



## A DESCRIPTIVE REVIEW ON *Myristica fragrans* Houtt

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### ABSTRACT

#### Key words

Chemistry, *Myristica fragrans*, Nutmeg, Pharmacology, Essential oils.

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*Nutmeg and mace are the two spices derived from several tree species in genus Myristica. They contain essential oil and is used therapeutically, cosmetic and culinary preparations. Several value addition products widens the commercial value of this herb. Although fifty percent shade is recommended in the initial levels, as the tree grows it can be reduced. It is better to adopt budding or grafting as there are possibility of plants seedlings to grow into male and female plants, resulting in the production of 50% unproductive male plants. The female trees start fruiting from 6 years old even though peak period is 20 years. Over dose of essential oils of nutmeg is having hallucination effects.*

### 1. INTRODUCTION

Nutmeg (*Myristica fragrans* Houtt) is an evergreen thick shady tree which produces high commercial value nuts and aril (mace). Being known for its wide coverage of use in Pharmaceutical as well as non-Pharmaceutical, we thought of having an insight to its full potentiality. On literature review we came to know that the fruit-seed structure is not that simple; at a point we were jumbled to differentiate the seed part in its dry form. Since gathering farming practice directly from the field gives a live observation, we decided to collect the specimen directly from a nutmeg plantation and with the help of a botanist identify the parts. Nakshatra Extract Life Sciences (NELS) have its organic farm where nutmeg trees are being cultivated as a major crop as an intercropping between coconuts. Other spices including pepper and many other fruit yielding trees added value to the farm which follows good farming practice (GFP) under experienced technical hands. The details regarding cultivation, collection, processing and products of nutmeg were procured directly from their botanist, also from Pharmacopoeias, various literatures and online data. The information available on the Pharmacognostical, Pharmacological, and Chemistry of Nutmeg (*Myristica fragrans*) has been extensively reviewed including details about cultivation parameters and usage.

*Myristica fragrans* Houtt, commonly known as Jathikka and Javitri in India, belongs to the family Myristicaceae. The name 'Myristica' is derived from the Greek word 'Myron', a sweet liquid distilled from the plant (Everett 1981). *M. fragrans* is one of the aromatic plants that are endowed with alluring properties of fragrance and flavours and produces odoriferous secondary metabolites in their fruits. (N.Parimala and S.Amerjothy 2013). No wonder, the nutmeg and mace have been popular for several hundreds of years.

### 1.1. Geographical source

Originated from the Banda Islands in the Moluccas of Eastern Indonesia, it is seldom found truly wild. It is now cultivated in tropical regions, especially Grenada in the West Indies, Sri Lanka and India (Purseglove, 1968; Bown, 1995).

### 1.2. Biophysical limits

The plant grows at an altitude of 700-4500m with a temperature 25-30°C. It requires a rainfall of 2000-3500mm. Nutmeg can grow on any kind of soil provided there is sufficient water but without any risk of water logging. It prefers soils of volcanic origin and those with high contents of organic matter with pH 6.5-7.5.

### 1.3. Pharmacognostical details of the plant

It is a spreading aromatic evergreen tree usually growing to 5 to 13 metres high, occasionally 20 metres. The pointed dark green leaves are arranged alternately along the branches and are borne on leaf stems about 1 cm long. Upper leaf surfaces are shiny. Flowers are usually single sexed; occasionally male and female flowers are found on the same tree. Female flowers arise in groups of 1 to 3; males in groups of 1 to 10. Flowers are pale yellow, waxy, fleshy and bell-shaped. The fruits are fleshy, drooping, yellow, smooth, 6 to 9 cm long with a longitudinal ridge. Fruit is yellow in colour having a shiny outer coat (exocarp) and a fleshy mesocarp below. Exocarp, mesocarp and endocarp together comprises the pericarp of the fruit. When ripe, the succulent yellow fruit (mesocarp) splits into 2 valves revealing a purplish-brown, shiny seed (nutmeg) surrounded by a red aril (mace).

Seeds (nutmegs) are broadly ovoid (2 to 3 cm long), firm, fleshy, brownish-white and transversed by red-brown veins. Nutmeg is the seed kernel inside the fruit and mace is the fleshy red, net like skin covering (aril) over the kernel (Purseglove, 1968). Oil seed is within the seed coat (endocarp) which gets detached after drying. Testa and tegmen are the layers of seed while perisperm have oil ducts within the endosperm which also houses embryo.

When fresh, the aril (mace) is bright scarlet becoming more horny, brittle and a yellowish-brown colour when dried (Purseglove, 1968). The trees do not give flowers until around 9 years old, but once start flowering they continue to do so for further 75 years. The trees bear 2 to 3 crops a year. The seeds (nutmegs) need 3 to 6 weeks to dry before they are ready for use. Digital pictures representing various parts of nutmeg yield and its artistic illustration is shown in figure 1 and 2 respectively. Figure 2 E and F shows partly removed calyx of male and female flower.

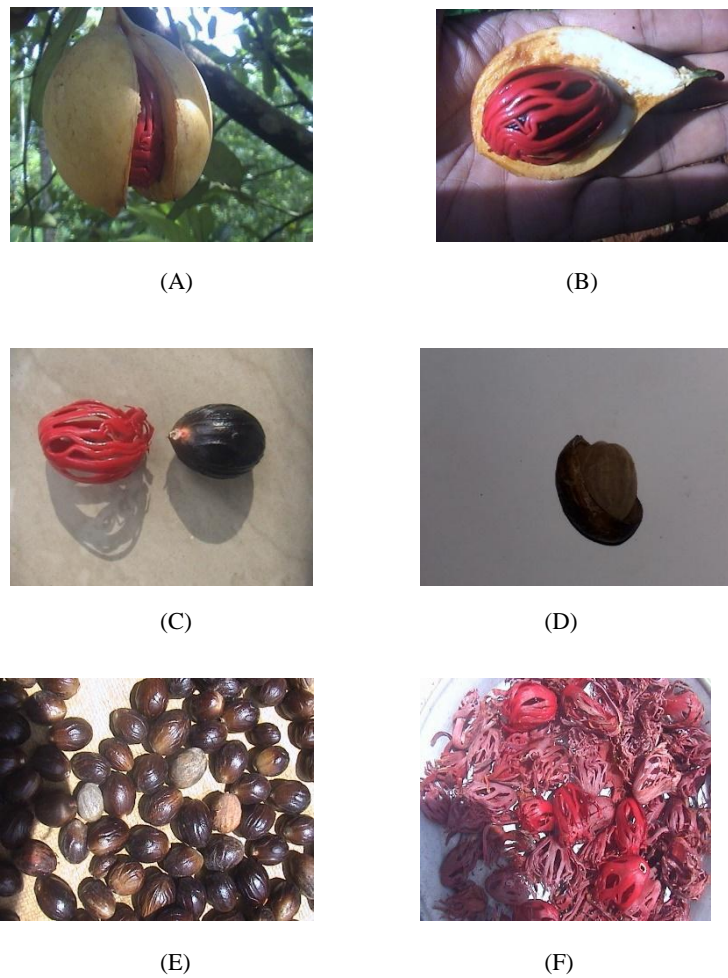


Figure 1: A ripen nutmeg whole fruit in its natural habitat which spitted into half (A), one half of mesocarp with embedded mace and nutmeg (B), mace and nutmeg separated (C), oil seed inside seed coat (D) nutmeg and mace kept for drying (E) and (F)

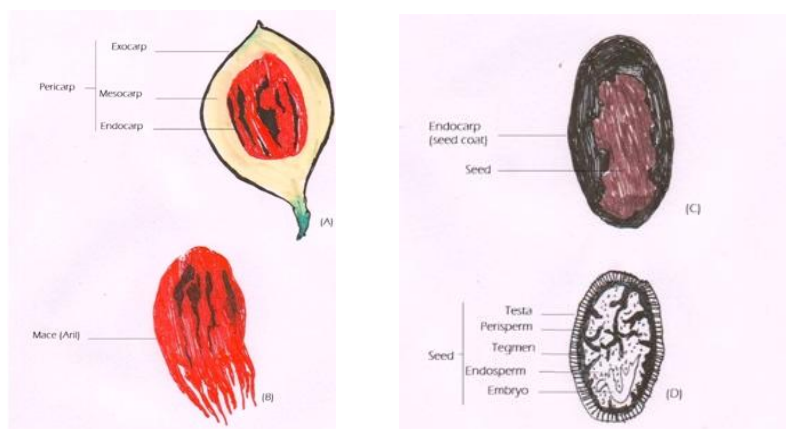
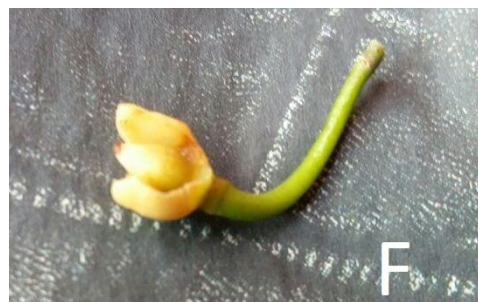


Figure 2: Artistic representation of anatomy of fruit and seed with descriptive parts: (A) fruit (B) mace (C) seed within seed coat, (D) cross section of a seed



(E) Male nutmeg flower (F) female nutmeg flower



Figure 3: Genesis of a nutmeg plant from its seeds and differentiated - into shoot and root systems to become an adult tree.

#### 1.4. Cultivation, processing and harvesting

Young nutmeg plants should be planted under 50% shade, but can be reduced progressively and after 6-7 years they can grow without shade at all. Trees should be well spaced so that branches don't touch each other and not to hamper flowering. Lower branches should be pruned to facilitate collection of dropped seeds. On our visit to organic farm of 'Nakshtra extracts Life Sciences' we were informed by their skilled resource person that as the tree grows the tap root degenerates and the fibrous roots become more active superficial feeders which provides the buoyancy for the entire tree.

#### 1.5. Propagation

The main problem is segregation of seedlings into male and female plants, resulting in the production of 50% unproductive male plants. So it's better to adopt budded or grafted plants.

Grafted plants are planted into the main field during the beginning of rainy season. Pits of 0.75m×0.75m×0.75m size are dug at a space of 9m×9m and are filled with organic manures and soil 15 days prior to planting. A male graft has to be planted for every 20 female plants in the field. Plants should be shaded in order to be protected from sun. It can be best when grown as intercrop in coconut gardens which are more than 15 years old. (M.Anandharajet al 2005).

#### 1.6. Manures and fertilisers

Information collected from organic farm of Nakshtra extracts Life Sciences recommends that care should be taken to avoid both water logging and drying of the soil since the tree is hydro sensitive. Ideally, 3-4 water sprinklers provide optimum watering during summer. Many farmers' supply bone meal (for calcium), goat droppings/ dried cow dung to nutmeg base without disturbing roots which are superficial feeders. Levigation of mud on top of the manure helps its easy digestion.

The Kerala Agriculture Department suggests 20g N (40g urea), 18g P<sub>2</sub>O<sub>5</sub>, and 50g K<sub>2</sub>O during the initial year and progressively increasing to 500g N, 250g P<sub>2</sub>O<sub>5</sub> and 1000g K<sub>2</sub>O per year. Farm yard manure (FYM) is to be applied at 25 kg for 7-8 years old plant and 50kg for a grown up plant of more than 15 years old. (M.Anandharajet *al* 2005).

### 1.7. Harvesting

The female trees start fruiting from 6 years old even though peak period is 20 years. The peak harvesting season is June–August. The fruits are ready for harvesting when the pericarp splits open. After harvesting outer fleshy part is removed and the mace is removed from the nut followed by sun drying. There are people who practice drying over native wood fire stove, especially during monsoon. The scarlet coloured mace becomes yellowish brown and brittle when drying is completed. The fleshy pericarp can be used for making jams, pickles and jellies.

### 1.8. Varieties

Indian Institute of Spices Research has released ‘IISR vishwasree’ which yield about 1000 fruits at the 8<sup>th</sup> year of planting. IISR has also released few elite lines such as A9- 20, 22, 25,69,150, A4-12,22,52, A11-23,70 as high yielders and distributed as grafts.

### 1.9. Pests and diseases

The most serious pest is the scolytid beetle *Phloeosinusribatus* which bores through bark causing dieback and death. Other damaging borers are *Xyleborusforficatus* and *X. myristicae*. The coffee bean weevil *Ataecerus fasciculatus* is a serious pest of stored nutmeg and mace.

The only fungal disease of major importance is *Stigmia myristicae*, a dry rot that causes the fruits to open when still young. Consequently the arils and seeds remain underdeveloped and are worthless. Soft rot of fruits caused by *Colletotric humgloeosporioides* also causes young unripe fruits to open prematurely. Root rots caused by *Fomesnoxius* and *Fomeslamoensis* may cause considerable damage. (M.Anandharajet *al* 2005). While most of the farmers depend on 1% bordeaux mixture (CUSO<sub>4</sub>: lime: water in the ratio of 1:1:100) for fungal rots, NELS practice 1% *Pseudomonas* solution as spray which is beneficial to preserve proper soil biosystem. It is mandatory to maintain the nutmeg field neat and tidy to avoid plant diseases and mosquitos which may be attracted by water filled split fruit coat. Many farmers supply neem cake to the tree base.

### 1.10. Chemical composition of *Myristica fragrans* fruit

The seed contains about 10% essential oil (Verghese 2001; Maya *et al.* 2004), which is mostly composed of terpene hydrocarbons (α-pinenes, camphene, p-cymene, sabinene, b-phellandrene, g-terpinene, limonene, myrcene (60% to 90%), terpene derivatives (linalool, geraniol, terpineol-5% to 15%) and phenylpropanes (myristicin, elemicin, safrole-2% to 20%). The presence of myristicin and elemicin, in the seed of *M. fragrans* is one of the reasons for its intoxicating effects (Sonavane *et al.* 2001).

Gopalakrishnan (1992) has made extensive studies on the composition of nutmeg and mace. The seeds also contain 25-30% fixed oils (myristic, stearic, palmitic, oleic, linoleic and lauric acids).

Besides, the seeds contain saponins, polyphenols, tannins, epicatechin, triterpenic sapogenins and fats (Varshney and Sharma 1968; Sathyavathy *et al.* 1987). Nutmeg has also been reported to contain calcium, phosphorous, iron, thiamine, riboflavin and niacin (Gopalan *et al.* 1984). Chromatography of the nutmeg extract revealed the presence of epicatechin and cyaniding (Gopalakrishnan & Mathew 1983).

### 1.11. Pharmacological actions

*M. fragrans* commonly known as nutmeg has aromatic, stimulant, narcotic, carminative, astringent, aphrodisiac, hypolipidemic, antithrombotic, anti-platelet aggregation, antifungal, anti dysenteric, anti-inflammatory activities. It is used as a remedy for stomach ache, rheumatism and vomiting of pregnancy. (Nadkarni KM). Active principles of nutmeg responsible for specific therapeutic activity are shown in table 1, while the chemical structure of active ingredients are shown in figure no. 4.

Table 1: Data providing therapeutic activity and the responsible active ingredient of Nutmeg

Therapeutic activity	Active constituent	Chief investigator
Antioxidant	Myristicin	Yadav and Bhatnagar., 2007
Antibacterial	Malbaricone	Orabiet <i>et al.</i> , 1991
Antidiabetic	Macelignan	Han <i>et al.</i> , 2008
Cytotoxicity	Dihydroguaiaretic acid	Park <i>et al.</i> , 1998
Hepatoprotective	Macelignan	Morita <i>et al.</i> , 2003
Insecticidal	Myristicin + pyrethrum	Park <i>et al.</i> , 2008
Molluscidal	Myristicin , Trimyristin	Singh & Agarwal., 1981; Singh & Agarwal., 1983
Memory enhancing	Myristicin	Parleet <i>et al.</i> , 2004
Hypolipidaemic	Myristicin	Sharma & Mathur., 1995; Ram <i>et al.</i> , 1996; Capasso <i>et al.</i> , 2000
Aphrodisiac	Myristicin	Tajuddin <i>et al.</i> , 2005

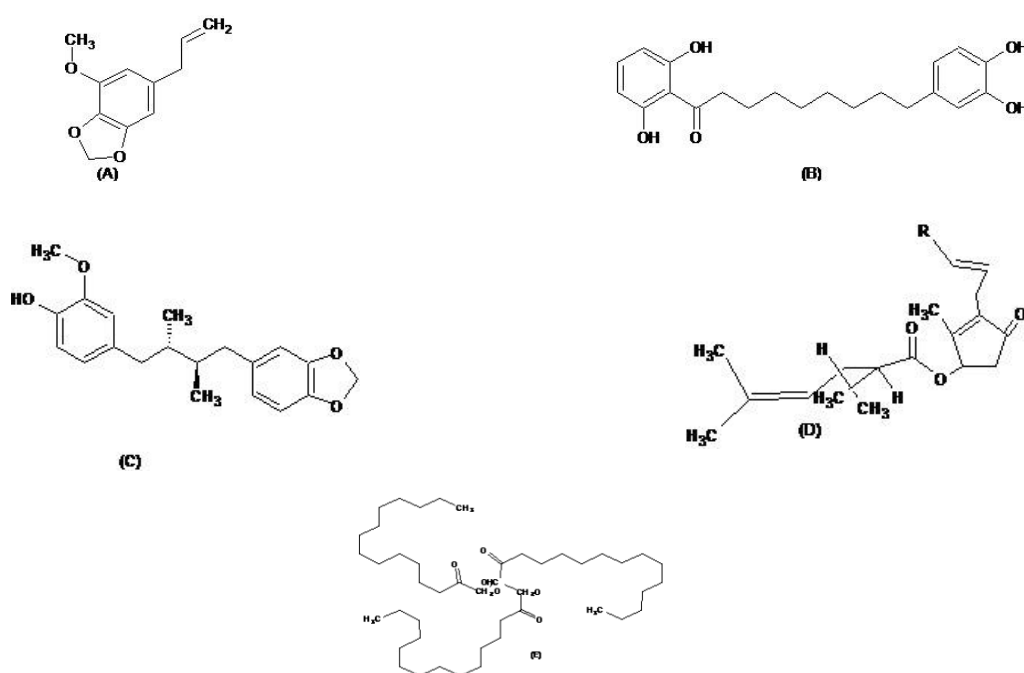


Figure 4: Chemical Structure of various active ingredients available in the nutmeg: Myristicin (A), Malbaricone (B), Macelignan(C), Pyrethrum (D), Trimyristin (E)

### 1.12. Toxicological effects

Toxicological effects including weak pulse, hypothermia, delirium, vertigo and nausea associated with ingestion of *M. fragrans* has been reported (Hallstrom & Thuvander 1997).

In human beings 6-7 mg/kg body weight of nutmeg is enough to cause psycho pharmacological effects. Ingestion of 5 gram of nutmeg corresponding to 1-2 mg myristicin/ kg body weight has been shown to cause intoxication [Helenna *et al*].

### 1.13. Usage

Food: Both nutmeg and mace are used in various culinary preparations. Nutmeg (crushed or grated as per requirement)/ mace is a mild, delicious baking spice with a sweet smell commonly added to sausages, meats, fish, soups, fruit pies, eggnog, puddings, vegetables and cakes, biscuits, custards, buns etc. It tastes very good in drinks like tea and soft drinks or mixed in milk and alcohol. Nutmeg is more pungent and sweeter than mace. The distinctive flavours are due to volatile oils, present in both tissues. Quite recently outer fleshy fruit, mesocarp is being used (value addition) in many beverages, squash, chutney, and pickles which was earlier discarded.

Essential oils: Grenada is the world's second largest producer of essential oils derived from the seeds of the nutmeg tree, *M. fragrans*. It also contains a valuable, thick, yellow, fat called Nutmeg butter used to make candles and is important in certain salves and medicines. The oil is used in soap, candle making, dental products and hair lotions.

Medicine: It is widely used as a traditional medicine in the Middle East and Asia. In Western medicine nutmeg is used as a stomachic, stimulant, carminative as well as for intestinal catarrh and colic, headaches, diarrhoea, vomiting, nausea, fever, bad breath, to stimulate appetites and to control flatulence. It is also valuable for its aphrodisiac and anti-inflammatory properties.

Abuse: Nutmeg has been known for its hallucinogenic properties for a long time. While adults may abuse the hallucinogenic properties of nutmeg, children may be at high risk at home, since nutmeg may be widely available as a cooking additive. In the course of its use in traditional medicine, overdose may occur. (Orwa.2009)

### 1.14. Commercial value

The colour of mace is an important factor, influencing its commercial value. The red pigment of mace was identified to be lycopene by thin layer chromatography and absorption studies (Gopalakrishnan 1979). Average rate of nutmeg mace in Indian market during the financial year 2014 was Rs.1100/kg. Based on the quality, both mace and nuts are graded into 'A', 'B', and 'C' and utilised for various purposes. Grads A' and 'B' is generally used for culinary preparations and food industry while grade 'B' (sometimes) and 'C' are used for extraction of essential oils.

## 2. CONCLUSION

It is clearly evident from the present literature review that *M. fragrans* deserves more attention by scientific community and public health specialists to explore its full range of benefits for the welfare of society. Because this single species have the potential to cure a large number of diseases there is a wide scope for various formulations and culinary.

It is advisable to control the fungal rots by Pseudomonas solution rather than Bordeaux mixture due to its toxicological and environmental safety is not recommended and will be soon banned under new regulations of EU.

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