kumar, 2011)
Anti-Oxidant Activity	Methanolic extract	In-vitro	DPPH radical scavenging activity	Methanolic extract of Seed and Flower	(Lee Seong Wei, 2011)
Anti-Oxidant Activity	Hexane & Ethyl acetate	In-vitro	DPPH radical scavenging activity	Ethyl acetate Hexane, extract of Flower	(Umadevi Parimi, 2012)
Anti-Oxidant Activity	Ethanol, Methanol & aqueous extracts	In-vitro	DPPH radical scavenging activity	Methanol, Ethanol, aqueous extracts of plant	(Rajshree Sinha, 2017)
Anti-Oxidant Activity	Aqueous & Methanolic	In-vitro	DPPH radical scavenging	Methanolic, Aqueous,	(Pramila Patil, 2021)

	extract		activity	extract of Arial Part	
Anti-oxidant Activity	Methanolic extract of bark	In-vitro	DPPH radical scavenging activity	Methanol Extract of Stem-Bark	(Ruksana Yesmin, 2021)
Anti-Oxidant Activity	Methanolic Extract	In-vitro	DPPH radical scavenging activity	Methanolic extract of Flower (Soxhlet & Microwave)	(V. Jaishree, 2011)
Anti-Oxidant Activity	Methanolic, aqueous extract	In-vitro	DPPH radical scavenging activity	Methanolic, aqueous extract of plant	(Malathi S., 2015)
Anti-Oxidant Activity	Ethanolic extract	In-vitro	DPPH radical scavenging activity	Ethanolic extract of Plant	(Waisul Qarani, 2023)
Anti-Oxidant Activity	Silver nanoparticle of aqueous extract	In-vitro	DPPH radical scavenging activity	Silver nanoparticle of aqueous fruit extract	(Azharuddin Daphedar, 2020)
Anti-Oxidant Activity	Ethanolic extract	In-vitro	DPPH radical scavenging activity	Ethanolic extract of leaves	(Meihong Liu, 2024)
Anti-aging activity	Ethanolic extract	In-vitro	Tyrosinase inhibitory activity	Ethanolic extract of Plant	(Waisul Qarani, 2023)
Anti-Cancer Activity	Human lung adenocarcinoma cells and MDA-MB-231 human breast adenocarcinoma cells	In-vitro	Cancer cell line	Methanolic extract of air branches	(Yeh YT, 2011)
Anti-Cancer Activity	Human breast adenocarcinoma (MCF-7)	In-vitro	Cancer cell line(MDA-MB-231)	Methanolic extract of seed and flower	(Lee Seong Wei, 2011)
Anti-Cancer Activity	*S. cerevisiae*	In-vitro	DNA repair or recombination-deficient mutants of the yeast *S. cerevisiae*	Endophytic Fungal extract isolated from Leaves, Stems & roots	(Vanessa Mara Chapla, 2014)

Anti-cancer Activity	Brine Shrimp (Artemia salina Leach)	In-vitro	Brine Shrimp lethality biossay	Methanolic extract of leaves	(Mohamed HM, 2009)
Anti-cancer Activity	Human epidermoid carcinoma of the nasopharynx	In-vitro	human epidermoid carcinoma of the nasopharynx test system	Ethanolic extract of stem	(JOSEPH J. HOFFMANN, 1977)
Anti-cancer Activity	Human amelanotic melanoma (C32) and human cervical carcinoma (HeLa)	In-vitro	SRB assay	Methylene chloride extract of Bark	(Korakot Atjanasuppat, 2009)
Anti-cancer Activity	DU-145 cell line	In-vitro	SRB assay	Ethanolic extract of fresh flower	(Iyer Ganesh, 2016)
Anti-cancer Activity	Swiss albino mice bearing Ehrlich Ascites Carcinoma (EAC) cells	In-vivo	Cell morphology and analysis the expression of cancer-related genes	Methanolic Extract of Stem-Bark	(Ruksana Yesmin, 2021)
Acetylcholinesterase(AchE) inhibitory Activity	Endophytic Fungal extract	In-vitro	TLC bioautographic assay	Endophytic Fungal extract isolated from Leaves, Stems & roots	(Vanessa Mara Chapla, 2014)
Anxiolytic Activity	Swiss albino mice	In-vivo	Light and Dark test ,Elevated Plus maze test	Ethanolic extract of leaves	(Pushpa V. H., 2022)
Antidepressant Activity	Swiss albino mice	In-vivo	Tail Suspension Test, Forced Swim Test	Ethanolic extract of leaves	(Pushpa V. H., 2022)
Helmintholytic Activity	*Pheretima posthuma*	In-vivo	Determination of Paralysis time(P) & Death	Methanolic & Aqueous extract of Leaves	(Dama G., 2011)

			time(D)		
Anti-tubercular Activity	*M. tuberculosis* MDR	In-vitro	Proportion method	Chlororform & Methanolic extract of Stem	(Ni Putu Ariantari, 2017)
Anti-tubercular Activity	*Mycobacterium tuberculosis*	In-vitro	Alamar Blue susceptibility test	Pet. Ether extract of Plant	(Shejale & Yeligar, 2019)
Anti-fertility Activity	Male & Female wistar rats	In-vivo	Anti-implantation activity, estrogenic & anti-estrogenic activity	Pet. Ether, choloroform & Ethanolic extract of Aerial	(Seema Devi, 2024)
Anti-fertility Activity	Male & Female wistar rats	In-vivo	Anti-implantation activity, estrogenic & anti-estrogenic activity	Hydroalcoholic Extract of Laves	(Seema Taprial, 2013)
Procognitive Activity	Mice of either sex	In-vivo	Hebb's William Maze(Rectangular Maze), Y Maze apparatus	N-hexane Extract of Leaves	(Hafsa Ahmad V. S., 2011)
Effect in Gut, airways & cardiovascular disorder activity	White albino rabbits	Invivo-Invitro	Isolated tissue preparation jejunam, Trachea, aorta	Ethanolic extract of Leaves	(Saqib, 2018)
Hypolipidemic Activity	Male & Female albino wistar rat	In-vivo	High fat induced Hyperlipidemia.	Aqueous & Methanolic Extract of Arial part	(Pramila Patil, 2021)
Antihyperlipidemic Activity	Triton WR 1339 Induced Male albino wistar rat	In-vivo	Triton induced hyperlipidemia	Methanolic extract of dried flower	(T.Ananthi, 2014)
DNA damage protection activity	Methanolic extract of Flower	In-vitro	Hydroxyl radical mediated	Methanolic extract of Flower	(V. Jaishree, 2011)

			DNA damage assay by electrophoresis, t-BOOH radical mediated DNA damage assay by electrophoresis	(Soxhlet & Microwave)	
Larvicidal & Pupicidal Activity	Aedes albopictus	In-vitro	Dose dependent larvicidal bioassay, Dose dependent pupicidal bioassay	ethyl acetate, chloroform, methanolic extract of Seeds	(Dutta M., 2023)
Schizonticidal Anti-Malarial Activity	Mouse	In-vitro	Blood parasitaemia level & mouse survival time	Methanolic extract of flower	(Eti Mehrotra, 2017)
Anti-spasmodic Activity	Chicken Ileum	In-vivo In-vitro	Isolated Chicken Ileum Preparation	Aqueous, Methanolic extract of stem bark	(Aswathy C. M. Pharm, 2020)

Marketed Preparations-

Ayurvedic Marketed Preparations – There are several Ayurvedic formulations such as Candanabalalaksadi Taila, Baladhatryadi Taila, Pushpachurna, Madana Kameswari Lehyam, Maharajaprasarini Taila, Pusp Churna are available in the market. (The Ministry, 2008) And formulations such as Dry leaf powder and essential oil are also available in the market.

Allopathic Marketed Preparations - Champaca-infused skincare (Brand name - Som Rasa Silk Skin Tint Champa), Champaca tea (Brand name - Organic Blend of Magnolia Champaca Flowers and black Tea from Chiangmai, Thailand), Champaca absolute (Brand name - Tom Ford), Champaca hair and body care.

Conclusion -

Medicinal plants help people live better lives and effectively maintain their health. Its ability to produce unique molecules that can be utilized to create new treatments has made it a useful ingredient in medications and cosmetics. Plants are living factories of phytochemicals that

produce a wide range of medications to treat different ailments. The future of herbal medications greatly depends on studying Indian traditional knowledge about plants. Because of their poisonous and negative effects, herbal medications could be a better option for treatment than synthetic ones. The active components of *Michelia champaca* leaves include flavonoids, sterols, phenols, glycosides, and alkaloids.

Many chromatographic techniques have been applied to the plant, such as Thin-layer chromatography (TLC), Gas chromatography (GC), High-performance liquid chromatography (HPLC), and Gas chromatography with Mass spectroscopy (GCMS), High-performance thin-layer chromatography (HPTLC).

Herbal medicine needs to be standardized in order to create formulations that have been supported by research. Through the economical and sustainable utilization of medicinal plant resources, scientists and researchers working in interdisciplinary research may generate native products beneficial in treating a variety of illnesses.

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