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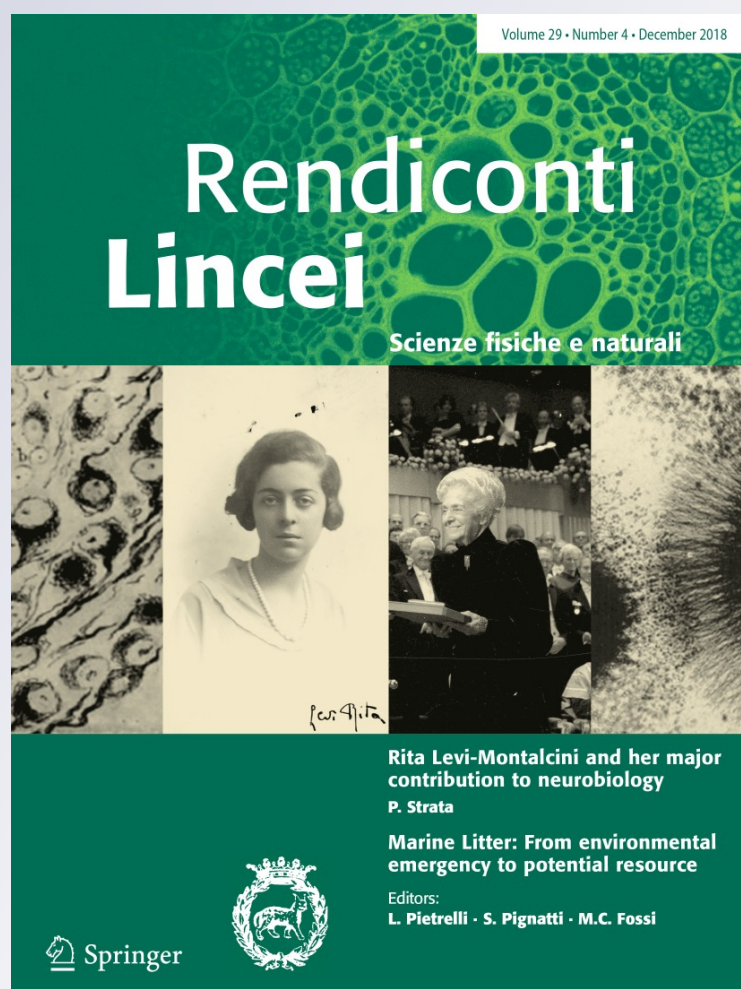
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“Spigo nardo”: from the Erbario Estense a possible solution for its taxonomical attribution

Chiara Beatrice Vicentini¹ · Fabrizio Buldrini² · Giovanna Bosi³ · Carlo Romagnoli³

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Abstract

The spikenard is a plant mentioned since early antiquity, mostly known for its intense and pungent aroma that made it a precious ingredient of many cosmetic recipes for luxury perfumes. The nature of the spikenard has been controversial since the ancient era and, still today, there is the need for a correct attribution of such a name to a currently accepted botanical species. Thanks to a specimen from the Este Herbarium (Erbario Estense), preserved in the Modena State Archives (Italy), we tried to bring our contribution to the debate concerning this topic. We checked all the Italian ancient herbaria in search of samples of spikenard, analysed past literary and medical–pharmaceutical sources from classical antiquity to the XIX century, and searched former and present ethno-botanical uses. Our investigation allowed us to ascertain that the spikenard samples preserved in the Renaissance Italian herbaria belong to *Nardostachys jatamansi* (D. Don) DC., a herbaceous species belonging to the Valerianaceae, native to alpine regions of the north-western Himalaya, still used in Ayurveda medicine and as a component of cosmetic products.

Keywords Este Duchy · Ancient herbaria · *Nardostachys jatamansi* · Medical recipes · Cosmetic plants

1 Introduction

It is well known that herbaria are collections of dried plants, whose utility for research and educational purposes was first recognised by Luca Ghini (1490–1556), who showed and explained dried plants during his lectures. The most ancient herbaria today are Italian and date back to the first half of the sixteenth century; many of them were prepared by Ghini’s pupils or by persons who were in touch with him, such as Ulisse Aldrovandi, Gherardo Cibo, Luigi Squalermo, Michele Merini etc. (Moggi 2012a, b, c; Mangani and Tongiorgi Tomasi 2013). The value of these first collections is

immense, for their antiquity and, consequently, their great historical importance, and because they are still in use as an instrument for scientific research. Indeed, they are a true cultural asset, whose monetary value is extremely high, comparable to that of artworks (Moggi 2012a).

The problems linked to the identification of the species preserved in the ancient herbaria are well known. The *exsiccata* (i.e., the dried plant samples fixed to the herbarium sheets) can easily be subject to corruption because of their antiquity and great fragility, or because of inappropriate preservation or mould and parasite attacks (Forneris and Cuccuini 2012), and transfers of the herbarium from one location to another made with a little care. The phytonyms written near the *exsiccata* not necessarily permit a connection to names today officially admitted. Since these *exsiccata* generally lack many parts of the plant, which are often mandatory for a credible identification, the latter is often uncertain and laborious (e.g., Costa et al. 2016, 2018). It is necessary to compare the *exsiccata* to the descriptions or illustrations of many different species, take into account the previous studies by other scholars, and even document or archive sources linked to the author or to the work under examination (Mariotti 1997).

✉ Fabrizio Buldrini
fabrizio.buldrini@unibo.it

¹ Dipartimento di Scienze della Vita e Biotecnologie–Sezione di Farmaco e Prodotti della Salute, Università degli Studi di Ferrara, Via Fossato di Mortara 17/19, 44121 Ferrara, Italy

² Dipartimento di Scienze Biologiche, Geologiche e Ambientali, Università di Bologna, Via Irnerio 42, 40126 Bologna, Italy

³ Dipartimento di Scienze della Vita, Università degli Studi di Modena e Reggio Emilia, Viale Caduti in Guerra 127, 41121 Modena, Italy

For decades, during the fifteenth and sixteenth centuries, Italy lived a season of great cultural vivacity: various cities hosted rich courts where patronage was common and scientific and medical research was highly encouraged. Among these cities, the case of Ferrara is particularly interesting. Thanks to the illuminated government of the Este dukes, Ferrara was, for a long time, the centre of intense cultural and commercial activities. Even in the medical and botanical fields, which were at that time strictly linked together, there was a great movement. Scientists came from everywhere bringing new ideas, new plants, and new spices, as a base for botanical studies, medical preparations, and perfume recipes (Vicentini and Mares 2008). A project concerning the analysis of ancient recipes from sixteenth century onwards is being carried out, thanks to a collaboration between the University and Biblioteca Ariostea of Ferrara. Among these documents, a medicinal-cosmetic papery codex is particularly important, which was compiled by various persons during the sixteenth century, and is commonly identified as *Pseudo-Savonarola* (Vertuani et al. 2014; Vicentini et al. 2014; Bonazza 2016).

In the present study, the raw materials of vegetal origin, which are cited in the historical documents of that epoch, were investigated also on the basis of coeval literature, in addition to today's knowledge. Among the many plants appearing in those texts, the so-called “spigo nardo” is especially interesting for the difficult attribution to a precise species. It is not clear what raw material was used in Ferrara under such name, since the information reported by the authors of that time is often ambiguous, due to the inexistence of the current binomial nomenclature and the diversity of their opinions, not rarely contrasting.

Not all documents concerning that period are preserved in Ferrara. When the Este family moved to Modena in 1598, all the files, documents, and works which constituted the Archivio Segreto Estense (= Este's Secret Archives) were also transferred to Modena and are now kept in the Archivio di Stato di Modena (= Modena State Archives). Among these documents, it was possible to consult the Erbario Estense, thanks to the collaboration with the University of Modena and Reggio Emilia and the availability of the Archivio di Stato di Modena. The latter is among the eldest in Europe, since it dates back to the second half of the sixteenth century (the precise date of composition is not known, but it is probable that this herbarium was put together in the last decades). The Erbario Estense was presumably prepared in Ferrara and then brought to Modena (Camus and Penzig 1885; Cremonini et al. 2016). It counts 180 *exsiccata*, including a sample of “spigo nardo” (n. 120; Fig. 1), which immediately required attention, since we realised that its exact identification would be a valid help to understand



Fig. 1 Specimen of “spigo nardo” preserved in Erbario Estense, c. 94, n. 120 (colour figure online)

what plant was used under this name at the Este's court. For this reason, both scientific and historical investigations were performed in the present study. Starting from the correct determination of the herbarium sample, the research allowed us to make order in the historical documents about “spigo nardo”. To identify a controversial species mentioned in past documents (particularly when these are of the pre-Linnaean period) or ancient herbaria, it is necessary to adopt a diachronic interdisciplinary approach. This takes into account all available sources of information and allows more reliable results to be obtained, rather than a simple analysis of ancient documents or herbarium samples (see, e.g., Pulvirenti et al. 2015; Costa et al. 2016; Bosi et al. 2017). In addition, it is important to remember that a herbarium sample from the sixteenth century is an object of inestimable historical and scientific value (Moggi 2012a) that should be handled as little as possible to avoid ruptures or damage. It is, therefore, unthinkable to subject it to genetic or anatomo-histological investigations, which could permit a certain identification, but would necessarily require a partial destruction of the sample itself, at least at the present stage of scientific knowledge. For this reason, our analysis was based on the comparison with other herbarium samples and the exam of ancient and modern written sources.

2 Materials and methods

The study, aimed at correctly attributing the specimen of “spigo nardo” from the Erbario Estense (formerly identified as *Andropogon nardus* L.—Camus and Penzig 1885) to a currently recognised species, was not easy, especially because, on the herbarium sheet, only a fragment of the entire plant is present, interpreted as the base of the plant itself by Camus and Penzig (1885). This part is usually the least characterising from a taxonomical viewpoint, and thus, it is insufficient to provide a credible identification.

Our research steps were articulated as follows.

First of all, we carried out a survey of all plants named “spigo nardo” or synonyms (e.g., “Nardo Indiano”, “Nardo Indico”, “Spica Nardi”, “Spico Nardo”...—Mattioli 1568; Penzig 1924) in other Italian herbaria dating from the sixteenth century: Erbario Aldrovandi, preserved at Bologna (BOLO); Erbario Cesalpino and Erbario Merini, preserved at Florence (FI); Erbario ex Cibo, preserved at Biblioteca Angelica in Rome. We also took into account, whenever available, the possible identifications proposed by other scholars.

To compare the ancient samples with the others prepared and preserved in the same way, we extended our research to more recent herbarium samples, looking for similar specimens whose identification was sure and certified. We based our investigations on the *exsiccata* preserved at Herbarium Centrale Italicum (Florence), which is the most important Italian herbarium. To perform a reliable analysis, we chose only the most complete samples, maintaining also basal parts and the root system.

The number of possible species, which were once named “spigo nardo”, was reduced thanks to the collaboration with experts in this field, such as Mauro Pellizzari and Filippo Piccoli (Ferrara). We finally limited our investigation to *Nardostachys jatamansi* (D. Don) DC., *Cymbopogon nardus* (L.) Rendle, and *Chrysopogon zizanioides* (L.) Roberty, of which 13 samples are present at FI. Attention was paid to the synonyms (The Plant List 2013; Tropicos 2018), to extend the search to all the possible samples. The first two species (respectively sub *Valeriana jatamensis* Jones—erroneous writing for *V. jatamansi* Jones = *N. jatamansi* (D. Don) DC.—and *Andropogon nardus* L. = *C. nardus* (L.) Rendle—see also Jarvis 2007) are the only ones cited in the *Dizionario universale di Materia Medica e di Terapeutica Generale* and denominated “spigo nardo” or “nardo indiano”. It is also specified that “spigo nardo” is “il solo di cui si faccia ancora qualche uso” (= the sole species still in use at present—Merat and de Lens 1837: 418). Furthermore, *C. nardus* and *C. zizanioides* are aromatic species which have a root system similar, for some aspects, to that of *N. jatamansi* (Clayton et al. 2006a

onwards and Clayton et al. 2006b onwards; Chen and Phillips 2006a, b). They produce essential oils largely used in the traditional oriental medicine (e.g., Seidemann 2005; Saikia 2006; Alagesaboopathi 2009; Avoseh et al. 2015).

Finally, we checked the principal textual sources of medical–pharmaceutical subject from the classical antiquity onwards, to compare descriptions and opinions concerning “spigo nardo” with herbarium samples and current scientific literature (see references in the next paragraphs). With this research, we tried to integrate the information obtained from ancient and modern herbaria that can nearly immediately direct to a precise species. At the same time, we did a critical evaluation of the pre-Linnaean literary sources.

3 Results and discussion

3.1 Analysis of the herbarium samples

Among Italian herbaria dating from the sixteenth century, our search of “spigo nardo” gave results only for Erbario Aldrovandi and for Erbario ex Cibo of Biblioteca Angelica of Rome, apart from the sample preserved in Erbario Estense. No samples were found in Erbario Cesalpino and Erbario Merini, even under different names (Caruel 1858; Chiovenda 1927, 1932).

The specimen of Erbario Aldrovandi (Fig. 2) is preserved in vol. 2, c. 307r. It consists only of a plant fragment covered by a fibrous and bristly layer. Near the sample, only “n. 1°”



Fig. 2 Specimen of *Nardus Indica* (= “spigo nardo”) preserved in Erbario Aldrovandi, vol. 2, c. 307r, n. 1. Erbario Aldrovandi is part of the collections of Erbario dell’Università di Bologna (BOLO) (colour figure online)

is written. This sample is datable at 1551, because the entire volume 2 was prepared in that year (Soldano 2000). In his manuscripts, preserved in the University Library of Bologna, Aldrovandi mentions this specimen as *Nardus indica* in the catalogue of the herbarium specimens ordinated by volume (ms. 125) and *Nardus Indi* in the catalogue of sample collection sites (ms. 136-III, pag. 158). The place of origin is India, according to what Aldrovandi writes in ms. 136-III. It is worthy of note that there was probably another sample of the same species in the same sheet 307, equally marked with “n. 1°”, that was removed by wrapping the sheet itself. The specimen was formerly identified as *Nardostachys jatamansi* (D. Don) DC. (Soldano 2000).

The specimen of the Erbario ex Cibo (Fig. 3) is preserved in Erbario B, vol. II, c. 102r, n. 843. It is named *Nardus Inda*, as is readable in the index of volume II, but, near the sample, only the number 843 is present. It is datable at 1550–1553, because Erbario ex Cibo was prepared in those years (Penzig 1904; Chiovenda 1909; Moggi 2012b; Mangani and Tongiorgi Tomasi 2013). The sample consists only of a plant fragment covered by a fibrous and bristly layer. It was formerly identified as *Nardostachys jatamansi* DC. (Chiovenda 1909).

A total of 11 herbarium samples preserved at FI (7 for *N. jatamansi*, 4 for *C. nardus*), collected between 1860 and 1920, were examined and finally compared with the specimen of Erbario Estense. For *C. zizanioides*, we examined two herbarium sheets, but this species was excluded for its

global aspect, which is too much different from the specimen under analysis. Based on the examination of the above-mentioned 11 samples, the “spigo nardo” from Erbario Estense is *Nardostachys jatamansi* (D. Don) DC., belonging to the Valerianaceae (bas. *Patrinia jatamansi* D. Don; syn. *N. chinensis* Batalin, *N. gracilis* Kitam., *N. grandiflora* DC., *Fedia grandiflora* Wallr. ex DC. [nom. inval.], *F. jatamansi* Wallr. ex DC. [nom. inval.], *Valeriana jatamansi* D. Don [nom. illeg.], *V. jatamansi* Roxb., and *V. jatamensis* Roxb.—see The Plant List 2013; Tropicos 2018). The decisive samples were: Coll. J.D. Hooker, 10-1862, in Herb. Ind. Or. Hook. fili V. Thomson; Coll. J.F. Duthie, 9-9-1885, in Flora of N.-W. India, Govt. Botanical Garden Saharanpur (Fig. 4); Coll. J.F. Duthie, 10-8-1883, in Flora of N.-W. India; Coll. G.A. Gummie, 29-8-1892, in Herb. Hort. Bot. Calcuttensis—Flora of the Sikkim Himalaya; Coll. J.F. Duthie, 21-9-1886, Govt. Botanical Garden Saharanpur—all samples sub *N. jatamansi* (D. Don) DC.; Leg. H.F. von Handel-Mazzetti, 16-7-1914, in Iter Sinense 1914–1918; Coll. J.D. Hooker, s.d., in Herb. Ind. Or. Hook. fili. V. Thomson—these two samples sub *N. grandiflora* DC.

As can be clearly ascertained in the specimens preserved at FI, *Cymbopogon nardus* and *Chrysopogon zizanioides* (Gramineae) have a global aspect of the root system and the basal part of the stems notably different from that of *N. jatamansi* and dissimilar from the samples preserved in the three mentioned Renaissance herbaria. In fact, *C. nardus* is a perennial caespitose herbaceous plant, with robust rootstock, not rhizomatous, and butt sheaths persistent and investing the base of the culm (Clayton et al. 2006a onwards; Chen and Phillips 2006a). *C. zizanioides* is a perennial caespitose herbaceous plant, with robust roots and short rhizomes (Clayton et al. 2006b onwards; Chen and Phillips 2006b).

In contrast, *Nardostachys jatamansi* (D. Don) DC. (Valerianaceae) is a perennial subrosulate rhizomatous



Fig. 3 Specimen of *Nardus Inda* (= “spigo nardo”) preserved in Erbario ex Cibo (Erbario B, vol. II, c. 102r, n. 843), maintained in Biblioteca Angelica of Rome (colour figure online)

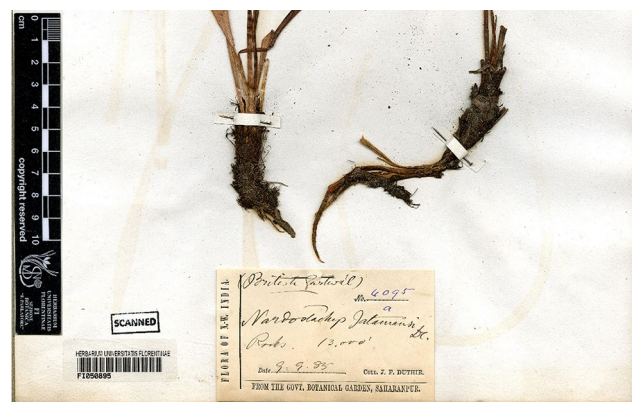


Fig. 4 Specimen of *Nardostachys jatamansi* (D. Don) DC. preserved in the Sezione di Botanica del Museo di Storia Naturale, Università di Firenze (Herbarium Centrale Italicum—FI). Coll. J.F. Duthie, 9-9-1885, in Flora of NW India, Govt. Botanical Garden Saharanpur (colour figure online)

herbaceous species. The rhizome is cylindrical, dark brown, 2.5–8 cm long and 0.5–1.5 cm broad (Gautam and Raina 2013), and robust and woody (Purohit et al. 2012a); the caudex is robust, erect, or oblique (Hong et al. 2011a). Remains of old leaves, which have been diversely interpreted by the authors, cover the rhizome and the caudex: only the caudex is “densely covered with fibrous or lamellar old leaf sheaths” for Hong et al. (2011a); only the rhizome is covered with “a reddish brown network of fibres that represent dry sheathing leaf bases” for Gautam and Raina (2013), or with “the reticulated remains of marcescent leaves” according to Weberling and Bittrich (2016). Based on the analysis of the herbarium samples preserved at FI and the comparison with the illustrations present in Lambert (1821)—lectotype of *Patrinia jatamansi* D. Don = *N. jatamansi* (D. Don) DC., see Mabberley and Noltie (2014)—and Hong et al. (2011b), we can affirm that the part of the plant present in the Italian Renaissance herbaria is the caudex, covered by the remains of old leaves. Therefore, *N. jatamansi* is the sole species coinciding with the Renaissance samples of Erbario Aldrovandi, Erbario ex Cibo, and Erbario Estense.

Thanks to our study, it was possible to confirm what Mariotti (1997) wrote concerning the identification of the “nardo” illustrated in Mattioli (1568). He proposed *N. jatamansi*, although in a dubitative way, referring also that, according to Berendes (1902), Dioscorides’ *nardus* can even be identified as *Patrinia scabiosaefolia* Fisch. or *Valeriana wallichii* DC. However, in our opinion, the interpretation as *N. jatamansi* is more credible, also thanks to the examination of the samples of the Italian Renaissance herbaria, and particularly that of Erbario Estense, which is, without doubts, the best preserved and the most complete among them.

N. jatamansi grows in subalpine and alpine areas (2200–5000 m a.s.l.) of the north-western regions of Himalaya, in Pakistan, India, Nepal, China, and Tibet, typically on steep, moisty, rocky, and undisturbed grassy slopes (Weberling 1978; Airi et al. 2000; Chauhan and Nautiyal 2005). The stem is 10–60 cm high, pubescent, and quadrangular. The leaves are entire, elongate, and spatulate–lanceolate, 15–20 cm long; the basal ones, borne by the caudex, are petiolate and disposed in groups, whereas the cauline leaves are 2–3 pairs only, sessile (Amatya and Sthapit 1994; Hong et al. 2011a; Purohit et al. 2012b; Gautam and Raina 2013, 2016). The inflorescences are thyrse, composed of 3–7 cymes aggregated in a terminal capitulum. They are made of small, pink–purplish, hermaphrodite, gamosepalous flowers, with pentamerous, tubular–campanulate corolla (Hong et al. 2011a; Gautam and Raina 2013; Weberling and Bittrich 2016). The reproduction is mostly vegetative, thanks to the rhizome ramets, forming dense clumps (Nautiyal et al. 2003).

At present, the cultivation of *N. jatamansi* is not practiced, neither in the East (Chauhan and Nautiyal 2005), nor

in Europe, where “spigo nardo” was always considered to be an imported product, coming to Europe thanks to the wide commercial network of the Venice Republic with the East (e.g., Mattioli 1568). The sole mention of a cultivation comes from Garcia de Orta, as reported by Clusius (1605) and Donzelli (1675), who reported of a widespread cultivation, principally for local use, in the regions near the River Ganges. In addition, Clusius (1605) specifies that *nardus* does not easily propagate by itself (“non faciliè enim spontè nascitur”). Therefore, we can reasonably affirm that the samples preserved in the Italian Renaissance herbaria were brought to Italy directly from Asia, as already supposed by Camus and Penzig (1885) for the sample of Erbario Estense.

3.2 A brief review of the botanical aspects of “nardo” and its history from the classical period to the eighteenth century

The Italian “nardo” derives from the Latin *nardus* or *nardum*, at its time borrowed from the Greek *νάρδος* or *νάρδον*, a term of Semitic origin (Hebrew *nērd*, Babylonian *lardu*; see André 2010). As the correspondent Greek term, the Latin *nardus* or *nardum* indicates both the plant and the unguent obtained from it, maybe, without a clear use distinction, although there was the tendency to separate *nardus* (the plant, feminine) from *nardum* (the unguent, neuter). Furthermore, even if the original use of the term seems to address to the present *N. jatamansi*, the Romans utilised it to designate also other plants with a pleasant odour (André 2010; Schrickx 2011). According to Caius Plinius Secundus, better known as Pliny the Elder, *nardus* is a plant whose leaves were extremely appreciated in India for the great importance as a perfume (“*folium Indis in maximo pretio [...] ut principali in unguentis*” – Hist. Nat., XII, 41–42). The description of the plant (ibid., XII, 42) is interesting: “*frutex est gravi et crassa radice sed brevi ac nigra fragilique, quamvis pingui, situm redolente, ut cypiros, aspero sapore, folio parvo densoque. Cacumina in aristas se spargunt, ideo gemina dote nardi spicas ac folia celebrant*” (= “the nard is a shrub, the root of which is heavy and thick but short and black, and although oily, brittle; it has a musty smell like the gladiolus, and an acrid taste; the leaves are small, and grow in clusters. The shoots of the nard sprout into ears, and consequently, both the spikes and the leaves of the nard are famous—a twofold product”—Rackham 1945). Such description recalls, in some respects, the modern ones of *N. jatamansi*, especially considering root system and leaves, but also its aromatic odour and pungent taste (see, e.g., Gautam and Raina 2013). Ancient peoples knew various “qualities” (i.e., different species with a similar use) of nard: Pliny the Elder (ibid., XII, 45, 47) cites the *nardum Indicum* (the most precious one, for its intense aroma), *Celticum*, *Creticum*, *rusticum*, etc. It is interesting to note that the other qualities

were said to be herbs (*herbae*), but not the *Indicum* (ibid., XII, 45), which was a shrub (*frutex*). Indeed, the general appearance of the plant, which forms dense clusters originating from numerous shoots with a spike-like base, may partly resemble a small compact shrub (Roxburgh 1799; Nautiyal et al. 2003). Concerning the use of the names, *nardum* without attributes indicated the true nard, that is the *nardum Indicum* (André 2010); *nardum Indicum* and *spica nardi* probably were synonyms in Roman age (e.g., Bauhin and Cherler 1651; Schrickx 2011).

In Italy and Europe, “spigo nardo” became again the object of animated debates from the XVI century onwards, due to the new interest for science and the rediscovery of many classical authors, who contributed to the origin of modern botany (Moggi 2012c).

Pietro Andrea Mattioli, in his *Discorsi* (edition of 1568), delineates the various types of “nardo” that he knows, confirming and specifying what he wrote in the first edition (Mattioli 1544, 1568). He names “Spico Nardo”, “Nardo Celtico”, “Nardo Montano”, “Nardo Salvatico Pontico”, or “phu”, which some still call “Nardo Selvatico”. His discussion is exhaustive, in provenance, description, and medical properties. “Nardo” is of two species: “Indiano” and “Soriano”, because the slopes of the mountains where they grow are oriented towards India and Syria, respectively. “Nardo Soriano” is excellent, fresh, light, red, extremely odorous, and with dense hairs. “Nardo Indiano” smells like gladiolus and has a short spike; the taste is bitter and seems to dry up the tongue when chewed; its sweet odour is persistent. It includes also “Nardo Gangetico”, which is called as such from River Ganges, which flows at the foot of the mountain on which it grows. Due to the high humidity of the place, “Nardo Gangetico” is less good, but bigger than the other one; from one root, it produces many spikes with dense hairs, heavy, and fastidious odour. The mountain’s nard (probably the good type of “Nardo Indiano”, collected at the highest altitudes, in opposition to “Nardo Gangetico”, growing in wetlands—Beck 2017) is much more odoriferous and has a shorter and smaller spike. There is also a nard called “Sampharítico” after the place where it is native (perhaps Saphar, in south-western Arabia—Beck 2017). In the apothecaries, the nard is called *Spica Nardi*. Mattioli has a quite correct concept (at least for his epoch) of the nature of “nardo Indiano”. Reporting Galenus’ words, he writes: “*nardum Indicam [...] quam spicam uocant; non quòd spica sit, radix etenim est, sed quòd spicae figuram habeat*” (= the Indian nard [...] which is called a spike, not because it is a spike—it is a root, in fact—but because it has the aspect of a spike).

He then cites Giovanni Manardo (1462–1536) from Ferrara and Luigi Squalermo (1512–1570, best known as l’Anguillara—Saccardo 1895), according to whom the “nardo” used in the apothecaries is neither “Indico” nor

“Soriano”, but “Gangetico”. Antonio Brasavola (1500–1555) is another author from Ferrara cited by Mattioli, who, like Manardo, in various passages of his treaties, has contradictory ideas concerning the part of the plant (the sole root or the entire plant) which has medicinal virtues.

Castore Durante (1585), in turn, distinguishes various kinds of nard: “Nardo Spico”, “Nardo Celtico”, “Nardo Spico Italiano”, “Nardo Spico Italiano Falso”, and “Asaro”. For “Nardo spico”, he writes that it is the same as the Latin *nardus Indica* and *spica nardi* and the Greek *νάρδος* and *ναρδόσταχυς*. Its habitat is in the mountains of India and near the River Ganges; about its real nature, he shares Mattioli’s opinion: “*Questo Nardo non è spica che nasca nella sommità de i fusti del Nardo. Ma è la radice, che ha forma di spica, perciòché da una base, o uero piede tira il nascimento suo con alcune radichette capillari*”. It is understood that the definition of the nard as a spike depends mostly on the remains of old leaves along the rhizome and, especially, the caudex (both formerly interpreted as a root, at least for a certain period), that make the latter relatively similar, in some respects, to the spike of some Gramineae. In this regard, the mention of the nard’s inflorescences by Pliny the Elder (Hist. Nat., XII, 42) is a *unicum*, that Mattioli (1568), in fact, attributes to an error (see also Squillace 2010 for a review).

A progress towards a better interpretation of the nature of “spigo nardo” was achieved by Carolus Clusius (Charles de l’Écluse). In contrast to what Mattioli and Durante wrote, he asserted that *nardus* is in reality of one form only, native to India, growing in the provinces of Mandou and Chitor and in the kingdoms of Delli, Bengala and Deccan. It is a root, bearing above the soil a short stem about three palms long, and other much shorter stems above it. The spikes stem from the top of the root and others around the stems (“*Certe radix est, spargens supra solum brevem virgulam, seu caulem circiter tres palmos longum [...] atque alias insuper virgulas multo breviores: in summa radice spicae producuntur, item aliae per virgulas*”—Clusius 1605). However, this description is partly debatable, because the stem is in reality erect, not prostrate or creeping as it appears from his words. At the end of the century, Robert Morison (1699), returning to Clusius’ opinion, added that the so-called spikes stem in a considerable number from the top of the root, and the part brought to Europe for pharmaceutical use is the top of the root. This part is covered by filamentous and convolute remains of rotten leaves (“*In summa radice spicae producuntur, & quidem nonnullae per virgulam. Quod nobis importatur nihil aliud est quam comatum radice caput, ex marcidorum foliorum nervosis filamentis convolutis congestum*”). Morison’s idea was later taken up by Lamarck (1783), who specified also that the part of commercial interest is neither a spike nor a root, but only the lower part of the stem, which at first bears leaves and subsequently only the ribs of the leaves themselves, after they have dried. This opinion seems to be

correct, in light of today's knowledge: the basal part of the stems (i.e., the caudex) bears, in fact, the basal leaves, which, when dried, leave only their remains attached to the caudex itself (Amatya and Sthapit 1994; Hong et al. 2011a, b).

3.3 Previous identifications of “spigo nardo”

We wondered, because the “spigo nardo” of the Erbario Estense was identified as *Andropogon nardus* L. (= *Cymbopogon nardus* (L.) Rendle) by Camus and Penzig (1885).

From the sixteenth century onwards, there have been various attempts to attribute to “spigo nardo” a precise botanical species. Here, we report only the most important ones, where the ancient name is inserted in a classification system or is assimilated to a recognised binomial classification.

The first attempt dates back to Morison (1699), who classified *nardus indica* among the “*Plantae culmiferae, seu calamiferae; Cerealia et Gramina dictae*”. Such position was later taken up by Linnaeus (1753), who attributed the Latin *nardus Indica* to his *Andropogon nardus* (class *Polygamia Monoecia*). The polynomial conceived by him for this species (*Andropogon paniculae ramis supradecompositis proliferis* = *Andropogon* with a panicle having over-decomposed proliferous branches), although it describes quite well the inflorescence of this species, is in reality referred to a species named *Lagurus*, not better specified, since he had no samples of that plant (Linnaeus 1747). The opinion of the Swedish scientist is questionable, also because he assimilates to his *A. nardus* Mattioli's (1568) *nardus Indica* and Bauhin's (1623) *Arundo odorata* (= Mattioli's *calamus odoratus*, that is *Acorus calamus* L.—see André 2010), which are completely different plants. Nevertheless, he was one of the most eminent and authoritative European naturalists and botanists at that epoch, and thus, various scholars followed his ideas about this subject for decades (e.g., Lamarck 1783; Persoon 1805; Sprengel 1807; De Jussieu 1820; Chaumeton et al. 1834; Hatchett 1836; Campana 1841) and even Camus and Penzig (1885). Such chaos is particularly manifest in Chaumeton et al. (1834), who associated a drawing of a *Lagurus* (probably *L. ovatus* L.) with the description of the nard, identified as *A. nardus* with respect to Linnaeus. Nonetheless, the description of the nard of commercial interest (the Indian one), surrounded by twisted and overlapped filaments which are, in reality, the ribs of dry leaves, reminds much more today's *Nardostachys jatamansi* than a graminaceous species (“*racine chevelue, ou plutôt un assemblage de filets entortillés attachés à la tête de la racine, qui ne sont autre chose que le filaments nerveux des feuilles deséchées, ramassées en petits paquets, de la grosseur d'un doigt, de couleur de rouille de fer, ou d'un brun roussâtre, d'un goût amer, âcre, aromatique, d'un odeur agréable, qui approche de celle du souchet*”). Anyway, at that time, it was known that, under the name *νάρδος/nardus*, the Ancients

knew many plants belonging to different genera and families (Shore 1799; De Jussieu 1825; Loiseleur-Deslongchamps 1825; Drapiez 1841). It seems that they attributed this name to all plants with an aromatic, hairy root (Merat and de Lens 1837). However, the name “nardo” was given particularly to the pharmacists' *spica nardi*, native to India, equivalent to the *nardus Indica* or “nardo indiano” (Lemery 1721; VV.AA. 1846). Again, it can be useful to refer some notes on a plant casually discovered in 1786 by the brother of Sir Gilbert Blane of Blanesfield, during his journey to India. The description of its characteristics reminds partly to what Pliny the Elder (Hist. Nat., XII, 42) and, partly, Mattioli (1544, 1568) wrote when speaking of *nardus*. It is a herbaceous plant with “*a strong aromatic odour; but both the smell and the virtues reside principally in the husky roots, which, in chewing, have a bitter, warm, and pungent taste, accompanied with some degree of that kind of glow in the mouth which cardamoms occasion*”. Sir Joseph Banks, who received some drawings and samples of that herb, was convinced that this plant, at a first reflection believed to be probably the spikenard, was a species of *Andropogon*, although still unknown and different from all plants imported as *nardus* (Blane 1790). At the beginning of the following century, the correctness of the attribution “spigo nardo” to *A. nardus* was already debated. Ottaviano Targioni Tozzetti, although following Linnaeus' interpretation (Targioni Tozzetti 1813, 1825), could not fail to write that “*vi è luogo per altro di dubitare che questa droga sia tutt'altro, poiché non pare probabile, che crescendo molto a guisa di canna ramosa, abbia dei così piccoli polloni fibrosi, come sono quelli, che col nome di Spigo nardo si conoscono nelle spezierie*” (Targioni Tozzetti 1813). As can be observed, the identification of “spigo nardo” (and consequently of the *νάρδος/nardus* of the Ancients) with a species of the family of the Gramineae was not without doubts, based more on Linnaeus' authority than on precise evidence. In any case, given the opinions of the above-mentioned scientists, so famous and accredited, it is quite plausible that Camus and Penzig (1885) estimated incorrect to attribute “spigo nardo” to a species different from *Andropogon nardus* L. (= *Cymbopogon nardus* (L.) Rendle).

In contrast to these scholars, in the late eighteenth century, Sir William Jones, based on his philological studies, proposed the attribution of the Ancients' nard to a diverse species (Jones 1799). However, his opinion remained a *unicum*, little considered or even criticised based on the attempts of exegesis of passages by Hippocrates, Dioscorides, and Avicenna (see Sprengel 1807). Nevertheless, Loiseleur-Deslongchamps (1825) himself believed that such considerations were worthy of note in his *Dictionnaire des Sciences Naturelles*. He wrote: “*il est maintenant constant, d'après les recherches du célèbre Jones, que le nard de Ptolémée et de Dioscoride n'est autre chose que la racine*

et le bas de la tige d'une plante connue des Hindous sous le nom de djabatâmsi [...], et que les Arabes appellent sombul, mot qui signifie épi, pique, parce qu'en effet la base de la tige est entourée de fibres qui ont l'apparence d'un épi, ce qui justifie parfaitement les noms de stachys, de spica que les Grecs et les Romains ont donnée à cette drogue. C'est une espèce de valériane qui croît dans les parties les plus éloignées et les plus montagneuses de l'Inde, telles que le Népal, le Bhoutan". In fact, Jones was the first who recognised that the descriptions of the plant and its odour reminded much more a species of the family of the Valerianaceae rather than Linnaeus' *Andropogon nardus*, so that he named this species *Valeriana jatamansi* (Jones 1799: 416; Lambert 1821). The description reported in the *Prodromus Florae Nepalensis* (Don 1825) is similar, in various respects, to that given by Pliny the Elder (Hist. Nat., XII, 42) speaking of *nardus*: "*Planta caespitosa. Radices fusiformes, longae, crassitie saepius digiti minoris, dimidio superiore rudimentis retiformibus foliorum marcidorum densè vestitae, infernè fibris numerosis brevibus instructae: facie ad caudam aliquorum animalium non paulò referunt. [...] Folia lanceolata, acuta, integerrima, coriacea, laevitèr pubescentia, nervosa, 2–7 pollices longa [...] Flores terminales, densè fasciculati*" (= Shrubby plant. Roots fusiform, long, quite often less thick than a finger, in the upper half densely covered by the net-shaped rests of rotting leaves, in the lower part made of numerous short fibres: the roots are quite similar to the tail of some animal. [...] Leaves lanceolate, acute, with margin entire, coriaceous, slightly pubescent, nervous, 2–7 in. long (approximately 5–18 cm) [...] Flowers terminal, densely fasciculate). Jones' opinion was shared by Shore (1799), who tried to demonstrate that the Ancients' nard is *jatamansi* (= *N. jatamansi*) by assiduous studies carried out directly in India. His investigations involved also local people and were later resumed by some scholars, such as De Candolle (1830), Merat and de Lens (1835) and even Antonio Targioni Tozzetti, who approved the ideas of the English philologist, equating "nardo indiano" (= "spigo nardo") to *N. jatamansi*. In addition, even if implicitly, he specified that the identification as *Andropogon nardus* was actually uncertain, whereas that as *N. jatamansi* was supported by precise observations (Targioni Tozzetti 1847).

A possible explanation of the initial attribution of "spigo nardo" to a plant ascribed to the Gramineae could be searched in the fact that, in Europe, up to the last years of the eighteenth century, only the rhizome and the caudex of the plant (i.e., the parts used for medical purposes) were known. The first descriptions, which properly mention flowers, inflorescences, and their characteristics, are those by Jones (1799), Roxburgh (1799), Lambert (1821), and Don (1825), who described the plant based on living individuals or entire fresh specimens. Sprengel (1807), who affirms that the nard was always believed to be a graminaceous species

("semper graminis speciem faciunt veteres"), indirectly underlines this fact.

3.4 Principal past and present uses of *Nardostachys jatamansi*

In this section, we report the uses surely attributable to *N. jatamansi*. The plant is mentioned under different names, with respect to past's habits.

Since ancient times, the most famous use of "nardo" has always been as a component or source of cosmetic preparations (perfumes, balsams, unguents, etc.). The most used part is the rhizome, rich in aromatic essential oils (e.g., Amatya and Sthapit 1994; Mulliken and Crofton 2008; Gautam and Raina 2013). One of the earliest citations of this use dates back to the time of Hammurabi (XVIII century BC). It is mentioned also in the Bible (Song of Solomon, 1: 12, 4: 13–14) and in the Gospels of Mark (14: 3–9), Matthew (26: 6–13), and John (12: 1–8) as the Jesus' unguent. The plant was, in fact, collected in the Himalaya mountains, and then sold in the markets of Mesopotamia and Mediterranean basin (Hatchett 1836; Grilli Caiola et al. 2013; Weberling and Bittrich 2016). During the Greek and Roman period, it was one of the precious components of the most valuable among perfumes, the "royal unguent", which was called like this, because it was prepared for the Parts' king: "*Ergo regale unguentum appellatur, quoniam Parthorum regibus ita temperatur*" (Pliny the Elder, Hist. Nat., XIII, 18). It was, obviously, one of the components of the *nardinum* (νάρδιον), also known as *foliatum*, an expensive female perfume characterised by an intense and persistent scent (Squillace 2010), that "*constat omphacio, balanino, junco, costo, nardo, amomo, myrrha, and balsamo*" (ibid., XIII, 15).

According to Aulus Cornelius Celsus, *nardum indicum* was also one of the ingredients of some medical preparations, such as antidotes and eyewashes: Zopyrus' antidote (Medicinae Libri Octo, V, 23.2 1938), *collyrium Theodoti* or ἀχάριστον (ibid., VI, 6.6), and *collyrium Nilei* (ibid., VI, 6.9). Other medical preparations (tooth pastes and antidotes), requiring this plant, were reported by Scribonius Largus (De Composit. Medic., par. LIX, LX, LXX, CXXI, CXLIV, CLXXVII, sub *nardus indica*, or *spica nardi* 2012), used against kidney inflammation and pain, lounge, and liver inflammation, vulval ache after child birth or abortion and to whiten the teeth.

The plant was also used for food: for example, it was a component of the *ius in copadiis* and *assa cervina* (Marcus Gavius Apicius, De re coquin., VII, 282, VIII, 347, sub *nardostatum* 2003).

A use of the leaves is attested by Pliny the Elder (Hist. Nat., XII, 44), who cites three qualities of leaves depending on their dimensions (*hadrosphaerum*, *mesosphaerum*,

and *microsphaerum*—the latter was the most precious one), Scribonius Largus (De Composit. Medic., par. CLXXVI) and Lucius Iunius Moderatus Columella (De re rustica, XII, 20, 5) (1977). Actually, these mentions (particularly the last two) are likely to refer to the other species named *nardus* (see André 2010); otherwise, we should think that the Ancients already knew some system to desiccate leaves and preserve them for quite a long time.

During the Middle Ages and the Renaissance, in Europe, *N. jatamansi* was used as a diuretic, against nausea, “*rodi-menti dello stomaco*” (= some sort of stomach-ache or acidity?) and meteorism, to solve hepatic and kidney problems and in ophthalmology. It was also believed to be decisive for gynaecological problems. It was a fundamental raw material for antidotes and *theriaca* (Mattioli 1568).

For the collection of “spigo nardo”, the biggest, cleanest, most recent, most coloured and most odoriferous spikes had to be chosen (Lemery 1721). Apothecaries sold it in the form of small, rusty-coloured packets made of filaments, attached to some roots (Merat and de Lens 1835). When it arrived in Italy, much of its medicinal virtues had been lost (Campana 1841), probably because of the long transport in conditions not suitable for its preservation. Until the end of the eighteenth century, physicians used it as a sudoriferous and diuretic, to remove viscera obstructions and especially to expel poisons: for this reason, it was necessary in preparations such as *theriaca*, *mithridatum*, *hiera colocynthidos*, *hiera picra*, *philonium*, *unguentum martiatum*, etc., which, by the early nineteenth century, were completely disused. It was classified as an alexiterous, cephalic, and cordial plant (Chaumeton et al. 1834; Merat and de Lens 1837; Campana 1841).

Since antiquity, “nardo” has always been a very rare and expensive product, so that it could be adulterated by means of other plant species or different materials. In this regard, Pliny the Elder (Hist. Nat., XII, 43) wrote: “*Adulteratur et pseudonardo herba quae ubique nascitur crassiore atque latiore folio et colore languido in candidum vergente, item sua radice permixta ponderis causa et cummi spumaque argenti aut stibi ac cypiro cypirive cortice*” (= “Nard is also adulterated with a plant called bastard nard, which grows everywhere, and has a thicker and broader leaf and a sickly colour inclining to white; also by being mixed with its own root to increase the weight, and with gum and silver spume or antimony and gladiolus or husk of gladiolus”—Rackham 1945). In addition, the very expensive “nardo indiano” was alterable by means of nine similar herb species: “*In hoc genere conveniet meminisse, herbarum, quae nardum Indicum imitarentur, species novem a nobis esse dictas: tanta materia adulterandi est*” (ibid., XIII, 16); the nine species imitating the Indian nard are indicated in lib. XII, 42–43: *pseudonardus*, *nardus Syriaca*, *nardus Celtica*, *nardus Cretica*, *cyperus*, *cypirus*, *baccharis*, *hirculus*, and *asarum*.

During the seventeenth and eighteenth centuries, it was adulterated by means of other species with similar root features or with a similar scent and taste, such as *Allium scorodoprasum* L., *A. victorialis* L., or *Valeriana celtica* L., which anyway had much less intense medicinal virtues than “nardo” (Chomel 1712; Merat and de Lens 1835, 1837).

At present, *N. jatamansi* is still in use for therapeutical purposes in India, Nepal, Bhutan, and part of China, but it is also sold in Europe and USA (Gautam and Raina 2013). Its multi-millennial importance as an aromatic and officinal plant is manifested in Ayurveda, homeopathy, popular medicine, and modern pharmaceutical industry (Purohit et al. 2012b). The species has a great reputation in the Ayurvedic medicine, and is a component of many formulations to treat epilepsy, hysteria, syncope, mental weakness, to combat stress and promote hair growth and blackness (Gupta et al. 2012). In popular pharmacopoeia of the regions of north-western Himalaya, it is also used for palpitations and insomnia. Its aromatic essential oil, obtained from the rhizome, is used as incense, flavouring agent and as a component in luxury perfumes (Gautam and Raina 2016). It also has antimicrobial, antifungal, hypotensive, antiarrhythmic, and anticonvulsant activity (Gupta et al. 2012) and is valuable for treating leprous wounds (Thakur and Hussain 1989). In addition, *N. jatamansi* has cardioprotective properties and is used to cure neural diseases. All parts of it have analgesic, antiemetic, and antipyretic action (Purohit et al. 2012b). It is probably effective to treat Alzheimer’s and Parkinson’s diseases (Gupta et al. 2012). Because of all these qualities, the species is known as a life-saving drug and is subject to massive overexploitation in the Himalayan region (Chauhan and Nautiyal 2005; Purohit et al. 2012a, b), so that, today, it is classified as critically endangered according to the IUCN Red List classification (Ved et al. 2015).

3.5 Final remarks

The study here presented allowed to confirm that “spigo nardo” from Erbario Estense is the same plant as *nardus indica* of Erbario Aldrovandi and Erbario ex Cibo, and is identifiable as *Nardostachys jatamansi*. Its presence in these herbaria is due to the commercial exchanges between the Venice Republic and the East.

This species was already well known by the Ancients for its aromatic and pharmaceutical qualities. The descriptions of the plant given during classical antiquity are relatively superficial, if examined in the light of today’s knowledge, but the principal characters are anyway represented, so that it is possible to see various similarities with the descriptions of the early 1800s. For centuries, the attribution of *nardus indica* or “spigo nardo” to an officially accepted botanical species (or to a species clearly recognisable as such) has been problematic, because, in

Europe, up to the late 1700s, only the drug was known. We can suppose that the Ancients had, perhaps, some knowledge of the entire plant, although imprecise, as seems to appear from the description by Pliny the Elder. However, at present, it is not possible to demonstrate it, because the concept that they had of a botanical species not necessarily coincides with what is today intended as a species, from a scientific viewpoint (Mariotti 1997; Moggi 2012a).

At the present stage of the research, the only Renaissance samples of “spigo nardo” are those from Erbario Aldrovandi, Erbario ex Cibo, and Erbario Estense, which are the most ancient in Italy and Europe. In particular, the specimen from Erbario Estense is absolutely the most complete and clearly identifiable. The presence of the species in question, together with that of other exotic plants such as “Garoffoli delle spiciarie” (= *Caryophyllus aromaticus* L.), is a proof that the author of this herbarium received some plants directly from the East (Camus and Penzig 1885). In Ferrara (and, more generally, in the entire Europe), “spigo nardo” is not cultivable, because habitat and climate are not suitable. Indeed, the list of the plants cultivated in two gardens of the Este Dukes that were present in Ferrara in the late 1500 s does not mention it. These gardens were the Giardino del Padiglione (“*orto padiglionis Sereniss.mi Ducis*”) and the hanging garden on the terrace of the Ferrara Castle (“*in uiridario super coquina Sereniss.mi Ducis*”), which was later known as the Giardino degli Aranci (Camus and Penzig 1885).

In conclusion, our study is a contribution to the identification and knowledge of this drug and its botanical history in Europe. Even if our results are far from definitive, they sum up a careful analysis of the herbarium samples combined with the previous studies and ancient literary and scientific sources. Therefore, we may say that our research has provided a quite thorough and detailed picture of the subject.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Involvement of human participants and/or animals No human participants or animals were involved in this study.

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