

# “Hexing Herbs” in Ethnobotanical Perspective: A Historical Review of the Uses of Anticholinergic Solanaceae Plants in Europe

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Though not the most frequently used botanical family, the Solanaceae or nightshade family has provided many plants of great importance around the world. Throughout Europe, the “hexing herbs,” plants from this family with anticholinergic alkaloids, have played an especially important role in the history and formation of traditions pertaining to plant use in many aspects of human life. Represented in Europe by the genera *Atropa*, *Datura*, *Hyoscyamus*, *Mandragora*, and *Scopolia*, the alkaloids hyoscyamine/atropine and scopolamine in these plants have allowed them to be used as medicines, poisons, and intoxicants, leading to the creation of a large mythos and extensive cultural valuation. Through a review of the literature, the exact roles that these “hexing herbs” have played in Europe in the past and present are discussed in this paper, ultimately showing the immense importance of these often misunderstood and vilified plants.

**Key Words:** Ethnobotany, Solanaceae, Hexing herbs, Europe, Anticholinergic, Tropane alkaloids.

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## Introduction

### OVERVIEW

Informally known as the “hexing herbs,” the anticholinergic members of the Solanaceae that are found in Europe likely earned this name through association with witches and magic. Referred to as “anticholinergic” due to their tropane alkaloids’ blocking of cholinergic action in the central and peripheral nervous system, a result of their effects on muscarine receptors, these plants are the only natural source of the valuable (and psychoactive) alkaloids scopolamine and hyoscyamine, as well as the racemic mixture of the latter’s L- and R-enantiomers that we call atropine (Adamse and Egmond 2010; Arroo et al. 2007; Maheshwari 2013). Though the Solanaceae may not be as important agriculturally as the Poaceae or Fabaceae, the ability of these alkaloids to influence our cardiovascular, respiratory, and nervous systems have

made them invaluable to humans throughout the ages (Arroo et al. 2007; Boyd et al. 1984). Used as inebriants, medicines, poisons, in rituals, and for many cultural inspirations, these plants have played a crucial role in the shaping of Europe.

Among these plants, five genera have been long represented in, or are native to, Europe. All are closely related and have nearly identical physiological effects.

*Atropa*—*A. belladonna*

Particularly known for its beautiful berries, this genus took its name from the Greek fate known to cut the life threads of mortals (Lee 2007). Represented by just one species in Europe, its natural range extends across the continent from west to east and down to the southern reaches; it has also been introduced to North America (Passos and Mironidou-Tzouveleki 2016). Though long considered less valuable than *Mandragora*, this plant is more common and has thus often been used as a substitute (Waniakowa 2007).

*Datura*—*D. stramonium*

*D. stramonium* L. is well known around the world, growing as a pesky annual weed in disturbed

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soils, and thus often appearing in crop fields (Furbee and Wermuth 1997; Soni et al. 2012). This genus contains the widest range of tropane alkaloids of the plants discussed here, with as many as 64 having been identified (Debnath and Chakraverty 2017). Though *D. stramonium* has been the species of this genus that has been in Europe the longest, other species such as *D. innoxia* Mill., have started to escape ornamental gardens and grow wild in the warmer parts of Europe, especially along the Mediterranean (Lakušić et al. 2017).

*D. stramonium* may be the more traditional European species, but debate persists about its origin. The most accepted theory at present, however, seems to involve a point of origin in the Americas with this plant then being brought back to Europe during the colonial era.

#### *Hyoscyamus*—*H. niger* and *H. albus*

Originally found in the Balkan Peninsula, *Hyoscyamus niger* L. spread through Europe as early as the Iron Age; now it is found around the world growing as a weed in disturbed soils and waste areas, while *H. albus* L. remains more tied to its region of origin (Begum et al. 2010; Hocking 1947; Kroll 1995; Orbak et al. 1998).

#### *Mandragora*—*M. officinarum* and *M. autumnalis*

Another Mediterranean genus, *Mandragora* has since been introduced to other parts of Europe, for example, reaching England in the mid-1500s (Passos and Mironidou-Tzouveleki 2016; Penicka 2008). Since antiquity, it was accepted that there were two different European species. These were traditionally referred to as a male species and a female species, thought to perhaps refer to *M. officinarum* L. and *M. autumnalis* Bertol., respectively (Daunay et al. 2008; Waniakowa 2007). Though still debated, today it is somewhat accepted that these are the two European species that share a range in southern Europe. However, *M. autumnalis* is thought by some to be hardier and to have a range that extends further north (Jackson 1979).

This genus was immensely popular throughout the ages, even being the most written of plant in the Solanaceae by Renaissance herbalists (Daunay et al. 2008). Its popularity was a result of the mystical aura that surrounded it in the minds of many throughout the years, likely caused by the anthropomorphic shape of its root inspiring the

imaginings of many and causing a large mythos and set of rituals to grow around it (Eleni et al. 2009; Tasić 2012).

#### *Scopolia*—*S. carniolica*

Limited in its natural range to southeast Europe, this genus normally grows in beech forests and is closely related to *Hyoscyamus* (Festi 1996). Though the rhizome of *S. carniolica* Jacq. is one of the main sources of scopolamine in the modern pharmaceutical industry, it seems to have been much less used than the other hexing herbs throughout history (Gadzikowska and Gryniewicz 2002).

## Recreational Use

Unsurprisingly, the powerful psychoactive alkaloids in the hexing herbs have led to their use as intoxicants. The wine of the famed Bacchanalian orgies of ancient Greece has been suggested to contain *Atropa belladonna* or *Mandragora autumnalis* to add to its intoxicating and arousing effect (Piccillo et al. 2006; Waniakowa 2007). Though this is theoretical at best, there is a good basis for it. Wine in antiquity has been claimed to be heavily diluted with water, and thus for it to cause the sorts of intoxications that are ascribed to it, it would need to include a strong inebriant besides the alcohol itself (Ruck 2015). *Hyoscyamus* seeds have been suggested as being mixed into the wine of antiquity independent of the Bacchanalian orgies, though this practice has been associated with the follies of youth, comparable to children sniffing glue in the modern era (Ruck 2015). This use of *Hyoscyamus* seeds in alcohol was likely far more widespread, with a large number having been uncovered from what appears to be a brewery in Germany dating as far back as 6000 B.C.E. (Stika 1996).

In the middle ages, *Hyoscyamus* seeds were said to be thrown on stoves in bathrooms thus creating a sort of intoxicating sauna where people were then euphemistically said to "collide" with one another (Müller 1998). *Hyoscyamus* was also used throughout Europe to strengthen beer, and likely represented the intoxicant of the common person unable to afford costly pleasures (Fühner 1925; Lee and Schilling 2006). This practice was so widespread (and occasionally deadly) that laws were passed against it in the early 1500s in what is now Germany (Cilenšek 1892; Fühner 1925). Additionally, its leaves came to be smoked in place of tobacco in

some regions, for example, the Satakunta region of Finland in the mid–eighteenth century C.E. (Gadd 2007). It was also used in parts of the Balkan Peninsula for strengthening wine, a use that it shared with *Atropa belladonna* there (Stevanović et al. 2014).

Later, *Datura* came to be used as an intoxicant in Europe. Powdered root and seeds were used in either wine or meat to cause a “pleasant madness” among European peoples of the fifteenth century C.E., while Russians also adopted the seeds for strengthening their beers (Lee and Schilling 2006; Porta 1658). Though it had a later start, *Datura* came to be the main intoxicating agent among the anticholinergic Solanaceae. As early as the 1800s, it came to be used as a recreational substance among young people, a role that it has held to the present both in Europe and around the world (Cilenšek 1892).

To describe *Datura* as being merely an intoxicant of the youth, however, would be inaccurate. Some parts of France’s Brittany region, for example, have a history of mixing *Datura stramonium* seeds into cider that was consumed by adult men until quite recently (Prado 2004). It is also often used as an adjunct to other recreational drugs in Croatia, or used in many parts of Europe by individuals who do not have the financial means to access their usual substances (Cohen et al. 2003; Podbevšek 2004). *Datura* is employed as an intoxicating agent so often that some individuals give up growing it in their gardens after having their bushes stolen or stripped of vegetation repeatedly (Pers. comm.). This plant was also smoked in some areas of Bosnia–Herzegovina when supplies of tobacco ran low during the Yugoslav wars in the 1990s (Redžić, 2006).

*Atropa belladonna* has long been used as an intoxicant among boys sent into the mountains to herd animals in Croatia, though this has not been recorded for a number of years (Lacković 2017). It has also been used until quite recently in areas of Romania and Moldova as an addition to wine (Sobrero 1975). Some have claimed that soldiers in the Ukrainian portion of the Carpathian mountains used to rub the juices of the berries on their face below their eyes to experience the mind-altering effects (Pers. comm.). Various cases of individuals poisoning themselves when trying to make use of the hallucinogenic properties of this plant likewise exist from around Europe (Hartmeier and Steurer 1996; Pestalozzi and Caduff 1986). Though less popular, *Mandragora* spp., *Hyoscyamus* spp., and *Scopolia carniolica* have also been used in such

manners within the past few decades in Europe (Colombo et al. 2010; Hatziisaak and Weber 1998; Piccillo et al. 2006; Vidović et al. 2005). In fact, in the 1980s a company in Germany was advertising teas in youth magazines containing plants such as *A. belladonna*, *H. niger*, *H. muticus* L., and *Mandragora* spp. to be used for hallucinogenic purposes (Pfänder et al. 1983). Likewise, *S. carniolica* was used as an intoxicant in Latvia and Lithuania at least into the middle of the last century (Fühner 1925).

Similarly, linguistics give us a window into the world of intoxication. In Finnish, for example, the name for *H. niger* translates to “mad cabbage” while *D. stramonium* is known as “spiky crazy grass” (Lempiäinen 1992; Suhonen 1936). This suggests that the intoxicating powers of these plants have been known for a long period of time and were seen as an important facet of the plants’ natures.

## Health and Beauty

### MEDICINE

Most famous, perhaps, was their use as part of the “soporific sponge,” a sponge that was soaked with a mixture of *Hyoscyamus*, *Mandragora*, *Solanum nigrum* L., *Papaver somniferum* L., and *Cicuta virosa* L. The soaked sponge was held over the face of a patient to put them to sleep before surgery (Carter 1996; Lee and Schilling 2006; Müller 1998; Porta 1658). With the increased use of opium preparations in the eleventh century C.E., however, this mixture began to see a decline in popularity due to its dangerous side effects (Carter 1996; Lee and Schilling 2006; Müller 1998). That being said, scopolamine and atropine from these plants are still used in western biomedical anesthetics, and are especially useful as they reduce salivation and bronchial secretions (Facchini 2001; Halpern 2004; Humphrey and O’Hagan 2001; Passos and Mironidou–Tzouveleki 2016).

The other main use of these plants has been in treating asthma and respiratory issues. As a result of the anticholinergic compounds blocking muscarine receptors in the smooth muscles of the respiratory system, tightness and swelling of the airway improves (Moulton and Fryer 2011). Within the last century, they have also been used for counteracting strong purgative drugs, in cases of mercury poisoning, and sometimes to treat morphine addiction (Hocking 1947). Today they are still grown and harvested for

the medicinal alkaloids they contain as it is more economical to extract the substances from plant material than to synthesize them in a lab (Arroo et al. 2007).

In some places, the medicinal values of these plants are so great that they are reflected in their common names. In Lithuania, for example, *Atropa belladonna*, *Datura stramonium*, and *Scopolia carniolica* all have names that are related to the verb for healing wounds (Šeškauskaitė and Gliwa 2006).

### *Atropa*

*A. belladonna* has found great use as a medicinal plant. The pattern here seems to emerge that modern usage of *A. belladonna* is centered on the Balkan Peninsula, likely due to socioeconomic challenges in

many of these countries that may restrict access to western medicines. For a complete review of medicinal uses, see Table 1.

### *Datura*

As it is largely believed to have originated outside of Europe, medicinal use of *Datura stramonium* for Europeans begins later than the other hexing herbs. Still, many medicinal uses have been recorded; these are summarized in Table 2.

### *Hyoscyamus*

As with *Atropa belladonna*, *Hyoscyamus* finds its modern medicinal use in Europe centered in the Balkans; medicinal uses are listed in Table 3.

TABLE 1. MEDICINAL APPLICATIONS OF *ATROPA BELLADONNA*

	Use	Location	References
Antiquity	Anesthetic; narcotic.	Classical Europe.	(Waniakowa 2007)
Middle ages – mid 1900s	Smoke for asthma; ointment for ulcers; headaches; menstrual symptoms; inflammation	Europe.	(Van Bingen 2001; Salter 1869; Ulbricht et al. 2004)
	Pain killer for cancer patients; to prepare the eye before cataract surgery; febrile diseases; plague; inflammation; gout; coma; spasms; cholera; epilepsy; hydrophobia; melancholy; mania; dropsies; jaundice; various sores	United Kingdom	(Cockayne 1865; Dyckman 1818; Marcet 1816)
Mid 1900s – present	Narcotic; skin disorders; aphrodisiac	Slovenia	(Kromar 1979; Lipič 1834)
	Pain in the hands, kidneys, and legs; fever	Romania	(Sobrero 1975)
	Weakness; cough; fever; toothache; abscesses	Moldova	(Sobrero 1975)
	Alcohol infusions of the root for rheumatism	Ukraine	(Sōukand and Pieroni, 2016)
	Alcohol infusions of the root for rheumatism; pain killer; gastro-intestinal issues; respiratory ailments; nervous system disorders	Southern Italy	(Guarino et al. 2008; Leporatti and Impieri 2007; Leporatti and Ivancheva 2003; De Natale and Pollio 2007)
	Sore joints and muscles	Greece	(Vrussel 2004)
	Fresh leaves packed on ulcers	Sardinia, Italy	(Sanna et al. 2006)
	Tincture of leaves, flowers, and roots as treatment for Parkinson's	Bulgaria	(Ivancheva and Stantcheva 2000; Leporatti and Ivancheva 2003)
	Leaves and roots as antineuralgics, relaxants, and for asthma; tea from the plant for gastric issues, cough, gout, neuralgia, and cancer; leaf extract for stomach disorders	Serbia	(Marković et al. 2010; Popović et al., 2012)
	Leaves smoked for asthma	Bosnia–Herzegovina	(Redžić 2007)

TABLE 2. MEDICINAL APPLICATIONS OF *DATURA STRAMONIUM*

Use	Location	References
1800s Smoked for asthma; ointment for inflammation, hemorrhoids, rheumatism, syphilitic pain; leaves applied fresh to tumors; extracts for epilepsy/spasms, mania, melancholy, mental illnesses	Europe	(Dyckman 1818; Marcet 1816)
Narcotic; treat skin diseases	Slovenia	(Lipič 1834)
2000s Reduce pain and swelling; treat asthma	Portugal	(Novais et al. 2004)
Treat nervous system disorders; smoked for asthma; antispasmodic; hand- or footbath for chilblains	Italy	(Guarino et al. 2008; Leporatti and Ivancheva 2003)
Tincture from the fruit for diarrhea	Belarus	(Söukand et al. 2017)
Fruits in compresses/decoctions for rheumatism	Romania	(Gorun et al. 2011; Pieroni et al. 2012)
Painkiller; antispasmodic; seeds used as abortifacient	Bulgaria	(Leporatti and Ivancheva 2003; Nedelcheva and Draganov 2014)
Leaves for asthma and neurosis	Bosnia–Herzegovina	(Redžić 2007)

### *Mandragora*

Many uses existed for this plant, usually based on its narcotic abilities; interestingly, we see more mention of this plant in ancient Greek documents than in Roman ones (Randolph 1905). Though use persisted into the Middle Ages, the height of medicinal use for this plant appears to have been in antiquity, with very little use surviving into the modern day. Uses are summarized in Table 4.

### *Scopolia*

Likely due to its more limited geographic range, *S. carniolica* has seen less usage as a medicinal plant than the other hexing herbs. Knowledge of its medicinal properties in the regions where it grows has lasted at least as recently as the past 30 years (Bernáth 1999). In the 1800s, it was well known in parts of Slovenia for treating skin issues, while it was being used in the Baltic nations as an anti-paralytic and abortifacient at least into the mid-1900s (Fühner 1925; Lipič 1834).

### *Industrial Products*

Making use of these plants, many medicinal products were created and sold throughout the past century. However, they were largely discontinued due to better alternatives arising, side effects, and the frequent abuse of some such products to get high, especially by young people (Jackson 2010). The majority of these products were cigarettes, incenses, and smoking mixtures intended to be

burned to help with asthma and were a mixture of *D. stramonium*, *A. belladonna*, and various filler items such as tobacco (Bethel 1978; Gowdy 1972). In the mid-1800s, *H. niger* was also reported to have been used in some products in England that were made for asthma, but it never obtained the same popularity (Salter 1860).

In addition to these products, “belladonna bandages” were available in some places and meant to be used for a variety of aches and pains including sciatica, rheumatism, sprains and strains, and even mere stiffness (Williams and du Vivier 1990). Patches using isolated scopolamine from these plants are still used as a treatment for motion sickness (Ulbricht et al. 2004).

### ANIMAL MEDICINE

Anticholinergic plants of the Solanaceae have been employed likewise for medicinal treatments in animals. *Atropa belladonna* was used for intestinal worms as well as external wounds in cattle until recently in Romania, while within the past few decades it has also been used as an antidote for some poisons and to widen the pupils of horses to allow them to see better at night (Sobrero 1975; Vučević-Bajt and Karlovic 2016). Pieces of root thrown into boiling water was also used as a sort of vapor treatment for horses with chronic pulmonary emphysema in this same region, a use that it shared with *Hyoscyamus niger* (Vučević-Bajt and Karlovic 2016). *H. niger* was known likewise in France to treat various maladies in horses, at least up until the beginning of the 1900s (Gubernatis 1882).

TABLE 3. MEDICINAL APPLICATIONS OF *HYOSCYAMUS SPP.*

	Use	Location	References
Antiquity	Seed paste as suppository or for earaches and to treat puffing of bowels or discharge from nerves; mixture with wine or vinegar applied topically for inflammation from stones, gout, swollen genitals or breasts; womb issues; cough; mucous; fluid discharge from eyes; excessive menstrual flow; fevers; toothaches; sleeping pills meant to treat pain; combined with cooked egg yolk as salve for eye; fumigant for gynecological issues; female infertility; semi-magical charm-like contraceptive	Classical Europe	(Celsus 1938; Dioscorides 2000; Hocking 1947; Moisan 1990)
Middle ages	Topical parasites; tooth ache; unguent applied to the testicles to decrease infidelity; healing wounds; anesthetic; final option in treating the plague	Europe	(Bifulco et al. 2016; Van Bingen 2001; Corner 1937; Fabbri 2007; Hatsis 2015; Kozłowska et al. 2018)
1500s – 1600s	Insomnia; constipation; watery eyes; external inflammation; tooth ache	Europe	(Jarić et al. 2014; Pardo-de-Santayana et al. 2014)
1700s – 1800s	Sciatica; cancer-related pain; rheumatism; milk retention; swelling; ulcers; spasms; cataracts; remove worms from eyes and teeth; ear ache; tumors; leprosy; female infertility; sore joints and muscles; mental illnesses; demonic possession; to ward of the devil and fantastic creatures	Europe	(Cockayne 1865; Dyckman 1818; Marcet 1816)
1900s	Analgesic for wounded soldiers during WWII	Europe	(Elpel 2018)
	Romani people used smoke to relieve pain	Romania	(Gorun et al. 2011)
2000s	Problems with nervous system; spasms; rheumatism; asthma; painkiller; seeds used to make rotting teeth fall out	Italy	(Guarino et al. 2008; Leporatti and Ivancheva 2003)
	Leaves and seeds used as tea for dry coughs, nervousness, wheezy breathing, asthma, hysteria, rheumatism, hypochondria; sedative	Serbia	(Jarić et al. 2014; Popović et al., 2012; Popović et al. 2014)
	Tea; externally applied for eye inflammation	Albania/Kosovo border	(Pieroni et al. 2011)
	Leaves smoked for asthma and neurosis	Bosnia–Herzegovina	(Redžić 2007)
	Spasms; asthma; painkiller	Bulgaria	(Leporatti and Ivancheva 2003; Nedelcheva and Draganov 2014)
	Leaves crushed/heated and applied topically to joints	Greece	(Vrussel 2004)

## COSMETICS

Along with their medicinal uses, these plants have been used for cosmetic purposes, such as the famous

example of *Atropa belladonna* getting its species name from Venetian women using it to enlarge their pupils (Carlini and Maia 2017; Passos and Mironidou–Tzouveleki 2016). Some claim that this

TABLE 4. MEDICINAL APPLICATIONS OF *MANDRAGORA* SPP.

	Use	Location	References
Antiquity	Depression and anxiety; anesthetic; compress for healing wounds; gout; gynecological conditions; spasms; fever; poultice for prolapsed rectums; dried root bark in wine as sleeping medication, surgical anesthetic, eye medicine, softener for suppositories, abortifacient; polenta-like mixture to apply leaves stored in brine to eyes, sore joints, ulcers, tumors; vinegar mixture with root bark for skin infections, snake bites, tooth ache, sleeping pills; eye salve that involved a number of other plants in combination with <i>Mandragora</i>	Classical	Europe
(Celsus 1938; Dioscorides 2000; Pliny the Elder 1855; Ramoutsaki et al. 2002; Waniakowa 2007)			
Middle ages	Mental illness; pain killer; lewdness; surgical anesthetic; decrease infidelity in men; final option in treating the plague	Europe	(Van Bingen 2001; Corner 1937; Fabbri 2007; Hatsis 2015)
2000s	Leaf or root decoctions for sore joints and muscles	Greece	(Vrussel 2004)

same plant was used as rouge for their cheeks as well (Hansen 1978). *Hyoscyamus niger* was known to be used in Italy as a hair dye around the eleventh century C.E. (Cavallo et al. 2008). This plant also had its seeds pressed into oil that was rubbed onto the body to cause hair to grow more slowly, while the smoke from the burning seeds was said to help with cracked lips (Porta 1658). *Mandragora* was suggested as a topical application to reduce the appearance of scars by Dioscorides (Dioscorides 2000).

## Hunting and Repelling Animals

### HUNTING

*Hyoscyamus* was thought to be useful in hunting hares. In England, the leaves were coated in a hare's blood and sewed into its pelt. In France, a juice made from this plant was poured onto the pelt instead, with the resulting charm being thought to attract hares (Gubernatis 1882; Morrissey 2014). Europeans also used *Hyoscyamus* for catching birds by mixing the seeds with barley and ox bile, thus rendering the birds "stupid" after they ate it, at which point they could be caught by hand (Porta 1658). The knowledge of this plant as a bird poison

was widespread in Europe as long ago as the 1400s (Gunda 1967).

### FISHING

*Atropa belladonna* was said to be used as a fish poison in Slovakia where its berries were kneaded with bread and butter and thrown into the water (Gunda 1967). A similar practice was recorded in the Transylvanian region of Romania (Gunda 1967). This practice, however, had largely disappeared by the 1960s (Gunda 1967).

*Datura stramonium* was not used in this manner until the 15th–sixteenth century, though it then became quite popular, often suppressing other fish poisons (Gunda 1967). It saw use through much of Hungary and Slovakia and south as far as Bosnia, and has been recorded in many other parts of Europe (Gunda 1967).

Likewise, *Hyoscyamus niger* has seen popularity as a fish poison; various authors have recorded its use for this purpose in Norway, Hungary, Slovakia, Romania, and Spain, with some use extending into the 1900s (Gunda 1967; Heizer 1953). *H. niger* has been known as a fish poison in Europe since the thirteenth century, especially in Germany (Gunda 1967).

## REPELLING

*Hyoscyamus* leaves were once placed on floors to repel mice, a practice that has continued until relatively recently in some areas such as Slovenia (Cilenšek 1892; Hocking 1947). Similarly, *Datura stramonium* leaves have been hung inside hen houses in parts of Italy to deter parasites, a use that has been documented even within the past few decades (Leporatti and Guarrera 2007). *Atropa belladonna* berries have been used to create a juice into which chunks of meat would be dipped before being put out into the woods to poison wolves; this practice was so widespread that the common name for *A. belladonna* in many languages translates roughly to "wolf cherry," displaying the importance of this plant for this particular usage (Waniakowa 2007). Similarly, *Hyoscyamus* was used in England to poison rabid dogs throughout the Middle English period (Morrissey 2014).

## Poisoning and Warfare

## ASSASSINATION AND PENAL SYSTEMS

*Hyoscyamus niger* has been known since antiquity to be a deadly poison as well as to be able to cause lasting insanity (Schultes 1969). Besides the vast number of assassinations and murders carried out by criminals, this plant was also used for capital punishment and euthanasia (Gubernatis 1882; Hocking 1947; Mayor 2015; Waniakowa 2007).

Antiquity was also a period of use for *Atropa belladonna*, the poison of choice for military tactics (Penicka 2008). The Scottish used this plant around 1000 C.E. to poison bread and wine before sending it to the invading Danish army, leading to a victory that later came to be immortalized in Shakespeare's *Macbeth* (Aikman 1827). This method of employing *A. belladonna* is unsurprising as it was also often used as a means of murder, much like *H. niger* (Waniakowa 2007). In fact, both of these plants were frequently used for this purpose in the Roman Empire (Horstmanshoff 1999). These plants were also indicated as the cause of many murders in the higher ranks of French society during the 1670s. Additionally, these plants would then lead to many individuals being tried and executed as witches and poison makers (Müller 1998).

## SUICIDE

*Atropa belladonna* often has been used with suicidal intent, and is still employed for this purpose (Fuchs et al. 2011; Heindl et al. 2000; Vončica et al. 2014; Waniakowa 2007). A high profile case emerged just a few decades ago when Robert Cochrane, one of the individuals at the forefront of the revival of modern witchcraft in the United Kingdom, committed what may have been a ritual suicide by taking *A. belladonna* and sleeping pills (Guiley 1989). *Datura stramonium* has likewise been implicated for this unfortunate purpose in Europe (Cilenšek 1892; Montcriol et al. 2007).

## WARFARE

Dating back to antiquity, both *Hyoscyamus niger* and *Atropa belladonna* were used as drugs to poison arrow tips and render the projectiles more deadly (Mayor 2015). *A. belladonna* likewise found use as a spear poison, with Pliny having written that one name for this plant in old Latin was "dorycnion," or "spear drug," suggesting a long history of use for this purpose even earlier in the period (Cilliers and Retief 2000; Mayor 2015). In later times, *H. niger* continued its use as an arrow poison, but this time among the Gauls and their descendants in Great Britain (Leslie 1866).

The use of *Hyoscyamus niger* also extended to medieval metal cooling techniques where the plant matter was mixed with the water into which the hot metal was quenched, thus making it useful in the manufacture of weapons as well as other metal tools and implements (Eamon 1980). Perhaps the strangest war-related use for this plant saw it used as an intoxicant in Scandinavia during the saga period to induce the famous berserker rage state among the elite warriors of the Vikings (Fatur 2019).

## AMUSEMENT

Poisoning individuals was used as a form of amusement at the 15th-century banquets of European nobility. *Atropa belladonna* and *Hyoscyamus spp.* were sneaked into beverages and then the intoxicated person's odd behavior would be mocked by the others of the assembly (Fühner 1925; Müller 1998; Porta 1658). The individuals poisoned thusly were often then convinced that they were animals



and behaved accordingly, to the delight of those gathered (Fühner 1925; Müller 1998).

#### OTHER

*Atropa belladonna*, *Datura stramonium*, and *Hyoscyamus niger* were all frequently used by robbers seeking to intoxicate an individual to the point where they would willingly give up their valuables, or at least be unable to resist (Sannita 1986).

Likewise, *Mandragora* is an example given by Plato of a plant that may be used to drug a ship's captain should some of the crew wish to commit a mutiny (Shorney 1969). This plant's reputation was very widespread, and a law was enacted in the Roman Empire in 81 C.E. that prosecuted unguent dealers who sold products containing *Mandragora* or certain other dangerous plants (Ogden 2002).

*Datura stramonium* has been recorded as being used as a rape drug in a fairly recent case involving a German gardener (Müller 1998).

As for *Hyoscyamus niger*, it was a valuable plant to frauds in the Middle Ages who used it to trick people needing dental work. The seeds were set into teeth and caused to burst with heat, the result of which looked much like a worm; the charlatans would then use the smoke of the plant to "help" their patients, and be long gone with the poor victim's money by the time they awoke and realized they had been scammed (Cilenšek 1892; Lee and Schilling 2006). Such trickery was also done with horses by incorporating *Hyoscyamus* into their feed. Cheats would poison the animals and then offer to cure them if the owner paid sufficiently (Porta 1658).

### Ritual Intoxication

#### DELPHI

Many authors claim that *Hyoscyamus* spp. were burned and the inhaled smoke caused the prophetesses at the Oracle of Delphi to enter a trance in which they delivered their prophecies, though actual sources from the time of the oracle are incredibly scarce and only begin to emerge once it was already in decline (Marchais–Roubelat and Roubelat 2011; Will 1942). Both *H. albus* and *H. niger* have been suggested for this purpose since they have both been claimed to have been known as Apollinaris or

Pythonian, both of which associate them with the Greek god of prophecy, Apollo, and the story in which he kills the monster, Python, to take the Oracle at Delphi from it (Day 2013; Luke and Krippner 2011; Paulsen 2010; Rättsch 1987; Schultes et al. 2001). It also has been claimed that intoxication with *H. albus* matches the ecstatic state that the prophetesses are thought to have entered when prophesizing (Rättsch 1987). This association is further strengthened in the minds of some as the Celtic god, Belenus, was often seen as representing Apollo and his name represented a vernacular for *H. niger*; this fits into the puzzle as he was also said by some to have priests who would use *H. niger* smoke in order to produce prophecies, though this has even less backing than the usage at Delphi (Prósper 2017).

Another Greek oracle, Dodonna, also has been theorized to have involved hallucinogenic vapors, but much less has been written of this (Littleton 1986).

#### WITCH OINTMENTS/WEREWOLVES

Even more controversial, the flying ointments associated with the witch hunts in Europe have long been claimed to include Solanaceae plants with anticholinergic alkaloids. The belief that these plants were being used by witches to create ointments to help them fly to demonic Sabbaths or transform into animals existed as long ago as the 1400s (Piomelli and Pollio 1994). Such beliefs were widespread in Europe, and especially prevalent among South Slavic peoples, with legends often focusing on ointments hidden under the hearth that allowed women to fly and change their shape (Marjanić 2006; Vukanovic 1989). That being said, such beliefs were not unanimous, with many people at various points in time believing that such ointments were fraudulent means of tricking others (Cilenšek 1892; Ostling 2016).

Many people who did admit to having made flying ointments confessed under torture, which makes their admissions seem like desperate attempts to end their pain (Bever 2008). These admissions (and the questions leading to them) were also clouded by a Christian worldview obsessed with witches and devil worship, meaning even those using such ointments may have confessed to using them in ways they had not or included more

repugnant ingredients in order to make their interrogators believe them; many ointments have been shown to have been created with false ingredients simply to appease the prosecutors (Henningsen 2009).

Proof is difficult to find in this matter. Identification of plants from old texts is often difficult and information before the 1400s on the topic was largely unrecorded as those using such ointments would have been poor and illiterate (Hatsis 2015; Piomelli and Pollio 1994). The church also labeled hallucinogens heretical and for quite a period sought to suppress knowledge of their use (Harner 1973). Additionally, even with the use of torture, very few transcripts from witch trials mention botanical flying ointments, instead usually mentioning that the ointment was an evil unguent provided by the devil (Penicka 2008). That being said, the possibility of these ointments having been used is not only high, but undeniable. Salves involving these plants have been used at least since the time of Dioscorides, and there is a history of anal and vaginal application of medicines as far back as ancient Greece, which could have evolved into using psychoactive ointments in this way (Hillman 2015; Lee and Schilling 2006). There has even been an archeological find from the 1st-century (C.E.) Denmark of a woman dressed as a priestess who was found both with *Hyoscyamus niger* seeds in a pouch around her neck as well as a tube of an oily ointment that may have been used together (Pentz et al. 2009). Some have even said that the first record of a flying ointment is to be found in Homer's *Iliad* when Hera smears herself with ambrosia, thus allowing her to fly from Mount Olympus (Rätsch 2005).

It has been suggested that the use of these ointments was already happening, likely either for medicinal purposes or by poor people who were seeking intoxication from affordable sources (Fühner 1925; Kromar 1979). In creating "love potions" that worked with the libido-enhancing powers of the hexing herbs, folk healers were already blurring the lines between medicine and magic. As time went by, this line was blurred more and more by the church as they swept herb-craft into a pile with their obsession with the devil and witchcraft (Hatsis 2015; Worobec 2006). As a result of this frenzy, many using these plants medicinally or even in attempts to poison others were classified as witches (Hatsis 2015). As Solanaceae plants with anticholinergic effects were among some of the most poisonous plants in Europe, they offered a prime

target for associations with witches (Penicka 2008). Their tendency to make the intoxicated act like an animal or think they had transformed into one also fell into this paradigm as witches were long thought to either be able to turn into animals or to be able to send their spirits forth in the forms of other creatures (Carruthers 2015; Copeland 1931; Čvorović 2013; Harf-lancner 1985; Harner 1973; Marjančić 2006; Nynavid 1615; Piomelli and Pollio 1994; Vukanović 1989). This was also likely what led to these exact same ointments being the cause of the werewolf phenomenon, where people would rage like wolves in the night while wearing animal pelts around their loins, though this was also blamed on a range of physical and mental illnesses, such as an overabundance of melancholy (Drake 1992; Harner 1973; Nynavid 1615).

Today, research has suggested that modern pagan movements avoid the use of these ointments, at least in the United States and the United Kingdom (Clifton 2001). That being said, some use does exist. At the time of writing, even a quick Google search will direct to sites where one can purchase items sold as flying ointments that claim to contain extracts from the hexing herbs; these are often associated with individuals practicing a form of modern herbalism that they refer to as the "poison path" (Pers. obs.).

## In Culture

### ART

In Europe, flowers that appear to represent *Atropa belladonna* remain carved into the stone pillars of an abbey in Ireland from around 1205 C.E. (Nelson and Stalley 2006). From this same century, a Salerno painting depicts the use of *Hyoscyamus* smoke for treating a disorder of the teeth (Müller 1998). There are also many tavern paintings from the 12th to the 16th centuries that depict people smoking pipes, which would have represented a time before tobacco was spread through Europe; some have suggested that these pipes could contain psychoactive plants, thus implicating the hexing herbs (Sayin 2014).

Perhaps their grandest appearance was in the form of medieval herbals. Images of *Atropa* begin to appear around 1500 C.E., though more botanically accurate versions seem to emerge about 30 years later (Daunay et al. 2008). This represents a considerable lag after *Hyoscyamus* and *Mandragora*

species began to appear in European herbals, with *Hyoscyamus* being depicted as far back as the eighth century C.E. in a Dioscoridean manuscript (Daunay et al. 2008). *Scopolia* and *Datura* were the last of the group to appear, not finding their way into the herbal tomes of Europe until the 1600s (Daunay et al. 2008).

An interesting form of art featuring these plants that merits mention is the postage stamp. *Atropa belladonna* has been used on stamps in Yugoslavia, Poland, England, and Albania, while a special stamp in Yugoslavia from the 1960s even depicted *A. belladonna* var. *lutea* as part of a series of stamps portraying medicinal plants of the country (Davies and Hollman 2002; Jouzier 2005; Schultes et al. 2001). *Hyoscyamus niger* was used on stamps in both Germany and Yugoslavia, while *Scopolia carniolica* also found its way to a Yugoslavian stamp (Jouzier 2005; Schultes et al. 2001). *Datura stramonium* was used on an Albanian stamp while *D. innoxia* was used in England's postal art (Jouzier 2005). Many others surely exist; however, these are examples that have been presented in academic literature.

#### LITERATURE

These plants have also been incorporated into many literary works of fiction, often in reference to their sinister and deadly attributes. Clearly, the hexing herbs were widely known by the time of Shakespeare, as they seem to have been incorporated into many of his works: the sleeping draught taken by Juliette has been suggested to be an anticholinergic plant of the Solanaceae, *Hyoscyamus* was likely the poisonous "hebenon" used as eardrops to murder Hamlet's father, and many passing references to the plants were also employed in his other works (Daunay et al. 2008; Harper–Leatherman and Miecznikowski 2012; Müller 1998; Penicka 2008; Tabor 1970; Ulbricht et al. 2004).

Much further back than Shakespeare, Apuleius wrote *Mandragora* into his famous *The Golden Ass*, where it is a drug given to a man who was expected to commit murder with it; as a result of the alkaloids, the victim was put into a deep sleep but survived and the man was indeed proven to be a murderer (Apuleius 1998).

Some have also hypothesized that these alkaloids have been written into the *Odyssey* and the *Iliad*, as well as potentially being the love potion in Wagner's famous opera, *Tristan und Isolde*, which is quite a viable idea as they were largely thought to have been

used in "love potions" in Europe for centuries (Hatsis 2015; Ulbricht et al. 2004; Weitz 2003).

#### MYTHOLOGY AND SUPERSTITION

The hexing herbs have also been extensively incorporated into mythology, folklore, and superstitions throughout Europe. Going back to ancient Greece, *Mandragora* and *Atropa* have both been extensively theorized to be the plants used in the *Odyssey* by the sorceress Circe to turn Odysseus's crew into pigs, though *Hyoscyamus* has also been suggested to a lesser extent (Aulakh and Mukerjee 1984; Dierbach 1833; Lee 2007; Müller 1998; Patočka and Jelínková 2018; Penicka 2008). Of these, *Mandragora* seems the most likely as one of its names in the first century C.E. was "Circaea," thus suggesting a link to the mythical witch (Daunay et al. 2008).

*Mandragora* has also been theorized to be the plant used by another sorceress, Medea, to create an unguent to make Jason invulnerable to fire in his quest to find the Golden Fleece, which itself was said to be kept in a garden where *Mandragora* grew (Harris 1916; Ogden 2002).

*Hyoscyamus*, meanwhile, holds its own place in Greek mythology. This plant was said to be dedicated to Typhon, a vicious monster defeated by the gods (Fabre 2003). Some myths even point toward this plant's flowers being worn as garlands around the necks of the ghosts of the dead that wandered the river Styx at the edge of the underworld (Lee and Schilling 2006). *Hyoscyamus albus* was more specifically considered a plant of Hercules, with Pliny having claimed that it was discovered by this particular demigod who has also been portrayed wearing a crown made from its blooms (Dierbach 1833; Gubernatis 1882).

Moving past the Greeks, *Mandragora* also holds an important place in the Christian bible, with its fruits being used by a woman who had previously been unable to conceive in order to become pregnant (Daunay et al. 2008; Penicka 2008). Such associations of *Mandragora* and fertility were widespread in Europe, with some saying that it was the plant of Aphrodite, Greek goddess of love, and that knowledge of its ability to impact libido was known as far back as ancient Egypt, thus earning it the name of "love apple" in many languages (Penicka 2008; Waniakowa 2007).

Perhaps the greatest mythology connected to these plants throughout the years was that which became popular in the Middle Ages surrounding

*Mandragora*. Though these beliefs have their roots as far back as Pliny and Dioscorides, they became truly widespread in Europe later (Randolph 1905). Beliefs in the special measures that must be taken to collect a *Mandragora* plant without being killed by its "scream" were prominent enough to have endured and to find traction in modern popular culture such as the well-known *Harry Potter* books and films. Some authors claimed that circles must be drawn around the plant with a sword before pulling it, while others suggest tying a hungry dog to the plant and allowing it to chase meat and then die in the place of the human wishing to collect the root (Randolph 1905). These plants came to be associated with death in other ways as well, being said to grow at gallows where hanged men's urine and semen fell or to grow at crossroads where suicide victims were buried (Penicka 2008; Randolph 1905; Waniakowa 2007). Though varied through the many regions of Europe, these stories have all been theorized to once more reach back to the mythology of ancient Greece, being associated with the titan Prometheus, with the plant having grown up where his ichor fell to the ground as a bird repeatedly ripped his liver out as punishment for his giving the gift of fire to humanity (Randolph 1905). So popular were these plants that German magicians known as *alraun* were said to use the roots as idols in the sixteenth century, bathing and clothing them in hopes that they would protect the household in which they resided; Alexander the Great has been said to owe his success to owning such an idol, and some Serbian and Croatian households continue this tradition to this day in the hopes of bringing luck and prosperity into their homes (Bingen 2001; Penicka 2008; Waniakowa 2007).

Independent of these myths surrounding *Mandragora*, European myths through the Middle Ages and beyond associated *Atropa belladonna* with the devil, with it once having been thought to be among his favorite plants that he would gently tend to (Patočka and Jelínková 2018). In Romania and Moldova, it has a history of being viewed differently, with people believing it to have the ability to grant extended life, a view that has resulted in a strong ritual system surrounding its harvest and use (Géza 1990; Sobrero 1975). Such use may extend back thousands of years, with suggested ritual use from the archeological record of the region dating past 4000 B.C.E. (Toderas et al. 2009). Some authors have suggested that *A. belladonna* derives its name from the Roman goddess of war, Bellona, and that her priests would ritually consume wine

infused with this plant. However, this has not been proven to be more than conjecture (Hatsis 2015). In some regions of France, it was believed that a silver cup would break if *Hyoscyamus* was placed in it, while in Germany it was a plant thought to bring rain (Gubernatis 1882).

#### SYMBOLS

The flowers of *Datura*, *Mandragora*, and *Hyoscyamus* were incorporated into the popular Victorian language of flowers (Campbell 2007).

#### GARDENING

With its showy blossoms, *Datura stramonium* has held a position as a valued novelty in the gardens of wealthy Europeans for centuries. As far back as the 1500s, this plant was said to be cultivated in both Germany and Italy (Egmond 2016; Gunda 1967). Though in more recent times, the other plants of this group (especially *A. belladonna*) have found some popularity in "poison gardens" among plant lovers, it seems *Datura's* close relative with a similar alkaloid profile, *Brugmansia*, is perhaps the most often grown for its large and showy flowers that come in a range of colors (Pers. obs.). *D. stramonium* still holds enough popularity though that in some municipalities in France it is illegal to grow due to its frequent abuse by young people (Boucher and Lagarce 2010).

#### OTHER

According to Dioscorides, *Mandragora* root was said to soften ivory when the two were boiled together and thus may have been employed by artisans to make sculpting easier (Dioscorides 2000).

### Conclusion

We can see that the Solanaceae has provided humans with plants that have played important roles in a variety of facets of our lives. The so-called "hexing herbs" and their anticholinergic alkaloids—scopolamine and hyoscyamine/atropine—have played just such roles in diverse fields ranging from healing to harming, art to intoxication, and many more. These plants from the genera *Atropa*, *Datura*, *Hyoscyamus*, *Mandragora*, and *Scopolia* are a fundamental part of the history

of Europe, and their value to the economic and ethnobotany of the continent throughout the millennia cannot be overstated.

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