

Rose (*Rosa damascena*) spread out prior to distillation. Photo ©2012 Gülbirlik Cooperative

TURKISH ROSE

**A Review of the History, Ethnobotany, and
Modern Uses of Rose Petals, Rose Oil,
Rose Water, and Other Rose Products**

By K. Hüsnü Can Başer^{1,3}, PhD; Ayten Altıntaş², PhD; Mine Kürkçüoğlu³, PhD

¹ BadeBio Biotechnology Ltd, Anadolu University Technopark, No. 104, 26470 Eskişehir, Turkey

² Istanbul University, Cerrahpaşa Faculty of Medicine, Department of the History of Medicine and Ethics, 34303 Cerrahpaşa – Fatih, Istanbul

³ Anadolu University, Faculty of Pharmacy, Department of Pharmacognosy, 26470 Eskişehir, Turkey

Introduction and History

Rose is a common name given to the thorny shrubs and climbing vines of the genus *Rosa* in the Rosaceae family. More than 100 *Rosa* species have been recorded throughout the world. Because rose is a popular garden plant, it is virtually impossible to determine the number of currently existing cultivars. The *Flora of Turkey and the East Aegean Islands* identifies 24 *Rosa* species growing in this region of the world.¹

Fossil records indicate that *Rosa* species have existed on the planet for at least 40 million years.² The earliest historical records on Mesopotamian cuneiform tablets indicate that rose became known to humans about 5,000 years ago. A clay tablet about Sargon I, King of Akkadia (2684-2630 BCE), records that the king brought rose saplings during his military campaign to the countries across the Tigris River. Because he formerly lived in the ancient city of Ur near Babylon, his trip was most probably to Southeastern Anatolia (present-day Turkey).³

Assyrian tablets tell of rose and rose water. Of course, it is not possible to identify the rose species discussed in these ancient texts, but its scent is praised, suggesting fragrant rose species such as *R. gallica*, *R. centifolia*, *R. moschata*, or *R. damascena* of Anatolia. Cuneiform texts also indicate that the roses were not directly distilled but boiled with water to produce fragrant water. The very small quantities prescribed — as little as one carat (3 grains) [0.2 g] — illustrate how precious it was.⁴

Roman naturalist Pliny the Elder (23-79 CE) described rose as astringent, and wrote that the petals, flowers, and heads were useful in medicine; health conditions for which rose was prescribed represented many parts of the body, including the head, ears, mouth, gums, tonsils, stomach, rectum, and uterus.⁵ The flowers taken in oxycrate (a mixture of water and vinegar) were said to arrest fluxes in females and blood-spitting. The seed was used as a liniment for toothache and as a diuretic, and its fragrance could be inhaled to clear the brain.

Dioscorides (40-90 CE) wrote of rose's cooling and astringent qualities, and that the liquor of roses cooked in wine was useful for treating headaches and ailments of the eyes, ears, gums, anus, and womb. Powdered, dried rose flowers were sprinkled on food for pain of the gums.⁶

According to an anonymous Syriac medical treatise of the 4th century CE, roses were used externally for eyes, mouth, foul breath, liver (as plaster), sores, and internally to treat the chest and stomach.⁷

In traditional Ayurvedic medicine in India, rosebuds are regarded as astringent and as having cardiac and

cephalic tonic properties. The petals are used to relieve uterine hemorrhage and are applied locally for oral ulcers.⁸ The oil or attar is used to disguise the unpleasant odor of certain ointments.⁹ This, in general, correlates with the cuneiform medical texts. It appears from cuneiform tablets that Assyrian doctors were precise in their use of rose water. *Penny Cyclopaedia* (ca. 1839)¹⁰ includes details for various medicinal uses of rose, such as the petals of *R. gallica* and *R. damascena*. The buds were to be collected before they expanded. The calyx and lower parts of the petals were dried, with about 2,000 flowers yielding 10 pounds of dry petals. The chief employment of the conserve of *R. gallica* was as a vehicle for other medicines. For the preparation of rose water, *R. centifolia* petals were plucked from fully grown flowers and then dried in the open air rather than in an oven (desiccation impairs the fragrance of *R. centifolia* while heightening that of *R. gallica*). A syrup could be made from the rose petals, but their chief use was distillation. One hundred pounds of rose flowers yielded less than 3 drachs of rose oil. According to Flückiger and Hanbury,¹¹ the ancients did not know how to distill rose oil; the rose oil of the Greek physician Dioscorides was a fatty oil in which roses had been steeped.

A confection of roses was made from fresh red rose petals, which were beaten and combined with refined sugar and then rubbed together (as a vehicle in the preparation of pills). The Hittites of Anatolia (1750-1180 BCE) knew rose as *pillu* and prepared medicines with it. However, it is not clear which species of rose they used.¹²

A picture of a rose discovered in a fresco in the Knossos Palace of Crete dating back to 1600 BCE is evidence of the use of rose by the Minoan civilization.¹³ A hieroglyph depicting a rose was found in the tomb of the Egyptian Pharaoh Thutmose IV (1600 BCE), and is the earliest record of the



Rose *Rosa damascena*. Photo ©2012 Gülbirlik Cooperative

rose in ancient Egyptian civilization. Egyptian queen Cleopatra (69-30 CE) was said to lay rose petals on Marcus Antonius's path to impress him. A wreath of roses was discovered later in an Egyptian burial chamber dating back to 400-200 CE.¹¹

The Chinese philosopher Confucius (551-479 BCE) wrote about the rose and its significance within the Chinese Empire. According to Confucius, roses were highly esteemed by the Emperor during the Zhou dynasty. They were said to be planted in the Royal Gardens in China, and the Royal Library is supposed to have contained over 600 books on rose and rose cultivation.¹³

The Significance of Rose in Religious, Spiritual, and Cultural Traditions

In Greek mythology, rose is the flower of the goddesses. Cloris, the goddess of flowers, wore a crown of roses. Rose was the symbol of Aphrodite, the goddess of love and beauty. When Aphrodite presented a rose to Eros, the god of love, rose became the symbol of love and desire. It is also the symbol of silence and secrecy, as Eros gave a rose to Harpocrates, the god of silence. In today's parlance, *sub rosa* ("under the rose") refers to something confidential, and is derived from medieval diplomatic meetings where a rose was hung as a sign of secrecy and confidentiality.¹⁴ In Homer's *The Iliad* (ca 900 BCE), Achilles' shield was decorated with roses and Aphrodite anointed Hector's dead body with rose oil.¹³ The Greek poet Sappho (600 BCE) was the first to call rose "the Queen of Flowers" in her verses.¹³

According to Greek historian Herodotus (490-420 BCE), the Phrygian king Midas, who reigned in Central Anatolia near Eskisehir in 700 BCE, grew fragrant roses in his gardens. After his defeat by the Persian army, he brought his roses to Macedonia. Those roses were believed to be *R. damascena* var. *semperflorens* (ever-flowering damask rose), which is still grown in some parts of Anatolia and referred to as "King's rose."¹³ Theophrastus (300 BCE), the Greek naturalist, wrote the botanical description of varieties of roses containing anywhere from 5 petals to 100 petals.¹³

Romans appreciated the rose and used it in their meetings, feasts, and parties because of its exquisite fragrance. Rose cultivation was initiated in Italy for local consumption and export. Early Christians repudiated rose as a pagan symbol; however, rose later became a symbol of Jesus as well as other martyrs who died under torture. The Virgin Mary was dubbed "the thornless rose," and, to some extent, pagan legends about Aphrodite began to be attributed to Mary.³

Rose appears in the ancient Zoroastrian religious book *Avesta* (written in Iran during the 9th century CE) as one of the symbols of immortal angels. Its religious significance expanded into countries where Zoroastrian culture spread, such as India, Syria, and Egypt. It was believed that the beautiful fragrance extracted from the flowers had mystical powers and played an important role in the worship of the god of light, Ahura Mazda.¹³

Rose is one of the most important symbols used by Oriental-Muslim poets, as well as within the mystical

Muslim tradition known as Sufism. The exquisite beauty and purity of rose flowers placed on a thorny branch rooted in the earth symbolizes the mystic path to Allah. Rose is also a symbol of the prophet Muhammad, whose perspiration purportedly smelled of rose, and rose oil and rose water are highly respected and often used in religious ceremonies and rituals throughout Turkey and the Middle East. Each year during the Muslim pilgrimage to Mecca known as Hajj, the black cloth of the Ka'ba's (the holiest shrine in Islam, located at the mosque in Mecca) is sprinkled with rose water from Iran or Turkey, and rose oil is burnt in Ka'ba's oil lamps.

Furthermore, rose is considered the flower of heaven in this tradition. When Abraham was thrown into the fire by the King Nimrod in Urfa (old Edessa) in Eastern Turkey, the fire is said to have turned into a pond surrounded by roses. Saint Ali, Muhammad's son-in-law, requested a bouquet of roses from Selman-i Farisi and died only after smelling the fragrant roses. Therefore, the rose is also a significant symbol of the Bektashi order of Sufism. Rose is a recurring motif in Rumi's (Mewlana) *Masnawi*: "Rose is sent to earth by the gardeners of paradise for empowering the mind and the eye of the spirit."¹³

Sultan Mehmet II, the conqueror of Istanbul in 1453, once depicted in miniature smelling roses, is said to have converted the Aya Sophia (Saint Sophia) church in Istanbul into a mosque after thoroughly washing it with rose water.¹³

History of Rose Oil and Water

Rose oil and rose water are obtained by hydro-distillation of fresh rose material. According to literature records, distillation is a recent invention. Most attribute it to Arabs' Alembic (9th century CE) and some attribute it to the alchemists of Alexandria (from 50 BCE onwards). According to one record, however, distillation by earthenware ceramic pots was first employed by the Indus Valley civilization (5000 BCE). The remnants of a distillation pot were excavated in Harappa.¹⁵ These ancient distillation assemblies resemble the attar production stills used to this day in Kannauj, India, which distill fragrant materials in water and then trap the distillate in sandalwood (*Santalum album*, Santalaceae) oil. If rose flowers are used in distillation, the product is called "rose attar" or "rose otto."

According to Mesopotamian clay tablets and unearthed extraction jugs dating back to 3500 BCE, Sumerians and Assyrians (1200 BCE) mastered the art of extracting fragrances. Fragrant materials were submerged in boiling water for a day and then drained. After adding oil, the mixture was slowly heated. The perfumes prepared with this method by the Assyrians were renowned.¹³ As rose also was cultivated in the Hanging Gardens of Babel, according to Herodotus, one can assume that rose oil also was also produced this same way.

In India, rose oil was once named *Itr-i Cihangiri* (Jahangir's fragrance) after the Mogul Emperor Jahangir who ruled from 1605 to 1627. According to the legend, when his wife Nurjahan was bathing in a warm water pond filled with roses, she discovered highly fragrant oil droplets on the surface of water. This legend appears in nearly all texts



Rose *Rosa gallica*
Photo ©2012 Steven Foster

related to rose oil. A competing version claims that ponds of the Shalimar Gardens in Lahore, Pakistan, were filled with roses during wedding feasts. On hot summer days, oil droplets would cover the water's surface, emitting rose fragrance into the air.¹³

Rose in Islamic Medical Texts

The 3 rose-derived drug products most predominantly discussed in ancient Islamic medical texts are rose water (distilled water of roses), rose confection or rose paste (a thick jam produced by blending roses with sugar or honey), and rose oil (made by steeping roses in sesame seed oil or olive oil left under the sun).¹³

Arab physician Al-Kindi (9th century CE) prescribed rose products for stomach pain, ulcers, liver and mouth diseases, and sore throat. He used rose oil for burns, ulcerated wounds, and as an ingredient of hemorrhoid salves.¹⁶ Al-Dinawari's (9th century CE) texts noted the refreshing effects of rose water and recommended it for fever. He also recommended the application of rose oil to the head for alleviating fever and due to its calming effect.¹³ Abu Bakr Mohammad ibn Zakariya Al-Razi (Rhazes), the 9th century (CE) Arab physician, called attention to the therapeutic value of rose and stated that "the rose diminishes drunkenness."¹³

The great physician Ibn-i Sina (Avicenna, 11th century CE) was the first scientist to emphasize rose fragrance's beneficial effects on the heart and the brain. "Because of its exquisite fragrance, the rose addresses the soul," he wrote. "It has a calming effect and is highly beneficial for fainting and for rapid heart beats." He praised rose water's effects on mind and spirit, and its beneficial effects on brain function and cognitive power — "It enhances comprehension and strengthens memory."¹⁷ Like Ibn-i Sina, Ibn-Al-Baitar also noted rose water's beneficial effects on the brain: "Rose water strengthens the mind and the brain, sharpens the senses, increases the life force; It is beneficial for rapid heart beats due to anxiety; because of its beneficial fragrance it empowers the body."¹⁸ Ibn-Al-Baitar also stated that boiling rose water and exposing the head to its steam had healing effects and that it was especially beneficial for eye diseases. Additionally, he recommended inhalation of the steam to alleviate drunkenness and headaches.

In his famous medical book *Kemaliye*, Mahmud of Shirvan (15th century CE) described a powder prepared by crushing dried rose petals in a mortar for application to the neck, breast, and armpits after bathing — while the skin is still moist — to impart a favorable smell to the body and to "treat the spirit." He claimed that this scent empowered spirituality and purified the heart. He wrote that "the fragrance of rose is the fragrance angels like."¹⁹ The same powder also is mentioned in the *Edviye-i Müfrefe (Simple Drugs)* of Ishak bin Murat (14th century CE) for use in Turkish baths (*hamams*). It was said to be beneficial for those suffering from scabies. If rubbed on pimples, it reportedly cleared them.²⁰ Salih bin Nasrullah (17th century CE) said of rose water in his book *Gayetül Beyan (Human Health and Sanitation Techniques)* that when rubbed on the body, it gives a pleasant smell, and

when rubbed on the head, it alleviates headache. He wrote that ground, dried rose can be rubbed on mouth ulcers to alleviate pain. It is reportedly also beneficial for smallpox or measles lesions if sprinkled on the skin.²¹ *Marifetname (Talent Book)* of Ibrahim Hakki of Erzurum (18th century) recommended rose water for headaches due to fever and as a treatment for fainting.²²

Eşref bin Muhammed (15th century CE), in his book *Haza'inü's-Saa'dat (Treasures of Happinesses)*, recommended food prepared with rose water as the most appropriate food for babies. He wrote, "...white honey is boiled with rose water until it has the desired consistency, its froth is skimmed, and delicately baked bread's crumb is put in that water and blended to make a sherbet, and it is fed to the baby at the next feeding..."²³

Importance of Rose Water in the Turkic Cultures

In the early history of Central Asian Turks, sacrificial horses and other sacrificial animals were washed with fragrant waters. It is highly probable that rose was one of the flowers used in the making of those fragrant waters, as it is said to be of Central Asian origin. In attempting to trace the steps of the Turks in their use of rose water, the available written sources reach back only as far as the 11th century.¹³

Two lengthy works written in the 11th century mention the use of rose in the Turkic societies: *Kitab-u Divan-i Lugat-it Turk (The Dictionary of Turkic Words)* by Mahmud Kashgari — a dictionary recognized as an important source for information on Turkic culture in its entirety, including its history, ethnology, geography, mythology, and folk literature — and *Kutadgu Bilig (Wisdom of Royal Glory)* by Yusuf Has Hajib, composed of recommendations for attaining happiness in the 2 worlds. In the latter monumental work, when Ugdulmish, the vizier's son, is advising Ogdurmish, the ascetic, on "the rules of conduct at a banquet," he suggests that Ogdurmish offer *culab* and *culengebin* syrups prepared with rose water. Ugdulmish says, "If drinks are not served with the meal, then that meal is spoiled for the diners. Serve *fuka* [slightly fermented millet drink], or *mizab* [a beverage that can induce drunkenness], or the syrups *culengebin* or *culab*. Do not ask me what else you can offer, ask others." *Culab* and *culengebin* are said to be beneficial for the stomach, and they have been included in medical manuscripts since the 9th century CE. The aforementioned text confirms that the Turks were preparing syrups using rose water.²⁴

In *The Dictionary of Turkic Words*, Mahmud Kashgari refers to a copper rose-water vessel as *kumgan*, supporting the fact that Turks were making rose water and thus had a word for it in their language. Further investigation of the word *kumgan* uncovers interesting historical information. Cosmographer and geographer Al-Dimashqi (1256-1327), a prominent scholar of the 13th century Muslim world, notes the important centers of rose-water production in the Middle East in his book *Nuhbetu'd-Dehr fi Acaibi'l-Berr ve'l-Bahr (Important Interesting Creatures of the World's Lands and Seas)*. He particularly emphasizes an outstanding center in Syria, called Mezzeh. He describes the art of making rose water practiced in Mezzeh as follows: "The

storage vessels were filled with roses or other flowers, then the alembics were put in their places. When each alembic was filled with rose water, the rose water was poured into huge glass jugs, or into copper vessels with two handles, called *kumkum*.²⁵ The term used by rose water manufacturers in Mezzeh sounds much like *kumgan*.

In Isparta, the modern-day center of rose cultivation in Turkey, the special vessel with a narrow mouth in which distilled rose oil is stored is still called *kumkuma*. The word also is commonly used by the people in the saying “gossip kumkuma,” which alludes to gossiping women. That the word for the copper ewer holding rose water, *kumgan*, was in use for 900 years illustrates the expansive time period of the tradition of rose water.

Anatolian Seljuki Turks used motifs of rose, rose water, and rose oil in their literary works. One of the careers of the Seljuk period was *gulab-ger*, meaning rose water manufacturer: “The one practicing that profession, would make rose water, bottle it, and sell it in his shop.”²⁶ The 13th century Persian poet and mystic Rumi also mentions *gulab-ger* in his *Divan-i Kebir*: “Wake up, find a way to move out of that cup, from that bottle of ‘the artisan making rose water,’ like sweat oozing out, and be free.”²⁷

The famous traveler Ibn Battuta (1340-1369) provided one of the earliest sources of information on rose-water production in Anatolia. In his travelogue, he wrote about the rose water produced in Nusaybin, near Mardin, and in its vicinity in 1330: “The rose water produced in this region is unique in its fragrance and its taste.” He also describes the tradition of using rose water after bathing in the *hamam* in Ladik.¹⁸

A study on an Ilhanate city (part of the Mongol empire in the area of ancient Persia) cites sources that discuss a “rose house” (*gülâb-hane*) beside the hospital. In the city, newly discovered in 1309, the rose-water manufacturing shop was one of the standing buildings.²⁸ The same was observed in the Ottoman city of Edirne, where the Edirne Darussifası (hospital), founded in 1488, also had a *gülâb-hane*, or *gulhane*. The official documents dating from 1489 note, “There are three lead furnaces for making rose water.”²⁹ Since rose water was used abundantly in the hospital in those days, the expenses of making rose water in the *furun-i gul* (rose furnace) were recorded.

Rose Production, Trade, and Cultivation During the Ottoman Period

In Edirne, rose water was manufactured in the Royal Palace. Roses were cultivated in the *gulhane* where rose water was also produced.



Ottoman physicians favored the psychologically beneficial effects of smelling roses. *Young girl smelling a rose. Image courtesy Mr. Metin And Osmanlı Tasvir Sanatları: 1 Minyatür. İstanbul: Türkiye İş Bankası Kültür Yayınları.*

In addition, there was a *gulhane* in the Topkapi Palace in Istanbul. Ottoman sultans resided in the Topkapi Palace for more than 350 years. There were huge gardens situated south of the palace near the shore of the Marmara Sea, and a large tract of those gardens — the Gulhane Gardens — was dedicated to roses. However, the palace’s rose-water consumption was far greater than it could sustain, and the rose water demand of *Dersaadet* (“door of happiness” — one of the old names of Istanbul) was supplied from Edirne. According to a sultan’s edict (*ferman*) dating from 1587, roses were brought from Edirne for cultivation in the Old Palace Gardens where the sultan resided before moving to Topkapi Palace. The Old Palace was also in Istanbul, located at Beyazıt, in the area where the Rectorate of Istanbul University now stands. Roses were cultivated in its gardens as well.

Rose water and rose products, such as rose confection and syrups, were used abundantly in the Ottoman Empire. In his travelogue, the Ottoman traveler Evliya Chelebi (1611-1682) mentioned the tradesmen of Istanbul in the 1640s, as well as *esnaf-i gulabciyan* (rose-water manufacturers). He wrote of 14 rose-water shops in the Old Bazaar, which employed a total of 70 people. Women from Edirne sold rose water in huge copper cauldrons in front of the Bazaar, and others in the shops sold fragrant waters, distilled water, and rose water. Although Chelebi is known for his exaggerations, records from 1642 indicate that 2,000 kilograms of rose water were bought for the Palace.³⁰

Rose water was offered during the banquets and meetings at the palaces of sultans, viziers, and high-ranking administrative officers. It was an ingredient of the famous fragrant soaps (*miski*) prepared in the *Helvahane* (halva kitchen) of the Topkapi Palace, as well as in other substances cooked there. The *Helvahane Book*, a register of the goods and substances bought for and prepared in the Helvahane, reports that fresh roses, rose water, and rose sherbets were purchased from Edirne. During the 15th, 16th, and 17th centuries, rose sherbet, rose confection (*gul-i mukerrer*), and other rose products occupied an important place among the comestibles bought for the Palace. Usually those rose products were purchased from Edirne.

Chelebi detailed the beauty of the flowers and the roses of Edirne in his travelogue. He praised the rose water produced there, writing, “and its rose water is unique among the lands of the world. And its roses and rose gardens adorn the world.”¹²

In the Ottoman tradition, “offering rose water” was a precious treat; the custom was practiced not only in the palaces, but in the most modest houses as well. To better grasp the importance of rose water, it is sufficient to

consider the lists of gifts presented to the sultans, the most outstanding of which were cited as high-quality rose water and exclusively created rose-water bottles.

Rose water use was abundant during all periods of the Ottoman history. However, there are limited sources that explain where rose water was produced or where and how the fragrant roses were cultivated. Historians presume that the tradition of rose water production in the Middle East continued during the Ottoman reign after the empire reached its farthest borders. Ample evidence suggests that rose water was produced in the Anatolian lands in the past, as in the example of Nusaybin, which is cited as an important center for fragrances, particularly high-quality rose water. In the 13th century, Ibn al-Baitar wrote “the roses with the sharpest fragrances are found in Nisibis [Nusaybin], and they produce rose water here.”¹⁸ Again in the 13th century, al-Dimashqi, the prominent cosmographer and geographer of the Muslim world, mentions the important centers of rose-water production in the Middle East in his book *Nühbetü’l-Dehr fî Acâibi’l-Berr ve’l-Bahr (Important Interesting Creatures of the World’s Lands and Seas)*.

Firuzâbad, and Quwar and the al-Jazeera regions in Iran, and the city of Nusaybin, were famous in producing rose water. Rose water of those regions was world renown. Rose water was bottled and sent from those lands, via marine route, to Khuzestan [a province in southwestern Persia], Khorasan [a former province of northeastern Persia, southwestern Afghanistan, and southern parts of Tajikistan, Turkmenistan, and Uzbekistan], India, China, Anatolia [Turkey], Hijaz [western Saudi Arabia on the Red Sea, the location of the Islamic holy cities of Mecca and Medina], Yemen, Syria, Egypt, Maghreb [Northwestern Africa, west of Egypt], Andalusia [Spain], and to various European countries.²⁵

Information about rose cultivation in Anatolia is found in the travelogue of Ibn Battuta (1304-1369), who wrote that rose water produced in Mardin, at Nusaybin and in its vicinity in 1330, had a “unique fragrance and a unique taste.”³¹ According to the aforementioned sources, in the 13th and the 14th centuries, exquisitely fragrant roses were cultivated in Nusaybin, and the rose water of Nusaybin was world-famous. Did the rose water tradition of Nusaybin persist in the same region during the Ottoman reign? There are no documents citing Nusaybin as a center of rose cultivation at this time, nor any suggesting that rose water was sent to the Ottoman palaces from that region. Historical sources convey that Edirne was the site for rose-water production that sated the huge demands of the Ottomans.

Kâtip Chelebi, in enumerating the significant products of Edirne, wrote about the rose gardens of the city and about rose water prepared in those gardens: “...Edirne has 450 gardens lying on the riverbanks of its three rivers. The

Fatih the Conqueror had opened the Istanbul mosque Hagia Sophia to prayer services only after it was washed with rose water, and ordered incenses and balms to be burnt inside for the temple to smell beautifully. *The miniature of Fatih the Conqueror, smelling a rose. Image courtesy Nurhan Atasoy. Hasbahçe.*

rivers flow pleasantly under the shades of the high trees of the gardens, yet the gardens cannot get even a sip of the rivers’ waters, but survive on the tear drops (rains) of their own land. At the end of the winter, the rivers overflow and flood the neighboring settlements.”

Evliya Chelebi also praised Edirne’s gardens. Chelebi left Istanbul in 1639, and after travelling for more than 30 years, settled in Egypt in 1670. During his travels, he recorded his observations in great detail. He allocated more than 20 pages in his book for Edirne.³⁰ “The great city of Edirne is covered all over with rose and hyacinth [*Hyacinthus orientalis*, Asparagaceae] and sweet basil [*Ocimum basilicum*, Lamiaceae] gardens, heavenly gardens resembling the gardens of Eden, and is covered with orchards forming a network, lying afar off with no limits or borders, the measure of which only God the Almighty knows,” he wrote. “There is no country in all the lands of Anatolia with such fertile soil, extending to all corners, and with such an abundance of grains.” In another page, he added to his praises of the city: “In those special gardens ... the varieties of flowers ornamenting this city of Edirne are roses and hyacinths and Anatolian musk and tulips [*Tulipa* spp., Liliaceae] and violets [*Viola* spp., Violaceae] and hyacinths and sweet basil and jasmines [*Jasminum* spp., Oleaceae] and Judas trees [*Cercis siliquastrum*, Fabaceae] and daffodils [*Narcissus* spp., Amaryllidaceae] and irises [*Iris* spp., Iridaceae] and gillyflowers [*Matthiola incana*, Brassicaceae] and peonies [*Paeonia* spp., Paeoniaceae] and carnations [*Dianthus* spp., Caryophyllaceae] and other thousand colored, fragrant, and decorative plants.”

Historical records document the cultivation of roses in Edirne, and that the rose saplings needed for Palace Gardens in Istanbul were delivered from Edirne. In 1587, Sultan Murad III issued a *ferman* (edict) “on the transfer of roses required for the Imperial Gardens, from Edirne,”³² confirming that roses for the Imperial Gardens were in fact transferred from Edirne. There is additional evidence that



fragrant roses were cultivated in the Imperial Gardens, and, during spring, palace attendants picked the roses to prepare rose confections.³³ An Ottoman agriculturist of the 19th century, Agop Zakarian, cited Edirne among the cities that produced “rose oil and rose water” in his book *Roses and Rose Products*, written in 1895.³⁴

The Rose Water Center of the Ottomans: Kazanlik

Post-18th century information on rose water and rose oil is more abundant. Sources note that rose cultivation was much advanced in Kazanlik and Zagra, the towns of the Chermen Province (Sanjak) of the Ottomans, and that rose water and rose oil were produced in both towns (which are located in modern-day Bulgaria).

Kazanlik developed into a significant rose-oil and rose-water center in the 18th century. Dervish Mehmed, the chief of the Imperial Food Store in the Topkapı Palace, recommended that the rose oil in one of his drug prescriptions was to be brought from Kazanlik. In his article on “oil preparations” he wrote: “In the past, the best rose oils used to come from the lands of India, then someone was able to produce this blessed oil in a place called Kazanlik, in Rumeli, and from then onwards that blessed oil began to come to Asitane [Istanbul] from Kazanlik, and began to be distributed to other countries from here. Every year a thousand miskals [1 miskal = 4.25 grams] rose oil is sent from Kazanlik to our much honored sultan’s palace. And sometimes a hundred, two hundreds, five hundreds are brought.”³⁵

The Rose, Its History (1906), written by Bulgarian P.I. Orozoff, confirms the above information. Orozoff founded the famous Bulgarian rose-oil manufacturing facilities, and he wrote that rose cultivation and the method of rose-oil production was “brought to Bulgaria by a Turkish tradesman at the end of the 17th century.”¹² By 1750, Bulgaria had become the principle source of rose oil. At that time, rose oil was produced by water-distillation of fresh roses, and cohobation of the distillates in open-fire copper stills. The oils collected by merchants were exported from the ports of Gallipoli, Istanbul, and Izmir. Records show the annual production of rose oil in the region during the 1850s was 1,500 to 1,800 kg.³⁶

At one time, various rose species were used for the production of rose oil. Later, *R. damascena* (known by common names such as Damask rose, Isparta rose, and Oil rose) was established as the only source. *Rosa damascena* is believed to be a hybrid of the *R. gallica* and the *R. phoenicia* species, created in years long past. Both parents are native rose species growing among the 25 species of *Rosa* recorded in the *Flora of Turkey*.¹ *Rosa damascena* var. *trigintipetala* (30-petalled rose) is widely cultivated in Turkey and Bulgaria.

In his book *Old Garden Roses in Turkey* (1994), Turhan Baytop wrote, “One of the most important evidences that the rose oil industry of Bulgaria was originally built by the Turks, is that the rose oil factories in Bulgaria are still using Turkish words like ‘baş, ayak, sherbet, çorba, aşılama’, even today.” Baytop pointed out that the rose gardens and rose distilleries in Bulgaria were not only founded by the Turks, but also were owned by them for a long time (approx-



The rose garden was an indispensable pleasure for the Ottomans. Image from *A Prince and a Princess in the Rose Garden*. *P Dergisi Bahçe ve Sanat Bahar*. 2004.

mately 200 years), and that the Bulgarians took them over after the owners left the country during the Russo-Turkish War from 1877 to 1878.³¹

An old record tells of rose-oil production in Edirne by an elderly woman, Mrs. Hadji Fatma:

The oil roses bloom in May, and the oil cauldrons are set on May 6th, the day of Hidrellez; they keep boiling continuously for about 25-26 days, til the end of May. There are two kinds of oil roses, light red roses and white roses. The white roses are not fragrant, and they stand among the red roses; they carry only a scant amount of oil; they are placed among the red roses because they freeze rapidly. The purest rose oil is the one that freezes rapidly. The lowly tradesmen add geranium to rose oil...

The time when the roses are in full bloom is called *doruk* [peak time]. During *doruk*, sometimes the rose

During the rose season, the sick are carried to the wells, and are immersed in the pulp residue.



Village-type rose oil distillation facility in Turkey.

Photos ©2012 Gülbirlik Cooperative

Ottoman lands by providing rose saplings and stills to farmers in Istanbul and numerous other areas of Turkey and Syria. Eventually, Isparta and Burdur provinces proved to be the most suitable for rose cultivation and oil production. In the early 1900s, Ismail Efendi started planting roses and distilling rose oil independently from the state and firmly established rose cultivation in Isparta. Rose cultivation in all of the other provinces ceased since the Isparta rose yielded 1 kg of rose oil from 4 tons of roses, while in other provinces as much as 6 to 12 tons of roses were needed to produce 1

cauldrons boil nonstop for four days and four nights. Then, the workers sleep in shifts. When the roses are boiling, the nights are festive. Players come from the town. They are fed by the landlord, drinks are offered, and the players play their violins, clarinets, drums, tambourines, and zurnas, and sing till sunset. Every day, when ten cauldrons are set up for rose water, two are set up for rose oil. The most beautiful folk songs of Rumeli were created when the roses were boiling. 'Only if I could see my love at dawn...'³⁷

kg of rose oil, making the oil non-profitable. (The Anadolu University research team of this article's primary author was able to acquire an old sample of rose oil produced in Bursa province and found it to have a pleasant fragrance despite being stored non-refrigerated for more than 60 years.)

The Modern Rose Industry in Turkey

Method of Production

Rose oil is produced by water distillation of fresh *R. damascena* flowers. Commercial oil-bearing rose is an entirely cultivated plant. After planting the rose twigs in a rose field, it takes at least 3 years for a rose plant to attain maturity. A mature rose field normally yields 5 tons of fresh roses per hectare. However, in a carefully nurtured field, the yield may increase to 7-to-8 tons per hectare. It is normal for a field to be productive for as long as 20 to 30 years. Rose harvest lasts for approximately one month between mid-May and mid-June. Roses are handpicked in the early hours of the day and transported either to factories or to the collection sites of various firms. A skilled worker can pick about 40 kg of roses in 8 hours. Factories remain open 24 hours a day — broken into 3 shifts — for one month. When the season is over, the factories are cleaned and closed down until the next season.

In village-type distillation, freshly picked flowers are loaded into 150- to 1,000-liter copper or galvanized steel open fire stills; most stills have a 300-liter capacity and consist of a retort and a head. The removable spherical head is connected to a pipe which leads through a pool filled with lukewarm water to cool the condensate. At the outlet, there is a 9-liter glass collecting flask. Typically, 10 kg of flowers and 60 liters of water are loaded into 300-liter stills and are distilled for 1 to 2

The Second Period of Rose Cultivation in the Ottoman Empire

In 1908, several years after the Russo-Turkish War of 1877 to 1878, Bulgaria separated from the Ottoman Empire and became an independent state. Turkish immigrants who left their homes in today's Bulgaria and migrated to Anatolia cultivated oil roses that they had brought along with them, initially in Bursa (a city in northwestern Turkey) and Istanbul. The second period of rose cultivation and rose distillation began in 1880; rose water and rose oil were first commercially produced in those regions in 1885.

Sultan Abdulhamit encouraged rose cultivation in

Woman picking roses in a garden in Turkey.
Photo ©2012 Gülbirlik Cooperative



hours in order to collect 2 flasks full of the distillate (18 liters). The oil does not separate due to the low concentration of oil in the distillate. Therefore, about 60 liters of the distillate are redistilled, yielding another 18 liters of distillate from which the oil that floats to the top is decanted. The aqueous phase is diluted with distilled water and marketed as rose water.

Generally, industrial production employs larger 3,000-liter copper or stainless-steel stills. Each still has a charge size of 400 to 500 kg flowers and can hold 1,500 to 2,000 liters of warm water. The stills are steam-jacketed, *i.e.*, they contain an inner double-wall inside of which steam is circulated. There may also be provision for the injection of live steam into the still to speed up distillation. The distillation process takes 1.5 hours. The condenser temperature is kept at 95°F (35°C) to avoid the solidification of waxes.

The distillate is collected in 200-liter stainless-steel Florentine flasks. The oil that separates out is called crude oil, first oil, or direct oil. Distillation is terminated when the distillate no longer has a bitter taste. The overflow of the Florentine flasks is collected in 500-liter tanks. These “bottom waters” or “first waters” are then pumped into 5,000-liter stainless-steel still tanks. These are cohobated in 3,000-liter stills for 1 to 1.5 hours to obtain what is called the second oil, cooked oil, or indirect oil. The distillate that remains after oil removal is sold as rose water. The first and second oils are filtered and kept in glass flasks in the dark. When production season is over, the first and second oils are mixed to yield Turkish rose oil and packed in special 2- to 5-liter tinned-steel containers called *kumkuma*. Generally 3.5 to 4 tons of flowers yield 1 kg rose oil — about 0.02% oil.

Rose concrete is obtained by extracting fresh roses with n-hexane and then removing the hexane, which leaves behind a highly fragrant solid extract that resembles shoe-polish wax. When rose concrete is extracted with ethanol and cold-filtered upon evaporation of ethanol under vacuum, the dark liquid obtained is known as rose absolute. Annually, about 7,000 tons of roses are processed to produce about 1,600 kg of rose oil and 2,400 kg of rose concrete. Four hundred kg of roses are required to produce 1 kg of rose concrete. The primary constituent of rose concrete is 2-phenylethyl alcohol, which also is the main constituent of the headspace odor of roses and rose water.^{36,38} One company in Turkey produces concentrated rose water without redistilling the waters of the first distillation.

The global rose-oil market is estimated to be about 3 tons annually. The world’s annual demand for [rose concrete] is reportedly 9 tons.³⁹ Turkey presently supplies 50 percent of the demand for rose oil.

There are 15 rose-oil factories in Isparta, Turkey, some owned by the state-controlled Gülbirlik Cooperative and others by private companies; five of them are relatively large complexes. Isparta ranks at the top in terms of the total amount of rose oil produced and the rate of rose oil and rose concrete produced per unit of rose flowers. In Turkey,

80 percent of the oil-bearing roses are cultivated in Isparta, and the remaining 20 percent are cultivated in Burdur, Afyon, and Denizli. According to 1998 statistics, 8,200 farmers were growing roses on about 1,772 hectares (1 hectare is roughly 2.5 acres) *in toto*. The total amount of rose flowers harvested was 6,034 tons, 2,901 tons of which came from Gülbirlik, and the remaining 3,133 tons from private enterprises. The amount of rose oil distilled from those flowers was 1,562 kg altogether; Gülbirlik distilled 751 kg, and private enterprises distilled 811 kg. The total funds paid to the farmers was 850 billion TL (Turkish lira; approximately \$469,000 USD). Exports amounted to \$2.5 million USD, with Gülbirlik accounting for \$1.5 million, and private enterprises accounting for \$1 million. Certified organic cultivation of rose also is carried out in Isparta. Two companies export about 30 kg of organic rose oil and about 4 tons of organic rose water. One of them also exports 1,250 kg of rose concrete and 750 kg of organic rose absolute.

More recently, in the Province of Isparta, approximately 8.5 tons of rose flowers, nearly 1.5 tons of rose oil, more than 8 tons of rose concrete and rose absolute, and 259 tons of rose water were produced in 2009; almost \$19 million of such rose products were exported. In 2008, the sale price of rose oil was \$6,384 per kilogram, and \$3 per kilogram for rose water, \$525 per kilogram for rose concrete, and \$1,300 per kilogram for rose absolute. In 2009, Turkey exported 1.2 tons of rose oil for a return of \$11.7 million, and in 2010, \$10.5 million in revenue was obtained from the export of 1 ton of rose oil. Nearly 90% of Turkish rose oil is exported to France, Switzerland, and the United States. Rose concrete is exported primarily to France, and Germany is the foremost importer of Turkish rose absolute.^{13,39} Table 1 shows 2011 and 2012 figures.³⁹

Chemical and Olfactive Features of Rose Oil

Citronellol is the main component of factory-produced Turkish rose oil (31 to 44%). It determines the basic roseaceous character of rose oil. Higher citronellol contents lead to increased sweetness which, when compared with near-equivalent quantities of geraniol (9 to 24%), contributes to strength and fortification of the body note. Conversely, when geraniol content of rose oil is comparatively low, the sweetness of the body note is maintained while strength diminishes. In some village oils, the geraniol content was observed to be higher than the citronellol content. In

Table 1. Turkish Rose Material Exports

Year	Rose Flower (Ton; TL/kg)	Rose Oil (kg; Euro/kg)	Rose Concrete (kg; Euro/kg)	Rose Water (kg; TL/kg)
2011	6000; 2.25	800-1000; 6250	6000; 700	60.000; 7
2012*	6500; n/a	1000-1100; n/a	6500; n/a	60.000; n/a

n/a = not available

*The 2012 figures indicate only the amounts of rose and rose materials produced but not the prices, as rose oil production ended in early July 2012, at which time this article was being completed. The data were obtained by the principal author, from Gülbirlik (A. Doğaner, oral communication, July 2012).



Rose *Rosa damascena*. Photo ©2012 Gülbirlik Cooperative

such cases, while the rosaceous character is maintained, it acquires an undesirable green, grassy quality.

In order to simplify the comparison of gas chromatographic results, citronellol/geraniol ratios of each of the oils are taken. Village oils give a ratio of 0.83 to 1.92%, while in factory oils the ratio is 2.30 to 4.84%. In Bulgarian rose oil the citronellol/geraniol ratio is around 1%.

The basic character of rose oil, mostly dependent upon citronellol and geraniol, is further modified by nerol (5 to 11 %) and farnesol (0.2 to 1.4 %). Their contents are slightly higher in village oils. Higher farnesol content leads to the establishment of strong floral character and an overall improvement of body-note volume. Nerol not only adds

to the rosaceous character but also to its freshness. In those cases where the geraniol content is low, however, the freshness of nerol manifests itself as slightly citrusy. When geraniol content is high, the combination of citronellol, geraniol, farnesol, and nerol results in a strong, sweet, floral, fresh rosaceous character. Other typical constituents of rose oil are geranyl acetate, nonanal, citronellyl formate, citronellyl acetate, eugenol, methyl eugenol, cis-rose oxide, alpha-terpineol, phenylethyl alcohol, and linalool. Damascenones and some sulfur compounds are among the minor components. Stearoptenes (paraffins) are natural constituents of rose oil (the major one being nonadecane) and due to their presence, rose oil solidifies at room temperature and when refrigerated. Stearoptene content in village oils is lower.^{35,36}

Gülbirlik is the largest rose-oil manufacturer in Turkey. The Pharmacognosy Department at the Faculty of Pharmacy at Anadolu University in Turkey has been analyzing the company's oils each year for the past 21 years. Table 2 summarizes the levels of major components found in rose oil during this 21-year period.

Production of Rose Oil Outside Turkey and Bulgaria

Bulgaria and Turkey are the main sources of rose oil to international markets, and these oils are generally preferred by perfumers. *Rosa damascena* is grown and rose oil is produced in Russia, Iran, Saudi Arabia, India, and China. Iran produces much of its rose water in Kashan (in north-central Iran). In Saudi Arabia, rose oil is produced in Taif, near Mecca. *Rosa centifolia* commonly is grown in Morocco, Uzbekistan, France, and Egypt, and is particularly desirable for the production of rose water. In China, rose oil is also produced from *R. rugosa*.

Rose Pharmacology

Several pharmacological studies have been performed with rose extracts and oil. Most studies have been conducted on products from *R. damascena*, while a few examined *R. centifolia*. The studies' results are summarized in Table 3. There is also a recent review paper available on the pharmacological effects of *R. damascena*.⁴⁰

Ancient texts mention that rose is good for disorders of the brain and the heart. (See "Rose in Islamic Medical Texts.") Several recent studies have provided scientific evidence for this information. The hydroalcoholic extract of *R. damascena* flowers has been shown to potentially increase heart rate and contractility in isolated guinea pig heart, possibly via a stimulatory effect on β -adrenergic receptors.⁴⁸ Furthermore, cyanidin-3-O- β -glucoside from rosebuds significantly suppressed angiotensin-I-converting enzyme (ACE) activity, suggesting a possible role in improving cardiovascular function since ACE is a key enzyme in the production of angiotensin II, a potent vasoconstrictor.⁷³

In a double-blind study on 16 patients (age 3 to 13 years; 9 girls and 7 boys), children with refractory epilepsy were administered 5 mg per kg of 10% of rose oil in vegetable

Table 2. Twenty-One Years of Turkish Gülbirlik Rose Oil (1986-2002 and 2008-2011)

Compound	Main components (%)	
	Min.	Max.
Citronellol	30.9	43.9
Geraniol	9.3	14.4
Nonadecane	8.2	14.7
Nerol	5.2	10.7
1-nonadecene	2.0	4.9
methyl eugenol	2.1	4.0
Heneicosane	2.5	4.2
geranyl acetate	1.0	2.3
phenylethyl alcohol	1.2	2.0
β -caryophyllene	0.7	1.6
citronellyl acetate	0.7	1.4
germacrene D	0.7	1.4
Linalool	0.6	2.1
(2E, 6E)-farnesol	0.6	1.4

oil or placebo 3 times per day. All had been under treatment for 3 to 6 weeks (baseline phase). They received either the essential oil or placebo for a period of 4 weeks and in between these periods, they took only their pre-existing antiepileptic drugs for 2 weeks (washout phase). The mean frequency of seizures in those using essential oil was significantly lower compared to those using placebos ($p=0.00$). The results showed that rose oil had an anticonvulsant effect and could reduce frequency of

seizures in children who were resistant to anti-epileptic drugs (AEDs).⁷⁰

Rosa damascena has beneficial effects on brain function and has potential applications for the treatment of dementia. A chloroformic extract of the *R. damascena* significantly induced neurite outgrowth activity and inhibited amyloid β ($A\beta$).⁶⁸ $A\beta$ is thought to be a major pathological cause of Alzheimer's disease. $A\beta(25-35)$, the major fragment of the full peptide $A\beta$ found in the

Table 3. Pharmacological Activities of Rose Materials

Type of Extract/Essential Oil	Activity Shown	Technique	Reference
Aqueous and/or ethanolic extract	Hypnotic	Pentobarbital-induced sleep time	41, 42
Aqueous and/or ethanolic extract	Analgesic	Hot plate, tail flick, acetic acid, and formalin tests	43, 44
Aqueous and/or ethanolic extract	Antitussive	Citric acid method	45
Aqueous and/or ethanolic extract	Bronchodilatory	Inhibition of calcium channels of guinea pig tracheal chain	46, 47
Aqueous and/or ethanolic extract	Potential of heart rate and contractility	Isolated guinea pig heart	48
Aqueous and/or ethanolic extract	Anti-inflammatory	Carrageenan-induced rat-paw edema	45, 49
Aqueous and/or ethanolic extract	Laxative Constipation	Rats by gavage and intraperitoneal injection	50
Aqueous and/or ethanolic extract	Anti-solar	Sun Protection Factor (SPF) determination	51
Aqueous and/or ethanolic extract	Antiaging	Mortality rate in adult <i>Drosophila</i> flies	52
Ethanolic extract (<i>R. centifolia</i>)	Antitussive	Mouse model induced by sulphur dioxide gas	53
Hydroalcoholic, ethanolic extracts, and essential oil	Antioxidant	Measurement of free radical scavenging activity	54-56
Methanolic extract	Antidiabetic	Measurement of α -glucosidase activity	57, 58
Methanolic extract	Anti-lipase	Reduction in turbidity of a triolein emulsion by porcine pancreatic lipase	59
Flavonoid compounds isolated from methanolic extract	Anti-HIV	Effects on C8166 human T lymphoblastoid cells infected with HIV-1MN and H9 human T-cell lymphoma cells chronically infected with HIV-1IIB	60
Essential oil and absolute	Antimicrobial	Disk, well-diffusion, microdilution methods	55, 61-67
Essential oil	Anticonvulsant	PTZ (Pentylenetetrazol)-induced seizures in Wistar rats The amygdala electrical kindling seizures in rat	68-70
Essential oil and phenylethyl alcohol	Neuroprotective, memory enhancing	Inhibition against acetylcholine esterase (AChE)	71
Chloroform extract	Neuroprotective, treatment of dementia	Neurite outgrowth activity testing	72
Cyanidin-3-O- β -glucoside from rose buds	Cardiovascular function	ACE (Angiotensin-I-converting enzyme) inhibition	73
Fresh flower juice	Hepatoprotective	Antioxidant activity tests	74
Herbal eye drop containing <i>R. damascena</i> extract	Ophthalmic disorders	Clinical tests	75

brains of Alzheimer patients, causes neural cell death, neuritic atrophy, synaptic loss, and memory impairment. The primary active ingredient in the chloroformic rose extract was found to be a very long, polyunsaturated fatty acid known as VLFA, which has a chemical formula of C₃₇H₆₄O₂. It protected atrophy induced by Aβ(25-35) and displayed strong neurite outgrowth activity.⁷²

An additional recent study suggested that rose oil and a main component of the rose fragrance, phenylethyl alcohol, significantly inhibits acetylcholine esterase (AChE) and butyrylcholine esterase (BChE).⁷¹

Lastly, dried rose flower buds are used in herbal teas; rose jam and syrups are prepared from fresh rose flowers; rose water is often sprinkled on participants of religious ceremonies and is added to traditional Turkish deserts such as *güllach* and *su muhallebisi* (a thick rice-flour pudding) for flavoring. *Gülbeşeker* is a rose-flavored confectionary which was particularly popular during the Ottoman period.

Conclusion

Rosa damascena and other fragrant rose species have been esteemed for centuries by almost every culture that has had access to their wonderful aromas. Rose has inspired artists to create masterpieces and kings and sultans to establish gardens for their beauty and fragrance. Rose has inspired legends, and humans throughout recorded history, and only recently, modern technology and chemical analyses have opened up new possibilities for this much-praised botanical. HG

Kemal Hüsnü Can Başer, PhD, professor of pharmacognosy, served as the dean of the Faculty of Pharmacy at Anadolu University from 1993 to 2001 and was the founding director of the Medicinal and Aromatic Plant and Drug Research Centre in Eskişehir, Turkey. He is currently the president of the International Council for Medicinal and Aromatic Plants and a board member of the International Society for Medicinal Plant and Natural Product Research. His research interests include essential oils, alkaloids, and the biological activities of medicinal and aromatic plants. He is the co-editor of the Handbook of Essential Oils: Science, Technology, and Applications, published by CRC Press in 2009, and has authored more than 650 research papers in peer-reviewed scientific journals.

Ayten Altıntaş, PhD, is a professor of medical history at Istanbul University.

Mine Kürkçüoğlu, PhD, is a researcher with 20 years experience working with rose and medicinal plants. She worked at the Medicinal and Aromatic Plant and Drug Research Centre from 1985 to 2002, and she is currently a professor of pharmacognosy at Anadolu University.

References

1. Davis PH. *Flora of Turkey and the East Aegean Islands*. Vol 4. Edinburgh, Scotland: Edinburgh University Press; 1972:106-128.
2. The genus *Rosa*. Auckland War Memorial Museum website. Available at: www.aucklandmuseum.com/Default.asp?i=1196. Accessed October 2, 2012.
3. Vercera L. *Classic Roses: A Concise Guide in Colour*. Secaucus, NJ: Chartwell Books Inc.; 1989.
4. Burlington Gardens, W.1. In: Thompson RC. *A Dictionary*

- of *Assyrian Botany*. London, England: The British Academy; 1949.
5. Pliny. *Natural History*. 21.73.121-125. In: Thompson RC. *A Dictionary of Assyrian Botany*. London, England: The British Academy; 1949.
6. Dioscorides. *De material medica*. Beck LY, trans. 2005.
7. Budge EAW. *The Syriac Book of Medicines*. London, England: Milford; 1913.
8. Khory RN. *Bombay Materia Medica*. New Dehli, India: Expert Book Agency; 1986.
9. Kirkitar KR, Basu BD. *Indian Medicinal Plants*. Allahabad, India: Indian Press; 1918.
10. Anon. *Penny Cyclopaedia of the Society for the Diffusion of Useful Knowledge*. London, England; 1841:158.
11. Flüchiger FA, Hanbury D. *Pharmacographia: A History of the Principal Drugs of Vegetable Origin, Met With in Great Britain and British India*, 2nd ed. London, England: Macmillan and Co.; 1879.
12. Baytop T. Osmanlı İmparatorluğu Döneminde Anadolu'da Yağ Güllü Yetiştirilmesi ve Gül Yağı. *Tıbbi ve Aromatik Bitkiler Bülteni*. 1990;4:8-10.
13. Altintas A. *Rose, Rose Water, Historical, Therapeutic and Cultural Perspectives*. Istanbul, Turkey: Maestro Publishing; 2010.
14. SubRosa. Scotland Europa website. Available at: <http://www.sdi.co.uk/scotland-europa/about-scotland-europa/subrosa.aspx>. Accessed October 9, 2012.
15. Schmidt E. Production of Essential Oils. In: Baser KHC, Buchbauer G, eds. *Handbook of Essential Oils: Science, Technology and Applications*. Boca Raton, FL: CRC Press; 2010:83-119.
16. Levey M. *The Medical Formulary of Aqrabadhin of Al Kindi* (Translated with a study of its Materia Medica). Madison, WI: University of Wisconsin Press; 1966.
17. Ibn Sina. *El-Karun Fi't-tıbb*. Vol 2, 1st ed. Kahya E, trans. Ankara: Atatürk Kültür Merkezi Başkanlığı Yayınları; 2003.
18. Ibnul-Baytar el-Mufredat Joseph V. Sontheimer; Große Zusammenstellung über die Kräfte der bekannten einfachen Heil- und Nahrungsmittel von Abu Mohammed Abdallah Ben Ahmed aus Malaga bekannt unter den Namen Ebn Baithar, II. Band Stuttgart; 1842:482.
19. Sirvanli M. *Kemaliye* (1430), Yelten M, ed. Istanbul: Istanbul University Faculty of Education Publications; 1993.
20. Geredeli İshak b. Murat, *Edviye-i Müfrefe* (1387). Canpolat M, Önler Z, eds. Ankara: TDK Yayınları; 2007.
21. Nasrullah SB. *Gayet-ül Beyan Fi Tedbir-i Beden-il İnsan*, Vol 1. Özkök A, trans. Ankara: Ve-Ga Publications; 1991.
22. Erzurumlu İbrahim Hakkı. *Marifetname*. Meyan F, trans. Istanbul: Bedir Yayınevi; 1999.
23. Eşref bin Muhammed. *Hazâinü's-Saadat*, 1460. Şehsuvaroğlu BN, ed. Ankara: Türk Tarih Kurumu Yayınevi; 1961.
24. Yusuf Has Hajib. *Kutadgu Bilig*. Arat RR, trans. Ankara: Türk Tarih Kurumu Yayınevi; 1988.
25. Şeyh'r Rebve. Şemsuddin Ebu Abdullah Muhammed b. Ebi Talib el-Ansari ed-Dimashqi, *Nubbetü'd-Dehr fi Acaibi'l Berr ve'l Babr*, Beirut, 1988. In: *Abdülhalik Bakır, Ortaçağ İslam Dünyasında İvriyat, Gıda, İlaç Üretimi ve Tağşişi, Production and Adulteration of Cosmetics, Food and Medicines in Medieval Islamic World*. Ankara; 2000.
26. Mercil E. *Türkiye Selçuklularında Meslekler (Careers in Anatolian Seljuks)*. Ankara: Türk Tarih Kurumu Yayınevi; 2000.
27. Rumi MC. *Divan-i Kebir*. Ergin NO trans. Ankara and Walla Walla: Republic of Turkey Ministry of Culture and Current; 1995.
28. Özgüdenli O. *Bir İlhanlı şehir modeli (Rab-i Raşidi)*, Esnaf ve Ekonomi Seminer, Istanbul. Vol 1. 2003:112.
29. Gökce N. Edirne Sultan II. Bayezid Darüşşifası Vakfinesine göre Darüşşifada Çalışan Personel ve Kullanılan İlaçlar (Personnel and Medicines in the Hospital according to the Charter of the Sultan Bayezid the Second Foundation Hospital in Edirne, Turkey). The Proceedings of the IV. History of Turkish Pharmacy Meeting, Istanbul. 2000: 317-318.

30. Evliya Çelebi b. Derviş Muhammed Zillî Evliya Çelebi Seyahatnamesi Transcription of the Manuscript Bağdat 304 in the Topkapı Palace. Book 3. Kahraman SA, Dağlı Y, eds. 1st ed. İstanbul: Yapı Kredi Yayınları; 1999.
31. Baytop T. Türkiye'de Eski Bahçe Gülleri Ankara: Kültür Bakanlığı; 2001:92.
32. Refik A. Onuncu Asr-ı Hicride İstanbul Hayatı. Uysal A, ed. İstanbul: Kültür Turizm Bakanlığı Yayınları No. 791; 1987: 20.
33. Bilgin A. Osmanlı Saray Mutfağı İstanbul: Kitabevi Yayınları; 2004.
34. Zakarian A. Gül ve Mahsulatı İzmir 1311(1895). In: Baytop T. Türkiye'de Eski Bahçe Gülleri Ankara: Kültür Bakanlığı; 2001:93.
35. Sarı N, Tuğ R. Enderun-ı Hümâyün Kılâr-ı Hassa Başkullukçusu Derviş Mehmed'in Dühn Terkiplerine Ait Risalesi Proceedings of the IV. History of Turkish Pharmacy Meeting. İstanbul. 2000:283-295.
36. Baser KHC. Turkish Rose Oil. *Perf. Flavour*. 1992;17(3):45-52.
37. Bakır A. Orta Çağ İslam Dünyasında Parfümcülük, Kutsal Dumandan Sihirli Damlaya: Parfüm, İstanbul: YKY; 2005:49.
38. Baser KHC, Kurkcuoglu M and Ozek T. Turkish rose oil: Recent results. *Perf. Flavour*. 2003;28(2):34-42.
39. Ormeci Kart MC, İkiz M, Demircan V. Development of oil rose (*Rosa damascena*) production and trade in Turkey. *J of the Suleyman Demirel University Faculty of Agriculture*. 2012;7(1):124-134.
40. Hossein BM, Naser SM, Zahra S, Somayeh A. Pharmacological effects of *Rosa damascena*. *Iranian J Basic Med Sci*. 2011;14(4):295-307.
41. Rakhshandah H, Hosseini M, Dolati K. Hypnotic effect of *Rosa damascena* in mice. *Iranian J Pharm Res*. 2004;3:181-185.
42. Rakhshandah H, Hosseini M. Potentiation of pentobarbital hypnosis by *Rosa damascena* in mice. *Indian J Exp Biol*. 2006;44:910-912.
43. Rakhshandah H, Vahdati mashhadian N, Dolati K, Hosseini M. Antinoceptive effect of *Rosa damascena* in mice. *J Biol Sci*. 2008;8:176-180.
44. Hajhashemi V, Ghannadi A, Hajiloo M. Analgesic and anti-inflammatory effects of *Rosa damascena* hydroalcoholic extract and its essential oil in animal models. *Iran J Pharm Res*. 2010; 9:163-168.
45. Shafei MN, Rakhshandah H, Boskabady MH. Antitussive effect of *Rosa damascena* in guinea pigs. *IJPR*. 2003;2:231-234.
46. Boskabady MH, Kiani S, Rakhshandah H. Relaxant effects of *Rosa damascena* on guinea pig tracheal chains and its possible mechanism(s). *J Ethnopharmacology*. 2006;106:377-382.
47. Rakhshandah H, Boskabady MH, Mossavi Z, Gholami M, Saberi Z. The differences in the relaxant effects of different fractions of *Rosa damascena* on guinea pig tracheal smooth muscle. *Iranian J Basic Med Sci*. 2010;13:126-132.
48. Boskabady MH, Vatanprast A, Parsee H, Ghasemzadeh M. Effect of aqueous-ethanolic extract from *Rosa damascena* on guinea pig isolated heart. *Iranian J Basic Med Sci*. 2011;14:116-121.
49. Maleev A, Neshtev G, Stoianov S, Sheikov N. The ulcer protective and antiinflammatory effect of Bulgarian rose oil. *Eksp Med Morfol*. 1972;11:55-60.
50. Arezoomandan R, Kazerani HR, Behnam-Rasooli M. The laxative and prokinetic effects of *Rosa damascena* mill in rats. *Iranian J Basic Med Sci*. 2011;14:9-16.
51. Tabrizi H, Mortazavi SA, Kamalinejad M. An *in vitro* evaluation of various *Rosa damascena* flower extracts as a natural antisolar agent. *Int J Cosmetic Sci*. 2003;25(6):259-265.
52. Jafari M, Zarban A, Pham S, Wang T. *Rosa damascena* decreased mortality in adult *Drosophila*. *J Med Food*. 2008;11(1):9-13.
53. Anand SR, Nikhila C, Lakshmi prasanna VC, Mobeena SK, Karunakar K, Bharathi N. Evaluation of anti-tussive activity of *Rosa centifolia*. *Int J Pharm Sci Res*. 2011;2(6):1473-1475.
54. Ozkan G, Sagdiç O, Baydar NG, Baydar H. Antioxidant and antibacterial activities of *Rosa damascena* flower extracts. *Int J Food Sci Technol*. 2004;10:277-281.
55. Kumar N, Bhandari P, Bikram SA, Shamsheer S, Bari B. Antioxidant activity and ultra-performance LC electrospray ionization-quadrupole time-of-flight mass spectrometry for phenolics-based fingerprinting of Rose species: *Rosa damascena*, *Rosa bourboniana* and *Rosa brunonii*. *Food Chem Toxicol*. 2009;47:361-367.
56. Shahriari S, Yasa N, Mohammadirad A, Khorasani R, Abdollahi M. *In vitro* antioxidant potential of *Rosa damascena* extract from Guilan, Iran comparable to α -tocopherol. *Int J Pharmacol*. 2007;3:187-190.
57. Gholamhoseinian A, Fallah H, Sharifi-far F, Mirtajaddini M. The inhibitory effect of some Iranian plant extracts on the alpha glucosidase. *Iranian J Basic Med Sci*. 2008;11:1-9.
58. Gholamhoseinian A, Fallah H, Shariffar F. Inhibitory effect of methanol extract of *Rosa damascena* Mill. *Phytomedicine*. 2009;16:935-941.
59. Gholamhoseinian A, Shahouzehi B, Shariffar F. Inhibitory effect of some plant extracts on pancreatic lipase. *Int J Pharmacol*. 2010;6(1):18-24.
60. Mahmood N, Piacente S, Pizza C, Burke A, Khan AL, Hay AJ. The anti-HIV activity and mechanisms of action of pure compounds isolated from *Rosa damascena*. *Biochem Biophys Res Commun*. 1996;229:73-79.
61. Ulusoy S, Boşgelmez-Tinaz G, Seçilmiş-Canbay H. Tocopherol, carotene, phenolic contents and antibacterial properties of rose essential oil, hydrosol and absolute. *Curr Microbiol*. 2009;59:554-558.
62. Basim E, Basim H. Antibacterial activity of *Rosa damascena* essential oil. *Fitoterapia*. 2003;74:394-396.
63. Andoğan BC, Baydar H, Kaya S, Demirci M, Özbaşar D, Mumcu E. Antimicrobial activity and chemical composition of some essential oils. *Arch Pharm Res*. 2008;25:860-864.
64. Adwan G, Mhanna M. Synergistic effects of plant extracts and antibiotics on *Staphylococcus aureus* strains isolated from clinical specimens. *Middle East J Sci Res*. 2008;3:134-139.
65. Lisin G, Safiyev S, Craker LE. Antimicrobial activity of some essential oils. *Acta Horticulturae (ISHS)*. 1999;501:283-288.
66. Gochev V, Wlcek K, Buchbauer G, et al. Comparative evaluation of antimicrobial activity and composition of rose oils from various geographic origins, in particular Bulgarian rose oil. *Nat Prod Commun*. 2008;3:1063-1068.
67. Etschmann MMW, Bluemke W, Sell D, Schrader J. Biotechnological production of 2-phenylethanol. *Appl Microbiol Biotechnol*. 2002;59:1-8.
68. Kheirabadi M, Moghimi A, Rakhshandeh H, Rassouli MB. Evaluation of the anticonvulsant activities of *Rosa damascena* on the PTZ induced seizures in wistar rats. *J Biol Sci*. 2008;8:426-430.
69. Ramezani R, Moghimi A, Rakhshandeh H, Eftehadi H, Kheirabadi M. The effect of *Rosa damascena* essential oil on the amygdala electrical kindling seizures in rat. *Pakistan J Biol Sci*. 2008;11:746-751.
70. Ashrafzadeh F, Rakhshandah H, Mahmoudi E. *Rosa damascena* oil: an adjunctive therapy for pediatric refractory seizure. *Iranian J Child Neurol*. 2007;13-17.
71. Senol FS, Orhan I, Kurkcuoglu M, et al. An *in vitro* approach to neuroprotective activity of *Rosa damascena* Mill, a medieval age traditional medicine used for memory enhancement. *Planta Med*. 2011;77(12):1440-1440.
72. Awale S, Tohda C, Tezuka Y, Miyazaki M, Kadota S. Protective effects of *Rosa damascena* and its active constituent on Ab(25-35)-induced neuritic atrophy. *eCAM* 2009;149:1-8.
73. Kwon EK, Lee DY, Lee H, et al. Flavonoids from the buds of *Rosa damascena* inhibit the activity of 3-Hydroxy-3-methylglutaryl-coenzyme A reductase and angiotensin I-converting enzyme. *J Agric Food Chem*. 2010;58:882-886.
74. Achuthan CR, Babu BH, Padikkala J. Antioxidant and hepatoprotective effects of *Rosa damascena*. *Pharm Biol*. 2003;41(5):357-361
75. Biswas NR, Gupta SK, Das GK, et al. Evaluation of ophthalmic eye drops - a herbal formulation in the management of various ophthalmic disorders. *Phytother Res*. 2001;15:618-620.