

## A REVIEW ON *MYRISTICA FRAGRANS* (NUTMEG)

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### ABSTRACT

Herbal medicine is the oldest form of healthcare known to mankind. Herbs had been used by all cultures throughout history. *Myristica fragrans* commonly known as 'Nutmeg', is an evergreen tree indigenous to India, Indonesia and Sri Lanka. It is the main source of spices, having a pleasant aromatic fragrance and widely used as flavouring agent and ability to enhance the taste of food. It has been known to provide many medicinal properties due to its complex molecular structure. Many phytoconstituents of *M. fragrans* is responsible for its effect in curing various diseases like antioxidant, antidiarrheal, hypolipidemic, antidepressant, aphrodisiac, anticonvulsant, antimicrobial, memory enhancer and hepatoprotective properties. This review attempts to highlight the available literature traditional uses, and its pharmacological activities of *Myristica fragrans*. This will be helpful to create interest towards Nutmeg and may be useful in developing new formulations with economical value.

**KEYWORDS:** *Myristica fragrans*, nutmeg, Traditional use. Pharmacological activity.

### 1. INTRODUCTION

Nature is served as primary source of numerous medicines for thousands of years Medicinal plants/herbs hold a great significant value. Medicinal plants/herbs possess phytochemical constituents that are medically important and are used for developing new drugs. *Myristica fragrance* is most important herbal medicinal plant commonly known as Nutmeg or Jaiphal, belonging to family Myristicaceae. The use of plants for health benefits and other purposes is a very common tradition, which has been in practice since ancient times. Medicinal products derived from the plants are often named as herbal medicines, herbal drugs. It is commonly used as spice, which is found in almost every kitchen to add flavour in many dishes especially in North India where it is used as an ingredient of garam masala. It is used in bakery and confectionary products, pudding, meats, sausages, sauces. In traditional systems of medicine such as Ayurveda and folk system this plant is used in treating variety of human ailments due to the presence of different kind of phytochemical constituents. It contains various essential oil constituents such as myristicin, elemicin, safrole, terpenes, alpha-pinene, beta-pinene, myristic acid and also present triacylglycerols like trimyristin, phenolic compounds, flavonoids, tocopherol, ascorbic acid, and many more other constituents are presents. The seeds and fruits parts of these plant are used in traditional practices for the treating various diseases like dysentery, weakness, sexual disorders, and darkness of complexion. The most common uses of *M. fragrans* is used as a carminative, anti-oxidant, analgesic, hypolipidemic, anti-pyretic, aphrodisiac, antiulcerogenic, anti-inflammatory, diuretic, hypnotic, antispasmodic, and stimulant. It is also used for treating the problems related to spleen, liver, and enhances the blood circulation, boosts up the brain functioning and enhance digestion. For centuries Nutmeg has been used all over the world as a valuable spice. Nutmeg has also been used in traditional remedies for stomach and kidney disorders along with its use in flavour enhancer of foods and beverages.



**Figure-** Fruits of *Myristica fragrans*

### TRADITIONAL USES

*Myristica fragrans* is commonly known as "Jatiphala" in Ayurveda. It is a valuable medicinal plant. It is used in many Ayurvedic practices for the treatment of numerous diseases. It significantly works on vitiated vatta and kapha. Its topical applications it is used as an anti-inflammatory, analgesic skin disorders. It is used in treating cold and headache and useful in removing the foul smell of wound. It is used as appetizer, anti-helminthic, enhances digestion, increases the liver metabolism, diarrhoea, dysentery, irritable bowel syndrome, constipation, loose motion, cholera, cardiac

problems. anti-mucolytic agent. It is helpful against cold, cough, asthma, and carminative. seed powder or decoction of the seeds used against diarrhoea and rheumatism. Chinese people use seed powder in the treatment of dysentery, digestive problem, piles, and leucorrhea. The fruits of *M. fragrans* plant as steam-bathing material. They also use this plant in the treatment of rheumatism, syphilis, and toothache. The fruit powder of *M. fragrans* as a remedy for burning, general weakness, headache and insomnia people use seeds along with milk to enhance their digestion. The fruit of this plant is used in cooking as a spice and to enhance the flavour. The use of Jaiphal along with ajwain seeds and choti elaichi to treat diarrhoea among infants.

## 2. METHODOLOGY

### PHARMACOLOGICAL ACTIVITIES

#### Antioxidant activity

Anti-oxidant Dorman et al., conducted an in-vitro study to check the anti-oxidant potential of many medicinal herbs against synthetic anti-oxidants like BHA (butylated hydroxy anisole), BHT (butylated hydroxytoluene), alpha tocopherol and pyrogallol. It was found from the study that essential oil extracted from nutmeg is an effective anti-oxidant agent.

Nutmeg possesses antioxidant activity due to the presence of various compounds including  $\beta$ caryophyllene and eugenol, having hydrogen atoms in the allylic or benzylic positions. Because of the comparatively simple abstraction of atomic hydrogen from these functional groups, these compounds have high antioxidant activity. The abstraction of atomic hydrogen is done by peroxy radicals that produced under oxidative stress. In another view, role of Eugenol in nutmeg favors the antioxidant property by promoting the activities of superoxide dismutase, catalase, glucose-6-phosphate dehydrogenase, glutathione peroxidase and glutamine transferase enzymes. 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 peroxyl 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. After absorption of lignans and their glycosides into the body, they are metabolized to produce biologically active compounds having catechol structures that are responsible of high antioxidant property of nutmeg seeds.

#### Immuno-modulatory and radio-protective activities

The lignans present in fresh nutmeg and mace show radio modifying and immune modulatory properties, present in the aqueous extract of fresh nutmeg mace. These properties found in cell free systems and protected PUC18 plasmid against radiation that induced DNA damage. The mammalian splenocytes in response to polyclonal T cell mitogen concanavalin A (Con A) proliferate. This process is inhibited by these mace lignans which was due to G1 phase of cell cycle and augmentation of apoptosis as presented by increase in pre G1 cells. The increase in activation of induced cell death by mace lignans was depending on the dosage. Splenocytes are protected by mace lignans against radiations. These radiations induced by producing intracellular reactive oxygen species depending on the dose. Mace lignans was not cytotoxic for lymphocytes. On the other hand, in splenocytes the radiation-induced DNA damage is inhibited by decreasing DNA fragmentation.

#### Antimicrobial activity

Anti-microbial Orabi et al., conducted an experimental study in 1991 to check the anti-microbial potential of mace of *M. fragrans* against *Staphylococcus aureus* and *Candida albicans*. It was revealed that resorcinols malabaricon B [1] and malabaricon C [2] both showed significant anti-microbial potential against *Staphylococcus aureus* and *Candida albicans*. As per the results of study conducted by Hattori et al., dehydro-di-isoeugenol and 5-methoxydehydrodiisogenol were found to be effective against *Streptococcus mutans*. They significantly helped in the inhibition of *Streptococcus mutans* growth.

The essential oil and different extracts of aromatic plants have shown strong antimicrobial activity against variety of fungi as well as bacteria. Narasimhan et al (2006) demonstrated the antibacterial activity by preparing chloroform extract of nutmeg against both gram negative and gram-positive bacteria. They found myristic acid and trimyristin are the main antibacterial compounds extracted from nutmeg seeds. Researchers isolated three lignans (mesodihydroguaiaretic acid, nectandrin-B and erythroaustrobailignan-6) showing antifungal activity, from the methanolic extract of nutmeg seeds. The development of wheat leaf rust and rice blast was suppressed by these three lignans. Some compounds like carvacrol,  $\gamma$ -cymene,  $\alpha$ -pinene,  $\beta$ -pinene, and  $\beta$ caryophyllene are reported to be antimicrobial present in essential oil of nutmeg seeds. Some plant phenolics are also reported for antimicrobial activity.

### Antifungal and anti-inflammatory activities

Antifungal and anti-inflammatory activities of plant essential oil are due to the presence of  $\beta$ -caryophyllene.  $\alpha$ -Pinene and  $\beta$ -pinene which are monoterpene hydrocarbons are also antimicrobial agents. They are involved in membrane disruption. Carvacol is another significant compound for antimicrobial activity. Carvacol works in the same way as the other phenolic compounds, which work through membrane destruction, resulting in an increase in permeability of membrane to potassium ions and protons, proton-motive force disruption and intracellular ATP pool depletion.  $\gamma$ Cymene (a precursor of carvacrol) could also be an important component. It has been demonstrated that  $\gamma$ cymene works synergistically with carvacrol in membrane enlarging, which results weakening of the membrane while alone shows weak antibacterial activity. It has been proposed that antimicrobial activity is due to the minor and major both compounds; while it is feasible that the major compound controlled by other minor compounds.

### Anti-inflammatory activity

Several authors reported anti-inflammatory activity of nutmeg as well as its oil. Like nonsteroidal anti-inflammatory drugs, pharmacological activities also exhibited by nutmeg oil. But anti-inflammatory activity is shown only by petroleum ether extracts. The total extract of nutmeg activated an enzyme that is AMP-activated protein kinase enzyme (potential therapeutic target) for curing the metabolic syndrome including type-2 diabetes and obesity. Seven compounds like tetrahydrofuroguaiacin B, 2,5-bis-aryl-3,4-dimethyltetrahydrofuranlignans, fragransin C1, saucernetindiol, nectandrin B, verrucosin, galbacin and nectandrin A were isolated from this extract as an active constituent. Some of the isolated compounds produced strong AMPK stimulation in differentiated C2C12 cells, at 5 $\mu$ M concentration. Nutmeg and its active components not only used to treat type-2 diabetes and obesity but also for the development of agent's other metabolic disorders.

### Anti-carcinogenic and hepatoprotective activity-

Anti-cancer Prakash et al., studied the anti-cancerous behavior of *Myristica fragrans* in an in-vitro study on human cell lines Colon cell (Colon502713, Colo205), Liver (Hep-2), Lung (A-549), Ovary OVCAR-5 and Prostrate (PC-5) and central nervous system. Ethanolic extract of seed of *Myristica fragrans* (Houtt) was found to be effective against these cell lines. Ethanolic extract exhibited highest anti-cancerous activity against OVCAR-5. The results of this study demonstrated that *Myristica fragrans* is a potent anti-cancer agent.

Nutmeg shows resistance against carcinogenic elements. Hussain and Rao, (1991) reported that, in Swiss albino mice uterine cervix, 3-methylcholanthrene-induced carcinogenesis could be prohibited by mace oral administration. Nutmeg also shows hepatoprotective activity. This property observed in rats with damaged liver, by giving nutmeg in their diets. Kyriakis et al., (1994) studied on the activities of hepatic carcinogen-metabolizing enzymes, like aryl hydrocarbon hydroxylase, cytochrome P450, and acid soluble sulphhydryl and glutathione-Transferase level in albino mice and checked the influence of essential oil from nutmeg. They found that the essential oil hinders the activities of the host enzymes related with detoxication and activation of xenobiotic components, as well as mutagens and chemical carcinogens.

Hepatoprotective Zhao et al., conducted an experimental study to check the effects of AEN (alcohol extract of nutmeg, the seed of *Myristica fragrans* on obesity and inflammation which are associated with Non-alcoholic fatty liver disease (NAFLD). They use mice models for the study. Models were fed with high-fat-diet. It was revealed from the study, alcohol extract of nutmeg significantly reduced the body weight and levels of inflammation, cholesterol and lipid accumulation, blood glucose which supports its use as an hepatoprotective agent. Dkhil et al., also studied hepatoprotective activity of *Myristica fragrans*. The study was carried out on rat models. Models were administered with paracetamol (acetaminophen; N-acetyl-p-amino-phenol (APAP) for the artificial induction of hepatotoxicity. *Myristica fragrans* Kernel extract showed some significant effect against APAP induced toxication.

### Aphrodisiac Activity-

Ahmed et al., conducted a study on male rat models to evaluate the activity of *Myristica fragrans* Houtt. (nutmeg) on sexual behavior. It was observed that 50% ethanolic extract of the plant exhibited aphrodisiac activity.

### Anti-stress activity-

was examined by Dhingra et al., on mice models. Stress was induced in the models by using two methods that are the forced swim test (FST) and the tail suspension test (TST) method. It was observed that *M. fragrans* extract significantly reduced the immobility periods of mice in both the FST and the TST methods.

### Anti-diarrhoeal -

A study was conducted by Gupta et al., on ileal loops of rabbit and guinea pig. E. coli heat labile (LT) and heat stable (ST) enterotoxins were used in this experimental study. The result revealed that hexane-soluble fraction was

associated with inhibition of secretory responses which were induced by *E. coli* heat labile (LT) and heat stable (ST) enterotoxins.

#### Antithrombotic-

As per the data report of an in-vitro study carried out by Janssens et al., it was revealed that eugenol and iso-eugenol were associated with inhibition of platelet aggregation, this attributes to its antithrombotic activity.

#### Hypolipidemic effect-

In-vivo study conducted on rabbit models by Ram et al., suggested that the oral administration of ethanolic extract of nutmeg at the dosage of 500 mg/kg at the regular interval of 60 days in artificially induced hypolipidemic rabbits significantly lowered the lipoprotein lipids levels which supports its use as an hypolipidemic agent. Sharma et al., carried out an in-vivo study on hypercholesterolemic rabbit models which revealed that administration of seed extract of *M. fragrans* exhibited properties like reduction in serum cholesterol and LDL cholesterol by 69.1 and 76.3%. It also lowered down the ratio of cholesterol/phospholipid by 31.2% and it significantly elevated the ratio of decreased HDL.

#### Anti-diabetic -

As per the study report of Han et al., macelignan extracted from *M. fragrans* is associated with anti-diabetic potential. It activates the peroxisome proliferator receptor (PPAR,  $\alpha/\beta$ ) which helps in improving the insulin sensitivity and lipid metabolic disorders.

#### Anti-convulsant-

Wahab et al., studied anti-convulsant potential of *M. fragrans* in well-established animal seizure models. It was observed that nutmeg oil exhibits anti-convulsant properties. During the study nutmeg oil showed anti-convulsant activity against tonic seizures induced by pentylenetetrazole which supports its use as an anticonvulsant agent.

### 3. CONCLUSION

*M. fragrans* is a mediational herb which is most used in traditional systems of medicine for treating various human ailments. It is widely used for the treatment of several diseases Apart from its therapeutic uses, it is well known spice used in almost all type of cooking. *Myristica fragrans* is a resource of medicinally active compounds and has diverse pharmacological effects; hence, this drug encourages researchers to explore its various novel therapeutic uses for the benefit of mankind.

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