

# Exploring Nutmeg (*Myristica fragrans*): A Comprehensive Review of its Nutritional Composition and Potential Health Benefits

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## ABSTRACT:

This article explores the multifaceted aspects of nutmeg, a cherished spice derived from the seeds of the *Myristica fragrans* tree. This spice performs a variety of roles, as demonstrated by its chemical makeup, historical relevance, and therapeutic advantages. Nutmeg is known by many different names across the world, which highlights its diverse cultural connotations. The article explores nutmeg's cultivation, the differences between nutmeg and mace, and the difficulties nutmeg trees provide due to their dioecious nature. The origins of nutmeg in the Banda Islands account for its historical relevance in international commerce and exploration. Its distinct flavor and possible health advantages are attributed to its chemical makeup, which includes substances like myristicin and eugenol. The antioxidant, anti-inflammatory, digestive, pain-relieving, sleep aid, and antibacterial qualities of nutmeg are further explored in the article. However, due to the possible negative consequences of excessive intake, especially with regard to psychoactive chemicals, a note of caution is issued emphasizing the need of moderation. The abstract highlights how important it is to have a well-rounded awareness of nutmeg's use in both culinary customs and possible medical uses.

## I. INTRODUCTION:

Nutmeg, extracted from the seeds of the *Myristica fragrans* tree, has been a cherished and versatile spice in culinary traditions around the world. In this exploration of nutmeg and its benefits, we embark on a journey to uncover the hidden treasures within this unassuming spice. From its intriguing nutritional composition to its potential for enhancing health and well-being, nutmeg's role extends far beyond the kitchen. This article delves into the multifaceted advantages it offers and underscores the significance of understanding its usage in a balanced and informed manner.

- Nutmeg is the evergreen plant belonging to family MYRISTICACE.
- Nutmeg has been cultivated throughout the world and used for food flavouring
- Nutmeg having different names in BHARAT as well as world
- In Bharat particularly in Tamilnadu and kerala it's known as JATHIKAI, Andhra it's called JAJI KAYA, in maharashtra it's known JAIPHAL.
- In other regions of world like Indonesia, it is called PALA. In Arabic countries it's known as josat at –Tib, Urdu it is called as JAIFAL.PIC: NUTMEG PLANTFrench it is called MUSCADE, Greek is known as MOSCHOKARIDO
- in china it is called as roudoukou
- nutmeg produces two separates spices, namely nutmeg and mace
- nutmeg is the dried kernel of the seed and mace is the dried aril surrounding it.
- nutmeg trees are dioecious plants (individual plant are either male or female), which are propagated sexually from seeds and asexually from cuttings or grafting.
- sexual propagation yields 50% male seedings, which are unproductive. because no reliable method has been found for determining plant sex before flowering in the sixth to eighth year, and sexual reproduction bears inconsistent yields, grafting is the prefer method of propagation.



Fig 1: Nutmeg Tree



Fig 2: Nutmeg Fruits. (self-captured)

#### History

The Portuguese found nutmeg in 1512, and it came from the Banda Islands in Indonesia. Dutch later on spread its significance. *Nuxmuscatum*, a Latin term meaning "musky nut," is where the name "nutmeg" originates.(13)

#### Historical Significance:

**Origin and Discovery:** Nutmeg is native to the Banda Islands in Indonesia, and its use can be traced back over a thousand years. It was initially discovered by traders and explorers who ventured into the remote Molucca Islands, where nutmeg trees grew abundantly.

**Early Trade and Monopoly:** Nutmeg became a highly sought-after commodity in Europe, Asia, and the Middle East. Its unique flavor and aroma made it a prized addition to cuisines, and it was also believed to have medicinal properties. European powers, including the Portuguese, Dutch, and British, competed fiercely to control the spice trade, leading to conflicts and the establishment of trade monopolies.

**Role in Exploration:** Nutmeg and other spices like cloves were a driving force behind the Age of Exploration in the 15th and 16th centuries. Countries sought to find direct routes to the spice-producing regions, leading to significant voyages, including Christopher Columbus's journey to the Americas.

**Colonization and Conflicts:** The competition for nutmeg led to the colonization of various regions, with the Dutch ultimately gaining control of the spice trade in the 17th century. This control was so absolute that the Dutch effectively controlled the entire nutmeg supply by destroying nutmeg trees on other islands to maintain their monopoly.

**Economic Value:** Nutmeg's economic value was immense during this period, with prices often

exceeding their weight in gold. The spice trade, including nutmeg, played a pivotal role in shaping the world's trade routes, economies, and global politics.

#### DEMOGRAPHY

A hot, humid climate without a dry season is essential for cultivation, though plants typically thrive in warmer climates. It thrives in soils that are red laterite, clay loam, and sandy loam. China, Indonesia, Taiwan, Malaysia, India, Grenada, South America, and Sri Lanka are among the countries where it is widely grown (14). The real production of nutmeg is hard to come by. The global nutmeg requirement is roughly 9,000 tons annually, but the average annual production is estimated to be between 10,000 and 12,000 tons (15). Sharing 20% and 75% of the global nutmeg market, respectively, Grenada and Indonesia control the nutmeg production and transportation (16).



Fig 3: *Myristica fragrans* (Nutmeg) Source: (Gupta and Rajpurohit, 2011)

#### BOTANY, MORPHOLOGY, ECOLOGY

Nutmeg trees can be either male or female and reach heights of 10 to 20 meters. Nutmeg trees don't start to bloom until they are 9 years old, and they then keep blooming for 75 years (16). Trees that are male or female have different features. Female trees can flower for up to seven months, and the entire development process took 154 days, while male trees flower all year long and take only 77 days to complete. Trees produce two to three crops annually, with July through October being the best time for them to flower (17). The branches tumbling in a whorl. Petioles have a length of roughly 30 cm. The leaves are glabrous and alternate. The flowers are dioecious and small auxiliary racemes. They are obtuse at the base, elliptical, aromatic, acuminate, glossy, and dark

green above, with a paler underside. They are 4-6 inches long.

The fruit is a pendulous, rounded drupe with a succulent pericarp. Rich in oil, the seed is firm, white, meaty, and crossed by reddish-brown veins. The tree has a powerful, sharp, aromatic flavor as well as a strong, pleasant, and unusual smell. It takes a warm, humid tropical climate to grow nutmeg. Although it can withstand temperatures between 12 and 38°C, the range of 22 to 34°C is thought to be ideal for its growth during the day.

Nutmeg blossoms are bell-shaped, pale yellow in color, and have a waxy, fleshy texture. The fruits of nutmeg trees are 6 to 9 cm long, with a longitudinal ridge; they are smooth and meaty, consisting of two parts: the mesocarp, which is fleshy beneath the exocarp, and the exocarp, which is a shiny outer coat. Nutmeg grows best in well-drained, fertile soil that has a high content of organic matter. A pH of 6.5 to 7.5 is ideal for nutmeg growth.

The fruit's pericarp is made up of the mesocarp and exocarp combined. The mesocarp splits into two pieces when it rips: mace and nutmeg. The mace, or lustrous, purplish-brown nutmeg is 2 to 3 cm long, solid, and meaty, with reddish-brown veins around it. It also contains an oilseed, which separates after drying, from the seed coat, or endocarp. While the perisperm contains oil channels inside the endosperm, which also shelters the embryo, the testa and legmen are transformed into the layers of seed. In three to six weeks, the seed is ready for usage (18,19). (Fig 4)



Fig 4: Morphology of Nutmeg

#### CHEMICAL COMPOSITION:

Nutmeg's chemical composition is indeed responsible for its distinctive flavor and aroma, as well as its potential health benefits. Here's a closer look at some of the key compounds found in nutmeg:

**Myristicin:** Myristicin is a natural organic compound that is responsible for the spicy, sweet aroma and flavor of nutmeg. It also has mild psychoactive properties, but consuming large quantities of myristicin can be toxic and lead to hallucinations and other adverse effects. Therefore, it should be used in moderation.

**Eugenol:** Eugenol is another aromatic compound found in nutmeg. It contributes to the warm and slightly spicy flavor of nutmeg. Eugenol is also present in cloves, cinnamon, and other spices, and it has been studied for its potential antioxidant and anti-inflammatory properties.

**Safrole:** Safrole is a compound found in small amounts in nutmeg. It has been used in the production of certain types of fragrances and flavors, but it is also considered a potential carcinogen. Its presence in nutmeg is generally low and not a significant health concern when nutmeg is consumed in reasonable amounts as a spice.

**Elemicin:** Like safrole, elemicin is found in small quantities in nutmeg. It contributes to the overall flavor and aroma of the spice. Elemicin, like safrole, has some psychoactive properties when consumed in large amounts.

The main constituents of *M. fragrans* have been found to be alkyl benzene derivatives (myristicin, elemicin, safrole etc.), terpenes, alpha-pinene, beta-pinene, myristic acid and trimyristin. Nutmeg contains about 10% essential oil, which is mostly composed of terpene hydrocarbons (sabinene and pinenes; furthermore camphene, cymene, phellandrene, terpinene, limonene, myrcene, together 60 to 80%), terpene derivatives (linalool, geraniol, terpineol, together 5 to 15%) and phenylpropanoids (myristicin, elemicin, safrole, eugenol and eugenol derivatives, together 15 to 20%). Of the latter group, myristicin (methoxy-safrole, typically 4%) is responsible for the hallucinogenic effect of nutmeg. Oil of mace (up to 12% in the spice) contains the same aroma components but the total fraction of terpenoids is increased to almost 90%. Both nutmeg and mace contain about 2% of lignans (diarylpropynes), which are nonvolatile dimers of phenylpropanoid constituents of the essential oil, e.g., dehydrodiisoeugenol. The main glycoside is trimyristin having anxiogenic activity.<sup>[(1)]</sup>

Nutmeg is typically used in small quantities as a spice in various dishes, and its chemical compounds, when used in moderation, contribute to its unique flavor and aroma. However, it's important to note that consuming very large amounts of nutmeg can lead to toxicity and unwanted side effects due to the psychoactive compounds like myristicin, safrole, and elemicin. It is best enjoyed in culinary dishes in appropriate amounts rather than as a recreational substance.

#### Medicinal and Therapeutic Benefits:

Nutmeg has indeed been traditionally used for various medicinal and therapeutic purposes, and some of these uses are supported by scientific research. Here are some of the potential medicinal benefits of nutmeg:

**Antioxidant Properties:** Nutmeg contains compounds like eugenol that have antioxidant properties. Antioxidants help protect the body's cells from damage caused by free radicals and may contribute to overall health.

Due to the presence of many molecules, including eugenol and -caryophyllene, which have hydrogen atoms in the allylic or benzylic positions, nutmeg has antioxidant effect. These compounds have significant antioxidant activity because the abstraction of atomic hydrogen from these functional groups is relatively straightforward. The atomic hydrogen is abstracted by peroxy radicals, which are created during oxidative stress. In accordance with a different theory, nutmeg's eugenol contributes to its antioxidant properties by enhancing the activity of the enzymes catalase, superoxide dismutase, glucose-6-phosphate dehydrogenase, glutathione peroxidase, and glutamine transferase.<sup>[[2]]</sup>

The compounds having catechol like structure as in caffeic acid are considered to be good antioxidants as they easily donate electrons or phenolic hydrogen to the acceptors, such as lipid peroxy groups or reactive oxygen species. Calliste et al (2010) stated that lignan derivatives are considered as a class of compounds that shows the antioxidant potential of nutmeg seeds.<sup>[[3]]</sup>

**Anti-Inflammatory Effects:** Eugenol, which is found in nutmeg, also has anti-inflammatory properties. Inflammation is associated with a variety of chronic diseases, so compounds with anti-inflammatory effects may be beneficial.

Several authors reported anti-inflammatory activity of nutmeg as well as its oil.<sup>[[4]]</sup> Pharmacological actions of nutmeg oil are comparable to those of

non-steroidal anti-inflammatory medications<sup>[[5]]</sup> But only petroleum ether extracts have been found to have anti-inflammatory action. An AMP-activated enzyme was activated by the nutmeg extract in its whole Potential therapeutic target for treating the metabolic syndrome, which includes type 2 diabetes and obesity, is the protein kinase enzyme. From this extract, seven active ingredients were identified, including tetrahydrofuroguaiacin B, 2,5-bis-aryl-3,4-dimethyl tetrahydrofuranlignans, fragransin C1, sauceretindiol, nectandrin B, verrucosin, galbacin, and nectandrin A. At 5 M concentrations, some of the isolated chemicals strongly stimulated AMPK in differentiated C2C12 cells. In addition to being used to treat type 2 diabetes, obesity, and other metabolic problems, nutmeg and its active ingredients are also employed to create new medications.<sup>[[6]]</sup>

**Digestive Aid:** In traditional medicine, nutmeg has been used to aid digestion and relieve gastrointestinal discomfort. It can be added to foods or beverages to help with issues like indigestion, bloating, and gas.

Nutmeg is derived from the seed of *Myristica fragrans*, and the spice, mace, is derived from the seed coat. Current uses of the plant include the treatment of gastrointestinal disturbances, such as cramps, flatulence, and diarrhea. It has been investigated as an antidiarrheal medication in calves.<sup>[[7]]</sup>

**Pain Relief:** Nutmeg oil, which can be extracted from the spice, has been used topically for pain relief, particularly for muscular aches and joint pain. It may provide a warming sensation when applied to the skin.

According to their research, nutmeg oil effectively reduces inflammation-related pain by inhibiting the COX-2 pathway and substance P release. The anti-inflammatory activities of nutmeg oil have also been demonstrated in an additional in vivo investigation of carrageenan-induced paw edema in rats.<sup>[[8]]</sup>

**Sleep Aid:** Nutmeg has a long history of use as a natural remedy for insomnia. Some people use a small amount of nutmeg in warm milk or as a spice in their food to promote relaxation and improve sleep quality. However, it's important to use nutmeg in moderation for this purpose, as excessive consumption can have adverse effects.

A ligroin extract of nutmeg (*Myristica fragrans*) caused a significant increase in the duration of light and deep sleep in the young chicken. The presence of trimyristin tended to increase the effect of the extract<sup>[[9]]</sup>

**Antimicrobial Properties:** Nutmeg and its constituents, such as eugenol, have demonstrated antimicrobial properties. They can inhibit the growth of certain bacteria and fungi, which may be useful for maintaining oral hygiene or addressing microbial infections.

Strong antimicrobial activity has been demonstrated by the essential oil and various extracts of aromatic plants against a variety of fungi and bacteria.<sup>[[11]]</sup>

In order to demonstrate the nutmeg's antibacterial activity against both gram negative and gram positive bacteria, Narasimhan et al. (2006) prepared a chloroform extract of the spice. They discovered that the primary antibacterial compounds extracted from nutmeg seeds are myristic acid and trimyristin. From the methanolic extract of nutmeg seeds, researchers isolated three lignans (meso-dihydroguaiaretic acid, nectandrin-B, and erythro-austrobailignan-6) with antifungal activity<sup>[[12]]</sup>.

It's important to note that while nutmeg has potential medicinal benefits, it should be used in moderation. Excessive consumption of nutmeg, especially for its psychoactive compounds like myristicin, can lead to toxicity and adverse effects, including hallucinations, nausea, and dizziness. Nutmeg is best enjoyed in small culinary quantities and as a complementary part of a balanced diet. If you're considering using nutmeg for medicinal purposes, it's advisable to consult with a healthcare professional for guidance and to ensure safe and appropriate use.

## II. CONCLUSION

Nutmeg emerges as a spice with a rich history, diverse cultural associations, and a complex chemical composition that contributes to its distinctive flavor and potential health benefits. Its role in shaping global trade and exploration underscores its economic and historical importance. The exploration of its chemical constituents reveals both its aromatic allure and the presence of compounds with possible medicinal properties. While acknowledging its traditional uses for digestion, pain relief, and sleep aid, the conclusion emphasizes the importance of moderation in consumption. Nutmeg's medicinal

potential is acknowledged, but the cautionary note stresses the need for informed and balanced usage, especially due to the psychoactive nature of certain compounds. Whether enhancing culinary delights or offering potential health benefits, nutmeg stands as a versatile spice that invites appreciation within the boundaries of responsible use.

## REFERENCE:

- [1]. PreeteeJaiswal, Pradeep Kumar, Vinay K Singh, Dinesh K Singh\*, Department of Zoology, DDU Gorakhpur University, INDIA, Biological Effects of *Myristicafragrans*, doi: <http://dx.doi.org/10.5016/1806-8774.2009v11p21>
- [2]. A.D. Gupta, D. Rajpurohit, Antioxidant and Antimicrobial Activity of Nutmeg (*Myristica fragrans*). In *Nuts and Seeds in Health and Disease Prevention*, Elsevier: 2011; pp 831-839.
- [3]. C. Calliste, D. Kozlowski, J. Duroux, Y. Champavier, A. Chulia, P. Trouillas. (2010). A new antioxidant from wild nutmeg. *Food chemistry*. 118(3): 489-496
- [4]. M. Mueller, S. Hobiger, A. Jungbauer. (2010). Anti-inflammatory activity of extracts from fruits, herbs and spices. *Food chemistry*. 122(4): 987-996
- [5]. O.A. Olajide, J.M. Makinde, S.O. Awe. (2000). Evaluation of the pharmacological properties of nutmeg oil in rats and mice. *Pharmaceutical biology*. 38(5): 385-390
- [6]. whole. P.H. Nguyen, T.V.T. Le, H.W. Kang, J. Chae, S.K. Kim, K.-i. Kwon, D.B. Seo, S.J. Lee, W.K. Oh. (2010). AMP-activated protein kinase (AMPK) activators from *Myristica fragrans* (nutmeg) and their anti-obesity effect. *Bioorganic & medicinal chemistry letters*. 20(14): 4128-4131.
- [7]. [https://www.google.com/search?q=DIGESTIVE+AID+OF+Myristica+fragrans&rlz=1C1GCEA\\_enIN1043IN1043&oq=DIGESTIVE+AID+OF+Myristica+fragrans&gs\\_lcrp=EgZjaHJvbWUyBggAEUUYOTIKCAEQABixAxiABDIKCAIQABixAxiABDIKCAMQLhixAxiABDIKCAQQABixAxiABDIKCAUQABixAxiABDIHCAyQABiABDIHCAcQABiABDIHCAgQABiABDIKCAkQABixAxiABNIBCDkyNDhqMGo3qAIAAsAIA&sourceid=chrome&ie=UTF-8](https://www.google.com/search?q=DIGESTIVE+AID+OF+Myristica+fragrans&rlz=1C1GCEA_enIN1043IN1043&oq=DIGESTIVE+AID+OF+Myristica+fragrans&gs_lcrp=EgZjaHJvbWUyBggAEUUYOTIKCAEQABixAxiABDIKCAIQABixAxiABDIKCAMQLhixAxiABDIKCAQQABixAxiABDIKCAUQABixAxiABDIHCAyQABiABDIHCAcQABiABDIHCAgQABiABDIKCAkQABixAxiABNIBCDkyNDhqMGo3qAIAAsAIA&sourceid=chrome&ie=UTF-8)

- [8]. Olajide, O.A.; Ajayi, F.F.; Ekhelar, A.I.; Awe, S.O.; Makinde, J.M.; Alada, A.R.A. Biological Effects of Myristica Fragrans (Nutmeg) Extract. *Phytother. Res.* **1999**, *345*, 344–345. [[Google Scholar](#)] [[CrossRef](#)]
- [9]. C J Sherry, L E Ray, R E Herron, The pharmacological effects of the ligroin extract of nutmeg (*Myristica fragrans*), DOI: [10.1016/0378-8741\(82\)90071-x](https://doi.org/10.1016/0378-8741(82)90071-x)
- [10]. M.A. Hanif, H.N. Bhatti, M.S. Jamil, R.S. Anjum,
- [11]. Jamil, M.M. Khan. (2010). Antibacterial and antifungal activities of essential oils extracted from medicinal plants using CO<sub>2</sub> supercritical fluid extraction technology. *Asian Journal of Chemistry.* *22(10): 7787.*
- [12]. J.Y. Cho, G.J. Choi, S.W. Son, K.S. Jang, H.K.Lim, S.O. Lee, N.D. Sung, K.Y. Cho, J.C. Kim. (2007). Isolation and antifungal activity of lignans from *Myristica fragrans* against various plant pathogenic fungi. *Pest Management Science: formerly Pesticide Science.* *63(9): 935-940.*
- [13]. . Gupta AD, Rajpurohit D. Antioxidant and antimicrobial activity of nutmeg (*Myristica fragrans*). In *Nuts and seeds in health and disease prevention.* 2011;1 :831-839. Academic Press.
- [14]. Haldankar PM, Rangwala AD. Nutmeg-a boon spice for Konkan. *Spice India.* 2009; *22:4-9.*
- [15]. Mintah FD. Sex determination in Nutmeg seedlings using scar primers. *Journal of Horticulture and Plant Research.*2018; *3:40-47.*
- [16]. Ambarwati S, Retnowati I, Nurfadila N and Dharmaputra OS. Determining appropriate postharvest handling method to minimize fungal infection and aflatoxin contamination in nutmeg (*Myristica fragrans*). *International Food Research Journal.* 2018; *25(2).*
- [17]. Abourashed EA, El-Alfy AT. Chemical diversity and pharmacological significance of the secondary metabolites of nutmeg (*Myristica fragrans*Houtt.). *Phytochemistry reviews: Proceedings of the Phytochemical Society of Europe.* 2016; *15(6): 1035–1056.*
- [18]. Pangabebean KA, Rusmarilin H and Suryanto D. The utilization of nutmeg seed (*Myristica fragrans*Houtt) extract as an antimicrobial on tempeh sausage. In *IOP Conference Series: Earth and Environmental Science.* 2019; *260(1): 012087.* IOP Publishing.
- [19]. Purwiyanti S, Wahyu Y, Rostiana O. Correlation between morphological characters and the sex phenotypes of *Myristica fragrans*Houtt Trees. In *IOP Conference Series: Earth and Environmental Science.* 2020; *418(1):012033.* IOP Publishing.
- [20]. Thomas J. Zumbroich, The Introduction Of nutmeg (*Myristica fragrans*Houtt.) and Cinnamon (*Cinnamomum Verum* J. Presl) To America. *Acta Botánica Venezuelica.* 2005; *155-160.*