



# Nutmeg and mace: The sweet and savoury spices

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## ABSTRACT

Nutmeg, mace (the membrane of the nutmeg seed), and cloves have long been considered as exotic spices in European cuisine. Nutmeg and mace come from the same tree, *Myristica fragrans* Houtt. (Myristicaceae), and share a large number of aromatic volatiles. The aroma/flavour of these spices is described as fruity, citrus, floral, herbal, roasted (mace)/green notes (nutmeg), woody, and spicy. Nowadays, nutmeg is found in many popular spice mixes, such as quatre épices, garam masala, pumpkin spice mix, and mixed spice. However, the vast majority of nutmeg (c. 90%) is added directly to processed foods, such as sausages and terrines, where it likely serves an antimicrobial function. At the same time, however, nutmeg also appears to complement milk-, cream-, and egg-based dishes particularly well (as in béchamel sauce). Nutmeg and mace are somewhat unusual amongst spices in being associated with both sweet and savoury dishes and drinks. Although relatively late arrivals to the European table, fashionable Europeans (in the 17th and 18th centuries) would once carry their own personal nutmeg graters around with them to season their food and drink at the table. However, while nutmeg and mace are called for in a large number of the dishes in Robert May's 17th century cookbook, pepper and chilli have nowadays become far more popular (at least by volume sold).

## 1. Introduction

Nutmeg, its aril or membrane (the red ribbon around the seed), mace (see Fig. 1), and cloves are all exotic spices originating from the Spice Islands (otherwise known as the Banda Islands, or Moluccas) of the Far East (Schivelbusch, 1993). Nutmeg and mace constitute two different parts of the same plum-to peach-sized fruit of the tropical Asian nutmeg tree *Myristica fragrans* Houtt. (Myristicaceae) (McGee, 2004, pp. 426–427).<sup>1</sup> This bushy evergreen tree usually grows 9–12 m or more tall, and fruits after 7 years (see Van Gils and Cox, 1994, on the ethnobotany of nutmeg). The trees can live to 100 and can yield as many as 20,000 nutmegs a season, but as Thring (2010) pointedly notes, that fecundity has never lowered the cost of this particular spice. On visiting Banda, Alfred G. Wallace (1869, p. 453) wrote that: “Few cultivated plants are more beautiful than nutmeg trees. They are handsomely shaped and glossy-leaved growing to the height of twenty or thirty feet, and bearing small yellowish flowers.” Mace is dried separately from the seed that it surrounds, and is described as having a gentler, more

rounded, flavour than nutmeg (at least by certain commentators). The English name nutmeg is derived from Old French and means “musky nut.” (Bramen, 2010).<sup>2</sup>

Currently, the main areas where nutmegs are grown are Indonesia and Grenada (West Indies),<sup>3</sup> accounting for 75% and 20% of market share, respectively. Indeed, nowadays, nutmeg and mace are typically identified simply as coming from the East or West Indies, respectively. Nutmeg is, however, also grown on a much smaller scale in Sri Lanka, India, China, Malaysia, Zanzibar, Mauritius, and the Solomon Islands (Rema and Krishnamoorthy, 2012). World production has been estimated at c. 12,000 tons per year, with around 2000 tons of mace produced.

### 1.1. History of nutmeg and mace's use

Nutmeg and mace are thought to have made their way to the Malabar and Coromandel coasts of India in the 1st Millennium AD. According to Tannahill (1973, p. 114), nutmeg, cloves, and mace were originally

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<sup>1</sup> McGee (2004, pp. 426–427), though, suggests that the tree may have originated in New Guinea. The name ‘Myristica’ is derived from the Greek word ‘Myron’, a sweet liquid distilled from the plant (Everett 1981).

<sup>2</sup> According to another suggestion, though, the word *nutmeg* comes from the Latin *nux*, meaning nut, and *muscat*, meaning musky (Trowbridge Filippone, 2022).

<sup>3</sup> Grenada even showcases a nutmeg fruit close to the hoist on the national flag. According to Vaughan (1993), this former British colony depends on the spice for 40 per cent of its gross national product.



Fig. 1. A) Photo showing nutmeg seed encased in red aril membrane; B) Illustration of *Myristicin fragrans*. [Illustration by Köhler, Public Domain.]. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

imported for their culinary, rather than medicinal, use. Nevertheless, nutmeg is also used medicinally in various parts of the world, and as part of various religious rituals (Van Gils and Cox, 1994). The first century Roman author and naturalist, Pliny, mentioned a tree whose nuts have two flavours, which is thought to reference nutmeg. The Romans used it as incense, for its pungent fragrance, and grated nutmeg was once also used in aromatic sachets (Vaughan, 1993). However, one finds no

mention of either nutmeg or mace in Apicius (1936), excepting a single medicinal recipe calling for a blade of mace.

In the 6th century, nutmegs were brought to Constantinople (modern-day Istanbul) by Arab merchants (Trowbridge Filippone, 2022). Over the next 600 years or so, the spice became a favourite of the European elite. The Holy Roman Emperor Henry VI had the streets of Rome fumigated with nutmeg before his coronation in the twelfth century (Kronl, 2007; see Lichtenstein and Casida, 1963, on the insecticidal properties of myristicin, one of the key active compounds in nutmeg). Intriguingly, Chaucer mentions nutmeg in connection with ale in his *Canterbury Tales*, written between 1387 and 1400 (Chaucer, 2000; Medieval Indonesia, 2019), suggesting that the spice was already known in Britain at this time.<sup>4</sup> As Medieval Indonesia (2019) notes: “The distance between Southwark, where Chaucer set the *Canterbury Tales* frame story, and Ternate, the main power in Maluku when the Portuguese arrived in the early sixteenth century, is 12,404 km (7707 miles).” Nutmeg became incredibly popular amongst the European nobility during the Middle Ages, despite it having been far less well-known in the ancient empires. The spice was also popular as an additive to food and drink at medieval banquets.

In contrast to many other spices, such as, for example, galangal, nutmeg and mace made little impact on European foods until the Middle Ages (Tannahill, 1973). Nutmeg only rarely appeared in Medieval German recipes (Klug et al., 2021). Though, according to Thring (2010): “The Arabs traded nutmeg through the Dark and Middle Ages, latterly funnelling it through Venice to season the tables of the European aristocracy. It was always fantastically expensive: a 14th-century German price table reveals that a pound of it cost as much as “seven fat oxen.” See also Laurioux (1985), on the role of spices in the medieval diet. Henisch (1976, pp. 103–104) talks of the conspicuous consumption of spices amongst the increasingly rich inhabitants of medieval Europe. By 1400, according to Freedman (2015), there was extensive use of pepper, ginger, sugar and cinnamon, and thus what distinguished the wealthy was the provision of rare and expensive spices such as nutmeg, cloves, and grains of Paradise. Around 1500, pepper, ginger, cinnamon, and sugar were the least expensive of the spices (Freedman, 2012). By contrast, cloves and nutmeg were perhaps three times the price of pepper, while saffron was 10–15 times more expensive (see also Spence, 2023b).

Tannahill (1973, p. 182) comments on the ‘fearsome’ use of spices such as ginger, pepper, saffron, cinnamon, cloves, and mace by medieval cooks. As Freedman (2012, p. 326) puts it: “Spices were ubiquitous in medieval gastronomy and also in medieval pharmacology.” In fact, Freedman (2012, p. 324) goes so far as to describe the European demand for spices in the late Middle Ages (A.D. 1200–1500) as ‘insatiable’. According to Schivelbusch (1993, 2005), spices such as nutmeg and cinnamon were, for a time at least, status symbols for the ruling classes of Europe, and nutmeg would be ground into alcoholic drinks by fashionable wealthy European gentlemen (see Fig. 2),<sup>5</sup> some of whom would even carry their own nutmeg grinders around with them. This enabled them to conspicuously improve upon the flavour of the meals that were served by their hosts. Smith (2007, p. 247) notes how: “The seventeenth century’s obsession with spices such as nutmeg led silversmiths across Europe to fashion pocket graters and receptacles for travellers and gave

<sup>4</sup> In The tale of Sir Thopas, the following appears: “And notemuge, to putte in ale, Whether it be moyste or stayle, or for to leye in cofre” which can be translated into modern English as “And nutmeg to put in ale, Whether it be fresh or stale, Or for to lay in a chest.” The latter line perhaps hinting at the spice’s fumigating properties.

<sup>5</sup> In the late 17th century, nutmeg and nutmeg graters became associated with drinking punch, which at that time was a popular alcoholic beverage. During the 18th century, fashionable men would often carry nutmeg in a pocket-sized silver container equipped with a grater in order to add the freshly grated spice to their punch.



Fig. 2. The street-seller of nutmeg-graters, from a Daguerreotype from Beard. (Image reprinted from <https://recollections.biz/blog/19th-century-spicy-trinkets-nutmeg-graters/>). This drawing showcases a male street-seller who specializes in selling nutmeg grates. In the man's hand is a sign with the text "I was born a cripple" and on his body he has a variety of nutmeg grates. [Photograph: Victorian London].

a new lease of life to the pomander, a ball of mixed aromatics carried as a preservative against infection, and a fashionable silver accoutrement in seventeenth-century England (Brierley, 1994, pp. 23–24; Glanville, 1990).<sup>5</sup> Freedman (2012) also mentions Gaspard d'Hauteville's impression of mid 17<sup>th</sup> century Poland where the food was redolent of nutmeg, cinnamon, saffron, and sugar." According to Reid (1990, pp. 76–77), imports of Moluccan spices to Europe grew slowly but surely throughout the eighteenth century. Notes that Joseph Nollekens, the great eighteenth-century English sculptor would try and scrounge for free spices taking pocketing nutmegs from the table at the Royal Academy of Arts dinners, contriving to accumulate a little stock of spices, without any expense whatsoever (Nollekens and his Times, 1828; as cited in David, 2016, pp. 93–94). As Elizabeth David (2016, p. 94) notes: "It was a civilized fad, the eighteenth-century love of portable nutmeg graters for the dining room, and the drawing room hot drinks, and for travelling." All of this raises the question of why nutmeg, and especially mace, appear so infrequently in recipes nowadays.

By the middle of the 19th century, one finds Jarrett (1855) suggesting that the use of either nutmeg or mace to flavour celery dishes was the height of vulgarity. Note that this suggestion is made at a time when the North American/British craze for celery, and hence its price,

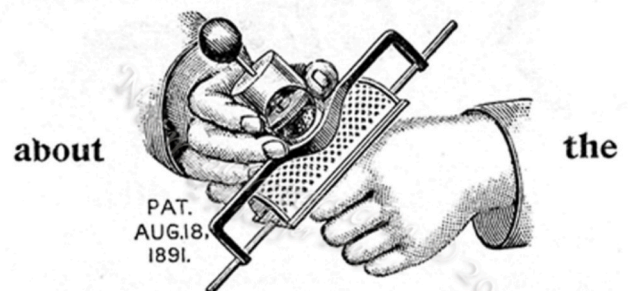
were at their peak (Spence, 2023a). The interest in, and widespread use of, nutmeg at around this time is highlighted by the American innovation known as the "kitchen-mechanical" or "patented" nutmeg grater that was developed in 1850 by Albert Hadley, a baker from Massachusetts, in collaboration with his neighbour, Edmund Brown, a tinsmith. Their grater, known as the *Brown & Hadley Rotary Nutmeg Grater*, was initially designed as a tool for bakers (see Fig. 3). However, there were soon a number of competing products on the market due to nutmeg's popularity amongst regular consumers. William Bradley, a neighbouring tinsmith, filed quickly for a patent, and hard though it may be to believe today, 20 mechanical grater patents were filed in an eight mile radius of Hadley's bakery within the following four decades. More recently, it has been suggested that a TV advert from Jamie Oliver led to a fourfold increase in sales of nutmeg in the UK (see Anon, 2005).

While once very popular in English cooking (i.e., since its appearance in the Medieval period), mace has seemingly largely disappeared from contemporary recipes. While nutmeg itself is not called for anything like as often as it once was, it is nowadays an integral part of a number of spice mixes, such as *quatre épices* in France, mixed spice in Britain (<https://www.bbcgoodfood.com/user/388309/recipe/mixed-spice>), *garam masala* in India, and pumpkin spice in North America. While nutmeg and mace were once especially popular amongst Europeans (especially perhaps the sea-faring nations), the two spices are used only sparingly in contemporary South-East Asian, Chinese, and Indian cuisine. Similarly, there would appear to be little tradition of using nutmeg or mace in South American cuisine either.

## 1.2. History of nutmeg production

Until the 16th century, Europe's only source of nutmeg were the Arab traders, who attempted to protect their monopoly over the nutmeg trade by spinning tall tales about the spice's origin. In fact, nutmeg (and hence mace) is indigenous only to the tiny Banda Islands (also called the "Spice Islands"), an island group in the Maluku Islands—an Indonesian archipelago.<sup>6</sup> The secrecy paid off for the Middle Eastern and Indian spice traders, who became very wealthy buying nutmeg from the Bandanese and selling it on to traders who would transport it from the

## TELL YOUR NEIGHBOR



## Edgar Nutmeg Grater.

SEND 25 CENTS FOR ONE.

THE EDGAR MANUFG. CO., Reading, Mass.

Fig. 3. An illustrated advertisement for the Edgar Nutmeg Grater. This grater was designed by George H. Thomas in 1891. [Picture: NutmegGraters] Note that one of the faces of contemporary box graters is still dedicated to nutmeg.

<sup>6</sup> By the end of the 16th century, Gerard, (1597, p. 1537) writes in *The Herbal* that: "The nutmeg tree groweth in the Indies, in an island especially called Banda."

shores of the Indian Ocean to the Mediterranean. Given that nutmeg, mace, and cloves all originated from the furthest reaches of the known world they were both more exotic and more valuable than other spices to Europeans than those spices that happened to be native to the Mediterranean or the Indian subcontinent.

Along with cloves, nutmeg and its aril, mace, helped to put the Spice Islands (the Moluccas, part of the Indonesian archipelago)<sup>7</sup> on the map of European sea powers. The Portuguese, and thereafter the Dutch, monopolized the trade in nutmeg until the 19th Century,<sup>8</sup> when the tree was planted in the Caribbean and elsewhere. In 1511, Portuguese sailors discovered the Maluku Islands. Although the Portuguese force was too small to take control, they were nevertheless able to purchase nutmeg (as well as mace and cloves) direct from the source, thus breaking the Arab monopoly on these particular spices. The Portuguese were not the only Europeans to profit from Indonesia's spices. The Dutch soon followed—and they were unwilling to simply buy spices alongside the Arab, Indian, and Portuguese traders (Keay, 2005).

The Dutch built a fort on the largest of the Banda Islands. Over the first two decades of the seventeenth century, they exerted increasing control over the archipelago, pressuring the Bandanese into signing a treaty that enshrined a Dutch East Indies Company monopoly over the spice trade, and seizing one of two British-controlled nutmeg-producing islands. In 1621, the Dutch took control of the Spice Islands, massacring many of the native Bandanese population and enslaving those who were left on nutmeg plantations, alongside workers brought in from elsewhere in the Indonesian archipelago (Thring, 2010). Any plantations outside of the Bandas were promptly destroyed.<sup>9</sup> In 1667, the Dutch received the last Bandanese island (Run) from the British in exchange for Manhattan (which, at the time, was merely a colony known as New Amsterdam; Milton, 1999; Thring, 2010). This gave the Dutch a monopoly over nutmeg. To ensure that the trade remained profitable, the Dutch kept prices artificially high, on occasion deliberately burning warehouses of nutmeg in Amsterdam to reduce the amount of the spice that was in circulation in Europe (note that they did the same thing with cinnamon).<sup>10</sup> Indeed, Reid (1990, pp. 76–77) charts the sharp fall in imports of Moluccan spices and pepper to Europe from the 1670s and 1620s.

Dutch Indonesia subsequently fell under French control, before being invaded by the British, during the Napoleonic Wars of the early nineteenth century, when Holland became part of Napoleon's empire. A treaty returned the Spice Islands to the Dutch, but not before the British had transplanted seedlings of nutmeg trees to areas under their control, that included Singapore, Ceylon (Sri Lanka), Bencoolen (southwest Sumatra), and Penang (in Malaysia). Subsequently, the spice then spread to Zanzibar, East Africa, and Grenada. Decades earlier, French traders (in 1769, the impeccably named Pierre Poivre, a roving French horticulturalist) had already managed to smuggle seedlings from the Bandas to their Mauritian colony (Thring, 2010). The Dutch monopoly was broken for good. Ultimately, nutmeg was once a spice of

geopolitical significance (Van Gils and Cox, 1994). However, given how much has been written on the early history of the spice trade (e.g., Dalby, 2000; Keay, 2005; Turner, 2005), this part of the story of nutmeg and mace will not be covered in any further detail here.

## 2. Flavour chemistry

The composition of nutmeg and mace depends on whether the raw spice or the oil is assessed (Schenk and Lamparsky, 1981; Thorpe and Whitely, 1939). Nutmeg seeds contain myristic acid, trymiristin, fatty acid glycerides and an essential oil, thought to be responsible for nutmeg intoxication, that contains myristicin, elemicin, eugenol and safrole (Pawar, 2024; see also Maya et al., 2004; Olajide et al., 2000). According to Matulyte et al. (2020): “The concentration of essential oil in nutmeg seeds is about 5–15% (Djilani and Dicko, 2012), and its major components are terpene hydrocarbons (sabinene, pinene, camphene, p-cymene, phellandrene, terpinene, limonene, and myrcene altogether make up 60%–80% of the oil), oxygenated terpenes (linalool, geraniol, and terpineol, which make up approximately 5%–15%) and aromatic ethers (myristicin, elemicin, safrole, eugenol, and eugenol derivatives, together constituting 15–20%)” (see also Chatterjee et al., 2015).

Mace contains greater quantities of the essential oil than nutmeg (8.1–10.3%, and 0.3–12.5%, respectively according to Ashokkumar et al., 2022; see also Verghese, 2001). The major constituents of nutmeg and mace oil are monoterpene hydrocarbons (including pinene and

**Table 1**

Chemical composition of acetone extract of nutmeg using GC-MS by Gupta et al. (2013) revealed the presence of 32 compounds representing 99.49% of the extract. The most important of these compounds are organized by % in the table. Relevant odour descriptors for the individual compounds are provided, where available.

Compound	%	Odour/flavour description
Sabinene	28.61	Warm, oily-peppery, woody-herbaceous and spicy odour
β-Pinene	10.26	Earthy and fresh odour
α-Pinene	9.72	Pine or rosemary odour
Terpinen-4-ol	5.80	Mild earthy and woody odour
Myristicin	4.30	Nutmeg-like odour
Limonene	3.76	Pleasant lemon-like odour
γ-Terpinene	3.71	Refreshingly herbaceous-citrusy odour
(Z)-p-Menth-2-en-1-ol	3.21	Woody-type odour
Isoeugenol	2.72	Sweet spicy clove woody carnation floral spice odour
Elemicin	2.67	Spicy-type odour
(E)-p-Menth-2-en-1-ol	2.15	NA
Myrcene	2.14	Earthy, fruity, and clove-like odour
α-Phellandrene	1.84	Peppery, woody and herbaceous aroma
p-Cymene	1.81	Aroma delivers hints of citrus, earth, and wood
Terpinolene	1.63	Floral aroma and a citrusy flavour that has a subtle, lingering sweetness with pine-like notes
α-Terpineol	1.62	Floral and sweet of Lilac type
α-Terpinene	1.61	Citrus-y, woody, terpy with camphoraceous and thymol notes
1,8-Cineole	1.59	Eucalyptus-like odour quality
Carvacrol	1.54	It has a characteristic pungent, warm odour of oregano
Camphene	1.50	Pungent odour
Linalool	1.12	Floral, citric, fresh and sweet odour

sabinene), together with smaller amounts of oxygenated monoterpenes, and aromatic ethers (including myristicin; Gopalakrishnan, 1992; Purselove et al., 1981; and see Power and Salway, 1907, 1908, for early

<sup>7</sup> Formerly known as the Spice Islands, it is now part of Maluku Province.

<sup>8</sup> Note that the English briefly took control of the Spice Islands between 1796 and 1803 (Van Gils and Cox, 1994). Interestingly, however, nutmeg doesn't make it into the index of Spencer's (2003): *British food: An extraordinary thousand years of history*.

<sup>9</sup> The 17th century London diary entry of Samuel Pepys, for Thursday 16th November 1665, describes how he was carried “down into the hold of the India shipp, and there did show me the greatest wealth lie in confusion that a man can see in the world. Pepper scattered through every chink, you trod upon it; and in cloves and nutmegs, I walked above the knees; whole rooms full.” (<https://www.pepysdiary.com/diary/1665/11/16/>).

<sup>10</sup> Repeating this pattern, Grenada and Indonesia burnt 350/300 tonnes of low-grade nutmeg respectively back in 1993 when the prices for the spice fell too low (c. \$550 a ton; Vaughan, 1993). Apparently, this had little long-term impact on prices though, given that the two countries have 7000 tonnes of the spice in storage.

research on the flavour chemistry of nutmeg) (see Table 1).<sup>11</sup> It has been suggested that aromatic ethers, myristicin, safrole, and elemicin determine the flavour of nutmeg, as well as being largely responsible for the seed's medicinal properties. Nevertheless, the composition of nutmeg (and mace) varies markedly by geographical location (see Rema and Krishnamoorthy, 2012, Table 22.3). Gas chromatography (GC) analysis of the oils of mace and nutmeg reveals 51 constituents in mace oil as compared to just 33 in nutmeg oil. Nevertheless, the two oils are qualitatively similar in terms of their composition, differing primarily in terms of the quantity of the various components. Nutmeg oil consists of 76.8% monoterpenes, 12.1% oxygenated monoterpenes, and 9.8% phenyl propanoid ether; mace oil, by contrast, contains 51.2% monoterpenes, 30.3% oxygenated monoterpenes and 18.8% phenyl propanoid ethers (Mallavarapu and Ramesh, 1998; see also Abourashed and El-Alfy, 2016; Maeda et al., 2008; McKee and Harden, 1991).

According to Farrimond (2018, p. 103): "A group of chemicals called neolignans have recently been discovered in nutmeg oil. These act on the temperature-sensing nerves on the tongue and in the mouth to give a numbing sense of lingering coolness." (see also Cao et al., 2015; Oanh et al., 2023).

### 3. Medicinal, pharmacological, hallucinogenic, and cosmetic uses of nutmeg

The nutmeg seed and its essential oil have long been used medicinally (Maeda et al., 2008, as well as a recreational drug, given the seed's putatively hallucinogenic properties (at least when consumed in sufficient quantities; Burroughs, 1959; X and Haley, 1965). The essential oil of nutmeg, meanwhile, is also used in the cosmetics industry (see Rema and Krishnamoorthy, 2012, for a review).<sup>12</sup>

#### 3.1. Medicinal use of nutmeg

Around 1000 AD, the Persian physician Ibn Sina described the "jansiban" or Banda nut (Thring, 2010). During the Middle Ages, nutmeg was believed to have the power to ward off mild illnesses, such as colds, as well as devastating diseases such as bubonic plague<sup>13</sup> (Nam, 2014; Riddle, 1965; Thring, 2010). The plague doctors of the era would once wear a beak filled with spices that included nutmeg, believing that it offered some protection (see Fig. 4). At the end of the 15th century, the hospital of Countess L'Isle made a routine of buying medicines that were made of pepper, cinnamon, cloves, nutmeg, grains of Paradise, and theriac (Balard, 1995, p. 99). Intriguingly, a popular 15th-century French herbal, *The book of simple medicine*, recommended nutmeg and mace for a range of ailments (Ospomer-Halleux, 1984). According to Ayurvedic medicine, mace can be used to treat stomach infections (Hemphill and Cobiac, 2006; see also Sultana et al., 2018, for other traditional medicinal uses). Intriguingly, Apicius (1936) includes a blade of mace in a concoction to treat a sick or weak stomach.

In Oriental medicine, nutmeg and mace oil have long had a variety of uses including as an aphrodisiac (Tajuddin et al., 2005), while various other uses have been documented amongst the indigenous inhabitants of the Spice Islands themselves (Van Gils and Cox, 1994). A related species, *Myristica fatua* Houtt., also indigenous to the Maluku islands, has been

<sup>11</sup> Parsnips also contain myristicin (Lichtenstein and Casida, 1963); According to Segnit (2010), this is particularly noticeable when the vegetables are roasted. Small amounts of myristicin can also be found in parsley, fresh dill, and star anise. The most important plant family containing myristicin is the Umbelliferae (syn. Ammiaceae or Apiaceae), embracing many of the rooty vegetables and common herbs (Shulgin, 1966).

<sup>12</sup> Note that the self-defence spray known as mace is unrelated to the spice of the same name.

<sup>13</sup> The Black Death was one such bubonic plague pandemic occurring in Western Eurasia and North Africa from 1346 to 1353.



Fig. 4. Plague Doctor (c. 1500's), were known to stuff their "beaks" with a mixture of spices, including nutmeg, thought to purify the air that they breathe. [Credit: Bridgeman Art Library].

reported to treat headaches (Burkill, 1935 pp. 1554–1556). According to Heyne (1927), nutmeg has long played an important role in traditional Indonesian medicine, while Rumphius (1755) noted its use to treat stomach and kidney disorders. Rheumatism and other aches of the limbs and joints have also been treated with the spice (Ridley, 1912, pp. 122–153). Motilal and Maharaj (2013) conducted a randomized, double-blind, controlled study to investigate nutmeg extract's effect on painful diabetic neuropathy. Medicinal uses of nutmeg to alleviate stomach disorders, rheumatism, nervousness, vomiting, sprains and headaches have also been practiced. Furthermore, nutmeg has been shown to act as an anti-depressant in male rats (Moinuddin et al., 2012). Nguyen et al. (2010) have also suggested that the AMP-activated protein kinase (AMPK) activators in nutmeg may have an anti-obesity effect.

Giles and Cox note that nutmeg is used to treat diarrhea, mouth sores, and insomnia. And as noted already, the myristicin in nutmeg has insecticidal properties (see Lichtenstein and Casida, 1963). Broadhurst et al. (2000) evaluated nutmeg, allspice, cinnamon, bay leaf, cloves, witch hazel, oregano, along with black and green tea in terms of their insulin-like biological activity. Cinnamon was found to have the most pronounced effect of any of the culinary and medical plant aqueous extracts that were tested *in vitro*. Nutmeg and mace possesses a range of antioxidant properties (Gupta et al., 2013; Madsen and Bertelsen, 1996; see also Calliste et al., 2010), as well as exhibiting anti-carcinogenic, anti-inflammatory (Olajide et al., 1999; Ozaki et al., 1989), anti-bacterial (Prabuseenivasan et al., 2006), anti-fungal, and hepatoprotective activity (e.g., Ashokkumar et al., 2022; Matulyte et al., 2020; Rema and Krishnamoorthy, 2012) (see Fig. 5).

Similar to many other spices, nutmeg and mace also possess

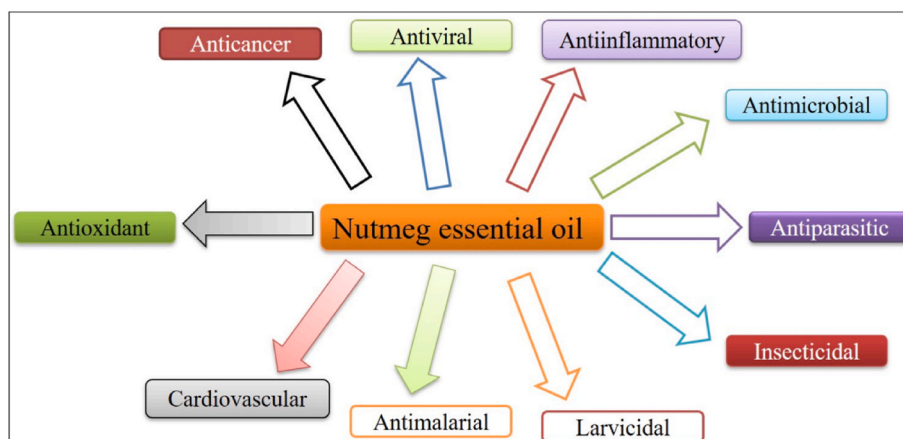


Fig. 5. Diagrammatic representation of potential biological and pharmacological activities of *M. fragrans* essential oil [Reprinted from Ashokkumar et al. (2022).].

antimicrobial properties (e.g., Mvuemba et al., 2009; Orabi and Mossa, 1991; Rema and Krishnamoorthy, 2012). However, it seems unlikely that the antimicrobial account of spice usage (Billing and Sherman, 1998), nor the suggestion that spices are added to mask spoilage, can provide a meaningful explanation for this culinary spice's widespread use in European food and drink at various points in history (see Bromham et al., 2021; Spence, 2021), especially given the spice's phenomenal price at certain points in European history. Note also that nutmeg is far from being the most effective antimicrobial agent according to a comparison reported by Billing and Sherman (1998).<sup>14</sup> And while the spice's use as a seasoning for sausages/terrine/mortadella, etc. undoubtedly fits this function (Gruber, 2022; Panggabean et al., 2019), what is noticeable in European cuisine is how often the spice is found in milk-based flavoured sauces, such as béchamel.<sup>15</sup> Mace, meanwhile, is often found in chutneys, pickles, and ketchups, which again fails to support the predictions of the antimicrobial hypothesis of spice use. However, as is so often the case when it comes to assessing the efficacy of medicinal spices, longer term clinical trials are needed to convincingly demonstrate the efficacy of nutmeg in treating insomnia, heart disease, peptic ulcers and oral care (Latha et al., 2005).

### 3.2. Hallucinogenic properties of nutmeg

The myristicin and elemicin fractions of nutmeg are responsible for the hallucinogenic properties of the seed (e.g., Gopalakrishnan, 1992; Schivelbusch, 1993; though McGee, 2004, considers the evidence weak).<sup>16</sup> Crucially, the proportion of the putatively hallucinogenic compounds, myristicin and elemicin, vary markedly depending on the source/origin of the plant (Guenther, 1950). This regional difference (see Rema and Krishnamoorthy, 2012, Table 22.3), note, may have contributed to ongoing debates concerning nutmeg's putative hallucinogenic properties (that have been suggested by many authors, e.g.,

Tannahill, 1973, p. 343).<sup>17</sup> According to the analysis presented by Rema and Krishnamoorthy, nutmegs from Grenada and St. Vincent contained less than 1% myristicin, while those from Indonesia contained 13.5%. Under the appropriate conditions of growth and storage, a high quality nutmeg seed may contain as much as 13 mg of myristicin per gram (Nowak et al., 2015). According to Van Gils and Cox (1994), there is no convincing evidence of hallucinogenic or other psychoactive properties other than, perhaps, nutmeg having a mild sedative function.

Greenberg and Ortiz (1983, pp. 8–20) refers to Lobelius in 1576, who observed a 'pregnant English Lady who, having eaten 10–12 nutmegs, became deliriously inebriated' (see Cushny, 1908). Rumphius (1755) mentions the tale of a couple of soldiers who fell asleep below a nutmeg tree and apparently woke up feeling drunk. In 1829, the pioneer Czech experimental physiologist Jan Evangelista Purkinje (Mazurak and Kusa, 2018) ate three nutmegs, reporting that his "... movements appeared entirely adequate, but were lost momentarily in dream pictures ..." (Weil, 1965). However, such examples are obviously nothing more than anecdotal. As Thring (2010) notes: "the old apothecaries were more cautious with nutmeg than with other spices. The Salerno School, the leading European medical establishment during the early Middle Ages, decreed: "One nut is good for you, the second will do you harm, the third will kill you."

Meanwhile, Weil (1965, 1967), describes nutmeg as a narcotic/psychoactive drug (see also Forrest and Heacock, 1972; Shulgin, 1966). It is, though, worth noting that some of the effects of excessive consumption that have been reported in the literature might actually be attributable to toxicity, which is more evident in some individuals than in others. Schultes and Hoffman (1980) suggest that the term 'pseudo-hallucinogen' might be a more appropriate descriptor for the consequences of nutmeg consumption. Certainly, the medical literature contains a number of published case reports concerning nutmeg intoxication (Casale et al., 2023; Pawar, 2024; Rahman et al., 2015; Weil, 1967), and even poisoning, which has, on rare occasion, proved fatal (Cushny, 1908; Jacobziner and Rayibin, 1965; Stein et al., 2001).

## 4. Contemporary culinary uses for nutmeg and mace

Nowadays, nutmeg is used to help flavour everything from doughnuts to eggnog, as well as being added to both hotdogs and sausages. Nutmeg appears frequently in a range of Dutch dishes, perhaps

<sup>17</sup> Indeed, it was the putatively hallucinogenic properties of nutmeg that led to the spice being banned in Saudi Arabia (Arndt, 1988).

<sup>14</sup> Mace is not mentioned in their analysis (though see Morabi et al., 1991, for evidence on this score).

<sup>15</sup> The first recipe of a sauce similar to béchamel is in the book *La Varenne's (La Varenne, 1651) Le cuisinier françois*, made with a roux, as in modern recipes. The name of the sauce was given in honour of Louis de Béchameil, a financier who held the honorary post of chief steward to King Louis XIV of France in the 17th century. Interestingly, however, nutmeg and mixed spice are not necessarily found in British milk-based desserts such as bread and butter pudding, rice pudding, or tapioca pudding.

<sup>16</sup> According to certain authors, thanks to the psychoactive chemical, myristicin (a relative of amphetamine), nutmeg can produce hallucinogenic effects if taken in sufficiently large quantities. The myristicin in nutmeg acts on the human body in a similar way to mescaline, the psychoactive compound found in peyote.

unsurprisingly given the nation's former control of the Spice Islands.<sup>18</sup> As [Thring \(2010\)](#) notes: "The Dutch, who had time to get to know nutmeg, add it to most of their vegetable dishes." The Dutch spice mix 'speculaaskruiden' also contains nutmeg ([Gruber, 2022](#)). Mace is primarily found in savoury dishes, and is used to flavour milk-based sauces and is found in processed meats, such as sausages ([Cui et al., 2015](#); [Lewis, 1984](#)). According to [Vaughan \(1993\)](#): "only about 10 per cent of the nutmeg consumed each year is bought from supermarkets. The rest is used in industrial food production, especially as a meat flavouring."

[Šojić et al. \(2015\)](#) have demonstrated the enhanced oxidative and microbial stability of cooked sausages that have added nutmeg oil (c. 20 ppm) leading to prolonged shelf life. According to [Rema and Krishnamoorthy \(2012\)](#), soups, pickles, ketchups, chutneys are also sometimes seasoned with mace. The flesh or meat of the nutmeg fruit (accounting for something like 78% of total mass) is sometimes used in jams ([Karseno & Setyawati, 2019](#); [Van Gils and Cox, 1994](#)). Nutmeg and mace oil are used to flavour soft drinks,<sup>19</sup> canned foods, and meat products. Nutmeg is often used in custard tarts (<https://www.bbcgoodfood.com/recipes/custard-tart>). At the same time, nutmeg is described as a warm spice ([Van Gils and Cox, 1994](#)), and this description fits with the spice's contemporary popularity as a festive end-of-year spice (e.g., in the mincemeat that fills mince pies, <https://www.bbcgoodfood.com/recipes/traditional-mincemeat>, and Christmas pudding recipes in Britain; e.g., <https://www.bbcgoodfood.com/recipes/classic-christmas-pudding>; as well as Thanksgiving dishes such as pumpkin pie in North America, [Bramen, 2010](#)).<sup>20</sup>

Elizabeth [David \(2016, p. 95\)](#) writes of how: "In English cooking nutmeg is used less imaginatively than in Italy. It goes into puddings and cakes and sweet creams, it is grated over milk junkets, cream curds, and the Christmas brandy butter. Our savoury dishes such as potted meats, sausages and pie fillings are seasoned with mace rather than with nutmeg. The tradition is probably based on some sort of logic. Mace is a part of the same fruit as the nutmeg and has a similar aroma but coarser, less sweet and more peppery."

#### 4.1. Nutmeg's use in spice mixes

Nutmeg is one of the key ingredients in several popular spice mixes. For example, it is found in 'quatre épices' (French for "four spices"), a popular French culinary spice mix that is also sometimes found in Middle-Eastern kitchens.<sup>21</sup> It is considered as the French allspice.<sup>22</sup> The spice mix contains ground pepper (white, black, or both), cloves, nutmeg, and dried ginger. The blend of spices typically specifies a larger proportion of pepper (usually white pepper) than the other spices,

<sup>18</sup> The Portuguese, who controlled trade with the Spice Islands for several centuries prior to the arrival of the Dutch, also make regular use of these spices. Interestingly, though, recipes for Portuguese egg tarts (Pastéis de nata) are typically spiced with cinnamon rather than nutmeg (<https://www.tastingtable.com/686035/portuguese-egg-tart-recipe-pastry/>).

<sup>19</sup> In fact, according to the recipes reprinted by [Pendergrast \(2000\)](#), nutmeg is one of the ingredients/spices in Coca-Cola (see also [Lorjaroenphon and Cadwallader, 2014](#)). This should perhaps not come as any surprise given the fact that Coca-Cola originated in The States in the latter half of the 19th century, at a time when the craze for nutmeg-graters, and hence presumably also for the spice itself, was seemingly at its peak.

<sup>20</sup> And see [Nishad et al. \(2018\)](#) on the synergistic effect of nutmeg and citrus peel extracts in terms of their antioxidant activity.

<sup>21</sup> Whilst its origins of this spice mix are not entirely clear, according to one online source, it may have originated in the port city of Saint-Malo, Brittany in the 17th century, where food was often influenced by Middle Eastern and Asian cuisines.

<sup>22</sup> *Pimenta dioica* L. (Merrill) (Allspice) Jamaica pepper has a flavour that is said to evoke a blend of nutmeg, cloves, and cinnamon.

though some recipes suggest using roughly equal parts of each spice.<sup>23</sup> In French cooking, quatre épices is typically used in soups, ragouts and pot-cooked dishes, vegetable preparations (e.g., potato **Dauphinoise**) and charcuterie, such as pâté, sausages, and terrines. Nutmeg is an important element of classic French béchamel sauces, and is a key element in the cauliflower, nutmeg, grapes, and béchamel dish created a few years ago by chef [Aduriz \(Coucquyt et al., 2020, p. 66\)](#).

Garam masala is an Indian spice blend that is usually added toward the end of cooking, so that it seasons the dish while adding its aroma. This popular spice mix contains nutmeg (along with cumin, coriander, cardamom, cinnamon, cloves, and black pepper). In North America, 'pumpkin spice' (a mixture of cinnamon, ginger, nutmeg, and cloves which, according to a commentary that appears in [Apicius \(1936, p. 99\)](#) suggests that: "cinnamon, nutmeg, ginger—spices which the insipid pumpkin needs") is the flavour of the fall (in North America). The original recipe for pumpkin spice dating back to the closing years of 18th century ([Friend, 2021](#)).<sup>24</sup> McCormick's blend, which was originally launched in 1934, includes four spices: cinnamon, ginger, nutmeg, and allspice ([Friend, 2021](#)). The Pumpkin Spice Latte has been Starbucks' most popular seasonal beverage of all time. In fact, since 2003, the company has sold more than 424 million of these beverages in the U.S. alone, according to [Friend \(2021\)](#), thus presumably accounting for a not inconsiderable amount of the popular demand for the spice.

#### 5. On the sensory qualities of nutmeg and mace

Nutmeg and mace are often described as having similar aromas/flavour profiles (e.g., [Hall, 1958](#); [Lawless et al., 2012](#)), and indeed they contain many of the same flavour compounds, albeit in different proportions. Other commentators have suggested that nutmeg and mace have similar, but distinctive, flavours; Both apparently have a clear, citrusy, fresh-pepper quality; Nutmeg is described as having a complex flavour consisting of a mixture of pine, flower, citrus, and warm peppery notes (the latter, note, associated with the presence of myristicin). [Van Gils and Cox \(1994\)](#) describe nutmeg as aromatic and as having a warm, slightly bitter taste. Both spices carry fresh, pine, flowery, and citrus notes but are dominated by woody, warm, somewhat peppery myristicin (sweet peppery nutmeg). According to [Coucquyt et al. \(2020\)](#), nutmeg and mace both share fruity, citrus, floral, herbal, woody, and spicy notes; In addition, they suggest that mace has roasted notes, while nutmeg, it is suggested, expresses green notes instead.<sup>25</sup> Meanwhile, according to [Bramen \(2010\)](#), mace has the spicier flavour with an aroma that she describes as akin to a cross between nutmeg and cloves. [Bramen](#) also writes about how nutmeg "adds complexity to both sweet and savoury dishes."

Given the similar flavour profiles of nutmeg and mace, one might wonder why one spice should be used over the other in recipes. At the same time, one might also ask why anyone would include both spices in the same recipe; Surely, it would be redundant if the flavour profiles of the two spices really were so similar. Nevertheless, this is precisely what is called for in some British mixed spice recipes (e.g., <https://www.bbcgoodfood.com/user/388309/recipe/mixed-spice>), as well as in [Simmons' \(1796\)](#), *American cookery*. [Hazlitt's \(1902\)](#) cookbook also includes a number of recipes calling for both nutmeg and mace. Nutmeg is darker, and tends to be used in sweets and those dishes that are based on cream, milk, and/or eggs. The natural affinity between nutmeg and milk/cream-based flavoured sauces is perhaps worth noting, given that

<sup>23</sup> Some variations of the mix use allspice or cinnamon instead of pepper, or cinnamon instead of ginger ([Montagné, 1961, p. 428](#)).

<sup>24</sup> The two recipes for spice-filled "pompkin" pie in [Amelia Simmons' 1796](#) reprint of her cookbook *American Cookery*, includes one made with nutmeg and ginger, the other with allspice and ginger ([Simmons, 1796](#)).

<sup>25</sup> Unusually, [Chartier \(2012\)](#) has very little to say on nutmeg, and absolutely nothing on mace.

it might be taken to suggest a pattern of spice usage that is based on flavour harmony (i.e., rather than an antimicrobial explanation). According to one online resource: “In addition, it is delicious when associated with dairy, as its earthiness and warmth will balance the creaminess that characterizes foods containing milk or cheese. For this reason, nutmeg is also used in cream-based sauces or cheesy dishes.” (Gruber, 2022). Indeed, in Indonesia, warm milk with grated nutmeg is widely used to help infants and toddlers to sleep. Mace, by contrast, tends to appear in meat dishes as well as in pickles, chutneys, and ketchup (McGee, 2004). According to one commentator, nutmeg and mace can be used interchangeably, but one should always opt for the fresh rather than pre-ground form of either (cf. Gruber, 2022). This is, however, obviously easier said than done in the case of ready-made spice mixes.

According to Segnit (2010, pp. 221–223), nutmeg can both help to make sweet, creamy dishes less cloying while at the same time making cruciferous vegetables less bitter. (Unfortunately, however, Segnit neglects to explain how the latter effect is supposed to work, and there doesn't appear to be any relevant peer-reviewed empirical research on the topic.) According to Lyman (1989, p. 67): “MSG supposedly enhances taste or perhaps aroma (but a dash of nutmeg will do the same without the added sodium)”. Elizabeth David (2016, p. 94) notes “I see no reason why we shouldn't revive it. David wants it in London restaurants for plain pasta with butter and parmesan, and for leaf spinach as well, To my mind, nutmeg is essential to these dishes, as indeed it is to béchamel sauce, cheese soufflés, and nearly all other cheese mixtures. Yet how many times, I wonder, have I been told by an apologetic waiter that there is no nutmeg in the house?” (This text originally appeared in a Williams-Sonoma booklet, from July 1975; see also Hopkinson and Haydock, 2014, on the combination of spinach and nutmeg). Given the production methods, there will always be something like five times more nutmeg than mace, by weight. It is therefore interesting to consider whether differences in price may possibly have influenced purchasing behaviour, and potentially also recipes, at certain points in history. However, evidence on this point is, though, hard to come by.

The flavour of nutmeg is said to become unpleasant with prolonged heating, perhaps explaining why it is often grated over a dish at the last minute (McGee, 2004). Note that this is exactly what would have happened when the fashionable folk who once carried their own nutmeg grater around with them, grated their nutmegs over the food and drink that they were about to consume. Woolgar (2018) also notes how some medieval recipes call for mace and other spices such as cloves to be cast on the dish at the dresser, in order to add spice and colour at the last minute before serving. Ultimately, therefore, one of the reasons as to why nutmeg might have been preferred to mace, given their similar sensory profiles, is presumably the relative ease with which nutmeg seeds can be carried and grated. Given its more pliable physical qualities, mace is easier to add (as a blade) to a sauce than it is to grate over food. According to Thring (2010): “Historically, mace was more common in cooking: it tended to be cheaper than nutmeg because it's rather more pungent, as well as easier to sell in small quantities.”

### 5.1. Nutmeg: the sweet and savoury spice

Nutmeg is an intriguing spice in the contemporary culinary landscape given that it is associated with both sweet and savoury foods.<sup>26</sup> Nowadays, nutmeg, like cinnamon, is a spice that many people in the west tend to associate with hot drinks (some have blamed the arrival of

the pumpkin spiced latte from Starbucks for this; Friend, 2021) and desserts.<sup>27</sup> Relevant in this regard, Blank and Mattes (1990) had a group of 36 female and 34 males smell (sniff), then taste 11 spices. Nutmeg, along with ginger, cloves, and cinnamon were all rated as tasting bitter. There was, however, a suggestion of cultural differences in people's taste associations with nutmeg and anise in particular. For the nonwhite group (who were mostly from outside the US, according to Blank and Mattes), nutmeg was rated as relatively similarly sweet (this differed for anise, while for the white US group the opposite was the case). Such results therefore suggest that there may be more variation in how sweet white North Americans find nutmeg to smell/taste, perhaps hinting at the different sweet versus savoury recipes in which this spice is incorporated as a function of one's food culture. It can be argued that many other spices, such as, for example, cumin, bay leaves (Spence, 2023c), vanilla, and to a lesser extent cinnamon (Spence, 2023d) are more clearly associated either with sweet or with savoury dishes (at least within a given culture/cuisine). Consider here only how vanilla is essentially a sweet spice (see Spence, 2022, for a review), this despite the fact that vanilla pods themselves actually taste bitter.

## 6. Conclusions

The exotic spices from the Indonesian Archipelago (in particular, nutmeg, mace, and cloves)<sup>28</sup> have, at certain points in history, been the most mysterious, not to mention amongst the most expensive, of spices (Freedman, 2008; Freedman, 2020). Although mace was once a very popular spice frequently found in British recipes (e.g., May, 1660; see also Hieatt, 2004) (see Table 2),<sup>29</sup> it has essentially disappeared from recipes (and seemingly from store shelves in the UK) in recent years. According to Vaughan (1993): “It is a relatively minor spice nowadays: world consumption of nutmeg is 10,000 tonnes a year, compared with black and white pepper, the most widely used spice, at 150,000 tonnes. Even pepper consumption is small compared with chillies: India, the biggest producer and consumer of spices in the world, grows and eats 600,000 tonnes of chillies every year.”

But why, one might ask, were nutmeg and mace once valued so highly by Europeans? Why cook with these highly exotic, and at points in history, hugely expensive spices? Well, the answer depends on where and when in time one considers. Nevertheless, the antimicrobial

**Table 2**

The number of mentions of various spices in popular British cookbooks over the centuries, highlighting how widely nutmeg and mace were once used (e.g., May, 1660). While the use of all the spices mentioned in the table decline dramatically over the centuries, this is perhaps most noticeable for nutmeg and mace. The figures were obtained by searching the Gutenberg digital versions of the relevant cookbooks.

Cookbook Author	Nutmeg	Mace	Cin(n)amon	Ginger
Pegge (c. 1390)	2	9	5	10
May (1660)	608	569	284	284
Kitchiner (1817)	73	66	37	49
Soyer (1849)	46	34	26	3
Beeton (1861)	208	298	37	136
Francaelli (1861)	10	0	10	8
Hazlitt (1902)	28	19	2	11

<sup>27</sup> Chartier (2012, p. 325) writes of desserts as “a kind of home in exile for spices such as cinnamon, cardamom, or nutmeg”.

<sup>28</sup> Cloves, note, will hopefully constitute the subject of a forthcoming article.

<sup>29</sup> Smith (2007, p. 252) notes how “Nutmeg, too, appeared for the first time in 40 per cent of recipes in Lancelot de Casteau's *Ouverture de cuisine* (de Casteau, 1694).” He continues “It gave Nicolas Boileau (1636–1711)(Boileau, 1969) the subject for one of his famous satires: ‘You like nutmeg, it's put on everything!’ (*Vous aimez la muscade, on en a mis partout!*).”

<sup>26</sup> Like cinnamon, nutmeg is used in both sweet and savoury dishes. In baking, nutmeg is said to pair well with cinnamon, cloves, anise, cardamom, and ginger. In savoury dishes, nutmeg complements cumin, black pepper, coriander, sage, thyme, chili pepper, mustard seed, and turmeric.



hypothesis and the masking of off-notes (pre-refrigeration) do not seem especially relevant here. Thring (2010): “What made nutmeg so captivating, so costly, for so long? One factor was its sheer rarity ... But nutmeg was always more than a flavouring. In its early history, like most spices, the Arabs traded it as scent, aphrodisiac and medicine. During the Black Death, nutmeg commanded hysterical prices because desperate people believed it might ward off plague.” At the same time, the very exoticism of spices such as nutmeg and mace may have been part of the reason why their use declined (see, for example, the discussion of seditious ‘hot’ spices in Ben Jonson’s, 1614, Bartholomew Fair; Jonson, 2004; Parrish, 2021).

Why, one might also ask, has nutmeg become strongly associated as a flavour added to milk-, cream-, and egg-based sauces and dishes? The antimicrobial hypothesis doesn’t help here, and instead one might consider the fundamental pleasantness (or harmony) of the flavour pairing involved. However, it is difficult to separate the effects of the familiarity of the pairing from the fundamental goodness, or otherwise of the match. Perhaps unsurprisingly, given that they come from the same tree, the two spices share essentially the same volatiles, yet at the same time, mace also has a subtly different aroma profile (more, it is suggested, due to quantitative, rather than qualitative, differences in aromatic volatiles). However, it is important to recognize that the relative ease of (transporting and) grating nutmeg may also have played a role in its prominence in recipes.

These days, nutmeg and mace (and their essential oils) are used sparingly, at least compared to the frequency of use that one finds in May’s (1660), *The accomplisht cook or, The art & mystery of cookery* cookbook (see Table 2). That said, these spices still appears in a range of sweet and savoury dishes and drinks, as well as constituting one of the key ingredients in several popular spice mixes used around the world. It should, though, be remembered that nowadays the vast majority of nutmeg (c. 90%) is added directly to a range of processed foods rather than being purchased directly by the consumer. Nutmeg is one of the few spices that has been reported to poison people, though such cases seem to be related to the overconsumption of nutmeg by those trying to access the spice’s putatively hallucinogenic properties, rather than its culinary flavouring potential. Thus, while consuming too much nutmeg can lead to dizziness, nausea, and even, on rare occasion, death, the small amounts that are typically used in cooking are perfectly safe (though see Carstairs and Cantrell, 2011; Demetriades et al., 2005).

### Implications for gastronomy

Nutmeg and mace are unusual spices in that they both come from the same tree *Myristica fragrans* Houtt., originally from the Banda islands of the Indonesian archipelago. At points in history, these spices have, been amongst the most expensive spices in Europe. While these two aromatic spices were once used in a wide range of dishes, their use has now fallen far behind that of pepper and chilli. In fact, the majority of nutmeg (c. 90%) is now used to flavour processed foods, such as sausages, charcuterie, and terrines. Intriguingly, nutmeg is associated with both sweet and savoury dishes, and is found in a number of popular spice mixes around the world, including quatre épices, garam masala, pumpkin spice mix, and mixed spice. Nutmeg and mace have similar flavour profiles and thus their distinctive role in food and drink over the centuries may have been determined, as much by the relative ease of grating nutmeg seeds, as by any subtle differences the flavour profiles of these two formerly exotic spices.

### CRedit authorship contribution statement

**Charles Spence:** Writing – review & editing, Writing – original draft, Conceptualization.

### Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

### Data availability

No data was used for the research described in the article.

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