

# ADALYA

25 2022



**AKMED**

KOÇ UNIVERSITY

Suna & İnan Kırac

Research Center for

Mediterranean Civilizations



25 2022

ISSN 1301-2746

# ADALYA

The Annual of the Koç University Suna & İnan Kıraç Research Center  
for Mediterranean Civilizations

(OFFPRINT)



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The Annual of the Koç University Suna & İnan Kırac Research Center  
for Mediterranean Civilizations (AKMED)

Adalya, a peer reviewed publication, is indexed in the A&HCI (Arts & Humanities Citation Index) – CC / A&H (Current Contents / Arts & Humanities), Social Sciences and Humanities Database of TÜBİTAK / ULAKBİM Tr index, ERIH PLUS (European Reference Index for the Humanities and Social Sciences), Scopus, SOBIAD, and Index Copernicus.

<i>Mode of publication</i>	Worldwide periodical
<i>Publisher certificate number</i>	18318
ISSN	1301-2746
<i>Publisher management</i>	Koç University Rumelifeneri Yolu, 34450 Sarıyer / İstanbul
<i>Publisher</i>	Umran Savaş İnan, President, on behalf of Koç University
<i>Editor-in-chief</i>	Oğuz Tekin
<i>Editors</i>	Tarkan Kahya and Arif Yacı
<i>English copyediting</i>	Mark Wilson
<i>Editorial advisory board</i>	(Members serve for a period of five years) Mustafa Adak, Akdeniz University (2018-2022) Engin Akyürek, Koç University (2018-2022) Emanuela Borgia, Università di Roma Sapienza (2021-2025) Nicholas D. Cahill, University of Wisconsin-Madison (2018-2022) Edhem Eldem, Boğaziçi University / Collège de France (2018-2022) C. Brian Rose, University of Pennsylvania (2018-2022) Christopher H. Roosevelt, Koç University (2021-2025) Charlotte Roueché, Emerita, King's College London (2019-2023)
©	Koç University AKMED, 2022
<i>Production</i>	Zero Production Ltd. Abdullah Sok. No. 17 Taksim 34433 İstanbul Tel: +90 (212) 244 75 21 • Fax: +90 (212) 244 32 09 info@zerobooksonline.com; www.zerobooksonline.com
<i>Printing</i>	Fotokitap Fotoğraf Ürünleri Paz. ve Tic. Ltd. Şti. Oruç Reis Mah. Tekstilkent B-5 Blok No. 10-AH111 Esenler - İstanbul / Türkiye Certificate number: 47448
<i>Mailing address</i>	Barbaros Mah. Kocatepe Sok. No. 22 Kaleiçi 07100 Antalya / Türkiye Tel: +90 (242) 243 42 74 • Fax: +90 (242) 243 80 13 https://akmed.ku.edu.tr
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# The Story of Storax in the Byzantine World: A Fragrant Resin of International Fame from Southern Anatolia

KORAY DURAK\*

## Abstract

This article traces the story of storax resin in the Late Antique and medieval periods in the Eastern Mediterranean world. Storax is a resin extracted from the Latin *Styrax officinalis* (Eng. snowbell; Turk. tesbih / ayı fındığı) that was firm and golden, hence called “solid storax,” and from *Liquidambar orientalis* Mill. (Eng. oriental sweetgum, Turk. sığla / günlük / buhur ağacı) that was sticky and less firm, hence “liquid storax.” Both trees are indigenous to the Eastern Mediterranean region, especially southern Asia Minor. The resin coming from these trees was used in medicine, perfume making, liturgy, and magic throughout the ages. The historical sources usually do not differentiate between the resins of two species, calling both storax. One of the aims of this article is to distinguish between the two resins on the basis of an indirect and limited context provided in the sources. It has been assumed that solid storax of the Classical period was replaced by liquid storax in the Late Antique and especially medieval periods. However, the current study shows that solid storax continued to be used in these periods, although it became rarer and more expensive than liquid storax. Moreover, the data on the commerce of storax shows the degree of integration of Byzantine southern Asia Minor to commercial networks of the medieval Near East, while storax’s frequent

## Öz

Bu makale, Geç Antik Çağ ve Orta Çağ’da storaks ismi verilen reçine üzerinedir. *Styrax officinalis* L.’den (İng. snowbell, Tr. tesbih / ayı fındığı) elde edilen, sert ve altın rengi olan ve bu yüzden “katı storaks” diye adlandırılan bir türün yanında, *Liquidambar orientalis* Mill.’den (İng. oriental sweetgum, Tr. sığla / günlük / buhur ağacı) elde edilen, yapışkan ve daha az katı olan ve bu yüzden “sıvı storaks” olarak bilinen bir türü de vardır. Her iki ağaç da Doğu Akdeniz, özellikle Güney Anadolu’da yetişir. Tarih boyunca bu iki ağaçtan çıkarılan reçine, tıpta, parfüm yapımında, liturjide ve büyücülükte kullanılmıştır. Tarihsel kaynaklarda birbirine benzeyen bu iki reçine arasında genellikle bir ayırım yapılmaması, modern araştırmacıların işini zorlaştırmaktadır. Bu makalenin amaçlarından biri, metinlerdeki dolaylı ve kısıtlı referanslar üzerinden iki tür arasındaki ayrımı göstermektir. Klasik Dönem’de yaygın şekilde kullanılan katı storaksın, Geç Antik Çağ’da ve özellikle Orta Çağ’da yerini sıvı storaksa bıraktığı düşünülmektedir. Bu varsayıma karşın, hâlihazırdaki çalışma, daha az bulunur ve pahalı olsa da katı storaksın söz konusu geç dönemlerde de mevcut olduğunu kanıtlamaktadır. Ayrıca, storaks ticareti üzerine elde edilen veriler, bize Bizans Dönemi’nde Güney Anadolu’nun Yakındoğu ticaret ağlarının parçası olduğunu gösterir. Storaksın Bizans tıbbi

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This research has been supported by Bogazici University Research Fund Grant no. 11921 and a Mellon grant from BU Byzantine Studies Research Center.

appearance in Byzantine medical writing, magical texts, and religious and popular imagination point to the central role this resin played in Byzantine culture.

**Keywords:** Pharmacology, medicine, Byzantine-Islamic relations, Byzantine trade, Pamphylia, Lycia.

yazınında, büyüçülük metinlerinde ve dini ve popüler imgelemde yaygın kullanımı, söz konusu maddenin Bizans kültüründe ne kadar önemli olduğuna işaret eder.

**Anahtar Kelimeler:** Farmakoloji, tıp, Bizans-İslam ilişkileri, Bizans'ta ticaret, Pamphylia, Likya.

## Introduction

Throughout history, the Taurus Mountains and its valleys facing the Mediterranean Sea have played a crucial role in the communications of the Eastern Mediterranean. The coast of southern Asia Minor possesses accessible bays and suitable ports for the maritime routes between the Near Eastern and Egyptian coasts and the Aegean Sea, while the mountain passes of the Taurus connect the Anatolian plateau to the Syrian plains. In the Byzantine period, the area extending from the Dodecanese Islands and Caria to Cilicia through Lycia, Pisidia, Pamphylia and Isauria acted as a bridge for the exchange of commodities between the Byzantine and Islamic worlds, which sold their local products to the Near Eastern markets as well. For instance, according to Ibn Hāwqāl, Attaleia was one of the two Byzantine cities (the other being Trebizond) producing substantial amounts of customs income for the Byzantine state by the third quarter of the 10th century, and ships arrived in Attaleia from Syria during that time.<sup>1</sup> There was a sizable Jewish community in Attaleia, and the capture of Jewish and Greek merchants from Attaleia and other ports in the region by Muslim pirates, as shown in the Genizah documents, attests to the commercial importance of Attaleia and its links to the Near East in the early 11th century.<sup>2</sup> To be specific about what was traded in and through Attaleia, we can go through the list of booty looted by Muslims from the Byzantine merchant ships anchored in Attaleia in 904: large amounts of merchandise, pieces of furniture, and vessels perhaps ceramic tableware.<sup>3</sup> Regarding the local products of the Pamphylian region, timber from the Taurus Mountains and the coast was a sought-after material among the Near Easterners, obtained through raids and trade.<sup>4</sup> Other than Byzantine silk from different regions of Asia Minor that passed to the Near Eastern markets through southern Asia Minor, the 11th-century Byzantine historian Attaleiates mentions tricolored silk cloths with borders in the Attaleia style.<sup>5</sup> Like Pamphylia, Cilicia on the eastern end of southern Asia Minor was a highway for the transportation of Islamic silk and spices to Constantinople, and for the export of Byzantine falcons and mastic to the Near Eastern markets. It also possessed local agricultural products and timber as well as textiles to sell to the other side of the frontier.<sup>6</sup>

Southern Byzantine provinces were especially prominent in the export of medicinal plants to the Islamic world. The pine-growing coastal regions of Asia Minor produced pine nuts; Crete exported medicinal plants such as wormwood; and northern Syria and Cilicia (centered around

<sup>1</sup> Ibn Hāwqāl 197. The transliteration system used by *Oxford Dictionary of Byzantium* is adopted for Greek names and terms, while the *Encyclopaedia of Islam (Second Edition)* is consulted for Arabic names and terms.

<sup>2</sup> Jacoby 1998, 91.

<sup>3</sup> 'Arīb ibn Sa'd al-Qurtūbī 6; Grégoire and Canard 1950, 167.

<sup>4</sup> Morrisson 2016, 113, 119-22; Zimmerman 2016, 71; Jacoby 2000, 36.

<sup>5</sup> Attaleiates 129.

<sup>6</sup> Durak 2013, 2018; Durak 2008, 228.



Antioch) exported wormwood, leopard's bane, and scammony.<sup>7</sup> To this list may be added the remark of the mid-12th-century al-Idrīsī that Ceramus in Caria produces aromatic plants as well as a physician's letter from Byzantine Seleukeia (1137) in which he mentions local mulberries, ribes / currants, barberries, and gentian sent as gifts to Egypt.<sup>8</sup>

## The Story of Storax

One of the plants exported from southern Asia Minor was storax, a resin extracted from a tree, and used in medicine, perfume-making, liturgy, and magic throughout the ages. Research on the story of this substance in the Byzantine period is extremely limited. In a one-page treatment A. Dalby asks whether *zygiaia* in the 10th-century Book of the Eparch could be storax, while F. Hild and H. Hellenkemper mention storax as a product of Cilicia.<sup>9</sup> The aim of this article is to trace the story of storax in the Late Antique and medieval periods. By studying the extraction of storax resin, its commercial availability in Byzantium and its export to the Islamic world, as well as its uses - especially in the field of medicine in the Byzantine world - we hope to contribute to the study of the commercial history of southern Asia Minor as well as Byzantine medicine in the Middle Ages. We hope also to examine the place of this fragrant gum in the Byzantine popular imagination. The period covered in the present investigation starts with the Late Antique period (c. third to sixth centuries CE) when Anatolia prospered and the Eastern Mediterranean remained united under the new regime in Constantinople. The seventh century witnessed the expansion of the early Islamic armies into Cyprus and Northern Syria, turning southern Asia Minor into a frontier zone of confrontation and communication between the Byzantines and the mainly Islamic dynasties to the south, i.e., the Umayyads of Damascus (661-750), the Abbasids of Baghdad (effective rule 750-945), the Tulunids (887-905) and the Ikhshidids (941-969) of Egypt, and the Hamdanids of Aleppo (890-1004) in the seventh to 10th centuries. In the 11th and the 12th centuries, southern Anatolia under the Comnenian dynasty faced the rising power of the Armenian Kingdom of Cilicia, and interacted with the Crusader states of the Levant and the Fatimids of Egypt. The 13th century provides a terminus for the present study, when the Seljuks of Konya and the Turkish beyliks following the Seljuk demise conquered the central and western parts of southern Anatolia from the Byzantines while the Armenian Kingdom consolidated its hegemony in Cilicia and Isauria.

The story of storax began much earlier than the period covered in this study, and involves some uncertainty concerning the identification of two resinous substances from two different plants known as storax. Historical sources did not usually differentiate between the two resins, which has contributed to confusion in modern works. According to recent scholarship, *Styrax officinalis* L. (Eng. snowbell; Turk. tesbih / ayı findığı) was the source of a resin that was firm and golden / sandy-brown in color, hence called "solid storax." However, *Liquidambar orientalis* Mill. (Eng. oriental sweetgum; Turk. sığla / günlük / buhur ağacı) is a tree that produces a liquid, sticky balsam that is reddish brown to black in color, hence "liquid storax."<sup>10</sup> Throughout this article, I will use the term "solid storax" for *Styrax officinalis* L. and "liquid

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<sup>7</sup> Hild and Hellenkemper 1990, 1:108-12; Hellenkemper and Hild 2004, 1:156-69.

<sup>8</sup> Idrīsī 1:304; Goitein 1964, 299.

<sup>9</sup> Dalby 2007, 54-55; Hild and Hellenkemper 1990, 1:111, 113.

<sup>10</sup> Amigues 2007, 262-82; Oflas 1972. See the commentary of F. Adams in his translation Paul of Aegina's medical work. Paul of Aegina 3:362; Nicolas 1978; Tanker and Sayron 1974, 108-9. For the earlier scholarship see Guibourt and Planchon 1876; Hanbury 1876, 129-45.

storax” for *Liquidambar orientalis* Mill. To complicate the subject more, modern scholarship of the last two hundred years distinguishes among a number of varieties of *Styrax officinalis* L. / solid storax, based on viscosity (from solid to semi-liquid) and on purity (from transparent to an opaque look with sawdust).<sup>11</sup> Moreover, based on the observations of western European travelers of the process of resin extraction from *Liquidambar orientalis* Mill. by the locals of southern Turkey (such as Yörüks) in the 19th and 20th centuries, it is possible to distinguish between true liquid storax (obtained by boiling bark with the resin on it, then skimming off the resin from the water), black liquid storax (obtained by boiling and pressuring the remaining bark repeatedly), and dried storax bark (already processed bark, dried and sold as incense).<sup>12</sup>

*Styrax officinalis* L. from the family *Styracaceae*, is a deciduous shrub 2-5 meters in height. It has fragrant flowers in clusters of three to six which appear in the late spring / early summer. It grows in alkaline soil, especially around pine forests. It has an expansive distribution in the Eastern Mediterranean, specifically Greater Syria, southern and western Turkey, Cyprus, and parts of Greece and the Aegean Islands.<sup>13</sup> According to Y. Vardar and S. Oflas, the resin from *Styrax officinalis* L., especially from Antakya, Karaisalı in Adana, and Kumluca in Antalya (all in southern Türkiye), is used in religious ceremonies by the locals.<sup>14</sup> *Liquidambar orientalis* Mill. from the family *Hamamelidaceae* is an aromatic tree that grows up to 30 meters tall with palmatifid leaves that resemble the leaves of a sycamore tree. It flowers in March and April and grows in flood plains, marshy places, and valleys near streams, up to 1800 meters above sea level. It is native to southern and southwestern Türkiye, and found most abundantly in Muğla and to some extent in the province of Antalya.<sup>15</sup>

## The Classical and Late Antique Periods: The Gift of Syria to the World

Στύραξ (Lat. *styrax*) in the sources of the Classical Greek period refers to the plant and balsam of *Styrax officinalis* L. In this period this resinous shrub was either endemic to Greater Syria (including modern Syria, Lebanon, Israel, and Palestine), or perhaps present in Southeast Europe and West Asia in ancient times as it is today. However, the demand could only be fulfilled from the *Styrax officinalis* L. shrubs growing in the Greater Syria region, for Herodotus claims that the Phoenicians exported storax to Greece.<sup>16</sup> The association of storax with *Styrax officinalis* L. does not mean that *Liquidambar orientalis* Mill. as a balsam-producing plant was unknown to the ancient Greeks. S. Amigues and L. Casson suggest that it is likely that the

<sup>11</sup> Oflas 1972, 66-67; Nicolas 1978, 160; Amigues 2007, 269 (based on P. Gennadios' observations in 1914); Diapoulis 1952, 120; Hanbury 1876, 132.

<sup>12</sup> The bark of *Liquidambar orientalis* Mill. is punctured to form oil ducts where the exudate forms, which then are collected in cans. Ciesla 2002, 44; Nicolas 1978, 159-60; Hanbury 1876, 136-42.

<sup>13</sup> On *Styrax officinalis* L. see Schönfelder and Schönfelder 1997, 43; Davis 1972, 144; Hovaneissian et al. 2006, 1195. Polunin and Huxley 1987, 143-44; Diapoulis 1952, 119. For the distribution of the two plants in discussion and the other species of the genus *Styrax* in Central / Southern America and in South-East Asia, and *Liquidambar styraciflua* of Central America and *Liquidambar altingiana* of South-East Asia, see Hovaneissian et al. 2006, 1193-195; Oflas 1972, 43-48.

<sup>14</sup> Oflas 1972, 66-67; Vardar and Oflas 1973, 145; N. Zeybek noted in 1970 that among the samples he collected in Türkiye, only the sample from Antakya produced resin.

<sup>15</sup> Diapoulis 1952, 120; Akman et al. 1992; Efe 1987; Oflas 1972; Efe and Dırık 1992. For *Liquidambar orientalis* Mill. in southwestern Türkiye, see Davis 1972, 4:264. For the availability of *Liquidambar orientalis* Mill. in Bozburun, Antalya, see Fakir 2006; Grieve 1959, 2:775.

<sup>16</sup> Hanbury 1876, 129-50 in his authoritative study on the source of storax in antiquity concluded that ancient storax must have been the solid / dry storax. For the same view, see Grieve 1959, 2:775; André 1985, 252; Herodotus 303. For storax in the Old and New Testament, see Sell 2019.

Classical world, especially by the Roman period, made use of liquid storax (i.e. *Liquidambar orientalis* Mill.).<sup>17</sup> It is the contention of modern scholars that the balsam of *Styrax officinalis* L. gradually became rarer, perhaps starting already from the fourth century BCE, as noticed by Galen in the second century CE. It was definitely much less common by the Late Antique period. The product was accompanied and later replaced by the more available balsam of *Liquidambar orientalis* Mill.<sup>18</sup> Investigations by later Classical and medieval sources including Islamic ones, with which I will engage, will tell us whether the resin of *Styrax officinalis* L. was unavailable by the end of the Late Antique period.

Before embarking on this investigation, the citation of a few major ancient authorities would provide a perspective on the complex use of storax during the Classical period. Herodotus informs his readers that Arabs used the fumes of *Styrax officinalis* L. to chase away snakes.<sup>19</sup> The scent of *Styrax officinalis* L., disturbing to animals but attractive to humans, earned its reputation as an aromatic plant. It is no wonder that the fourth-century BCE philosopher Theophrastus lists storax among the aromatic plants (ἀρώματα) in his *Enquiry into Plants*.<sup>20</sup> The same shrub was also a favorite fumigation material for religious ceremonies and festive events in this polytheistic age. Athenaeus of Naucratis in the Roman period refers in his *Deipnosophistae* to the burning of storax at the Dionysiac festivals for its pleasant smell.<sup>21</sup>

The Hippocratic corpus from the period between the fifth and third centuries BCE recommends the use of storax seven times in the gynecological treatises. Storax is used as incense or powder in these treatises, for which the solid form rather than liquid was appropriate.<sup>22</sup> The Greek-speaking geographer Strabo (d. 24 CE) from Roman Asia Minor provides the longest account of storax from the Classical period, though conflating information on the two separate resins. In his description of the Selge region in Pisidia, Strabo first writes: “it is the styrax-tree that is produced in greatest abundance there, a tree which is not large but grows straight up, the tree from which the styracine javelins are made...” The description of the tree fits the characteristics of *Styrax officinalis* L. However, as S. Amigues shows, the rest of Strabo’s account, which concerns the process of resin extraction, represents the collecting of *Liquidambar orientalis* Mill.’s sap:

And a species of wood-eating worm is bred in the trunk which eats through the wood of the tree to the surface, and at first pours out raspings like bran or sawdust, which are piled up at the root of the tree; and then a liquid substance exudes which readily hardens into a substance like gum. But a part of this liquid flows down upon the raspings at the root of the tree and mixes with both them and the soil, except so much of it as condenses on the surface of the raspings and remains pure, and except the part which hardens on the surface of the trunk

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<sup>17</sup> Amigues 2007, 262. The use of *Liquidambar orientalis* Mill. as an additive can be traced back to the Bronze Age. Wine jars in a Middle Bronze Age wine cellar from a palace in Tell Kabri, Israel, contain traces of *Liquidambar orientalis* Mill. as an additive. Based on the observation that the current *Styrax officinalis* L. shrub does not produce a resin that would match the historical descriptions, some argue that storax of the ancients was actually the balsam of *Liquidambar orientalis* Mill. See *Encyclopaedia Judaica* 19 s.v. “Storax”; Koh et al. 2014, 5.

<sup>18</sup> Hanbury 1876, 132; Oflas 1972, 65; Meikle 1985, 1089; Amigues 2007, 270, 286, 311, 313-14; Modugno et al. 2006, 298; Serpico and White 2000, 437.

<sup>19</sup> Herodotus 303; Amigues 2007, 285-86.

<sup>20</sup> Theophrastus 2:249.

<sup>21</sup> Athenaeus Book 14.23.

<sup>22</sup> Amigues 2007, 286; Totelin 2009, 146-47, 191.

down which it flows, this too being pure. And the people make a kind of substance mixed with wood and earth from that which is not pure, this being more fragrant than the pure substance but otherwise inferior in strength to it (a fact unnoticed by most people), which is used in large quantities as frankincense by the worshippers of the gods.<sup>23</sup>

Leaving aside the wood-eating worms, which probably refer to insects such as moths that do not have any effect on the production of the resin, it is possible to distinguish three varieties of *Liquidambar orientalis* Mill. in the quotation above. The first is the purest that hardens on the surface of the trunk as it flows down; the second is a less pure resin that flows down the raspings and the soil mixing with them; the third is the most inferior variety that is mixed with wood and earth and used as incense in religious liturgy. Since the Selge region had both *Styrax officinalis* L. and *Liquidambar orientalis* Mill., it is natural that Strabo started describing the former, and continued by describing the latter.<sup>24</sup> Pliny the Elder's account on storax fifty years after Strabo's clearly depicts *Styrax officinalis* L., not only because of Pliny's comparison of this tree to quince in appearance, but also because of its location (primarily Syria, and Seleukeia; secondly Pisidia, Sidon, Cyprus, and Cilicia; thirdly the worst variety from Pamphylia and Crete) and its viscosity (*Styrax officinalis* L. could be unctuous and viscous but not liquid).<sup>25</sup>

Around the same time Dioscorides, the great pharmacologist of the Roman Imperial period (d. 90 CE), starts his narrative by likening storax tree to quince, meaning that he had solid storax in mind. He defines the best variety, which comes from Gabala (Lebanon), Pisidia, and Cilicia, as "yellow, fatty, and resinous; it has whitish lumps, its scent lasts for a very long time and when softened, it releases some honey-like moisture." This description suits the characteristics of *Styrax officinalis* L. He also notes a second variety, writing that "storax that is black, friable, and bran-like is inferior," befitting the description of black storax made from *Liquidambar orientalis* Mill. He adds, "There is also a sap resembling gum and which is translucent and myrrh-like; this, however, is scarce." This account again refers to *Styrax officinalis* L.<sup>26</sup>

Finally, Galen, another Greek physician of the Roman period and probably the greatest synthesizer of Classical medical knowledge, distinguishes between varieties of storax. The most active storax carries a light-yellow color and is produced in such small quantities in Pamphylia that Galen prefers using it for the emperor as well as those who can pay. This variety is definitely *Styrax officinalis* L. The inferior storax has a more or less brown color depending on the impurity content. Due to its darker color, this latter variety probably came from *Liquidambar orientalis* Mill.<sup>27</sup> In *Peri Antidotōn*, Galen again refers to the rarity of the storax *calamitis* (καλαμίτης : reed-shaped) from Pamphylia, and likens the superiority of this storax to that of Falerne wine over table wine. *Calamitis* might refer to the reed-shape of the resin *Styrax officinalis* L., or to the relatively semi-fluid nature of the same resin that would be carried in the knots of reeds.<sup>28</sup>

<sup>23</sup> Strabo 5:482-83.

<sup>24</sup> Amigues 2007, 293.

<sup>25</sup> Pliny the Elder 3:151-52. Amigues 2007, 309-10.

<sup>26</sup> Dioscorides Book 1.59-60; Amigues 2007, 308-9.

<sup>27</sup> Galen, *De compositione*, 13:954; Amigues 2007, 311. For Galen's description of the powers of storax as *materia medica* and the medical conditions for which storax is used, see Galen, *De simplicium*, 12:131.

<sup>28</sup> Galen, *De antidotis*, 79. For the discussion on *calamitis*, see Amigues 2007, 314; Stephanus of Athens 104-5; Engler 1907, 12; Oflas 1972, 66; Hanbury 1876, 132.

In the Late Antique period - the first period of focus of this article - storax continued to be used both as incense and as a drug ingredient. The evidence allows us to claim that solid storax was still available, although it was more difficult to find than liquid storax. Although one cannot argue that ancient lexica reflected the most up-to-date information about material culture, the lexicon of Greek words by Hesychios from fifth- or sixth-century Alexandria defines storax as a tree out of which lance / spear heads were made and which was used as an incense. These famous lances were made from *Styrax officinalis* L.<sup>29</sup> Late antique information on the use of storax as an incense in churches and / or for religious purposes comes from the life of Symeon the Stylite the Younger (521-592). In the *vita* of this saint, who lived around Antioch, the future mother of Symeon goes to a holy man named John the Forerunner and prays for a son. John tells her that the Lord has responded to her prayers and gives her storax incense to burn in front of his holy icon.<sup>30</sup> Use of solid storax for liturgical purposes is confirmed in archaeological evidence too. The residual deposit of resin from an incense burner, found at North Necropolis in Antinoe, Egypt and dating to the fifth to seventh centuries CE, are proven to belong to *Styrax officinalis* L.<sup>31</sup> It is no wonder that storax incense was associated with prayer in the anonymous and undated *Theoretikon Paradeission*.<sup>32</sup> Late antique people saw storax as a quintessentially fragrant substance. The early Christian theologian Clement of Alexandria (d. 215) defines storax as having a “peasant odor” and being “the most pleasant of spices” in his theological discussions and comments on the Pentateuch concerning the subjects of smell and death, respectively. Cyril of Alexandria describes storax in his comments on Genesis in the Old Testament as “the most pleasant of ἀρώματα (aromatic plants).”<sup>33</sup> People of the period noted the fragrance of the flowers of the storax tree too. Theodoret of Cyrillus, a fifth-century bishop from northern Syria, sent to a friend Cilician honey produced by “bees plundering the flowers of storax.”<sup>34</sup> The color and fragrance of storax were associated with each other in the late antique popular mind. While speaking about the association of senses in the human mind, John Philoponos (d. c. 570), in his commentary on Aristotle’s *De Anima*, gives the following example: “Having seen something yellow we say that we saw something fragrant; for I say seeing is associated / in harmony with the fragrant. And having smelled storax, I say that I smelled yellow.”<sup>35</sup> Storax was used to perfume the hair too. Hair extracted from the mummified remains of a female in a sarcophagus from fourth-century CE Thessaloniki contains vanillin and cinnamates, which are found in *Liquidambar orientalis* Mill.<sup>36</sup>

Solid storax was probably a more expensive and rare resin than the liquid. While thanking his friend for a letter, Libanius, the great rhetorician of fourth-century Antioch, reveals that he found the letter even more agreeable than storax, which his friend complains is not received from Isauria anymore.<sup>37</sup> The rarity of solid storax was reflected in its price. The edict of Emperor Diocletian, which set maximum prices in 301, lists “storax of Cilicia” and “storax

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<sup>29</sup> Hesychios Sigma, 2092.

<sup>30</sup> In another instance, he tells her to take “this mass of storax,” which she must burn with her hands in the church; see Bompaire 1954. chap. 3.10 and 2.8. For a recent translation, see van den Ven 1970.

<sup>31</sup> Modugno et al. 2006, 303.

<sup>32</sup> Littlewood 1992, 130.

<sup>33</sup> Clement of Alexandria Book 8.9.31; Cyril of Alexandria 69:240.

<sup>34</sup> Théodoret de Cyr. Letter 14.

<sup>35</sup> *Ioannis Philoponi in Aristotelis de anima libros commentaria* 38.

<sup>36</sup> Papageorgopoulou et al. 2009, 39.

<sup>37</sup> Libanius 318.

of Antioch” as having the maximum prices of 500 denarius and 200 denarius per pound respectively, although storax oil was much cheaper at 30 denarius per pound. Referring to the distinction made by Classical authors like Galen and Pliny based on rarity and high price, M. Corbier and S. Amigues claim that the Cilician storax was probably the resin of *Styrax officinalis* L. while Antiochene storax was probably extracted from *Liquidambar orientalis* Mill.<sup>38</sup> The separate “50 lb. Isaurian storax” and “150 lb. of storax,” listed among the gifts to St. Peter’s Basilica in Rome by Constantine the Great in the early fourth century, may refer to a distinction between solid and liquid storax with the Isaurian storax being the former.<sup>39</sup> The presence of solid storax in the edict of Diocletian shows that *Styrax officinalis* L. was more expensive than it had formerly been, but it was still available by the early fourth century.

The export of storax from the southern Anatolian coast to the rest of the world must have been easy since it was very well connected to the rest of the Mediterranean in the Roman and Late Antique periods.<sup>40</sup> Traces of *Styrax officinalis* L. can be found in the material culture of southern Asia Minor. Some of the amphorae from Sagalassos in Pisidia, dating to the period between the fourth and seventh centuries, contain *Styrax officinalis* L. leaf impressions on their rims. The function of these leaf impressions is not clear, and the amphorae in question did not exclusively carry wine, although at one point they did. However, according to P.M. Bes and L. Vanhecke, the local producers of the amphorae may have been aware that storax would be used as a flavoring for wine.<sup>41</sup> Moreover, storax was sold in the city of Aphrodisias in western Asia Minor in the fourth and fifth centuries. A graffito from the city’s Tetrastoon represents a list of goods traded there, including major consumption goods and “less certainly” storax.<sup>42</sup> By the first century CE, merchants traded storax to India via the Red Sea and the Gulf of Aden to northwestern India, because the route is described in *The Periplus of the Erythraean Sea*, a mid-first century CE account of commercial travel from the Roman world to Africa and India. According to this anonymous work, storax was carried on boats from Egypt to Muza, modern al-Mukha on the western coast of Yemen. The same boats must have sailed to the northwest Indian coast because storax was among the commodities brought to Barbarikon at the mouth of Indus in northwestern India and Barygaza, the main port of northwestern India close to modern Mumbai.<sup>43</sup> Unfortunately, we cannot determine which form of storax was mentioned in the Periplus.<sup>44</sup>

Storax was a Roman export to China in the Late Antique period.<sup>45</sup> Chinese sources prove that storax continued to be exported to India and the Far East during this period. The superb examinations of the Chinese sources, especially from the fifth and sixth centuries, by Berthold

<sup>38</sup> *Diokletians Preisedikt* 285-86; Mireille 1985, 97; Amigues 2007, 312. [https://www.academia.edu/23644199/New\\_English\\_translation\\_of\\_the\\_Price\\_Edict\\_of\\_Diocletianus](https://www.academia.edu/23644199/New_English_translation_of_the_Price_Edict_of_Diocletianus)

<sup>39</sup> *Liber Pontificalis* 1:177-78; Seland 2012, 120; Caseau 2007, 88-89.

<sup>40</sup> On the connectivity of Lycia, see Foss 1994; Dündar 2016, 289-90; Zimmermann 1992.

<sup>41</sup> Bes and Vanhecke, 2015, 107-66; Vroom 2018, 146. For a case of wine flavored by storax employed in late antique medical lore, see Oribasius 5.33.12. For aromatized wine appearing in late antique Egyptian papyri, see Trismegistos 64533 in <https://papyri.info/>. For the discussion on the representation of storax tree on the Hellenistic-period coins of Selge in Pisidia, see Amigues 2007, 294-308 and Bess and Vanhecke 2015, 127-28.

<sup>42</sup> Lavan 2006, 229; Stroobants and Poblome 2015, 85.

<sup>43</sup> Casson 1989, 66-67, 74-75, 80-81. For dating, see Casson 1989, 6.

<sup>44</sup> For the historiography of the discussion on the nature of the storax sent to India and China, see Schoff 1912, 128-29; Casson 1989, 163-64; E.H. Warmington 1974, 266 identifies the storax sent to China as *Liquidambar orientalis* Mill.; cf. Hirth 1885, 263-66.

<sup>45</sup> Ferguson 1978, 590; Mango 1996, 140; Whitfield 2018, 1:324.

Laufer and Lin Ying show that the storax in question (*sube*) in this period was most probably solid storax. It was a precious item employed in making perfume and to a limited extent medicine. It was also transported via land routes between Parthian / Sassanid Iran and China.<sup>46</sup> However, the description of the production process of storax by a seventh century source, Liang shu, is more similar to that of liquid storax. In Liang shu, we read that *sube* is not a natural product but a mixture of various fragrances. People gather and boil it, squeeze its juice out, and sell the dregs to traders. Another source dated prior to 527 - Kwan ci - speaks of “pressing the juice out of *subole*” to make an aromatic substance.<sup>47</sup> Boiling and pressing as well as the use of dregs would seem to indicate the production of liquid storax. It is possible to trace the presence of both solid and liquid storax in the Chinese sources stretching from the Classical period to the early Middle Ages. However, as Ying warns, the subject requires further study.

Medical sources also testify to the availability of solid storax in the Late Antique period. Papyrus evidence from late antique Egypt also testifies to the use of storax in contemporary medical practice.<sup>48</sup> Storax is widely visible in the famous medical compilations of the era - Oribasios of Pergamon, Aetios of Amida, Alexander of Tralles, and Paul of Aegina. Compiled from ancient medical sources, these were voluminous but practical handbooks for their readers. Relatively rich information on storax’s qualities and places of use can be gleaned from these handbooks, since they covered various topics ranging from diagnosis of diseases to pharmacology, and dietetics to surgery. Quoting verbatim from Dioscorides’ *De materia medica*, Oribasios describes storax as a yellow, fatty, resinous substance coming from a tree similar to a quince tree and having heating, emollient, and digestive properties. It is used in compounds against coughs, catarrhs, discharges from the nostrils, hoarseness of voice, and menstruation-related problems. The description suits the resin of *Styrax officinalis* L.<sup>49</sup> Oribasios, in the sections of his *Medical Collections* where he prescribes various compound drugs for diseases, does not distinguish between the different varieties of storax nor does he give any provenance. However, it is not difficult to understand that he had solid storax in mind from the way the substance is expected to be employed. For instance, for a mixture called *Sturakaton*, the author asks the reader to skim the honey and grind the storax.<sup>50</sup> Likewise, for the preparation of a purgative medicine, he recommends the cutting of storax in a mortar.<sup>51</sup> Grinding or cutting could only be done to solid storax.

Aetios of Amida from the early sixth century repeats Dioscorides’ observations about solid storax’s properties and the medical areas for which it was used.<sup>52</sup> Unlike that of Oribasios, Aetios’ medical treatise - *Tetrabiblos* - mentions different varieties of storax: *calamitis* / reed-shaped (*καλαμίτης*), high quality (*πρώτειος*), good (*κάλος*), yellowish / golden (*ξανθός*), and fatty / greasy (*λιπαρός*).<sup>53</sup> Since golden color, fatty texture, and high / good quality are defined as characteristics of *Styrax officinalis* L. by Classical authors, Aetios of Amida must have had solid storax in mind. This point is also proven by the way the storax is added into the compound

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<sup>46</sup> Laufer 1919, 456-60; Ying 2004, 330-33.

<sup>47</sup> Ying 2004, 333; Laufer 1919, 456.

<sup>48</sup> p.coll.youtie.2.86, p.nyu.2.51, p.oxy.16.2053, p.oxy.54.3731, p.prag.1.88 in <https://papyri.info/>

<sup>49</sup> Oribasius 12.σ.57; Oribasius *Synopsis* 2.56.55.

<sup>50</sup> Oribasius 5, 33.12.

<sup>51</sup> Oribasius 8, 43.1.

<sup>52</sup> Aetius 7.3.

<sup>53</sup> Aetius 1.123, 1.132, 8.75, 16.167, 16.175, 12.59.

drugs in his work. In various recipes, Aetios recommends softening the storax with saliva, cutting it into smaller pieces, melting it, and pounding it.<sup>54</sup>

Among the great compilers Alexander of Tralles from the sixth century, who wrote the twelve-volume *Therapeutics* and *On Fevers*, does not expand on the properties of storax *à la Dioscoride*. Paul of Aegina, who wrote his seven-volume *Epitome* in the seventh century, briefly recaps what Oribasios wrote about the properties and uses of solid storax.<sup>55</sup> Both authors recommend simply “storax” in some cases, but other times indicate specific varieties. For example, Paul of Aegina recommends storax (without further qualification) quite often especially for stomach and kidney problems as well as for coughing. However, he is more specific in three instances: fatty storax against scyrrhus; white storax (λευκός) for purging phelgm; and storax *calamitis* in the Peonian antidote.<sup>56</sup> Both Isaurian storax and storax *calamitis* must be solid storax resins, and the attributes “fatty” and “white” also indicate the solid form.<sup>57</sup> Alexander of Tralles also uses the generic term “storax” for his medical recipes to treat cough, reflux and stomach problems, and fever.<sup>58</sup> The method of mixing the storax nevertheless shows that he had the solid form in mind. For a compound against quartan fever he asks the physician to mix a number of *materia medica* including storax. He adds that one should spread the storax, dissolving it in honey and sprinkling the dry parts (τὰ ξηρά) on it. Similarly, in a recipe attributed to Galen, the author lists a number of simple drugs including spikenard, frankincense, and storax, and asks the preparer to soften the dry material in wine for a day. Defining storax as “dry” points to the use of the resin of *Styrax officinalis* L.<sup>59</sup> Concerning storax of different varieties, Alexander of Tralles warns his reader to use storax of good quality (καλοῦ) in a compound against quartan fever, Isaurian storax against abdominal induration, and storax *calamitis* twice - in a pill against coughing and in the Marciatum salve for stomach problems.<sup>60</sup> The good quality and the reference to Isaurian storax point more to *Styrax officinalis* L.

The association of storax with fragrant smells can be traced in medical writing too. Oribasios’ suggestion of applying “bee-glue that is golden and fragrant, and smelling of storax” not only reminds us of Theodoret of Cyrrhus’ description of Cilician honey, but also shows the use of this honey in medicine.<sup>61</sup> The same author recommends the use of soot obtained from storax, which he claims to be similar to the soot of frankincense. Paul of Aegina also makes use of the storax soot and recommends storax repeatedly in the section on compounds of perfume and cyphi, an ancient incense.<sup>62</sup>

Concerning provenance, Cilicia, Antioch, and Isauria were the major locations where storax could be found, as the primary sources quoted above show (Theodoret of Cyrrhus, Libanius, the Price Edict of Diocletian and Alexander of Tralles). The western-most distribution area seems to be Crete because Stephen of Byzantium refers in his sixth-century geographical

<sup>54</sup> Aetius 12.65.40, 1.131.18, 12.59.6, 12.67.48, 12.63.51.

<sup>55</sup> Paulus Aegineta 7.3

<sup>56</sup> Paulus Aegineta 4.32, 7, 4, 7.11.

<sup>57</sup> Paulus Aegineta 4.32, 7.4, 7.11.

<sup>58</sup> Alexander of Tralles 1.429, 2.77, 2.157, 2.181, 2.269, 2.435.

<sup>59</sup> Alexander of Tralles 1.435, 2.295.

<sup>60</sup> Alexander of Tralles 1.425, 2.303, 2.179, 1.401.

<sup>61</sup> Oribasius 12.π.30: “Πρόπολιν παραληπτέον τὴν ξανθὴν καὶ εὐώδη, στύρακος πνέουσας, ...”

<sup>62</sup> Oribasius 11.λ.7, 15.1.18; Paulus Aegineta 7.3, 7.22, *passim*.



dictionary *Ethnika* to a mountain called Sturakion in Crete where “the inhabitants are storax-makers.”<sup>63</sup> Stephen of Athens, who wrote a commentary on Hippocrates’ aphorisms in late sixth / early seventh centuries, gives the geographical origins of this hot and moist balm. He writes: “From Isauria bolt-shaped and reed-shaped storax, and such items” (ἀπὸ δὲ Ἰσαυρίας ὁ στύραξ ὁ γομφίτης καὶ ὁ καλάμιτης καὶ τὰ τοιαῦτα).<sup>64</sup> As this shows, Isauria was home to the resin of *Styrax officinalis* L. in various forms, two of which were most famous - the bolt-shaped / γομφίτης (*storax gomphytis*) and the reed-shaped (κἀλαμίτης). Stephen’s elucidation of storax might mean that these varieties of *Styrax officinalis* L. were available in Hippocrates’ time or in his own time.

A similar picture emerges when we look at medical works in the Latin-speaking Mediterranean in the Late Antique period. The writers in question do not usually specify the storax variety they have in mind. For instance, the writer of the *Medicina Plinii*, a reference book for travelers written before 400 CE, recommends simply storax, while Marcellinus from the Gaul, *magister officiorum* under Theodosios I in the late fourth century, includes storax in the compounds for stomach problems and coughing, and for problems with tendon nodules in his *De medicamentis*.<sup>65</sup> There was even a compound drug named *sturakinon*, described in the *Chronic Affections* of Cornelius Aurelianus in the fifth century.<sup>66</sup> Storax was always associated with a good scent. The writer of the fourth- / fifth- century medical poem titled *De medica* counts storax (“storacem”) among aromatics emitting a fragrant smell.<sup>67</sup> A number of sources show that *Styrax officinalis* L. was still available during the Late Antique period. In Cassius Felix’s *De Medicina* from the mid-fifth century, references to the best quality storax from Isauria and “styracis calamitae” point to *Styrax officinalis* L.<sup>68</sup> Isidore of Seville (d. 636), who used among others Pliny the Elder as a source for his *Etymologiae*, gives under the heading of “aromatic trees (de aromaticis arboribus)” a definition of storax that is very close to those of Dioscorides and Pliny the Elder:

The storax is a tree of Arabia, similar to the quince, whose shoots exude sap from their crevices during the rising of the dog star. When its distillate falls to the ground, it is unclean, but when it is preserved in its own bark, it is clean. The distillate clinging to rods and reeds is clean and whitish, but then becomes yellowed because of the sun. The storax itself is reedy, oily, resinous, of pleasant odor, and moist, and it emits a sort of honey-like liquid. Moreover, storax is so called because the sap of this tree flows and is solidified ...<sup>69</sup>

Isidore does not differentiate between different varieties of storax as Dioscorides and Pliny the Elder do, but his description reflects the characteristics of *Styrax officinalis* L. completely.

<sup>63</sup> Stephan von Byzanz 588.

<sup>64</sup> Stephanus of Athens 104-5, 156-57.

<sup>65</sup> *Medicina Plinii* 2020, 72 (Latin text), 222. The storax in question is *Styrax officinalis* according to the editor. Marcellus Empiricus 154, 203, 208-10, 219.

<sup>66</sup> Tecusan 2004, 229. According to Aetios of Amida 1935, 1.123, *sturakinon* was made by boiling “storax” and the best quality olive oil in the same pot; *Sturakaton* (στουρακάτον) was another compound made from storax, good-quality wine, and honey; cf. Nikolaos Myrepsos 935.

<sup>67</sup> Cilliers 2018, 133.

<sup>68</sup> Cassius Felix 133, 138.

<sup>69</sup> Isidore of Seville 17.7-8. For the translation into English, see *Etymologies of Isidore of Seville* 14-15, 348.

In addition to Byzantine medicine, Byzantine magical practices involved the use of storax. In a late antique anonymous collection of magical recipes written in the fourth century, *The Kyranides*, the reader is told to rub storax into a concoction used for conceiving a baby.<sup>70</sup> The action of rubbing allows us identify the substance as solid storax. In the Greek magical papyri from Roman and late antique Egypt, storax appears frequently among *materia magica*. The plant is attributed to the god Kronos because it is heavy and fragrant. For instance, a lead plate with spells is “consecrated” with “bitter aromatics” like storax to restrain anything like chariots and demons. There is storax among the offerings for a “bear charm that accomplishes everything.” Likewise, in a slender spell, an offering of Cretan storax is made.<sup>71</sup> The statement in a papyrus that the leaves of storax are twisted like a ram’s horn brings to mind the leaves of *Styrax officinalis* L., which are curved.<sup>72</sup> Finally, in a letter with fictitious characters for satirical purposes, the Roman or late antique writer Alkiphron describes a woman from Phrygia with the knowledge of divination who prepares among other items, “tall / large? storax (στύρακα μακρὸν)” for purification purposes.<sup>73</sup>

In short, although we cannot be sure whether the generic term “storax” as used in the late antique medical compilations referred to the dry or solid forms, occasional references in Greek and Latin medical works to storax of good / high quality, storax *calamitis*, yellowish / golden storax, fatty / greasy storax, and Isaurian storax all point to the availability of and preference for solid storax in the period from the third to the seventh centuries. The archaeological evidence proves the use of both solid and liquid storax in the late antique Mediterranean.

### Byzantine Period: “Pamphylia Full of Aroma”

The seventh century witnessed the end of the late antique political order. The late Roman and Sassanid political centers were replaced by the Umayyad and later Abbasid dynasties in the Near East and North Africa, and by the Byzantine state controlling the southern Balkans, Asia Minor, and parts of Italy. In the culturally and politically consolidated Byzantine empire, storax (στύραξ) continued to be used as perfume, incense, and *materia medica* until the late Middle Ages. A letter sent from Theodore, the Metropolitan of Kyzikos, to Constantine VII Porphyrogennetos in the 10th century contains an invaluable reference to storax. This shows that this fragrant substance was in high demand and made a suitable present from an emperor to a high-ranking member of the clergy at this time. In his letter, Theodore thanks the emperor for sending him the storax and talks of “the fragrant luxury of storax.”<sup>74</sup> We find other references to the aromatic qualities of storax in two Byzantine lexica. *Etymologicum Gudianum*, a lexicon providing the origins of the words and their derivations from around the 11th century, defines storax as “a type of tree whose fruit is called by the same name.”<sup>75</sup> Thomas Magister (d. 1328), who wrote a lexicon of Attic words and phrases, defines storax as incense

<sup>70</sup> *Die Kyraniden* 1.18. For other references, see “storax” in 3.1 and “storax *calamitis*” in 2.3.

<sup>71</sup> *Papyri Graecae magicae. Die griechischen Zauberpapyri* 1973-1974, 13.18, 7.429, 4.1312, 4.2638. For translation, see *The Greek Magical Papyri Including the Demotic Spells* 1986, 63, 129, 87.

<sup>72</sup> *Demotic Magical Papyrus of London and Leiden* 1904, verso, col. 4 / 6-19.

<sup>73</sup> *Alciphronis rhetoris epistularum libri 4*, 4:19. The meaning of tall / large storax is unclear to me.

<sup>74</sup> *Épistoliers byzantins du Xe siècle* 323.

<sup>75</sup> *Etymologicum Graecae linguae Gudianum et alia grammaticorum scripta e codicibus manuscriptis nunc primum edita* 1818, 497.

(θυμίαμά).<sup>76</sup> While discussing the senses, Sophinias, a 13th- / 14th-century philosopher, defines storax together with aloe as having a biting taste but a sweet smell in his commentary on Aristotle's *On the Soul*.<sup>77</sup>

Other non-medical medieval sources not only show that Byzantines continued to value storax as an aromatic substance, but also give southern Asia Minor as the provenance of storax. Stephen of Byzantium's description of Crete as a storax-producing area in the sixth century is repeated by Eustathios of Thessalonica in his 12th-century commentary on Homer's *Iliad*.<sup>78</sup> Even though this piece of information might be an antiquarian repetition, the following sources leave no doubt that storax was exploited in southern Asia Minor from Lycia and Pamphylia to Isauria in the middle Byzantine period (7th-11th centuries). In his geography in Armenian, dated to the seventh century with a shorter version written not later than 800, Ananias of Širak writes the following for Pamphylia: "An aromatic gum is found here called storax which is formed in the hollows of trees eaten by worms." Similarly, for the Taurus Mountains in Isauria, he writes, "the mountains yield gum, storax, colophane,<sup>79</sup> obergomphis (gomphytis), and calamite; all of which flow from the trees and are produced by the boring of a yellow-colored worm with black markings, like a blight." He also locates in Lycia "an aromatic resin which flows from a tree like gum."<sup>80</sup> Both descriptions by Ananias of Širak bring to mind the naturally flowing gum of *Styrax officinalis* L. Photios, the ninth-century Byzantine patriarch and intellectual, summarizes Philostrate's *On Apollonios* in the *Bibliotheka* and speaks of "Pamphylia full of aroma." He summarizes Philostrate's view that panthers, attracted to the scent of storax, came from Armenia and roamed across the Taurus Mountains. One may be suspicious of this information as reflecting the time of Photios, because the *Bibliotheka* is a list of book summaries of ancient authors. However, Photios himself first makes a contemporary reference to the Taurus Mountains by saying "the part of the Taurus Mountains that is in our country." He also confirms the truth of the statement about panthers by adding the expression "which I know (οἶδα)"<sup>81</sup> Neither Eustathios of Thessalonica nor Ananias of Širak nor Photios distinguish between solid and liquid storax. Fortunately, the observations of Abbot Daniel, a Russian pilgrim on his way to the Holy Land in 1106-1107, present invaluable information on this subject. Speaking on the production and export of storax from the Lycian coast between the towns of Makri and Myra, Abbot Daniel presents the preparation of "black gomphytis (*igofit*) *thumiama* (*timijan*) / incense": From a tree comes a sort of juice which is collected with a piece of iron. The tree resembles the alder and is called *zygia* (Rus. *zykia*). *Zygia* is mixed with the exude of a shrub resembling the aspen and called *raka* / *stourik*. Daniel concludes in Old Russian that "This [*stourik* resin] is gathered and mixed with the produce of the first tree [*zygia*] and the whole is then boiled in a copper. Thus, it is that they prepare the gomphytis incense, which is sold to the merchants in leather bottles [bags]." The first tree must be *Liquidambar orientalis* Mill. due to its resemblance to the alder and the liquidity of its exude, while the second is *Styrax officinalis* L. because it is a shrub as Daniel describes. Perhaps both liquid and solid storax were mixed to obtain a final product, contributing to the conflation of the two species

<sup>76</sup> *Thomae Magistri sive Theoduli monachi ecloga vocum Atticarum* 1832, 334.

<sup>77</sup> *Sophonias, In libros Aristotelis Libros de anima paraphrasis* 91.

<sup>78</sup> *Eustathii archiepiscopi Thessalonicensis commentarii ad Homeri Iliadem pertinentes* 1:432.

<sup>79</sup> Pine resin. Lardos et al. 2011, 7, 12, 15.

<sup>80</sup> Hewsen 1971, 187, 198-99; *Geography of Ananias of Širak* 1992, 52A, 54A. Both versions prove that storax was a commercial item in Lycia, Pamphylia, and Isauria.

<sup>81</sup> Photius 5:172.

into one in the minds of the people. Or as Amigues claims, the sawdust from *Styrax officinalis* L. was added to liquid storax to solidify it.<sup>82</sup>

The use of storax in magical practices continues unabated in the middle and late Byzantine periods. *The Kyranides* - the late antique collection of magical recipes in which storax is listed as part of the *materia magica* - was consulted throughout the later periods. For example, Patriarch Athanasios I (d. 1310) protested against the use of *The Kyranides*.<sup>83</sup> The Magical Treatise of Solomon, also known as *Hygromanteia*, was a textbook for magical practices such as instructions on how to prepare magical spells, charms, and amulets. *Hygromanteia* contains material as old as the sixth century, although Ioannes Marathakis finds the 13th to 15th centuries as more plausible for dating the work. In this collection from twelve manuscripts, storax appears many times as an ingredient, mostly as incense.<sup>84</sup>

An examination of Byzantine medical sources proves the continued use of storax in the middle and late Byzantine periods. An iatroposion, specifically devoted to “the Diseases and Cures of Women” and attributed to a period between the sixth to the 11th centuries (possibly the seventh), contains a significant number of references to the use of storax.<sup>85</sup> The unknown female author of this iatrosophion named Metrodora employs the burning of storax (in its absence, to be replaced by resin or frankincense) to figure out whether a woman is sterile or not. The verdict is that the woman is not sterile if she can smell the scent from her mouth.<sup>86</sup> A similar fumigation containing “storax” to find out whether a woman is sterile or not is also recommended by Theophilus Protospatharios, who dates to the seventh to 11th centuries.<sup>87</sup> Leo the Iatrosophist, traditionally dated to the ninth century, recommends the fumigation of the lower parts of the female body by “fragrant substances for ion such as storax and similar substances.” For the treatment of “the ascent [ anadrome ] of the womb” supposedly causes the suffocation of the organ in question.<sup>88</sup> Similarly, Paul of Nicaea, approximately dated to the seventh to 10th centuries, mentions storax twice in his medical compendium: in a liquid remedy to be drunk at night against coughing and a drink with a storax base. Likewise, Theophanes Nonnos from the 10th century uses storax in a compound against coughing. However, most of Paul’s information is based on previous works, especially that of Paul of Aegina, making his suggestions a repetition of already available knowledge rather than original contributions.<sup>89</sup>

<sup>82</sup> *Pilgrimage of the Russian Abbot Daniel in the Holy Land* 1895, 6-7; Amigues 2007, 275-76; Dalby 2007, 54-55. The identification of *zygia* as the resin of *Liquidambar orientalis* Mill. is significant because if the term “zugaia” (ζυγαίαν, acc.), which appears among the commodities traded by the dealers in aromatics and dyes (μυρωτο) in the Book of Eparch (a 10th century document regulating the commercial life of Constantinople), corresponds to *zygia* of Abbot Daniel, then we have a proof of liquid storax finding its place among the important aromatics / *materia medica* in the shops of 10th century Constantinople. However, the most recent editor of the Book of the Eparch, Johannes Koder, *Das Eparchenbuch Leons des Weisen* 110-11, reads *zugaia* as any substance that can be weighed in a beam balance rather than liquid storax.

<sup>83</sup> Koiranides 1991, 2:1136-137.

<sup>84</sup> *Magical Treatise of Solomon, or Hygromanteia* 99, 136, 156, 177, 260, 272, 324, 343, 358.

<sup>85</sup> Storti 2018.

<sup>86</sup> *Il libro di Metrodora* 55. Storax was an ingredient in a number of incense / fumigation (θυσίημα), *Il libro di Metrodora* 64. Not totally related to women’s diseases, Metrodora recommends a theriac which contains storax against the bites of animals and for those suffering from colic and dysentery. Storax was frequently employed in this work, especially in compound drugs against cough and stomach problems. *Il libro di Metrodora* 65, 85, 79-80, 69, 87-88.

<sup>87</sup> Theophilus Protospatharius 2:476. In an anonymous 10th-century collection of recipes, we encounter “storax” among the ingredients of a gastric plaster; cf. Rance 2017, 86.

<sup>88</sup> Leo Medicus 201.

<sup>89</sup> Paolo di Nicea 115, 156; Bio 1992; *Theophanis Nonni Epitome de curatione morborum graece ac latin*, vol. 1. 1794, 386. For the employment of storax in a poultice containing storax in a therapeutical text dating to the period

From the late Byzantine period come a number of medical works with references to storax. Two 13th-century works make abundant use of this substance. John the Physician's *Therapeutics* is a practical work containing medical recipes in over two hundred chapters from the Aegean or Cyprus. The writer recommends storax in a compound against vomiting in the learned version of the text ( $\kappa$ ) and in three different compounds against coughing in the popular version of the text ( $\omega$ ).<sup>90</sup> Likewise, Pēpagomenos' *Iatrica*, a catalogue of diseases with remedies, contains a number of compound drugs / pills with storax to be used against coughing and stomach problems as well as a fumigation menstruation. Storax also appears as part of an aphrodisiac in the *Iatrica* since the resin was considered "hot" in quality.<sup>91</sup>

Next to the medical compilations that combined the medical heritage of the past and the need to be practical, that is to say, to offer their readers practical and up-to-date solutions to their health problems, there were also *xenon* (meaning "hospital" in medieval Greek) texts that were written in the hospital context by and for the doctors in these institutions with the sole purpose of healing patients. These texts -  $\Theta$  text dating from the period between the 10th to 12th centuries and Xenon remedies attributed to Michael Aktouarios between 1050 and 1204 - list various combined drugs organized into chapters by disease. Although storax does not appear to be one of the most frequently employed *materia medica* in these texts, storax appears not surprisingly in an electuary against coughing.<sup>92</sup> Storax had its place not only in the Byzantine pharmacological lore, but also in dietary calendars too, although diet and drugs were not two independent spheres but two congruent means to sustain a healthy life. Hierophilos' well-known and well-read text is witness to the ubiquity of storax in texts that provided readers with the most appropriate food items for each month / season. Hierophilos, dated tentatively to 11th-13th centuries, recommends people with strong constitution / stomach to drink a dry decoction made of storax (ξηρόζεμα πίνειν διὰ ... στύρακος) in January, a month when one should not mind consuming hearty food and thick, heavy mixtures.<sup>93</sup>

As seen up to this point, Byzantine sources do not usually differentiate between solid and liquid storax in their vocabulary, using simply the term στύραξ. However, in *De remediis*

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postdating the 10th / 11th centuries, see Jeanselme 1930, 155. The *Hippiatrica* from the period of Constantine VII Porphyrogenetos contains more than forty-five references to storax. This shows the use of this substance not only in human medicine but also in animal treatments in the 10th century. For example, a reference appears in a formula for the treatment of intestinal pain in horses; pounded opopanax and storax are added to the formula. *Corpus hippiatricorum Graecorum* 1:196. For the use of "balsam of storax" for the treatment of dental problems in horses, see *Corpus hippiatricorum Graecorum* 2:206. For other references, see *Corpus hippiatricorum Graecorum* 1:108. I did not attempt to document here the forty-five plus references to storax in the work. Another reference to the use of storax in horse medicine comes from the *Sylloge Tacticorum*. The writer of this early tenth-century military manual, who incorporated his own contemporary observations and practical needs while imitating previous examples of military manuals, warns his reader that the juice of storax (ὁ τοῦ στύρακος χυλός) makes horses ill. This reference not only shows that juice was made out of storax, but also consolidates the argument that storax in the Hippiatric corpus discussed above had contemporary relevance. *Sylloge Tacticorum quae olim "Inedita Leonis Tactica" dicebatur* ch. 66.1. For the practical aspect of the information contained in the *Sylloge Tacticorum*, see Chatzelis and Harris 2017, 5, 7-8.

<sup>90</sup> John the Physicians's *Therapeutics* 88, 246, 283, 316. A short medical encyclopedia dating to the period between the second half of the 11th to the 15th centuries, Cod. Plut. 7.19 in Biblioteca Medicea Laurenziana, has eleven references to storax; cf. Litavrin 1971, 1993.

<sup>91</sup> Demetrio Pēpagomeno 63, 69, 75, 76, 82, 110.

<sup>92</sup> Bennett 2003, 434, 405. A manuscript entitled "Therapeutic medical treatments set in order by various doctors according to the order of classification of the hospital" (Oxford MS. Barocci 150), which Bennett dates to a period between the ninth and 11th centuries, gives a recipe for a nonspecific counter-irritant plaster. Storax is included among the ingredients of the plaster; cf. Oxford, Bodleian Library, MS. Barocci 150, fols. 29r-32v. in Bennett 2000, 289.

<sup>93</sup> *Anecdota Atheniensia et alia* 2:456-57; Jeanselme 1924, 218, 228-29.

*parabilibus / On Remedies Easily Procured*, whose authorship has been attributed to Galen but was written sometime between the fourth and 12th centuries, the author recommends the use of liquid storax (στύρακα τὴν ὑγρὰν) mixed with wine to combat pain on one side of the head.<sup>94</sup> This is the most direct reference to the differentiation between liquid and solid storax in Byzantine writing. Nevertheless, the fact that Byzantine writers talk about varieties of storax can be taken as a proof of the differentiation between liquid and solid storax. That Metrodora asks the doctor to use the best-quality storax in an antidote against quartan fever and internal ailments indicates that there were varieties of storax that differed in quality in the middle Byzantine period.<sup>95</sup> Metrodora recommends storax *calamitis* twice and Isaurian storax (Στύρακος ἰσαυρικοῦ) once, both of which are traditionally associated with *Styrax officinalis* L.<sup>96</sup> Likewise, in a xenon text from the period between 1050 and 1204, we find “pure storax *calamitus*” (στύρακος καλαμίτου ἀκράτου gen.) in an emplaster against coldness of the stomach and kidney.<sup>97</sup> In a pill against coughing, Pepagomenos adds “yellow storax” (στύρακος ξανθοῦ gen.) to the mixture. *Xanthos* (ξανθός) as yellow of various shades “with a tinge of red, brown, auburn” is a major characteristic of *Styrax officinalis* L.<sup>98</sup> We encounter the same yellow storax again, this time twice (as “fatty yellow storax” in the second instance) in the *Dynameron* of the 13th-century physician Nikolaos Myrepsos.<sup>99</sup> In over 2500 recipes found in the *Dynameron*, we encounter storax in its simple form, and particular varieties are also mentioned very frequently: over 300 times we find references to “storax,” over 50 times “storax *calamitis*,”<sup>100</sup> seven times “storax of the highest-quality,”<sup>101</sup> four times “fatty storax,”<sup>102</sup> twice “red storax” and “red storax of good-quality,” and once “storax ouzing out in drops / viscous (στακτός nom.)”<sup>103</sup> Because the quality of fattiness, the color yellow, viscosity, and the term *calamitis* and *staktos* were all associated with *Styrax officinalis* L. in ancient and medieval medicinal writing, we can argue that some of the storax varieties in the works of Pepagomenos and Nikolaos Myrepsos were solid. It is difficult to identify the basis for the differentiation between regular and pure storax, or among regular storax, good-quality storax, and highest-quality storax, since it might refer to the difference between liquid and solid storax, the latter of which was deemed to be more valuable and rarer. Or it might be related to varieties of the resin of *Liquidambar orientalis* Mill., whose purity or quality was determined by the amount of raspings and soil in the resin, as ancient writers claimed. To summarize, evidence from Byzantine writing not only proves that storax was widely employed in Byzantine medicine until the 14th century when southern Asia Minor was in the hands of Seljuks of Konya or the beyliks, but also proves that solid storax

<sup>94</sup> Pseudo-Galenus 398. For the date of the Pseudo-Galenic text, see Totelin 2021, 31-37; 2017, 107-9. The work of Brodersen 2020, which I could not obtain, is the most recent and extensive study on *De remediis parabilibus*.

<sup>95</sup> *Il libro di Metrodora* 90.

<sup>96</sup> *Il libro di Metrodora* 87-88.

<sup>97</sup> For dating, see Bennett 2003, 405.

<sup>98</sup> Demetrio Pepagomeno 69.

<sup>99</sup> Nikolaos Myrepsos 590, 774. In the medical lexicon of Pseudo-Galen, a synonym of xanthion (ξανθιον / Xanthium strumarium), a plant used for dyeing hair yellow, is given as storax. The similarity of the words xanthion and xanthos (yellow) might explain the association of two plants in the lexicon; see *Anecdota Atheniensia et alia* 2.391: ξάνθιον ἦτοι στύραξ.

<sup>100</sup> Nikolaos Myrepsos passim.

<sup>101</sup> Nikolaos Myrepsos 83, 119, 155, 171, 470, 501, 623.

<sup>102</sup> Nikolaos Myrepsos 541, 545, 590, 622.

<sup>103</sup> Nikolaos Myrepsos 39, 69. Even though some scholars identified staktos with *Liquidambar orientalis* Mill., this view has been refuted; see *Un glossaire de matière médicale* 1940, 113; Sell 2019, 89-92.

was still available in the middle and late Byzantine periods. It is probable that the common, undefined “storax” in Byzantine writing was from *Liquidambar orientalis* Mill.

The distribution area of the two species of storax was right on the frontier zone between the Byzantine and Islamic worlds in the Middle Ages. This land and sea frontier was a porous one, allowing the international trade of storax. The border in question changed through the decades of the 10th century due to new military developments. For this reason, it is worth tracing the story of storax in the Islamic Near East by examining Arabic sources of the period.

### Islamic World: Storax as a Byzantine Product

It should be stated at the outset that medieval Arabic writers distinguished between solid and liquid storax, corresponding to *Styrax officinalis* L. and *Liquidambar orientalis* Mill. respectively.<sup>104</sup> They discuss storax under the terms *may'a*, *labnī* and *astarak* together, believing that these terms refer to varieties of the same tree. The great physician of the Middle Ages, Ibn Sīnā (d. 1037), discusses storax under the terms *mī'ab*, *labnī*, and *astarak*.<sup>105</sup> His account of *may'a* can be divided neatly into two sections. He begins: “According to some physicians, the variety in which the drug exudes by itself like gum is considered fresh. Its other variety is obtained by the process of decoction. The first one is yellow in color. On becoming old, it turns golden yellow in color. It is now considered to be very valuable.” The fresh, yellow or golden yellow exudate, which is very expensive and obtained without much processing, is definitely *Styrax officinalis* L. In the second section, Ibn Sīnā writes “The variety, which is obtained after peeling of its barks, is black in color.” The reference to the process of decoction and to the blackness indicates that this second variety is actually the gum of *Liquidambar orientalis* Mill. The writer conflates the two distinct resins by ascribing them to the same tree: “The variety obtained by decocting the bark is called liquid storax while the remaining part or sediment and oil cake constitute dry storax.” Ibn Sīnā defines *astarak* as a variety of *may'a* and borrows from Discorides in describing the characteristics of *Styrax officinalis* L. For instance, he refers to its clear white color and greasy texture, its odor like that of myrrh, and its unavailability. However, in the entry on *lubnā*, the Persian scholar describes *lubnā* as “*may'a*, which is also called *sa'ila*, *asl al-lubnā*, and *astarak*,” confusing the two distinct resins again. His description of *lubnā* as a gum of the tree similar to quince, yellow in color, fragrant as honey, and resembling myrrh makes one think of *Styrax officinalis* L. He also states that the oil of *lubnā* is found in Syria, the main distribution area of *Styrax*. On the other hand, his references to the liquid nature of *lubnā*, and his description of it as a Roman tree (*ṣḥadjara rūmiyya*) are clear references to *Liquidambar orientalis* Mill. since *Liquidambar* grew in Asia Minor.<sup>106</sup>

A contemporary of Ibn Sīnā and another Persian scholar writing in Arabic, this time from the Ghaznavid east is al-Bīrūnī. He provided valuable information on various *materia medica* in *Kitāb al-ṣaydala fi 'l-ṭibb* (*The Book of Pharmacy in Medicine*). His views are very similar to those of Ibn Sīnā in seeing two varieties of *may'a*: a flowing (*al-sa'ila*) kind called *asl al-labnī*, which is red as well as white in color, and another variety that is dry / solid (*al-yā bis*). Quoting from Abū Ḍjurayḥ, al-Bīrūnī describes *al-sa'ila* variety as a tree brought from *al-Rūm* (Byzantium) with its bark, which was cooked and squeezed. This medieval process

<sup>104</sup> Levey 1961, 408; *Un glossaire de matière médicale* 1940, 113.

<sup>105</sup> The English translators mistakenly identify all three entries (*may'a*, *labnī*, and *astarak*) as *Styrax officinalis*; see Ibn Sīnā 1998 edition 449.

<sup>106</sup> Ibn Sīnā 390, 577-78, 594. For the English text published in 1998 see Ibn Sīnā, 1998 edition 63-64, 410.

is remarkably similar to the boiling and pressing of *Liquidambar orientalis* L. bark to obtain the liquid resin in modern Turkey. Quoting from Cato and Dioscorides, al-Bīrūnī shows his reader how solid storax is better than the liquid, blackish one (maybe referring to the black storax), how it grows in Cilicia, and how difficult it is to find, pointing out the rarity of *Styrax officinalis* L. by the Middle Ages.<sup>107</sup>

Both liquid and dry storax were commonly-used medicinal items in the pharmacopoeia of medieval Islamic civilization, which proves the contemporary availability of the items. Sābūr b. Sahl, the ninth-century Abbasid court Nestorian physician and pharmacist, recommends in his *al-Akrābādīn* (*The Dispensatory*) *may'a sa'ila* (liquid storax) in sixteen different compound drugs, and *may'a yābis* (solid storax) in three compound drugs. He asks his reader to pound and strain liquid and solid storax, in addition to other *materia medica*, in a preparation against abdominal pains and coldness of the body.<sup>108</sup> The presence of liquid and dry storax both in Arabic medical sources shows that both *Liquidambar orientalis* Mill. and *Styrax officinalis* L. were available for consumption.

Islamic geographers too are replete with references to dry and liquid storax as medicinal items coming from Byzantium. Islamic geographers are unanimous in locating the provenance of these items in the "Roman lands." Ibn al- Faḳīh, a Persian geographer from the early 10th century in his *Muḳbtaṣar kitāb al-buldān* (*The Concise Book of Lands*), provides a fairly similar account of *may'a* and claims that *al-Rūm* (representing Byzantines in his understanding) possesses "among perfumes (ʿiṭr), *may'a* and mastic."<sup>109</sup> Two other geographers from the 10th / 11th centuries are more precise about the exact provenance of *may'a*. The ambitious traveler and probable merchant Ibn Ḥawḳal, who wrote his *Kitāb sūrat al-arḍ* (*The Shape of the Earth*) in 977 and edited it again in 988, states the following about storax (*may'a*) in the section on the Byzantine Empire, more specifically on the coast extending from Cilicia to Attaleia: "This region (Aklimiya),<sup>110</sup> a neighbor of the district of Adjya (Aigia in Cilicia), is a source of storax (*may'a*) which is exported to the whole world by land and sea from this region and its environs." The mountains belonging to the Byzantines, which Ibn Ḥawḳal refers to as Aklimiya, are the Taurus Mountains, the traditional distribution area of both liquid and solid storax.<sup>111</sup> It is important to note that storax was carried both by land and sea, and Aigia was probably among the ports for transportation by sea, since the city was on the Cilician coast. Facing south, it acted as a natural entrepôt for goods from Cilicia and Isauria. Repeating al-Iṣṭaḳḫrī, Ibn Ḥawḳal gives the following information for Cyprus, which was conquered by the Byzantines prior to the time when he composed his work: "The distance between Djabala (on the Syrian coast) and Cyprus is a travel of two days. The distance from Cyprus to Asia Minor is the same. Cyprus produces excellent mastic, abundant storax (*may'a*), silk, and linen."<sup>112</sup>

A second geographical work, *Kitāb gharā'ib al-funūn* (*Book of Curiosities of the Sciences*) confirms what Ibn Ḥawḳal wrote. Written in Egypt between 1020 and 1050, this cosmological

<sup>107</sup> Bīrūnī 594. According to Hanbury 1876, 149-50, black storax was a less valuable mix of incense made from olibanum and liquid storax made into cakes / plaques.

<sup>108</sup> Ibn Sahl passim recommends storax (*may'a*) 14 times, liquid storax 16 times, and solid storax (*may'a yābis*) 3 times. For the preparation against abdominal pains and coldness of the body, see Ibn Sahl 35.

<sup>109</sup> Ibn al- Faḳīh 148.

<sup>110</sup> The mountains of Aklimiya are the Taurus Mountains extending eastwards from the Antalya region to Cilicia, most of which was under Byzantine rule in the early Middle Ages.

<sup>111</sup> Ibn Ḥawḳal 201.

<sup>112</sup> Ibn Ḥawḳal 204.



work presents a commercial and geographical map of the Eastern Mediterranean Sea in light of the new political realities of the 11th century. By then, the Byzantine forces had consolidated their gains under the reigns of Phokas and Tzimiskes and near masters of the Eastern Mediterranean Sea. In this anonymous work that pays particular attention to ports and sea routes, we read that “from this island (Cyprus) gum mastic, *lādhan*, dry and fresh storax (*may‘a al-yābis wa al-ṭarīyyā*), vitriol, blue-green vitriol, white vitriol, and all other provisions imported from Byzantium.”<sup>113</sup> Although Cyprus produced ladanum and vitriol locally, mastic was a product of Chios, meaning that not all the products listed had to originate from Cyprus. Moreover, the reference to “all other provisions imported from Byzantium” shows that Cyprus was a stepping stone for many commodities originating from Asia Minor and Greece. It is likely that merchants sailing from the Cypriot port of Soloi arrived at southern Anatolian ports such as Aigia to buy storax from the locals.<sup>114</sup>

In short, medieval Islamic writers do not differentiate between the plants that produce storax, but rather see the resins as varieties from one tree. The main two varieties in their view are the liquid (*may‘a al-sa‘ila*) and dry or solid / congealed storax (*may‘a al-yābis* or *al-djāmida*). As seen in Ibn Sīnā’s account, many believed that liquid storax was acquired by decocting the bark of the tree while solid storax was the sediment from the decoction. However, the characteristics of liquid storax defined as flowing and red to black in color, depending on the amount of residue in it, point to *Liquidambar orientalis* Mill. However, the characteristics of solid storax, namely white to golden yellow in color, more valuable and more difficult to find, point to *Styrax officinalis* L. By the turn of the first millennium CE, both forms seem to have been imported into the Near Eastern markets from the Byzantine Empire, because Crete, Cyprus, and southern Asia Minor - the distribution area of *Liquidambar* - along with Pisidia, Cilicia, and northern and western Syria - the distribution area of *Styrax* - were under Byzantine control.

## Conclusion

A resin known as “styrax” in Greek and most commonly as “may‘a” in Arabic was employed in medicine, magic, perfumery, and incense-making in the Near East and Mediterranean from ancient times to the Middle Ages. Storax was collected in southern Asia Minor in a region extending from Rhodes in the west to the area around Antioch in the east. This balm, known to be hot and moist according to humoral theory, was a common item in the Byzantine and Islamic *materia medica*. It had antiseptic effects, and was used especially to combat respiratory and gastrointestinal problems. It was even an eponym for the compound drugs named *sturakinon* and *sturakaton*. Byzantine magicians, calling storax bitter and heavy, made use of it in slander spells and charms, mostly as incense throughout the centuries. The aromatic characteristic of storax was the cause of its fame in the popular culture of the Classical and medieval periods. Byzantine and Islamic writers refer to its fragrance almost without exception. While the sixth-century philosopher Philoponos sees the yellow color and fragrant smell of storax as the most conspicuous characteristic of the resin, the late Byzantine philosopher Sophinius describes storax as having a bitter taste but a sweet smell. While people of the Eastern Mediterranean flavored their wine with storax, bees were attracted to the balm of storax, producing the famous

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<sup>113</sup> *An Eleventh-Century Egyptian Guide to the Universe; The Book of Curiosities* 2014, 1, 116 [A Fol. 36b], 476.

<sup>114</sup> The writer of the *Book of Curiosities* remarks: “Sulīs (Soloi); protects from the Notos wind; in it are the ships of the merchants of Cyprus.” *An Eleventh-Century Egyptian Guide to the Universe; The Book of Curiosities* 2014, 114 [A Fol. 36b], 478.

Cilician honey. Even panthers were drawn to its smell in the Taurus Mountains in the words of the Constantinopolitan bishop Photios. Storax could be found both in religious imagination and actual religious space. Theological writers associated it with prayer and the heavens, and believers burned this fragrant gum in front of icons and in cemeteries. Moreover, storax was an appropriate gift among the members of the elite, as in the case of Constantine the Great's donation to the St. Peter Church in the fourth century or Constantine VII's gift to the bishop of Kyzikos in the 10th century.

Our duty would have been much easier if we could identify the storax in the historical records precisely with one plant species. Two resins from two different trees have been named storax throughout history. Their almost identical medical uses, olfactory traits, and provenance in addition to their resemblance in material and appearance makes them very difficult to distinguish in the historical sources, especially when these sources did not generally differentiate between the two resins. According to modern scholarship, a firm and golden / sandy-brown storax - traditionally called solid storax - was obtained from *Styrax officinalis* L., while a liquid and sticky balsam, reddish brown to black in color - traditionally called liquid storax - was obtained from *Liquidambar orientalis* Mill. On top of this complication, one should add that the ancients differentiated among varieties of *Styrax officinalis* L. resin based on viscosity (from solid to semi-liquid), purity (from transparent to opaque), and shape (bolt-shaped, reed-shaped). Likewise, they distinguished among varieties of *Liquidambar orientalis* Mill. resin, preferring the most liquid form with the least impurities over the other varieties. One should also keep in mind that storax was mixed with many other substances for adulteration or enhancement, as proven by the statements of Dioscorides and Pliny the Elder from the Classical period and Islamic sources from the medieval period.<sup>115</sup> Abbot Daniel's statement that solid and liquid storax were mixed to produce black gomphytis incense in 12th-century Lycia attests to the possibility of the two species of storax being traded as one product. As a general rule, we can speak of two "pure" resins from two species: yellow / golden storax with a fatty, honey-like texture that came from Isauria, Cilicia, and Syria is more likely to be the resin of *Styrax officinalis* L. whereas liquid, sticky, reddish storax resin or resinous bark was more likely from *Liquidambar orientalis* Mill. However, there were many varieties of this resin called storax in medieval markets, owing to differences in the exudation process, extraction and production methods, as well as adulteration and enhancement.

Modern scholarship holds that solid storax of the Classical period was replaced by liquid storax in the Late Roman and especially medieval periods, although no explanation is given for the disappearance of solid storax.<sup>116</sup> However, this study shows that solid storax continued to be used in later centuries. Material as well as written evidence points to the availability of the resin of *Styrax officinalis* L., although it was rarer and more expensive than that of *Liquidambar orientalis* L. As we have attempted to show, the high price and rarity of solid storax can be traced in late antique archeological and written evidence, for example, in Diocletian's Price Edict and Libanius' complaint in a letter. It is true that the writers of the late-antique medical compilations from the Greek East and Latin West rely on Classical writers such

<sup>115</sup> Dioscorides 1.28, 1.40, 1.59-66; Levey 1961, 408; Pliny the Elder 3:151-52. For adulteration with sand and ashes in the 19th century, see Hanbury 1876, 141.

<sup>116</sup> A. Dalby 2007, 54-55 suggests that *Liquidambar orientalis* Mill. was exploited in southern Asia Minor after Syria was lost to the Muslims in the early Middle Ages. This argument does not explain why solid storax became rare in the whole medieval Mediterranean world and why the Near Eastern buyers were ready to buy the Byzantine liquid storax enthusiastically.

as Strabo and Dioscorides when they describe the qualities of storax, thus feeding into the confusion about the surrounding solid versus liquid storax already present in the Classical sources. However, the same writers are very practically oriented when they recommend compound drugs for ailments in their works. The fact that they ask their readers to use “white,” “yellow,” “golden,” “fatty” storax on certain occasions, or to cut or grind storax proves that these compilers had solid storax in mind, probably next to the liquid storax. In the Byzantine period too, direct evidence from the pilgrimage account of Abbot Daniel and various references to “liquid (ὕγρον, acc.),” “yellow,” and “fatty” storax as well as “storax in drops” in medical sources show that solid storax was available in medieval markets. Its existence is confirmed in medieval Arabic sources too. Islamic geographical and medical sources clearly distinguish between the liquid (*al-sa'ila*) and the solid (*al-camida*) forms, although many thought that they came from the same tree.<sup>117</sup>

In the Middle Ages storax harvested in southern Asia Minor was consumed both within the borders of the Byzantine Empire and in foreign markets. After being harvested and processed between June and October,<sup>118</sup> it was ready to be traded in winter, and most likely reached its destination by spring when the mountain and sea routes were fully open. It was not transported in amphorae. As al-Bīrūnī and Abbot Daniel state, dry storax was transported in small wooden boxes while liquid storax was carried in leather bags.<sup>119</sup> Until the Byzantine expansion into Islamic Cilicia and Syria in the second half of the 10th century, Byzantine storax came from Caria, Lycia, Pamphylia, and Isauria. It was exported to the Islamic world via the Taurus land border and Cyprus. After the Byzantine expansion, the two other centers of storax exploitation, Cilicia and northern Syria, were added to the Byzantine territory, making Byzantium the sole provider of storax in the international markets. In the 12th to 14th centuries, when southern Asia Minor was largely under Turkish and Armenian rule, storax from this region could still be found in the markets of the gradually diminishing Byzantine Empire. The story of storax in this later period, though not drastically different from that in the Byzantine world in terms of provenance and production methods, is the subject of another investigation to be pursued by the medievalists of Turkish Asia Minor.

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<sup>117</sup> A separate examination of the Arabic sources on storax is planned by the author of the present article.

<sup>118</sup> Nicolas 1978, 159-60.

<sup>119</sup> Bīrūnī 594. This information is confirmed by Daniel the Abbot's description less than a century later; see *Pilgrimage of the Russian Abbot Daniel in the Holy Land* 1895, 7.

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