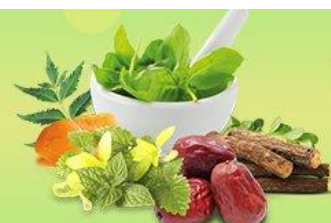


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## A comprehensive review on therapeutic uses of *Myristica fragrans* in traditional systems of medicine

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### Abstract

*Myristica fragrans* is an aromatic evergreen tree which belongs to Myristicaceae family. Nutmeg (seed) and Mace (arillus) which are two separate spices derived from the fruit of tree *Myristica fragrans* used as spices in culinary and in traditional systems of medicine. This study was carried out to give an overview on *Myristica fragrans* according to traditional systems of medicine and to review the recent scientific evidences of phytochemical and pharmacological studies systematically. While reviewing the literature, it reveals *Myristica fragrans* shows therapeutic actions such as appetizer, carminative, digestive, stomachic and aphrodisiac activities and *Myristica fragrans* shows therapeutic uses such as indigestion, loss of appetite, diarrhoea, cough, asthma and sexual debility. Numerous studies have indicated that *M. fragrans* contains diverse phytochemicals such as Myristicin, Myristic Acid, Trimyristin, Elemicin, Safrole, Lignans, Neolignans, Maceneolignans etc. which exhibit many of pharmacological activities such as Anti-allergic activity, Antibacterial activity, Anti-cancer activity, Anticonvulsant activity, Anti-diabetic activity, Anti-diarrhoeal activity, Anti-depressant activity, Anti-fungal activity, Anti-inflammatory activity, Anti-microbial activity, Anti-oxidant activity, Analgesic activity, Aphrodisiac activity, Gastro-protective activity, Hepatoprotective activity, and Immunomodulatory effect. Myristicin, Myristic Acid, Trimyristin are the most active compounds among them. The aim of this review is to comprehensively summarize the phytochemical and pharmacological properties of *Myristica fragrans* that have reported to date.

**Keywords:** Jaiphal, Javitri, Jatiphala, Jayapatri, mace, nutmeg

### Introduction

A spice is a dried seed, fruit, root, bark or flower of a plant or a herb used in small quantities for flavor, color or as a preservative. The spices and Herbs used for flavor, aroma and medicinal properties derive a special value from the said factors [1]. Spices and herbs have been in use for centuries both for culinary and medicinal purposes. Spices not only enhance the flavor, aroma, and color of food and beverages, but they can also protect from acute and chronic diseases. Long before modern medicine, spices were valued for their ability to help individuals in disease prevention and health promotion [2].

*Myristica fragrans* is an aromatic evergreen tree which belongs to Myristicaceae family. Nutmeg (seed) and Mace (arillus) which are two separate spices derived from the fruit of tree *Myristica fragrans*. Nutmeg is the seed kernel inside the fruit and mace is the red lacy covering (aril) on the kernel. These are used as spices in culinary and in traditional systems of medicine [3].

### Methodology

A systematic literature search was carried out to review articles and to gather the information available in the literature regarding *Myristica fragrans* in the view of description of the plant, chemical constituents, part used, therapeutic action and therapeutic uses, and recent scientific evidences of phytochemical and pharmacological activities. All the available information on *Myristica fragrans* was compiled from Unani, Ayurveda and Siddha textbooks & Pharmacopoeias and electronic databases such as Google scholar and PubMed.

### Results

#### Scientific Classification of *Myristica fragrans* [4]

Kingdom: Plantae  
Division: Tracheophytes  
Class: Magnoliopsida  
Order: Magnoliales

Family: Myristicaceae  
 Genus: Myristica  
 Species: *M. fragrans* Houtt  
 Botanical name: *Myristica fragrans* Houuttuyn [5].  
 Synonyms: *M. moschata* Thunb., *M. officinalis* Linn., *M. armocatica* Lamk [5].

**Vernacular names** [5]

English: Nutmeg, Mace tree  
 Tamil: *Sadikkay*  
 Sinhala: *Sadikka* (Nutmeg), *Wasawasi* (Arillus/Mace)  
 Unani Tibbi name: *Jaiphal*, *Javitri/ Bisbasa* [6] (Arillus/Mace)  
 Sanksrit name: *Jatiphala*, *Jayapatri* [7] (Arillus/Mace)



Fig 1: Seeds of *Myristica fragrans*



Fig 2: Arills/ Mace of *Myristica fragrans*

**Description of the plant** [5]

A moderate sized evergreen tree, 8-13 m high with numerous spreading branches covered with greyish-brown rather smooth bark, young branches green;

**Leaves:** simple, alternate, shortly petiolate, estipulate, somewhat convex above, 10-15cm long, ovate or oblong-

ovate, acute at both ends, entire, smooth, strongly veined, dark green and paler beneath;

**Flowers:** regular, unisexual, yellowish, dioecious in small axillary racemes of 2-6 flowers, flowers sometimes solitary in the female tree, pedicels slender, drooping with a single, quickly deciduous, rounded bract just below the flower; perianth about 1cm long, fleshy, bell-shaped or urceolate, nearly smooth, pale yellow, cut into 3 (rarely 4) spreading or erect, triangular, acute teeth, aestivation valvate;

**Fruit:** pendulous, about 7.5cm by 5cm, grooved by a longitudinal furrow which passes through the somewhat lateral apiculus marking the positions of the stigmas, smooth, yellow; pericarp nearly 1.2 cm thick, tough and fleshy, yellowish-white, dehiscent from above along the furrow into two equal halves and containing a single erect seed which completely fills the cavity, out of which it readily falls when ripe;

**Seed:** about 3 cm long, broadly ovoid, blunt, closely enveloped and almost completely covered by an irregularly cut, fleshy arillus (mace) which is cup-shaped round the basal hilum and much folded over the top of the seed, brilliant scarlet when fresh, but yellow and brittle when dry, testa very hard and thick, dark brown, smooth and shining, marked with impressions from the tightly arillus, inner seed coat thin, membranous, pale brown, nucleus of the seed (nutmeg) wrinkled externally, mainly consisting of the abundant endosperm, which is rather soft but firm, whitish and marbled with numerous reddish-brown vein-like partitions into which the inner seed coat penetrates (ruminated), embryo at base of the hilum, cotyledons foliaceous, lacinated.

**Parts used**

Seed, Arillus [6] (mace)

**Chemical Constituents**

The principal constituents of Nutmeg are a Fixed oil, Volatile oil 3% containing D-pinene, Myristin, Myristic acid and its Ester, Myristicin, Fatty acids etc [7].

**Properties of *Myristica fragrans* according to Unani, Ayurveda and Siddha systems of medicine**

Table 01 shows the properties of the *Myristica fragrans* according to the traditional systems of medicine.

**Table 1:** Properties of *Myristica fragrans* according to Unani, Ayurveda and Siddha systems of medicine

Unani [6]	Ayurveda [7, 8]	Siddha [9]
<p><b>1. Taste:</b> Pungent and slightly bitter (Nutmeg), Slightly bitter (Arillus/Mace)</p> <p><b>2. Mizaj (Temperament):</b> Hot 2<sup>0</sup> Dry 3<sup>0</sup></p>	<p><b>1. Rasa (Taste):</b> <i>Katu</i> (Pungent), <i>Tikta</i> (Bitter) and Astringent</p> <p><b>2. Guna (Attribute):</b> <i>Laghu</i> (Light), <i>Snigdha</i> (Oily) and <i>Tiksna</i> (Sharp)</p> <p><b>3. Virya (Potency):</b> <i>Usna</i> (Hot)</p> <p><b>4. Vipaka (Post digestive effect):</b> <i>Katu</i> (Pungent)</p>	<p><b>1. Cuvai (Taste):</b> <i>Kaarppu</i> (Pungent), <i>Thuvarppu</i> (Astringent)</p> <p><b>2. Gunam (Character):</b> <i>Ilaku</i> (Light), <i>Koormai</i> (Sharp)</p> <p><b>3. Virium (Potency):</b> <i>Veppam</i> (Hot)</p> <p><b>4. Pirivu (Class):</b> <i>Kaarppu</i> (Pungent)</p>

**Therapeutic actions of *Myristica fragrans* according to Unani, Ayurveda and Siddha systems of medicine**

Table 02 shows the Therapeutic actions of *Myristica*

*fragrans* according to the traditional systems of medicine.

**Table 2:** Therapeutic actions of *Myristica fragrans* according to Unani, Ayurveda and Siddha systems of medicine

Unani [6]	Ayurveda [7, 8]	Siddha [9]
<b>Jaiphal (Nutmeg)</b> 1. <i>Muqawwi-e-Meda</i> (Stomachic) 2. <i>Muqawwi-e-Bah</i> (Aphrodisiac) 3. <i>Muqawwi</i> (Tonic) 4. <i>Muhallil-e-Waram</i> (Anti-inflammatory) <b>Javitri/ Bisbasa (Arillus/Mace)</b> 1. <i>Muqawwi-e-Meda</i> (Stomachic) 2. <i>Hazim</i> (Digestive) 3. <i>Kasir-e-Riyah</i> (Carminative) 4. <i>Muqawwi-e-Qalb</i> (Cardiotonic)	1. <i>Deepana</i> (Appetizer) 2. <i>Digestant</i> 3. <i>Grahi</i> (Anti-diarrhoeal) 4. <i>Vrsya</i> (Aphrodisiac) 5. <i>Mukhalednasaka</i> 6. <i>Mukhadaurgandhyasnasaka</i> (Anti-hallitosis) 6. <i>Kaphavatapana</i> (Alleviates <i>Vata</i> and <i>Kapha</i> dosas) 7. <i>Stambhana</i>	1. <i>Akadduvayvakatri</i> (Carminative) 2. <i>Kaamamperukki</i> (Aphrodisiac) 3. <i>Manamootti</i> (Aromatic) 4. <i>Moorchchaiyundaakki</i> (Sedative/ Hypnotic) 5. <i>Uramaakki</i> (Nutrient) 6. <i>Veppamundaakki</i> (Stimulant)

**Therapeutic uses of *Myristica fragrans* according to Unani, Ayurveda and Siddha systems of medicine** according to the traditional systems of medicine.

Table 03 shows the Therapeutic uses of *Myristica fragrans*

**Table 3:** Therapeutic uses of *Myristica fragrans* according to Unani, Ayurveda and Siddha systems of medicine

Unani [6]	Ayurveda [7, 8]	Siddha [9]
<b>Jaiphal (Nutmeg)</b> 1. <i>Ishal</i> (Diarrhoea) 2. <i>Falij</i> (Paralysis) 3. <i>Wajaul Mafasil</i> (Arthritis) <b>Javitri/ Bisbasa (Arillus/Mace)</b> 1. <i>Amraz-e-Qalb</i> (Cardiac diseases) 2. <i>Su-e-Hazm</i> (Indigestion) 3. <i>Zof-e-Bah</i> (Sexual debility)	1. <i>Atisara</i> (Diarrhoea) 2. <i>Svasa</i> (Asthma) 3. <i>Chardi</i> (Vomiting) 4. <i>Kasa</i> (Cough) 5. <i>Pinasa</i> (Catarrh) 6. <i>Grahani</i> 7. <i>Mukharoga</i> (Oral diseases) 8. <i>Sukrameha</i> (Spermatorrhoea) 9. Loss of appetite 10. Indigestion 11. Worm infestation 12. Premature ejaculation 13. Dysmenorrhoea.	1. <i>Pasiththeekkuraivu</i> (Loss of Appetite) 2. <i>Iraippu</i> (Tuberculosis) 3. <i>Irumal</i> (Cough) 4. <i>Naalpatta Kazhichchal</i> (Chronic Dysentery) 5. <i>Perunkazhichchal</i> (Diarrhoea) 6. <i>Vinthuk Kuraivu</i> (Oligospermia)

**Compound formulations of *Myristica fragrans* according to Unani, Ayurveda and Siddha systems of medicine** according to the traditional systems of medicine.

Table 04 shows the Compound formulations of *Myristica*

**Table 4:** Compound formulations of *Myristica fragrans* according to Unani, Ayurveda and Siddha systems of medicine

Unani [6]	Ayurveda [7, 8]	Siddha [9]
<b>Jaiphal (Nutmeg)</b> 1. Laboob-e-Kabir 2. Laboob-e-Asrar 3. Jawarish-Ood-Shirin 4. Habb-e-Mumsik. <b>Javitri/ Bisbasa (Arillus/Mace)</b> 1. Jawarish Bisbasa 2. Jawarish Zarooni 3. Jawarish Zanjabeel 4. Habb-e-Azaraq 5. Habb-e-Jadwar 6. Habb-e-Mumsik 7. Laboob-e-Kabir 8. Laboob-e-Hazik	1. Jatiphaladi Curna 2. Jatiphaladi Vati	1. Ashtapayiravak Kulikai 2. Saampiranippoo Pathangam 3. Surapunga Vilvathi Ilakam 4. Ilaku Santhanaathi Thailam 5. Kapaada Maathirai

**Dosage of Fenugreek according to Unani, Ayurveda and Siddha systems of medicine** to the traditional systems of medicine.

Table 04 shows the Dosage of *Myristica fragrans* according

**Table 4:** Dosage of *Myristica fragrans* according to Unani, Ayurveda and Siddha systems of medicine

Unani [6]	Ayurveda [7, 8]	Siddha [9]
4-5g (Nutmeg) 1.5-10.5g (Arillus/ Mace)	0.5-1g (Powder)	500mg – 1g (Powder)

**Scientific evidences on phytochemical studies of *Myristica fragrans*** phytochemical studies of *Myristica fragrans*.

Following table shows the recent evidences on

**Table 5:** Phytochemical studies of *Myristica fragrans*

Name of the Chemical constituents	Part Used	References
Aryltetralin and Diarylbutane lignans <sup>[10]</sup> 1-5	Methanol extracts of Seeds	Kwon HS, <i>et al.</i> (2008)
Dihydrobenzofuran Neolignans and Myticaganal A-C <sup>[11]</sup> (1-3)	Seed	Chumkaew P, <i>et al.</i> (2019)
Eight New Neolignans and Maceneolignans A-H <sup>[12]</sup> (1-8)	Methanol extract of the Arils	Morikawa T, <i>et al.</i> (2016)
Four Lignans, Meso-Dihydroguaiaretic acid, Macelignan, Fragransin A2 & Nectandrin B <sup>[13]</sup>	Seeds	Thuong PT, <i>et al.</i> (2014)
Lignan Compound <sup>[14]</sup>	N-Hexane Root Extract	Ginting B, <i>et al.</i> (2020)
Macelignan <sup>[15]</sup>	Nutmeg Mace	Paul S, <i>et al.</i> (2013)
Myristicin <sup>[16]</sup>	Aril (Mace)	Naikodi MA, <i>et al.</i> (2011)
Myristicin <sup>[17]</sup>	Essential oil	Wang Y, <i>et al.</i> (2004)
Myristicin, Myristic Acid, Trimyristin, Elemicin & Safrole <sup>[18]</sup>	Essential Oil	Setty JV, <i>et al.</i> (2020)
Myristic Acid, Myristicin, Terpinen-4-ol, Alpha-Pinene & Safrole <sup>[19]</sup>	Essential oil	Qiu Q, <i>et al.</i> (2004)
Myristicin, Methyleugenol, Safrole, Dehydrodiisoeugenol, Guaiacin & Myrhisolignan <sup>[20]</sup>	Seed	Yang XW, <i>et al.</i> (2008)
Myristigranol (a new Diarylpropane derivative), one Diarylpropanoid & three Stilbenoids <sup>[21]</sup>	Methanol extract of Wood	Hiranrat A, <i>et al.</i> (2019)
Myrifralignan <sup>[22]</sup>	Seed	Cao GY, <i>et al.</i> (2015)
Phenolic compounds <sup>[23]</sup>	Fruit	Duan L, <i>et al.</i> (2009)
Phenylpropanoid Compound <sup>[24]</sup>	Extract of Seed	Maeda A, <i>et al.</i> (2008)
Trimyristin <sup>[25]</sup>	Chloroform extract of seeds	Narasimhan B, <i>et al.</i> (2006)
3',4',7-trihydroxyflavone <sup>[26]</sup>	Methanolic extract of crude Seed Kernel	Dzotam JK, <i>et al.</i> (2018)
$\alpha$ -phellandrene, 3-Carene, p-cymene, Limonene, $\alpha$ -Thujene, $\alpha$ -pinene, Camphene, Sabinene, $\beta$ -pinene, and Myrcene, $\alpha$ -terpinene, $\gamma$ -Terpinene, Terpinolene & Myristicin <sup>[27]</sup>	Essential Oil	Ibrahim MA, <i>et al.</i> (2020)

### Scientific evidences on pharmacological activities of *Myristica fragrans*

Following table shows the recent evidences on

pharmacological activities of *Myristica fragrans*.

**Table 6:** Pharmacological activities of *Myristica fragrans*

Pharmacological activity	Part Used	References
Anti-allergic activity <sup>[28]</sup>	Extract of wood, nutmeg and mace	Champasuri S, <i>et al.</i> (2016)
Antibacterial activity <sup>[25, 15, 29, 26, 30, 31]</sup>	Extract of Seed	Narasimhan B, <i>et al.</i> (2006)
	Extract of Seed	Paul S, <i>et al.</i> (2013)
	Essential Oil	Wang J, <i>et al.</i> (2019)
	Methanolic extract of crude seed kernel	Dzotam JK, <i>et al.</i> (2018)
	Ethyl acetate & ethanol extracts from Flesh, Seed & Mace	Shafiei Z, <i>et al.</i> (2012)
	Hydrolats and Essential Oil	Matulyte I, <i>et al.</i> (2020)
Anti-cancer activity <sup>[15, 32, 33, 34, 35, 36, 14, 13]</sup>	Nutmeg Mace	Paul S, <i>et al.</i> (2013)
	Extract of the Leaves	Akinboro A, <i>et al.</i> (2012)
	Essential Oil	Piaru SP, <i>et al.</i> (2012)
	Water extract of Seed	Kim EY, <i>et al.</i> (2016)
	Methanolic extract	Chung JY, <i>et al.</i> (2006)
	Ethanollic Mace Extract	Suthisamphat N, <i>et al.</i> (2020)
	N-Hexane Root Extract	Ginting B, <i>et al.</i> (2020)
Seeds	Thuong PT, <i>et al.</i> (2014)	
Anticonvulsant activity <sup>[37]</sup>	Volatile oil of nutmeg, the dried seed kernel	Wahab A, <i>et al.</i> (2009)
Anti-diabetic activity <sup>[15, 38]</sup>	Nutmeg Mace	Paul S, <i>et al.</i> (2013)
	Extract of Nutmeg	Pashapoor A, <i>et al.</i> (2020)
Anti-diarrhoeal activity <sup>[39]</sup>	Serial extracts of the Seeds	Pillai NR, <i>et al.</i> (1991)
Anti-depressant activity <sup>[40, 41]</sup>	Herbal extract	Moinuddin G, <i>et al.</i> (2012)
	N-hexane extract of Seeds	Dhingra D, <i>et al.</i> (2006)
Anti-fungal activity <sup>[42]</sup>	Methanolic extract of Seeds	Cho JY, <i>et al.</i> (2007)
Anti-inflammatory activity <sup>[43, 15, 44, 45, 46]</sup>	Extract of Wood, Nutmeg and Mace	Champasuri S, <i>et al.</i> (2016)
	Nutmeg Mace	Paul S, <i>et al.</i> (2013)
	Seed	Cuong TD, <i>et al.</i> (2011)
	Seed	Lee JY, <i>et al.</i> (2011)
	Pericarp of Nutmeg	Zhang CR, <i>et al.</i> (2015)
Anti-microbial activity <sup>[18]</sup>	Essential Oil	Setty JV, <i>et al.</i> (2020)
Anti-oxidant activity <sup>[47, 33, 24, 32, 46]</sup>	Seed	Li CW, <i>et al.</i> (2020)
	Essential oil	Piaru SP, <i>et al.</i> (2012)

	Extract of Seed	Maeda A, <i>et al.</i> (2008)
	Extract of the Leaves	Akinboro A, <i>et al.</i> (2011)
	Pericarp of Nutmeg	Zhang CR, <i>et al.</i> (2015)
Analgesic activity <sup>[48]</sup>	Nutmeg seed kernels	Hayfaa AA, <i>et al.</i> (2013)
Aphrodisiac activity <sup>[49, 50]</sup>	Ethanol extracts of Nutmeg	Tajuddin, <i>et al.</i> (2003)
	Ethanol extracts of Nutmeg	Tajuddin, <i>et al.</i> (2005)
Gastro-protective activity <sup>[51]</sup>	Extract of the Seeds	Sattar A, <i>et al.</i> (2019)
Hepatoprotective activity <sup>[15, 52, 53]</sup>	Nutmeg Mace	Paul S, <i>et al.</i> (2013)
	Essential Oil	Morita T, <i>et al.</i> (2003)
	Kernal extract of Nutmeg	Dkhil MA, <i>et al.</i> (2019)
Immunomodulatory effect <sup>[54]</sup>	Aqueous Extract of Fresh Nutmeg Mace	Checker R, <i>et al.</i> (2008)

## Discussion

While reviewing the literature, it reveals *Myristica fragrans* shows therapeutic actions such as appetizer, carminative, digestive, stomachic and aphrodisiac activities and *Myristica fragrans* shows therapeutic uses such as indigestion, loss of appetite, diarrhoea, cough, asthma and sexual debility. Numerous studies have indicated that *M. fragrans* contains diverse phytochemicals such as Myristicin, Myristic Acid, Trimyristin, Elemicin, Safrole, Lignans, Neolignans, and Maceneolignans etc. which exhibit many of pharmacological activities such as Anti-allergic activity, Antibacterial activity, Anti-cancer activity, Anticonvulsant activity, Anti-diabetic activity, Anti-diarrhoeal activity, Anti-depressant activity, Anti-fungal activity, Anti-inflammatory activity, Anti-microbial activity, Anti-oxidant activity, Analgesic activity, Aphrodisiac activity, Gastro-protective activity, Hepatoprotective activity, and Immunomodulatory effect. Myristicin, Myristic Acid, Trimyristin are the most active compounds among them.

## Conclusion

*Myristica fragrans* is an aromatic evergreen tree which belongs to Myristicaceae family. Nutmeg (seed) and Mace (arillus) which are two separate spices derived from the fruit of tree *Myristica fragrans*. Nutmeg is the seed kernel inside the fruit and mace is the red lacy covering (aril) on the kernel. These are used as spices in culinary and in traditional systems of medicine. This review is to comprehensively summarized the phytochemical and pharmacological properties of *Myristica fragrans* that have reported to date.

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