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## Myristica fragrans: An Exploration of the Narcotic Spice

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Nutmeg, now a common household spice, comes from the tree *Myristica fragrans*, which originates from the Indonesian Banda Islands (also known as the Spice Islands). The name nutmeg comes from Latin, *nux muscat*, meaning musky nut. Legend has it that when *M. fragrans* sets seed, the musky smell of the nutmegs is so overpowering that it causes birds of paradise to fall to the ground (Krieg 1964). This may have more to do with the narcotic properties of nutmeg than with its characteristic scent, but it is this musky quality that has made nutmeg a popular flavoring for both sweet and savory dishes.

While the inhabitants of the Banda Islands apparently made no use of nutmeg as a condiment, it is known to have been used as a spice and medicine in India and the Middle East as early as 700 B.C.E., (Kalbhen 1971), while its therapeutic applications have been recorded by Arab physicians since the seventh century C.E. (Weil 1967). Nutmeg did not appear in Europe until the Middle Ages and reports conflict regarding whether it was introduced by Arab traders or by returning crusaders, although it was probably a little of both. While introduced to Europe in the Middle Ages, nutmeg was likely a rare commodity until the sixteenth century when the Portuguese discovered that the Banda



Islands were the hitherto concealed source of nutmeg (Stein et al. 2001).

After this discovery, nutmeg became a major European commodity. Trade was monopolized by the Portuguese and the Dutch, but eventually came under sole control of the Dutch after an extended military campaign in 1621 that left most of the Islands' inhabitants dead. The Dutch ran the Islands like a plantation and mounted regular expeditions to eradicate sources of nutmeg outside of their control. At the height of its value, nutmeg was carried by Europeans as a display of wealth. Nutmeg graters became fashionable

accoutrements, and diners would grate their own nutmeg at fancy restaurants. The Dutch continued to dominate the trade in nutmeg until the nineteenth century when the British took temporary control of the Banda Islands during the Napoleonic Wars and were able to break the monopoly by successfully cultivating nutmeg in the West Indies. Nutmeg has subsequently become a major export product in the West Indies and is now featured on the national flag of Grenada.

By the twentieth century, the popularity of nutmeg as a spice subsided and stabilized. Around this time it became rumored that nutmeg was an effective abortifacient. This use offered the West its first glimpses into the narcotic properties of nutmeg, as a number of young women became delirious after using large quantities of nutmeg to induce miscarriages (Kalbhen 1971).

It may have been these turn-of-the-century reports that led to the use of nutmeg in American prisons by the 1940s or earlier. Despite the length of time that nutmeg's properties have been recognized, fairly little is understood about the actions of this mysterious nut. This article is an attempt to compile the existing information about nutmeg into one place and to provide the reader with a more comprehensive understanding of nutmeg and its peculiar properties.

## NUTMEG AS SPICE

Of course, nutmeg is most well-known as a spice. Nutmeg also produces the spice "mace," which is made from the red membrane, or aril, that covers the nutmeg seed. Mace is not as sweet as nutmeg, but has a more delicate flavor, although both are used similarly in cooking. Mace contains the same oils that make nutmeg psychoactive. The popularity of the two spices peaked in England in the eighteenth century. The English used nutmeg to spice a wide array of dishes, including roast mutton, stewed pork, pies, puddings, and cordials. Nutmeg and mace have been used to flavor many other foods, such as soups, gravies, milk products, fruit juices, sweet sauces, gelatins, alcoholic beverages, snack foods, and breakfast cereals; they have also been used as general condiments. Sometimes nutmeg was used quite liberally in cooking. One seventeenth century cake recipe calls for six nutmegs to two pounds of sugar (Wilson 1999). Although nutmeg was once used widely to flavor a variety of dishes, and while it remains a component of most spice cabinets, its use has dwindled to the occasional flavoring of pies, cookies, and eggnog.

## NUTMEG AS MEDICINE

Since the time that nutmeg became popular as a spice, it has also been used in medicine. Nutmeg has been employed for healing purposes from the Middle East, to India, to China. After being introduced to Europe, many of these medicinal applications were then adopted by European physicians. While nutmeg was put to use for an




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assortment of medical purposes, several applications merit particular mention due to their persistence and widespread acceptance.

Nutmeg has been used to treat rheumatism in Indonesia, Malaysia, England, and China. The essential oil is used externally to treat rheumatic pains, limb pains, general aches, and inflammation. In England, far into the twentieth century, a nutmeg was simply carried in one's pocket to ward off the pains of rheumatism (Rudgley 1998).

Nutmeg has been used for its sedative effect to treat nervous complaints and to promote sleep in Malaysia and India. The inhabitants of the Moluccas would mix nutmeg with milk or a banana drink to give to children as a sleep aid (Rätsch 2005). In Europe, older women would carry nutmegs with them in silver graters to promote sound sleep (Krieg 1964). Nutmeg has also been widely used as an analgesic.

Nutmeg is probably most widely used to treat stomach complaints. It has been used in South East Asia, India, the Middle East, and Europe to treat stomach aches and cramps, to aid digestion, and to dispel gas.

Perhaps the most infamous medical use of nutmeg, as mentioned earlier, is as an abortifacient. It is not clear how far back this use dates, but it was a popular--albeit ineffective--"remedy" at the end of the nineteenth century and beginning of the twentieth century.

While there doesn't appear to be any traditional use of nutmeg as a mood elevator, several individuals have noted that it does indeed have such properties. The German writer Georg Meister noted nutmeg's uplifting effects in his 1692 work *Der Orientalisch-Indianische Kunst- und Lust-Gärtner (Oriental-Indian Art and Pleasure Gardener)* commenting that "it can greatly refresh even the ill and cheer them up with fresh spirits" (Rätsch 2005); and the twelfth century mystic Hildegard von Bingen had this to say:

When a human being eats nutmeg it opens his heart, and his sense is pure, and it puts him in a good state of mind. Take nutmeg and (in the same amount) cinnamon and some cloves and grind them up. And then, from this powder and some water, make flour--and roll out some little tarts. Eat these often and it will lower the bitterness of your heart and your mind and open your heart and your numbed senses. It will make your spirit happy, purify and cleanse your mind, lower all bad fluids in you, give your blood a good tonic, and make you strong (Rätsch & Müller-Ebeling 2006).

I have personally noted that nutmeg taken regularly in small amounts helps elevate mood, while reducing stress and anxiety.

Nutmeg is still used in Arabic and Indian folk medicine today, but its use as an herbal remedy in Europe is long forgotten. Use as a medicine never seems to have caught on in the United States, with the exception of its use as an abortifacient in the nineteenth century.

## **NUTMEG AS APHRODISIAC**

One little-known application of nutmeg is its traditional use as an aphrodisiac. In India, nutmeg has been added to curry dishes and also to betel quids for its aphrodisiac effect (Rätsch 2005). Nutmeg is recognized as an aphrodisiac in Malaysia and in Arab countries, and its counterpart, mace, is prescribed by physicians in the Near East as an aphrodisiac (Forrest & Heacock 1972).

While the use of nutmeg as an aphrodisiac in Europe does not appear to have been well-known or widespread, several examples exist. William Salmon, a seventeenth century Englishman writing in 1693, described a self-experiment in which nutmeg oil rubbed on the

genitals produced sexual excitation (Rudgley 1998, citing Salmon 1693). Most peculiar, perhaps, is an old German folk tradition in which a girl would swallow a nutmeg whole, collect the intact nut after it passed, and then powder and mix it in the food of her beloved. Doing such was supposed to cause the man in question to fall deeply in love with the girl (Rätsch 2005).

The traditional use of nutmeg as an aphrodisiac was recently put to the test by researchers at the Aligarh Muslim University in Aligarh, India. Their findings strongly support such an application. Their study was conducted by orally administering a 50% ethanol extract of nutmeg to male rats and monitoring changes in mating behaviors and sexual function. The extract was shown to significantly increase the frequency of erections and the mounting frequency, to decrease the amount of time between sexual episodes, and to significantly delay ejaculation in the test animals. In an earlier study on male mice, conducted by the same group, four of the six mice mated three females each while the remaining two mated five females each. This is in comparison to the control group, where two mice mated two females each and the remaining four mated only one female a piece. In order to test the purely libido-enhancing effects of nutmeg separately from the effects on physical sexual function, the research group anesthetized the genitals of the test animals and monitored the mounting behavior. While the rats could not properly perform, their attempts to mount were significantly higher than those in the control group. In addition, the research group conducted testing to determine the toxicity of the 50% ethanol extract, and found that doses up to eight times the active dose in the test animals displayed no signs of short-term toxicity (i.e., no mortality and no gross behavioral changes). The findings of these studies strongly corroborate the traditional uses of nutmeg to improve sexual function and enhance the sex drive, and suggest that nutmeg may be a safe and effective herbal remedy in treating sexual disorders (Tajuddin et al. 2003; Tajuddin et al. 2005).

## **NUTMEG FOR DREAM ENHANCEMENT**

There is not much written about the effect of nutmeg upon dreaming. Many experimenters have described the effects of nutmeg as having a dream-like quality and of promoting vivid daydreams. Many users also report increased dream recall as well as an increase in the vividness and lucidity of their dreams. From my own experiences, as well, I have found that nutmeg increases dream recall.

The most complete report of the effects of nutmeg on dreams comes from Paul Devereaux, who ingested two teaspoons of ground nutmeg and sprinkled essential oil of nutmeg on his pillow and sheets as part of a self-experiment. Devereaux reported becoming fully self-aware during a dream where he was flying through a tunnel at high speed. Devereaux also found that his tactile senses were partially operational while dreaming. When flying over a landscape of sorts, Devereaux described snatching at the leaves of a passing tree and reported feeling "the pull of the branches and the foliage digging into my hand" (Rudgley 1998).

Devereaux's report reinforces the contention that nutmeg may have an effect on the lucidity of dreams and on dream recall; however, more definite support is lacking.

## **NUTMEG AS INEBRIANT**

Nutmeg has historically been used in Egypt as a surrogate for hashish. It has also been used in India, either chewed, or snuffed with tobacco, or added to betel chew, but little information is available on these practices (Schultes & Hofmann 1992).

Nutmeg was introduced first as a spice into Europe, and later as a medicine. The Europeans remained ignorant of the inebriating properties of this most popular of spices for several centuries.

The first nutmeg inebriation on record was reported in 1576 when a pregnant English woman became delirious after eating between ten and twelve nutmegs (Stein et al. 2001). Had it not been for the rumors of nutmeg's efficaciousness as an abortifacient, the psychoactive

properties of nutmeg may have remained unknown for a long time. Occasional case notes of nutmeg poisoning were published subsequently, but nutmeg's inebriating qualities remained largely obscure and unexplored.

In the late nineteenth and early twentieth centuries, nutmeg again became popular as an abortifacient. The tales of nutmeg poisoning increased, and many more case studies were reported. This helped to paint a clearer picture of the actions and effects of nutmeg. It is not certain how nutmeg came to be a recreational drug, but it appears to have its origins in the early twentieth century when its use emerged in United States' prisons as an alternative to marijuana and other illicit substances. Some authors suggest that use of nutmeg as a narcotic didn't emerge until after World War II. However, the report by Malcolm X that there was a nutmeg culture at Charlestown State Prison in 1946 suggests that prisoners had already been keen to the properties of nutmeg for some time. Malcolm X described his experiences with nutmeg in his autobiography, published in 1965:

I first got high in Charlestown on nutmeg. My cellmate was among at least a hundred nutmeg men who, for money or cigarettes, bought from kitchen worker inmates penny matchboxes full of stolen nutmeg. I grabbed a box as though it were a pound of heavy drugs. Stirred into a glass of cold water, a penny matchbox full of nutmeg had the kick of three or four reefers (Haley 1965).

Malcolm X's autobiography sparked interest in nutmeg's narcotic properties within the counter-culture--interest that has carried through to the present day. The use of nutmeg in prisons eventually became so widespread that nutmeg was ultimately removed from prison kitchens.

The fact that nutmeg was cheap and legal made the narcotic popular among prisoners, seamen, soldiers, and struggling musicians. Jazz saxophonist Charlie Parker reportedly knew about the narcotic properties of nutmeg, and would take the ground spice in Coca-Cola or milk (Rudgley 1998).

While many have experimented with nutmeg since the 1960s, it remains viewed as a second-class drug, deserving of little attention.

## EFFECTS OF NUTMEG

Physiological effects include dry mouth, nausea, tachycardia, cutaneous flushing, paresthesia, hypotension, euphoria, detachment, CNS excitation, hallucinations, and dyspnea. Nutmeg does not cause any obvious effect on pupil size.

Nutmeg is perhaps best described as a deliriant. In low doses nutmeg inebriation shares characteristics of the combination of alcohol and marijuana. In higher doses the effects are more similar to those of the tropane alkaloids, causing confusion, disorientation, and hallucinations. The effects of nutmeg come on and dissipate in waves. One moment there may be a feeling of inebriation, while the next moment the feeling has passed. As the effects subside, the veil between ordinary and non-ordinary reality remains thin, allowing the user some control to switch back and forth between states of consciousness.

One reason why the effects of nutmeg remain mysterious to so many is that nutmeg inebriation follows a unique time-line. This is also the cause of much animosity towards nutmeg. People approach nutmeg expecting effects to come on within an hour as they do with traditional psychedelics like psilocybin-containing mushrooms or LSD. When it does not, people--believing they have not taken enough--will increase their dose and inadvertently become much more inebriated than planned. To best describe the effects of nutmeg inebriation, and to avoid mishaps, I have broken them down into stages and summarized the effects that one might experience during each phase of inebriation.

**THRESHOLD STAGE (hours 1-4):** The major effects of nutmeg generally do not take effect

until the fourth hour after ingestion. However, nutmeg produces subtle effects within the first hour, and the effects rise in waves over the next three hours until inebriation takes hold. These effects are often written off as placebo due to their mild nature, but the changes are noticeably distinct. Generally these threshold effects are experienced as a combination of feeling energetic and yet markedly relaxed at the same time. One may perceive changes in pressure in the head, changes which are usually interpreted as either light-headedness or the beginnings of a headache. The effects experienced in this stage are otherwise similar to those caused by a pint or two of good beer, depending on dosage.

**INITIAL INEBRIATION (hours 4-8):** The truly inebriating properties of nutmeg generally take hold within the fourth or fifth hour following consumption. By this time cotton mouth has set in and the eyes have become bloodshot. The inebriation takes on a strong alcohol/marijuana-like buzz, which continues to rise in waves, and concentration becomes difficult. The senses become enhanced and hilarity tends to set in. This is followed by the onset of closed-eye visuals, time distortion, and the beginnings of slurred speech. Reality may take on a dream-like nature during this stage.

**PEAK INEBRIATION (hours 8-12):** The peak generally sets in around the eighth or ninth hour following ingestion and usually continues for three or four hours. At this point the user may experience auditory hallucinations, closed-eye visuals and possibly mild open-eye visuals, including walls breathing and disturbances in the peripheral vision. The user's speech may become slurred and he or she may experience loss of coordination similar to drunkenness.

**END OF PEAK (hours 13-18):** Around the thirteenth hour it usually becomes apparent that the peak is over and the user might feel a slight letting up in the effects. The effects decrease slowly, and usually do so in waves, much like the onset.

**RESIDUAL INEBRIATION (hours 19-25):** By hour nineteen the main inebriating effects of nutmeg have generally worn off. The user will probably still feel moderately stoned for the next seven or eight hours. Some report feeling weak and tired by this point in the trip. Those who sleep during this stage may find their dreams to be exceptionally vivid and easy to recall upon waking. Hangover effects may set in for those who forget to remain hydrated.

**FINAL STAGE-BASELINE (hours 26-32):** By hour thirty-two most users will be more or less back to baseline. The user will likely continue to feel relaxed, perhaps slightly stoned, and may continue to experience difficulty concentrating for another day or two.

## DOSAGE

The potency of nutmeg can vary significantly from sample to sample; one should be aware of how potent one's material is before taking a large dose. Nutmeg from the East Indies is said to be more potent than that produced in the West Indies, and freshly ground nutmeg is reputed to be more potent than pre-ground. Nutmeg is not very conducive to adjustment of dose since onset may take up to six hours, making familiarity with potency quite important.

The following information on dosage is based on my own experiences and on an analysis of 176 experience reports posted on-line at Erowid.org.

**THRESHOLD (3-5 grams or 1-1.5 tsp)** A threshold dose of nutmeg is marked by euphoria, relaxation, mood elevation, hilarity and enhancement of the senses. Baseline is around hour eighteen. Some people will not experience effects at this level.

**LOW--MODERATE (6-10 grams or 1.5-3 tsp)** A low-moderate dose of nutmeg will produce a more distinct effect than a threshold dose, and may cause visual distortions, closed-eye visuals, and auditory hallucinations. Short-term memory may become impaired and speech may become slightly slurred during the peak of a low-moderate dose.

**MODERATE (11-15 grams or 1-1.5 Tbsp)** A moderate dose of nutmeg can cause slurred speech, disorientation, and loss of coordination. Previously stated effects increase and the user may experience mild visual phenomenon.

**MODERATE-HIGH (16-20 grams or 1.5-2 Tbsp)** A moderate-high dose may produce a waking dream-like state. One individual sought emergency room services after ingesting 15-20 grams of nutmeg. The user reported experiencing trouble breathing, blackouts, delusions, and panic (Marquis 2006).

**HIGH (20-25 grams or 2-2.5 Tbsp)** A high dose may increase the perception of being in a dream world. Users may begin experiencing stomach pain.

**NOT RECOMMENDED (25+ grams or 2.5+ Tbsp)** Doses this high usually will not increase the psychoactive effects of nutmeg, but will likely increase the length of the trip and thus will take longer to recover from. Physical discomforts such as stomach pain, abnormally rapid heartbeat, nausea, and dizziness tend to increase. Vomiting seldom occurs. User may experience trouble breathing or trouble urinating. Users may also become delusional. Out of sixty-six individuals who reported taking more than 25 grams of nutmeg, 17% reported having a difficult experience and 45% of these sought emergency room care. The average dose for those reporting negative effects was between 29 and 30 grams, though the median dose was only 25 grams. The average dose for those seeking ER care was 47.5 grams, while the median dose was 52.5 grams. With the variability in potency of nutmeg, some samples might require a high dose to produce a moderate effect, but one should be extremely familiar with the potency of his or her material before taking a high or not-recommended dose.

## PREPARATION

The easiest way to take nutmeg is to grind whole nutmegs and add them to juice. Freshly ground nutmeg is the best, because powdered nutmeg soon loses the oils that give it its distinct flavor and unique properties. I find the flavor goes with orange juice quite well--one just has to accept that the juice will be thick, if not chunky. A good way to test the potency of nutmeg is to insert a darning needle (or similar device) one centimeter into the flesh of the nut; if a drop of oil bubbles up after pulling the needle out then the nutmeg is good.

Karlos Fandango reports on Erowid.org that the active principle can be extracted by boiling nutmeg and collecting the waxy film that collects on top of the pot as the water cools (Fandango 2001). What Fandango has described is a way of extracting the fixed oil of nutmeg, otherwise known as nutmeg butter. Nutmeg butter has limited medicinal or cosmetic use, and does not contain the suspected active components of nutmeg, which are primarily myristicin, elemicin, and safrole (while myristicin alone has been shown to be psychoactive, it does not appear to completely replicate the inebriation caused by nutmeg). Nutmeg butter does contain trimyristin, which may have slight sedative effects. However, my attempts to repeat Fandango's recipe produced no sedation nor any other psychoactive effects.

Another preparation floating around the Internet is a recipe for "space paste" (Me 2001). The recipe is as follows, where one "part" equals a tablespoon.

- 4 parts nutmeg (ground from whole nutmeg)
- 4 parts almonds (soak overnight and rinse)
- 4 parts raw pistachios
- 2 parts cinnamon
- 1 part cumin
- 1 part tarragon
- 1 part oregano
- 1 part basil
- 1 part turmeric
- 1/2 part cayenne pepper

1/2 part black pepper  
maple syrup (to taste)

One Internet poster, identifying himself as "Me," compared eating two tablespoons of space paste to eating marijuana brownies and reported that this dose produced mild hallucinations (Me 2001). Two tablespoons of paste would contain less than one teaspoon of nutmeg--a threshold dose at best. However, a quick search of the Internet demonstrated that "Me" was not the only individual to have success with this recipe. The following question was submitted to a medical web site:

Mother brings 14 y.o. female to emergency room. Initial exam is exceptional for elevated respiration and BP, nausea, moderate perspiration, and child complaining of colorful hallucinations. A typical LSD case, or maybe an exotic hallucinogen? Nope. Kids made a concoction out of the following ingredients: Nutmeg, almonds, raw pistachios, cinnamon, cumin, tarragon, oregano, basil, turmeric, cayenne pepper, black pepper, and Maple Syrup, mixed into a vanilla milkshake. Nice coating for pork chops, but is there anything here that would explain the patient's condition? -- Houston, TX (Houston 2006).

The questioner was advised that nutmeg was the likely culprit. However, given the low levels of nutmeg, other ingredients likely play a synergistic role in the inebriating effect. The author, "Me," declares that the recipe will not work unless all ingredients are included. Black pepper also contains high levels of myristicin, and the Winter 2003 issue of *The Entheogen Review* commented on how the chemical piperine from black pepper inhibits the metabolism of some drugs/chemicals, leading to an increase in their effects [TER 12(4): 134]. Capsaicin, a chemical found in cayenne pepper, is also a mild inhibitor of cytochrome P450 2E1, which is a mixed-function oxidase involved in metabolism that mediates some drug interactions. It could be that one or both of these peppers is the reason why lower doses of nutmeg seem to have stronger effects when taken via this preparation.

While few inebriating plant preparations are palatable for the average person, there are some low-dose nutmeg preparations useful as aphrodisiacs or mood-elevators that are quite agreeable. Add 1/4 to 1/2 tsp of nutmeg to a cup of hot chocolate and let it simmer until the surface of the drink becomes oily. This makes for a spicy drink that helps to allay anxiety and imbues confidence and a positive outlook.

Christian Rätsch and Claudia Müller-Ebeling (2006) offer the following recipe for "Cookies for Preventing Sadness" in their book *Pagan Christmas: The Plants, Spirits, and Rituals at the Origins of Yuletide*. The recipe is slightly modified for purposes of American baking measurements.

2 Tbsp ground nutmeg  
2 Tbsp ground cinnamon  
1.5 tsp ground cloves  
3 cups flour  
3/4 cup sugar  
2 sticks of butter  
2 eggs  
pinch salt  
3/4 cup chopped almonds

Mix ingredients and bake cookies at 350°F for five to ten minutes. The cookies are sweet, spicy, and they lift the spirits. Perfect for the holidays.

## PHARMACOLOGY & TOXICITY

Nutmeg consists of 45-60% cellulose and solid matter, 24-40% fixed oils and 5-15% volatile oils. The fixed oil (or "butter") of nutmeg is an orange-colored waxy substance. The butter contains 70-85% trimyristin, which has been shown to have a sedative effect on chickens, and it also contains myristic acid. The real power of nutmeg, however, is contained within the volatile (or essential) oil.

The volatile oil of nutmeg is a pale-yellow, nearly colorless liquid, with a distinct smell of nutmeg. The volatile oil contains 80% monoterpenes and 5% monoterpene alcohols with the remainder made up by aromatic ethers and miscellaneous compounds (Forrest & Heacock 1972). The aromatic ether fraction contains myristicin, elemicin, and safrole, along with other alkyl-benzene derivatives, such as estragole, eugenol, iso-elemicin, iso-eugenol, methyl-eugenol, methyl-isoeugenol, and methoxy-eugenol (Kalbhen 1971; Forrest & Heacock 1972; Shulgin 1967; Shulgin et al. 1967; Duke 2008), and it is believed to be responsible for the psychoactive effects of nutmeg.

It has been speculated that the psychoactivity of myristicin, elemicin, and safrole is due to their metabolizing into known psychoactive compounds. Alexander Shulgin proposed in 1967 that the compounds would metabolize in the body as follows: myristicin to MMDA; elemicin to TMA; and safrole into MDA (Shulgin 1967). However, studies that have tried to confirm this process were unable to detect amphetamine-type compounds in the urine of rats that were administered myristicin and safrole (Forrest & Heacock 1972, citing Oswald et al. 1971).

The psychoactive effects of nutmeg are still not well understood, and only myristicin has been tested on human subjects.

Myristicin, or methoxysafrole, is a benzodioxole with slight MAO-inhibiting properties. Myristicin is a colorless oil that generally does not crystallize, even at extremely low temperatures (i.e., -30°C). Myristicin is mostly stable upon storage, but still subject to gradual changes in composition. Myristicin is insoluble in water and only slightly soluble in ethanol. The best solvents for extracting myristicin are benzene and diethyl ether.

Myristicin generally makes up 4-8% of nutmeg's volatile oil and has been found in concentrations as high as 1.3% of nutmeg by weight (C.E.F.S. 2005). The myristicin content in mace is generally double that of nutmeg, making it potentially more potent than nutmeg.

Myristicin is active at the 5-HT receptors in the brain, and has been shown to have hypotensive, sedative, anti-depressant, anesthetic, hallucinogenic, and serotonergic properties (Sangalli & Chiang 2001). Large doses generally cause hyper-excitability, followed by CNS depression. Myristicin is fairly unique as a hallucinogen (if it may be classified as such), because it lacks a nitrogen atom. It is also rare for a compound lacking a nitrogen group to show activity at the brain's 5-HT receptors.

Myristicin's psychoactive properties were confirmed by a study on ten human participants in 1961 (Hallstrom & Thuvander 1997, citing Truitt et al. 1961). Each of the participants was administered 400 mg of myristicin, or approximately 6-7 mg/kg by body weight. Only four of the participants experienced psychoactive effects, including euphoria, anxiety, and trouble concentrating.<sup>1</sup>

That only four participants experienced psychoactive effects at this level suggests that 400 mg or (6-7 mg/kg) is a threshold effective dose for nearly half of the population. Time of onset was between two and three hours after ingestion. Interestingly, 400 mg of myristicin is around twice the amount of myristicin that would be present in a moderate-high psychoactive dose of nutmeg, suggesting that myristicin is not the sole psychoactive agent in nutmeg.

Myristicin is found elsewhere in nature, notably in black pepper, carrots, celery, dill weed, parsley, and parsnip. Myristicin is almost completely processed in the body within 48 hours of ingestion. This long processing period may help to explain the extraordinary length of nutmeg's

effect.

Because of myristicin's close relationship with safrole, it has long been considered a "suspected carcinogen." However, scientific data is lacking on this point. Several studies indicate possible carcinogenicity, but the results have been statistically insignificant. Myristicin has shown mild DNA binding properties, an indicator of carcinogenicity, but has not been found to be genotoxic (Hallstrom & Thuvander 1997).

In one study, twelve rats were administered 10 mg/kg of myristicin per day for twenty-six days. After this period, no differences in body weight were discernible from the control group and no abnormalities were detected in the liver or kidneys. The LD-50 (lethal dose for 50% of the population) in rats was shown to be greater than 1000 mg/kg (Hallstrom & Thuvander 1997). For comparison sake, the threshold effective dose in humans stands around 6-7 mg/kg.

Myristicin has also been suspected as a potential hepatotoxin, but the studies available suggest that rather than being hepatotoxic, myristicin may in fact be hepatoprotective (Morita et al. 2003).

One study consisted of injecting mice with LPS (lipopolysaccharide) and d-GaIN (d-galactosamine), both liver toxins, and measuring the changes in levels of ALT (alanine aminotransferase) and AST (aspartate aminotransferase), both enzymes that indicate liver injury. A single oral dose of myristicin at quantities of 50, 100 and 200 mg/kg was shown to inhibit serum elevations of both ALT and AST in the injected mice (Morita et al. 2003). Further, DNA fragmentation generally caused by the liver toxins LPS and d-GaIN was effectively suppressed by a single oral dose of 200 mg/kg of myristicin (Morita et al. 2003).

Several studies on mice suggest that myristicin may reduce the frequency of and inhibit the growth of tumors. One study showed that myristicin significantly reduced tumor formation in the lungs and forestomachs of mice with benzo(a)pyrene-induced carcinogenicity (Hallstrom & Thuvander 1997). Myristicin has also been shown to be an inducer of GST (glutathione S-transferase), a substance that inhibits tumorigenesis. Myristicin was shown to cause a fourfold increase in GST activity in the liver and a threefold increase in the small intestine (C.S.W.G. 1997).

Studies on other animals have been less promising. Cats orally administered 400 mg/kg of myristicin experienced fatty degeneration of the liver while rabbits and guinea pigs administered myristicin subcutaneously experienced both brain and liver lesions (Forrest & Heacock 1972).

Studies on chronic and reproductive toxicity and carcinogenicity of myristicin are still lacking. Further studies on myristicin's hepatoprotective and tumor-inhibiting properties are also needed.

Elemicin, one of the other suspected psychoactive components of nutmeg, is similar to myristicin in that it lacks a nitrogen group and is also active at the brain's 5-HT receptors. Elemicin has displayed anti-depressant, hallucinogenic, anti-histamine, hypotensive and anti-serotonergic properties (Sangalli & Chiang 2000). There is some evidence of DNA binding and genotoxicity with elemicin (C.E.F.S. 2005). Studies on hepatocarcinogenicity have been inconclusive.

Safrole is also suspected of contributing to the psychoactive properties of nutmeg, but there is sparse evidence to support this theory. Safrole makes up 75-80% of oil of sassafras, which has been used medicinally for hundreds of years and has never been reported to be hallucinogenic (Forrest & Heacock 1972). The FDA considers safrole to be carcinogenic--a finding that some herbalists take issue with based on its long history of safe use by various Native American groups (Buhner 1998).

The terpenes are generally not suspected of contributing to the psychoactivity of nutmeg. However, many compounds from the terpenic fraction of nutmeg are structurally similar to known CNS stimulants. Overdoses on some terpene-containing medicines have also been reported to produce similar reactions to those caused by nutmeg (Forrest & Heacock 1972). Whether psychoactive or not, the terpenes may still contribute to the effect of nutmeg by irritating the gastrointestinal tract and thus facilitating absorption of the suspected psychoactive compounds (Kalbhen 1971).

While the toxicity of nutmeg is still in question, there are numerous reports of accidental poisonings and emergency room visits that help provide some extra information. In poisoning cases vitals are taken and organs are checked and monitored for abnormalities. Several case studies merit brief mention. The *Journal of Internal Medicine* reported on the case of a thirty-two-year-old man who sought emergency room care after ingesting seven grams of ground nutmeg (Sjoholm et al. 1998). The hospital ran tests on the man and found that his blood count, electrolyte levels, calcium and liver enzymes were all within normal ranges. The *Journal of Clinical Toxicology* also reported on a nutmeg poisoning case involving a thirteen-year-old who had ingested 15-25 grams of nutmeg (Sangalli & Chiang 2000). Tests conducted on the boy showed that electrolyte levels, renal and liver function, urinalysis, hematology, and a pelvic ultrasound all returned without abnormality. Almost all cases of nutmeg poisoning are resolved without note and most emergency room visits are accounted for by accidental poisonings or by panic reactions.

There are two recorded deaths involving nutmeg poisoning. The first case involved an eight-year-old boy who ingested fourteen grams of nutmeg, or the equivalent of 560 mg/kg of myristicin by body weight (Stein et al. 2001). The boy fell into a coma and died twenty-four hours after ingestion. There do not appear to be any other explanations beyond nutmeg poisoning for the boy's death. The second case involved the death of a fifty-five-year-old woman (Stein et al. 2001). The woman was found with toxic, but not fatal, concentrations of flunitrazepam (Rohypnol) in her blood. Blood tests also showed the presence of myristicin, with a speculated dose of between 560 and 840 mg/kg of myristicin by body weight. While the myristicin levels in the two fatal cases are comparable, it is believed that the combination of a high dose of nutmeg and a toxic dose of flunitrazepam was the cause of death. Other instances from emergency rooms and poison control centers report that cases of nutmeg poisoning involving up to eighty grams of nutmeg (or up to 1100 mg/kg of myristicin by body weight) have occurred without the presence of life-threatening symptoms (Stein et al. 2001).

## CONCLUSIONS

Nutmeg has been used for thousands of years for multiple purposes. It appears to have a fairly large safety margin for use, although the long-term effects of nutmeg use on the body are not well understood. The biggest known danger from experimentation is dehydration, and the biggest discomfort the resulting hangover. By keeping non-alcoholic/non-caffeinated fluids handy, and drinking often, this hangover (which can otherwise last several days) can likely be avoided.

The most promising aspects of nutmeg seem to be its potential as an anti-depressant and as an aphrodisiac when used in small doses. I have felt improvements in mood and decreases in anxiety with as little as 1/4 tsp in a cup of chocolate, or with one or two cookies from the recipe above. With knowledge of nutmeg's mood-elevating properties going back a thousand years or more, further investigation into the potential of nutmeg as an anti-depressant seems merited.

All in all, nutmeg is a well-rounded little nut. It may be used to brighten your day, to spice up your love life, to flavor your food, to induce vivid dreams, or to just get plain stoned. This seed has been overlooked and misunderstood by manyentheophiles, but once one is privy to her secrets she can become a valuable ally.

## Notes #

1. Another secondary source (Shulgin et al. 1967) also citing Truitt et al. 1961, claimed symptoms from 400 mg of myristicin "at least suggestive of psychotropic effects in 6 out of 10 subjects." The original paper by Truitt et al. states that there was a "definite reaction" in each of 4 subjects, and that 2 subjects each had a "questionable reaction."

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