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Continuity and change in medicinal plant use: The example of monasteries on Cyprus and historical *iatrosophia* texts ☆

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ABSTRACT

Ethnopharmacological relevance: How medicinal plant knowledge changes over time is a question of central importance in modern ethnopharmacological research. However, only few studies are available which undertook a comprehensive exploration of the evolution of plant use in human cultures.
Aims: In order to understand this dynamic process, we conduct a systematic diachronic investigation to explore continuity and change in two knowledge systems which are closely related but separated in time —historical *iatrosophia* texts and today's Greek Orthodox monasteries on Cyprus.
Materials and methods: An ethnobotanical study was conducted in 21 of the island's monasteries involving various types of interview as well as a written questionnaire survey. Data about medicinal plant use collected in the monasteries was analysed and quantitatively compared to historical *iatrosophia* texts using data from our pre-existing dataset.
Results: We found a core group of plant taxa for which a high consensus exists among the monasteries regarding their medicinal usefulness. Various means and routes of knowledge transmission appear to be involved in the development of this knowledge. The systematic comparison between the monasteries and the *iatrosophia* shows similarities and differences on various levels. While the plants used by the nuns and monks have by the majority a relationship to the *iatrosophia* and show a remarkable historical consistency in terms of their use for defined groups of ailments, the importance of many of these plants and the use of herbal medicines in general have changed.
Conclusions: This is one of the first studies from the Mediterranean region which is based on a systematic ethnopharmacological analysis involving comprehensive datasets of historical and modern ethnographic data. The example illustrates continuity and change in 'traditional' knowledge as well as the adoption of new knowledge and provides the opportunity to look beyond the dichotomy between traditional and modern concepts of plant usage. Overall, the study suggests that a systematic diachronic approach can facilitate a better understanding of the complex and dynamic processes involved in the development of medicinal plant knowledge.

1. Introduction

One of the core interests in today's scientific inquiry is "to understand how systems change over time, whether they are atoms, molecules, organisms, ecosystems, climates, galaxies, black holes or universes" (Shapiro, 2011). This focus also plays a central role in modern ethnopharmacological research in the context of continuity and change in human-plant relationships. As illustrated by a review of ethnopharmacological field studies published in this journal in the years 2007 to 2009 the question "what has changed over time (and what has caused this change)" was one of the scientific concerns in these articles (Heinrich et al., 2009).

The need to better understand the development of knowledge systems about plant use is supported by recent findings of ethnobotanical or ethnopharmacological field studies which suggest that local or indigenous knowledge about the use of plants as medicine or food is currently undergoing diverse and often dramatic changes. In the Mediterranean region, for example, pre-existing routes of mainly oral knowledge transmission appear to be eroding mainly as a result of socio-structural changes; It has been shown that here information on the local use of plants is increasingly restricted to people of middle age or beyond (Nebel et al., 2006; González-Tejero et al., 2008; Savo et al., 2011). The consequence of the generational shift is presumably linked with the loss of a substantial part of this knowledge. However, as examples from other regions illustrate, it would be

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a one-sided perspective to conclude that local or indigenous knowledge about the use of plants shows only decreasing tendencies: In a public market in north-eastern Brazil the conservation of a basic repertoire of plants but also an increase of the taxonomic richness and the adoption of new plant uses could be observed within a seven year interval (Albuquerque et al., 2007); Although medicinal plant use in Estonia progressively relies on a narrow selection of plants there is a number of species which shows an increase in use over the last one hundred years (Sõukand and Kalle, 2011). These examples suggest that the processes involved in the development of medicinal plant knowledge are complex and in particular point to the dynamism intrinsic to the system. According to Johnson (1992) 'traditional' knowledge can be considered both cumulative and dynamic, it builds on the experience of earlier generations but also adapts to new technologies and socioeconomic developments.

That the consideration of dynamic and evolving aspects in human plant use can contribute to a better understanding of the development of knowledge about the use of plants was suggested earlier by our group (Heinrich et al., 2006). In the same paper it was emphasised that a diachronic perspective can offer a suitable methodological approach to undertake such an investigation. However, only relatively few studies have been published so far which include a systematic comparative analysis of data from different points in time with the aim to explore evolution of plant use in local or indigenous knowledge systems (Kufer et al., 2005; Albuquerque et al., 2007; Leonti et al., 2010; Łuczaj, 2010; Sõukand and Kalle, 2011). Various reasons may be responsible for the relatively limited output in this area of ethnobotanical or ethnopharmacological research such as the lack of comprehensive diachronic data of specific areas or cultures but also the laborious and time-consuming process required to make such data accessible to statistical analysis.

The example studied in this paper is the first of its kind from the Eastern Mediterranean and offers the opportunity to conduct a systematic diachronic investigation based on semi-quantitative datasets from two knowledge systems which are closely related but separated in time—historical *iatrosophia* texts and today's Greek Orthodox monasteries on Cyprus.

When reviewing the worldwide status of traditional medicine the World Health Organisation (2001) noticed with respect to Cyprus that "written records, especially from monasteries, record different types of traditional medicine and herbal preparations that were practised from the Middle Ages through the 19th century". Essentially, this account by the WHO makes reference to historical *iatrosophia* texts and their link to local monasteries and at the same time points to the (past) importance of these monasteries in terms of medicinal plant knowledge.

The *iatrosophia* (ιατροσόφια, Greek for 'wisdom of healing') are a type of Greek medical literature of Byzantine origin which developed in the environment of the hospitals of the Byzantine Empire where they served as handbooks for the daily medical practice containing recipes and therapeutic advice (Temkin, 1962; Varella, 1999; Touwaide, 2007). The link between monasteries and *iatrosophia* is based on the fact that texts originating from the times of the Ottoman Empire were largely produced in Greek Orthodox monasteries (Chrysanthis, 1950; Varella, 1999). As suggested by the historical context, the *iatrosophia* texts were not only produced but also came into practical use in the monasteries. In Cyprus, during the island's Ottoman period (1571–1878), some of the local monasteries had dedicated premises for the nursing of the sick. The most famous example of this tradition in Cyprus is the monastery of Makhairas, which was reputed as a 'Pancyprian hospital' (Kargotis, 1951). Here, monks prepared remedies and dispensed them to people visiting the monastery in need for medical care. Many of these remedies must have been based on *iatrosophia* texts (Stavridis, 2006). The *Iatrosophikon* of Makhairas (Filaretos, 1924–1925) written in 1849 is a product of this activity (Lardos, 2006) and the most extensive *iatrosophia* text known from the island (Lardos et al., 2011). Towards the middle of the 20th century the monasteries lost their importance as medical centres, largely as a result of the modernisation of the island's health-care sector, and eventually abandoned the production as well as the practical use of these texts.

Today, more than two dozen monasteries belonging to the Church of Cyprus are still in operation in the Greek-speaking part of the island (http://www.churchofcyprus.org.cy/ last accessed 21/11/2011). Most of these monastic communities maintain a rural and traditional lifestyle which to a considerable extent is regulated by the *typikon*, the written rule of a monastery (see e.g. Thomas and Constantinides-Hero, 2000).

Although various ethnobotanical and ethnopharmacological studies dealing with the island (Arnold-Apostolides, 1985; Della et al., 2006; González-Tejero et al., 2008; Hadjichambis et al., 2008; Karousou and Deirmentzoglou, 2011) or its expatriate communities (Yöney et al., 2010) were conducted in the last few decades, investigations focusing specifically on plant usage in local monasteries are lacking.

The present study is part of a larger project focusing on the herbal *materia medica* and its use in historical *iatrosophia* texts and present-day knowledge on plant usage in Greek Orthodox monasteries in the Greek-speaking part of Cyprus and thereby ties in with the above scenario of traditional medicine on Cyprus outlined by the WHO. The principle aim of this study is to explore continuity and change in plant use in a model part of a cultural environment with a rich tradition of herbal texts. To this end, we investigate modern medicinal plant use in monasteries and compare this knowledge with one of historical *iatrosophia* texts using data from a pre-existing dataset (Lardos et al., 2011).

2. Background and methods

This study included 21 Greek-Orthodox monasteries in the Greek-speaking part of the island from which written or oral consent was obtained. Fourteen of them were run by nuns and seven by monks. The 21 monasteries are spread over the whole southern part of the island (Fig. 1). Most of them are situated in the Troodos Mountains or their adjacent foothills as well as along the southern edge of the Mesaoria plain.

Interviews were conducted with 64 research participants (38 female and 26 male, aged between 25 and 91, average age 55). Of those, 49 (29 female and 20 male, aged between 25 and 91, average 57) participated in the field study and 46 (26 female and 20 male, aged between 26 and 91, average 52) in the written questionnaire survey.

2.1. Field study (FS)

Field work was conducted in September 2007 and during the periods March to May 2008 as well as March to May 2009. To collect information standard ethnobotanical tools were used including different interview types (unstructured, semi-structured and structured interviews) and interview techniques (field and checklist interviews, participant observation) (Martin, 1995; Alexiades and Sheldon, 1996; Cotton, 1996; LeCompte and Schensul, 1999; Heinrich et al., 2009). With the majority of the monasteries each between three and four interviews were conducted.

Voucher specimens of plants reported by the informants were collected during the interview or, alternatively, following the interview and shown to the informant for confirmation. In general, common cultivated vegetables and fruits were not sampled. We also abstained from collecting multiple samples of frequently

Fig. 1. Satellite image of Cyprus showing the location of the 21 monasteries taking part in the field study.

reported cultivated herbs but also of wild growing plants if confusion with other species could be excluded.

Permits for collecting and export of voucher specimens originating from areas outside of the state forests of Cyprus were obtained from the Environment Service of the Ministry of Agriculture, Natural Resources and Environment (now Department of Environment) (Ref. no. 254/03/I) and for specimens originating from the state forests of Cyprus from the Forestry Department of the Ministry of Agriculture, Natural Resources and Environment (Ref. no. 2.15.001). Most of the plant specimens were identified in the field using the *Flora of Cyprus*, Volume 1 and 2 (Meikle, 1977, 1985). Whenever possible specimens were collected in five copies. Critically endangered taxa listed in the Annex II of the Law on the Protection and Management of Nature and Wildlife (No. 153(I), 2003), the legislation implementing CITES in Cyprus, were never regarded for sampling. Complete sets of voucher specimens were deposited at the herbarium of the Centre for Pharmacognosy and Phytotherapy, The School of Pharmacy (University of London; now UCL School of Pharmacy) (UK) (two sets of specimens), the herbariums of the Environment Service and the Forestry Department of the Ministry of Agriculture, Natural Resources and Environment in Nicosia (CY) (one set of specimens each) and the herbarium Z/ZT of the University and ETH Zurich (CH) (one set of specimens).

Field interviews (Alexiades and Sheldon, 1996; Vogl et al., 2004) were conducted during walks in the gardens of the monasteries and the adjacent surrounding area. However, field interviews outside of the monastery's garden were not always feasible (i) and (ii) or proved little successful (iii): (i) The majority of the monasteries visited adhered to a strict daily schedule, a circumstance which substantially limited the time available for interviews or field walks, respectively; (ii) Older members of the monastic community often belonged to the informants with special knowledge but in many cases were no longer able to undertake field walks; (iii) Due to the very sparse precipitation in the rainy season of 2007/2008 an extreme drought continued to prevail on the island (Michaelides and Pashiardis, 2008). As a consequence, in many of the areas visited during the field study in spring 2008 several of the annual or perennial species did not appear or remained in sterile state, respectively.

Because of these circumstances we decided to also conduct checklist interviews (Alexiades and Sheldon, 1996) with all monasteries based on a pre-defined list of plants. The selection of plants used in the checklist interviews was based on the 95 species described in Savvides (2000) and Della et al. (2006). During the interviews, each of the species was discussed with the informants by showing the respective plant photograph from Savvides (2000), Tsintides et al. (2002) and Hadjikyriakou (2007) or from AL's picture library. To reduce the risk of confusion with similar looking species the vernacular name(s) listed in Savvides (2000) and Della et al. (2006) were also provided.

For the data collection in the field study two specific questionnaires (Edwards et al., 2005) were prepared. Questionnaire 1 was used to collect general information about the monastery, Questionnaire 2 was filled out for each plant mentioned during an interview and covered various aspects of the plant or its use including also additional vernacular name(s), part used, preparation and application.

Two of the 21 monasteries could not be involved in face-to-face interviews but instead gave their consent to provide information in written form. For this purpose a questionnaire was developed which included the points addressed in the above Questionnaires 1 and 2. In this questionnaire the monasteries were provided with a list of taxa based on plants reported in the previous field or checklist interviews. Plants were listed by means of their common vernacular names according to Arnold-Apostolides (1985), Savvides (2000), Zannettou-Pandeli (2000) and Della et al. (2006). With the exception of commonly known cultivated herbs with unambiguous vernacular names each entry included a photograph from Savvides (2000) or AL's picture library.

2.2. Written questionnaire survey (WQ)

With the aim to collect further data on plant uses a written questionnaire survey (WQ) was introduced as part of the interview procedure. Since this approach should specifically benefit the intended diachronic comparison between the monasteries and the *iatrosophia*, the written questionnaire was prepared based on the plants listed in the *Iatrosophikon* of Makhairas (Lardos, 2006). From this list the 143 plants of local origin mentioned in more than one recipe of the historical text were selected and listed in the questionnaire by means of their common vernacular names according to Arnold-Apostolides (1985) and Zannettou-Pandeli (2000). With the exception of commonly known crops, each entry included a photograph from Zannettou-Pandeli (1998), Georgiades (1987 and 1992) or AL's picture library. The written questionnaire was distributed to the 21 monasteries included in the field study. Altogether from ten monasteries completed questionnaires were obtained.

2.3. Data management

All data recorded in FS and WQ were entered into a database and coded. Every plant use reported was treated as a separate record and counted as one use report (UR). To allow for a comparison with the medicinal plant uses in the *iatrosophia* texts, all medicinal URs were categorised into the same use groups as the URs of the historical texts (see Lardos et al., 2011): CA-cardiovascular & blood, EE-ears & eyes, DE-dermatological, FV-fevers (including malaria), GI-gastrointesinal & hepatic, GY-gynaecological, HA-headache & migraine, MS-musculo-sceletal, OC-oral cavity, RE-respiratory tract, UG-urogenital, VA-various conditions. Duplicate records representing identical plant uses reported by the *same* monastery were removed from the list of the plant uses analogously as done with the data of the *iatrosophia* texts (Lardos et al., 2011).

2.4. Investigation of the data from the monasteries and comparison with the iatrosophia

First, checklists of the taxa with medicinal uses were obtained and examined for their frequency of citations (Tardio and Pardo-de-Santayana, 2008; Heinrich et al., 2009), hence the number of monasteries citing the plant, and their use reports (URs). The taxa most frequently cited which together accumulate at least 50% of all taxa citations are investigated in detail and compared to the *iatrosophia* texts using data from our pre existing dataset (Lardos et al., 2011).

In a further approach a systematic comparative analysis of the medicinal plant knowledge of the monasteries and the *iatrosophia* (Lardos et al., 2011) was conducted by focusing on plant taxa and plant uses. To this end largely pre-established ethnobotanical methods were chosen which involved a quantitative analysis and which allowed a subsequent statistical comparison of the data.

Plant taxa which can be found in the Cypriot flora were analysed from a taxonomical perspective (Meikle, 1977, 1985; Della, 1999) and regarding the diversity of use by means of the relative importance (*RI*) index. The *RI* index, developed by Bennett and Prance (2000) and adapted by Albuquerque et al. (2006), measures a plant's versatility based on the number of body systems treated by it and the number of medicinal uses attributed to it. *RI* values were calculated using the formula: $RI=(\#UGs/\#UG_{max})+(\#PUs/\#PU_{max})$ (#UGs: Number of use groups treated by a given species; $\#UG_{max}$: Number of use groups treated by the most versatile species; #PUs: Number of plant uses of a given species; $\#PU_{max}$: Number of plant uses of the most versatile species). The relationship between the *RI* values of the species present in both datasets was compared using Spearman's rank correlation coefficient.

Plant uses were analysed based on the distribution of URs over the twelve medicinal use groups in order to assess the importance of different groups of ailments as well as in terms of their historical consistency. To investigate the historical consistency of medicinal plant uses (PUs) of the monasteries with those of the *iatrosophia*, we adopted the approach introduced by Kufer et al. (2005). First, for each species mentioned in the monasteries the distribution of the PUs over the twelve use groups was compared to the distribution of the PUs of the same species in the *iatrosophia* and classified into one of the two categories, (i) same use group or (ii) different use group. If a species was not mentioned in the historical texts the corresponding PUs were classified into a separate category, (iii) not in *iatrosophia*. The analogous comparison was conducted with the URs. Frequency analysis of the numbers of citations and use reports as well as statistical testing (LeCompte and Schensul, 1999) were conducted using SPSS® Version 17.0. Any other data analysis was conducted using Microsoft® Excel. In all cases a p-value of <0.05 was accepted as the level of statistical significance.

3. Results and discussion

3.1. Medicinal plant use in the monasteries

Overall 154 medicinally used plant taxa (species, groups of species, subspecies, varieties) were documented in this study (Appendix A). Of these 88 were reported in the field study (FS) involving 21 monasteries and 96 in the written questionnaire (WQ) involving 10 monasteries. The medicinal uses of these plants were recorded in 1240 URs. Of these 628 URs are based on FS and 673 URs on WQ with 61 URs resulting both from FS and WQ with the corresponding plant uses being reported in both datasets.

The majority of the plant uses reported appear to be still in use in the monasteries today and thus represent active ethnobotanical knowledge (Atran et al., 2004). Only 113 (9%) medicinal URs were clearly stated as being no longer practiced (However, the real figure may be higher because in 167 (13%) URs from WQ no such information was stated). Certain cases also have an ambiguous position; a plant use may still be practised in only some of all the monasteries which reported it. The medicinal use of overall ten (6%) taxa appears to have been completely abandoned (Appendix A). One such example, cited in four monasteries, is *Papaver somniferum* L. (Papaveraceae) and the use of latex from its poppies as a sedative.

Some of the plants reported in WQ and the checklist interview in FS, hence in absence of plant material, were identified with a group of species rather than one particular species (Appendix A) because the vernacular name reported can refer to more than one botanical species. This problem is largely linked to the under-differentiation of certain biological species in folk taxonomic systems (Berlin et al., 1966). Most of these cases concern closely related species of one and the same genus and can be explained by the concept of plant complexes first described by Linares and Bye (1987).

3.1.1. Most frequently cited taxa

Only 15 (17%) of the 88 medicinal taxa cited in FS and only 23 (24%) of the 96 medicinal taxa cited in WQ account for over 50% of the total of 303 or 340 citations, respectively (Figs. 2 and 3). These altogether 32 different taxa (six are cited in both FS and WQ) represent a core group of plants for which a high consensus exists among the monasteries regarding their medicinal use (Table 1).

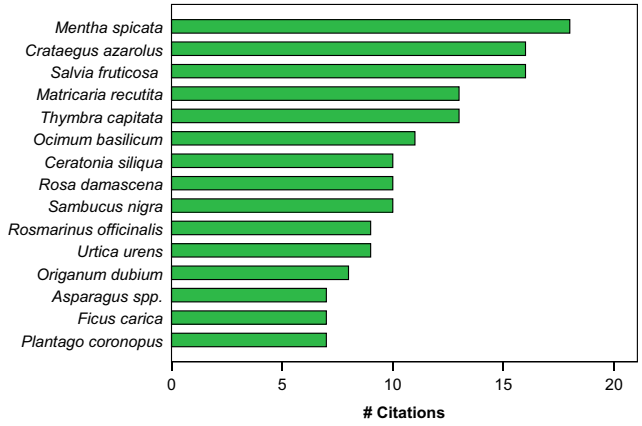

Fig. 2. Frequency of citations per taxa reported in FS. Out of a total of 88 medicinal taxa only the top ranking taxa accounting for at least 50% of all citations are shown ($n=303$).

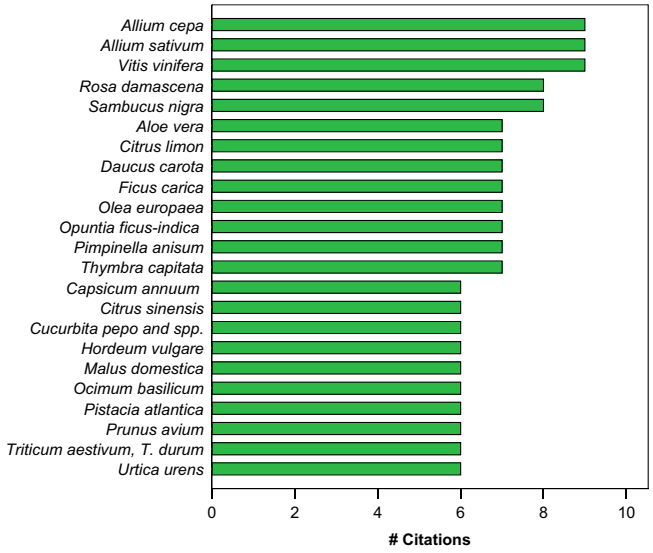

Fig. 3. Frequency of citations per taxa reported in WQ. Out of a total of 96 medicinal taxa only the top ranking taxa accounting for at least 50% of all citations are shown ($n=340$).

One the other hand, the data indicate that the majority of the plants recorded in this study is used for medicinal purposes only by a minor number of the monasteries.

The majority of the 32 taxa belong to the Lamiaceae (six taxa), Rosaceae (four taxa), Amaryllidaceae, Apiaceae, Poaceae or Rutaceae (two taxa each) and include aromatic herbs, vegetables, fruits, grains, spices as well as plants more typically known as medicines. Top ranking taxa in terms of frequency of citations are, in FS, *Mentha spicata* L. subsp. *spicata* (cited in 18 of 21 monasteries), *Crataegus azarolus* L. (16) and *Salvia fruticosa* Mill. (16) and, in WQ, *Vitis vinifera* L. (cited in 10 of 10 monasteries), *Allium cepa* L. (9), *Allium sativum* L. (9), *Rosa damascena* Mill. (8) and *Sambucus nigra* L. (8) (Table 1).

Mentha spicata L. ssp. *spicata* (syn. *Mentha viridis* (L.) L.), spearmint, is the most cited taxon in FS and accounts for 28 medicinal URs. The herb is applied as a tea mainly used as a carminative, in stomach ache, colics, abdominal and menstrual pain or in colds. It exhibits a similar range of indication in the *iatrosophia* texts with main uses in gastrointestinal, gynaecological and respiratory tract complaints. *Mentha spicata* L. was also the most cited species in the Turkish Cypriot migrant community of London (Yöney et al., 2010).

Crataegus azarolus L., azarole, has 29 URs which predominantly concern the cardiovascular system. The traditional jam of the fruit (*ladápin*) or its preserve in syrup (*glykó tou mosfýlou*) was mentioned to be beneficial for the heart. Additionally, blood pressure and cholesterol lowering effects were attributed to the tea of flowers and leaves. The utilisation of *Crataegus* species in diseases of the heart is a relatively modern indication which became popular only in the 19th century (Schilcher, 2000: 216). Perhaps this is one of the reasons why plants of this genus are not mentioned in the *iatrosophia* texts.

Salvia fruticosa Mill. (syn. *Salvia triloba* L.f.) is the species with the highest number of URs in FS. This sage species is especially abundant in the Eastern Mediterranean and, as highlighted by Meikle (1977, 1985), shows its greatest range of variation in Cyprus. Most of the 51 URs concern the tea prepared from the leaves which is mainly used for respiratory tract (common cold, cough, flu, sore throat) or digestive disorders and sometimes in kidney pain or as a general tonic. Respiratory tract and gastrointestinal conditions are also the most important uses of the species in the *iatrosophia*.

Vitis vinifera L. (vine) was cited by all monasteries taking part in WQ and has 75 URs, the highest number attained by any of the plants reported in the monasteries. Obviously this is linked to the species being the source of a variety of products. Only 19 URs refer directly to plant parts such as grapes or leaves, while the remaining 56 URs concern some item produced from grapes such as vinegar (13 URs), wine (22 URs) and *zivanía*, the local pomace brandy (21 URs). The URs concern various applications including decoctions of raisins for the treatment of constipation and other disorders of the intestines, liniments of vinegar to ease insect stings or skin rash, liniments of *zivanía* in colds or rheumatic conditions, red wine as a beverage beneficial for the cardiovascular system, as a wound disinfectant or in inflammations of the gums. *Vitis vinifera* is also the plant with the highest number of medicinal URs in the *iatrosophia* (82 records). This illustrates the species' long-lasting high cultural importance on the island, not only in an agricultural or culinary context (Hadjikyriakou, 2007), but also in terms of medicine. Archaeobotanical evidence suggests that products of *Vitis vinifera* were in use on Cyprus as early as the Pottery Neolithic, approx. 5th millennium BCE (Le Brun, 1996: 2, 11) and that the species was cultivated here from the 2nd millennium BCE (Hjelmqvist, 1979: 110). However, despite the species' consistent importance as a source of medicine most of the main uses of red wine, vinegar or spirit in the monasteries have no relevance in the *iatrosophia*. The cardiovascular uses of red wine appear to be based on the suggested link between moderate red wine consumption and reduced risk of cardiovascular disease (Lippi et al., 2010) and reflects the influence of modern dietary recommendations.

Allium cepa, onion, has 28 URs linked to the bulb which is predominantly used in plasters, poultices and liniments for the treatment of bruises, abscesses and other injuries. *Allium sativum*, garlic, has 21 URs, most of which concern the use of the bulb as a food in elevated blood-pressure and atherosclerosis or because of its antimicrobial and antiparasitic effects on the intestines. In the *iatrosophia*, onion or garlic is used not only for the same dermatological or gastrointestinal, respectively, conditions but in some cases also with exactly the same preparation as in the monasteries. The gastrointestinal use of cloves of *Avena Allium sativa* is also an example of a plant use with a cross-cultural importance which at the same time represents ancient knowledge; garlic was reported as a vermifuge in northern Nigeria (Etkin and Ross, 1982) or from the Amalfi coast in southern Italy (Savo et al., 2011). The same plant use was already described by Dioscorides in his *De Materia Medica* (Berendes, 1902: II.181). In contrast to gastrointestinal complaints the use of garlic in cardiovascular conditions illustrates the influence of modern medicine on local plant use. According to Leonti (2011) cardiovascular applications of garlic are a relatively recent introduction to ethnopharmacopoeias and based on knowledge derived from pharmacological and clinical research. Scientific research about the cardiovascular effects of garlic can be traced back to the first half of the 20th century and publications of human studies in this range of indication became abundant from the late 1960s (Rahman, 2001). By the 1980s the use of garlic in hypertension had also found its way into Cypriot herbal medicine (Arnold-Apostolides, 1985).

Sambucus nigra L., common elder, has 24 URs in WQ and 29 URs in FS. Most of them concern the tea prepared from the flowers which is predominantly used for respiratory tract disorders, above all common cold and sore throat, or applied as a poultice in irritated and sore eyes. Respiratory tract conditions are also among the major uses of elder flowers in the *iatrosophia*, beside their use as a kind of panacea.

Rosa damsacena, Damask rose, has 23 URs in FS and 15 URs in WQ. Rose petals, the plant part most frequently used, are the source for the preparation of sweet preserves, tea or rose water

Table 1
Most frequently cited medicinal taxa in the monasteries.

Family, Scientific name[1]	Vernacular name[2]	Plant part or product used[3]	Form of application	Int. type[4]	#Cit.[5]	Use groups and *UR*[6]	#*UR*[7]	Use group and *UR* in *iatrosophia*[6]	#*UR iat*[7]
Adoxaceae									
Sambucus nigra L.	*koufoxyliá**, *zamboúkkos**, *mermerká*	Flower, leaf	Tea, poultice, liniment, gargle	FS WQ	10 8	CA1, EE 6, FV 2, OC 2, RE 18 CA 1, DE 1, EE 8, FV 1, GI 1, RE 12	29 24	DE 5, FV 5, GI 3, GY 2, HA 1, MS 2, RE 5, UG 1, VA 5	29
Amaryllidaceae									
Allium cepa L.	*kremmýdi**	Bulb	Food, liniment, plaster, inhalation	WQ	9	CA 6, DE 12, EE 1, GI 2, GY 2 OC 1, RE 3, VA 1	28	DE 7, EE 3, FV 1, GI 3, GY 2, UG 2, VA 3	21
Allium sativum L.	*skórdo**	Bulb	Food	WQ	9	CA 9, EE 1, GI 5, RE 3, VA 3	21	DE 9, EE 2, FV 1, GI 4, MS 1, OC 2, RE 3, VA 9	31
Anacardiaceae									
Pistacia atlantica Desf. [AL 009]	*trémithos, tremithiá, tremithkiá**	oleo resin, fruit, *terebinth seed oil*	Food, chew, liniment	WQ	6	CA 2, DE 1, GI 3, MS 1, OC 4	11	DE 14, GI 4, RE 2, UG 2	22
Apiaceae									
Daucus carota L.	*karróto, dafkí**	Tap root	Food, beverage	WQ	7	EE 6, VA 3	9	DE 2, UG 1	3
Pimpinella anisum L.	*glykánisos**	Fruit	Tea, beverage	WQ	7	GI 15, RE 5, UG 1, VA 2	23	FV 2, GI 10, GY 2, OC 1, RE 5, UG 2, VA 3	25
Asparagaceae									
Asparagus acutifolius L. [AL 089] and *A. stipularis* Forssk. [AL 060]	*agrelliá*	Tender shoot	Food	FS	7	UG 14	14	CA 1, DE 1, GI 1, OC 1, UG 5, VA 1	10
Asteraceae									
Matricaria recutita L. [AL 031]	*hamomíli*	Flower	Tea, poultice	FS	13	DE 3, EE 2, GI 11, GY 1, HA 1, MS 1, RE 15, UG 2, VA 6	42	DE 1, EE 1, FV 1, GI 3	6
Cactaceae									
Opuntia ficus-indica L.	*papoutsosykiá**	Fruit, green shoot segment	Food, beverage, liniment	WQ	7	CA 2, DE 1, GI 7, UG 2	12	–	–
Cucurbitaceae									
Cucurbita pepo L. and spp.	*kolokýtha*	Fruit, seed	Food, plaster	WQ	6	DE 1, GI 10, VA 2	13	DE 1, EE 1, GI 2, GY 1, HA 2, VA 1	8
Fabaceae									
Ceratonia siliqua L.	*teratshiá, haroupiá*	Fruit pod, leaf, *carob juice*	Food, beverage, tea	FS	10	GI 13	13	DE 1, GI 1, RE 1, UG 2	5
Lamiaceae									
Menta spicata L. ssp. *spicata* [AL 033, 034, 070, 083]	*dyósmos*, *dyósmin*	Leaf, tender shoot	Tea	FS	18	GI 17, GY 2, HA 1, RE 7, VA 1	28	DE 1, EE 2, GI 8, GY 2, HA 2, OC 1, RE 2, UG 2, VA 2	21
Ocimum basilicum L. [AL 107]	*vasilikós**, *vasilitshiá*	Leaf, flower	Tea, food, inhalation	FS WQ	11 6	CA 1, GI 4, HA 3, RE 6, VA 9 CA 2, GI 1, RE 3, VA 9	23 15	DE 1, EE 1, GI 2	4
Origanum dubium Boiss. [AL 004, 035, 077]	*rígani*	Inflorescence, leaf	Tea, food	FS	8	GI 8, RE 11, VA 1	20	GI 4, OC 1, RE 2, VA 1	8
Rosmarinus officinalis L. [AL 061]	*lasmarín*, *dendrolívano*	Leaf, *essential oil*	Tea, liniment	FS	9	CA 5, HA 5, RE 3, VA 6	19	DE 5, EE 1, GI 1, GY 1, OC 4, RE 2, UG 1, VA 5	20
Salvia fruticosa Mill.[a] [AL 006, 039, 057]	*spatshiá, hahomiliá, faskomiliá*	Leaf	Tea, poultice	FS	16	CA 3, EE 1, FV 1, GI 9, HA 1, MS 1, RE 22, UG 5, VA 8	51	DE 2, FV 2, GI 7, GY 1, RE 5, VA 1	18
Thymbra capitata (L.) Cav. (syn. *Thymus capitatus* (L.) Hoffsgg. et Link) [AL 046]	*throumpín**, *ágrio thymári*	Flowering herb, flower, leaf	Tea, chew	FS	13	CA 1, GI 3, HA 1, RE 23, UG 1, VA 5	34	RE 1	1
				WQ	7	CA 1, GI 1, MS 1, RE 8, VA 3	14		
Moraceae									
Ficus carica L.	*sykiá**	Fruit, milky juice	Food, beverage	WQ	7	CA 1, DE 1, GI 8, RE 2, VA 1	13	DE 10, EE 1, GI 4, MS 1, RE 5, VA 3	24
Oleaceae									
Olea europaea L. (cultivated)	*eliá**	Fruit, leaf, *olive oil*	Tea, beverage, food, liniment	WQ	7	CA 9, DE 2, GI 4, MS 1, RE 2, VA 5	23	DE 5, EE 2, GI 4, MS 2, OC 2, RE 5, VA 1	21
Plantaginaceae									
Plantago coronopus L. ssp. *commutata* (Guss.) Pilger [AL 018]	*lithóspasto*	Leaf, spike	Tea	FS	7	GI 1, RE 1, UG 11	13	–	–
Poaceae									
Hordeum vulgare L.	*krithári**, *klittári*	Seed, *bread*	Beverage, food	WQ	6	CA 2, EE 1, GI 3, GY 1, UG 6	13	DE 1, GY 1, MS 1, RE 1	4
Triticum aestivum L., *T. durum* Desf.	*sitári**	Seed, *bread*	Beverage, food, plaster	WQ	6	GI 3, UG 4, VA 2	9	DE 4, GI 2, UG 1	7

Table 1 (*continued*)

Family, Scientific name[1]	Vernacular name[2]	Plant part or product used[3]	Form of application	Int. type[4]	#Cit.[5]	Use groups and *UR*[6]	#*UR*[7]	Use group and *UR* in *iatrosophia*[6]	#*UR iat*[7]
Rosaceae									
Crataegus azarolus L. [AL 014]	*mosfyliá*	Flower and leaf, fruit	Food, tea	FS	16	CA 23, GI 2, UG 1, VA 3	29	–	–
Malus domestica Borkh.	*miliá**	Fruit, fruit peel, *vinegar*	Food, beverage	WQ	6	GI 8, UG 1, VA 5	14	EE 1, GI 1, RE 2	4
Prunus avium (L.) L.	*kerashiá**	Fruit, fruit stalk, seed	Tea, food	WQ	6	CA 3, UG 7	10	EE 1, GI 5, RE 2, UG 1, VA 4	13
Rosa damascena Mill. [AL 047]	*triantafylliá**	Petal, fruit, leaf, *rose water*, *rose oil*	Tea, food, liniment, washing, poultice,	FS	10	DE 1, EE 2, GI 9, HA 1, OC 3, RE 1, VA 6	23	DE 14, EE 4, GI 11, HA 2, OC 4, RE 2, UG 1, VA 4	42
			beverage	WQ	8	DE 1, EE 2, GI 9, OC 1, VA 2	15		
Rutaceae									
Citrus limon (L.) Burm. f.	*lemoniá**	Fruit, fruit peel, flower, leaf, *lemon oil*	Beverage, food, liniment, inhalation, snuff	WQ	7	CA 3, DE 2, GI 8, RE 9, VA 4	26	DE 3, EE 1, FV 1, GI 5, HA 1, RE 1, UG 4	16
Citrus sinensis Osbeck	*portokaliá**	Fruit, flower	Beverage, food	WQ	6	GI 3, MS 1, RE 5, VA 1	10	GI 1	1
Solanaceae									
Capsicum annuum L. Longum Group	*piperiá**, *apsó pipéri*	Fruit, leaf	Food, plaster	WQ	6	CA 2, DE 1, GI 1, RE 1, VA 3	8	RE 1	1
Urticaceae									
Urtica urens L. [AL 105]	*tsouknítha, tsiknίththa, (o)xynítha, sknítha**	Aerial part	Tea, food	FS	9	CA 3, GI 1, MS 5, RE 1, UG 6	16	GI 1, MS 1, OC 3, RE 2	7
Vitaceae									
Vitis vinifera L.	*ampélos, ampéli, klíma**	Fruit, leaf, *grape molasses*	Food, beverage	WQ	9	CA 1, DE 2, GI 4, RE 2, UG 3, VA 7	19	DE 16, EE 1, FV 1, GI 4, GY 1, HA 1, MS 1, OC 1, RE 4, UG 2, VA 8	40
″	*krasí*	Wine (red)	Beverage, washing, gargle	WQ	8	CA 8, DE 3, GI 2, OC 3, RE 1, VA 5	22	CA 1, EE 2, FV 1, GI 5, GY 1, OC 1, FE 1, UG 2, VA 7	21
″	*xídi*	Vinegar	Liniment, poultice, beverage, steam bath	WQ	6	CA 1, DE 6, FV 2, GI 1, OC 2, VA 1	13	GI 6, GY 1, OC 3, RE 1, UG 1, VA 2	14
″	*zivanía*	Spirit	Liniment, poultice, gargle, snuff	WQ	10	DE 2, GI 3, MS 5, RE 10, VA 1	21	DE 2, EE 1, GI 1, OC 3	7[b]
Xanthorrhoeaceae									
Aloe vera (L.) Burm.f.	*alói**	Leaf, leaf sap	Plaster, liniment, beverage	WQ	7	DE 13, GI 1, VA 1	15	DE 16, EE 7, FV 2, GI 10, GY 1, HA 1, RE 5, UG 2, VA 2	46

[1] Family classifications follow the Angiosperm Phylogeny Group, APG III (2009). Botanical binomials follow The Plant List (www.theplantlist.com). Specimen codes of botanical vouchers are indicated in brackets following the species name.

[2] Vernacular names indicated with an asterisk (*) were pre-suggested in the written questionnaire (WQ) based on Arnold-Apostolides (1985) or Zannettou-Pandeli (2000) and confirmed by the informants. All other names were spontaneously reported by the informants.

[3] Products of the particular plant part(s) are in italics.

[4] Interview type in which the respective plant use was cited: FS=field study, WQ=written questionnaire.

[5] Number of monasteries citing the plant for medicinal purposes in FS or WQ.

[6] Use groups and number of use reports (*UR*): CA-cardiovascular & blood, EE-ears & eyes, DE-dermatological, FV-fevers (including malaria), GI-gastrointesinal & hepatic, GY-gynaecological, HA-headache & migraine, MS-musculo-sceletal, OC-oral cavity, RE-respiratory tract, UG-urogenital, VA-various conditions.

[7] Number of medicinal use reports (*UR*).

[a] (*Salvia fruticosa* Mill.): Earlier authors separated the most extreme form, usually found at higher altitudes, as *Salvia cypria* Unger & Kotschy or *Salvia fruticosa* subsp. *cypria* (Kotschy) Holmboe. The voucher specimens collected in locations of the Troodos Mountains (AL 006, 039, 057) correspond to the description of this type in Hadjikyriakou (2007).

[b] (*Vitis vinifera* L., spirit): URs in the *iatrosophia* refer to *rakí*, a locally used term to denote grape spirits in general.

(*rodòstamma*). Rose water was distilled in Fars (Iran) as early as the 9th century CE (Gennadios, 1914) and its production is known from Cyprus at least since the 16th century (Hadjikyriakou, 2007). In the monasteries the species' major field of indication are gastrointestinal complaints, in particular constipation which is mainly treated by eating a sweet preserve of rose petals. The same kind of preparation was mentioned for the treatment of this condition in the *Geoponikon*, a *iatrosophia* text from 1643 (recipe PΛH, p. 225 (Kostoula, 1991)).

As these case studies show, several aspects of medicinal plant use in the monasteries can be traced back to knowledge and practices found in *iatrosophia* texts. On the other hand, various of the applications reported have their origin in European folk traditions or herbal medicine of the 19th century but also modern Western phytotherapy or current concepts about diet and health. This corresponds to Leonti (2011) who pointed out that local knowledge becomes increasingly intermingled with biomedical knowledge and that this information will eventually be transmitted back to researchers in the field. It can be assumed that the monasteries gained access to this knowledge through written sources including historical texts such as the *iatrosophia* as well as modern texts on herbal medicine, either through their direct study or indirectly through formal education.

Medicinal plant use in the monasteries also shows many parallels to plant uses recorded in villages (Arnold-Apostolides, 1985; González-Tejero et al., 2008) or herbal shops (Karousou and Deirmentzoglou, 2011) of the Greek-speaking part of the island as well as in the migrant community of Turkish-speaking Cypriots in London (Yöney et al., 2010); A cross-check of the plants discussed above with ethnopharmacological information in these studies shows correspondences in terms of the main uses in the majority of the cases. This is little surprisingly as most of the nuns and monks grew up or spent a considerable part of their lives in local villages but also because the monasteries maintain an often close contact with the neighbouring communities. Taken together, this suggests common cultural knowledge and highlights the putative importance of oral intra-communal routes of knowledge transmission.

3.2. Comparative analysis of the monasteries and the iatrosophia

3.2.1. Medicinal floras

We counted 151 taxa from 47 families in the medicinal flora of the monasteries and 214 taxa from 71 families in the medicinal flora of the *iatrosophia*. In order to allow for the consistency of the plant lists of the two medicinal floras, species appearing in both of the datasets had to be listed in the same way. In the plant list of the monasteries this required the combination of certain individually recorded species into the same groups of species or plant complexes (see Section 3.1), respectively, as in the plant list of the historical texts. As a result of this, the above number of medicinal taxa in the monasteries (151) is smaller than the corresponding number reported in Section 3.1.1 (154 taxa).

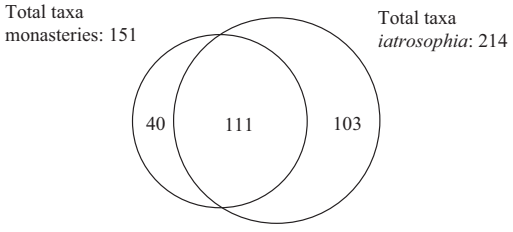

Fig. 4. Taxa used medicinally in the monasteries and the *iatrosophia*. Overlapping areas indicate the number of shared species.

The monasteries and the *iatrosophia* share a pool of 111 taxa (Fig. 4). On the other hand, 40 (26.4%) taxa of the overall 151 taxa in the medicinal flora of the monasteries are not represented in the medicinal flora of the *iatrosophia*. Vice versa, 103 (48.1%) taxa of the 214 taxa in the dataset of the historical texts are not used medicinally in the monasteries. This shows that more than half of the plants used as medicines in the historical texts are still used medicinally in the monasteries and, on the other hand, that the great majority of the plants used by the monks and nuns have a relationship to the *iatrosophia* texts.

3.2.2. Diversity of medicinal uses of taxa

Despite the considerable overlap of the two medicinal floras there are substantial differences in the numbers of uses and use groups in many taxa between the monasteries and the *iatrosophia* (Appendices B1 and B2); this is expressed by the low correlation of the *RI* values of the taxa present in both of the datasets (Spearman's correlation coefficient, $r_s = 0.26$). To a certain extent methodological reasons may play a part in the differences observed: The number of uses of the plant with the highest *RI* value in each of the datasets differ considerably (monasteries: 27 uses, *Salvia fruticosa*; *iatrosophia*: 43 uses, *Pistacia lentiscus* (Appendices B1 and B2)). Since this figure is used in the calculation formula (see Section 2.4) it has a direct influence on the *RI* values of all other plants in the dataset. For example, although *Rosa damascena* has only 18 uses in the monasteries but 35 in the *iatrosophia*, *RI* values do not emphasise this difference (1.44 and 1.45, respectively). Consequently, this sort of bias has to be taken into account not only in the calculation of the overall relationship of *RI* values but also the comparative analysis of the individual *RI* values of pairs of plants (see below).

The detailed comparison of the ten species ranking highest in terms of *RI* values in the monasteries or the *iatrosophia* shows various similarities and differences (Tables 2 and 3). *Rosa damascena*, *Sambucus nigra* or *Vitis vinifera* are among the top ranking species in both of the datasets. Perhaps the most striking difference among the ten top ranking species of the two datasets is the presence of very aromatic herbaceous plants (*Matricaria recutita*, *Ocimum basilicum*, *Salvia fruticosa*, *Thymbra capitata*) in

Table 2
The ten highest ranking species in terms of *RI* values in the monasteries (MON) are shown together with the number of use groups (# UGs) and the number of medicinal plant uses (# PUs). The corresponding figures of the species in the *iatrosophia* (IAT) are also indicated.

Plant species	Dataset	# UGs	# PUs	*RI*
Salvia fruticosa Mill.	MON	9	27	2.00
	IAT	6	17	0.94
Matricaria recutita L.	MON	9	23	1.85
	IAT	4	5	0.48
Sambucus nigra L.	MON	7	22	1.59
	IAT	9	27	1.45
Thymbra capitata (L.) Cav.	MON	7	22	1.59
	IAT	1	1	0.11
Allium cepa L.	MON	8	17	1.52
	IAT	7	20	1.10
Rosa damascena Mill.	MON	7	18	1.44
	IAT	7	35	1.45
Urtica urens L.	MON	6	19	1.37
	IAT	4	5	0.48
Citrus limon (L.) Burm. f.	MON	5	20	1.30
	IAT	7	16	1.01
Ocimum basilicum L.	MON	5	20	1.30
	IAT	3	4	0.37
Vitis vinifera L. (wine)*	MON	6	17	1.30
	IAT	9	19	1.26

* Plant parts and products of *Vitis vinifera* were analysed separately.

Table 3
The ten highest ranking species in terms of *RI* values in the *iatrosophia* (IAT) are shown together with the number of use groups (# UGs) and the number of medicinal plant uses (# PUs). The corresponding figures of the species in the monasteries (MON) are also indicated.

Plant species	Dataset	# UGs	# PUs	*RI*
Pistacia lentiscus L.	IAT	10	43	1.91
	MON	2	2	0.3
Vitis vinifera L. (fruit, leaf)*	IAT	11	36	1.84
	MON	6	14	1.19
Aloe vera (L.) Burm.f.	IAT	9	43	1.82
	MON	3	7	0.59
Urginea maritima Baker	IAT	9	33	1.59
	MON	1	2	0.19
Crocus sativus L.	IAT	8	34	1.52
	MON	1	1	0.15
Ruta chalepensis L.	IAT	9	30	1.52
	MON	0	0	0
Foeniculum vulgare Mill.	IAT	9	28	1.47
	MON	5	7	0.81
Rosa damascena Mill.	IAT	7	35	1.45
	MON	7	18	1.44
Sambucus nigra L.	IAT	9	27	1.45
	MON	7	22	1.59
Laurus nobilis L.	IAT	9	24	1.38
	MON	2	2	0.3

* Plant parts and products of *Vitis vinifera* were separately analysed.

the monasteries (Table 2) while this group of plants is not emphasised in the *iatrosophia* (Table 3).

In the monasteries, *Salvia fruticosa* is the species with the highest *RI* value (2.00). Twenty-seven different medicinal PUs were reported, the highest number any species attained in this dataset. The majority of the species ranking high in this dataset including *Ocimum basilicum*, *Matricaria recutita*, *Salvia fruticosa* but also *Citrus limon*, *Rosa damascena, Sambucus nigra* and *Urtica urens* are frequently found in the monastic garden either cultivated or as weedy, managed plants. Hence, these plants grow in the immediate surrounding area and often are more or less constantly available all over the year. Also other examples show that plants from the home garden or such which grow in other nearby places contribute most to the people's medico-botanical resources (Frei et al., 2000; Sõukand and Kalle, 2011). It has been demonstrated that more accessible and abundant plants are perceived as more useful (Phillips and Gentry, 1993; Stepp and Moerman, 2001; Thomas et al., 2009). In addition to ecological factors also commercial importance may contribute to the high appreciation of these plant resources in the monasteries; eleven of the monasteries sell the above and other aromatic and medicinal plants, as dry tea herbs, spices or sweet preserves to visitors. Very often these plants are grown in small scale cultivations which are supported by the Horticulture Section of the Ministry of Agriculture as part of the programme for the sustainable development of rural areas (http://www.moa.gov.cy/moa/da/da.nsf). Key concerns in these governmental efforts are not only the increase of the farmers' income but also the protection of native populations and their natural habitats by covering the demand for these plants with cultivated qualities (Ypourgeio Georgias, Fysikon Poron kai Perivallontos, 2010). As shown by Karousou and Deirmentzoglou (2011) half of the 28 native or naturalised taxa found in the Cypriot herbal market are provided exclusively from cultivations.

The list of the *iatrosophia* texts includes plants or plant substances with a use that can be traced back to Graeco-Roman times (see Berendes, 1902): *Aloe vera* (aloes), *Crocus sativus* (saffron), *Pistacia lentiscus* (mastic), *Ruta chalepenis* and *Urginea maritima* (Table 3). *Pistacia lentiscus* is the species with the highest *RI* value in this dataset (1.91). The comparison with the monasteries shows that many of the species ranking high in the *iatrosophia* have either fallen into disuse (*Ruta chalepensis*) or lost their diversity in medicinal uses (*Crocus sativus*, *Laurus nobilis*, *Pistacia lentiscus* or *Urginea maritima*). Various reasons might be responsible for this.

The distribution range of *Ruta chalepensis* is restricted to specific areas of the island distant from most of the monasteries (Meikle, 1977, 1985). Also, in the local popular medicine this herb as well as *Urginea maritima* have been known for quite some time to cause adverse effects (Arnold-Apostolides, 1985), the latter in particular after oral application (Blaschek et al., 2007). This could explain that the medicinal uses of *Urginea maritima* reported in the monasteries are restricted to topical applications. The data from González-Tejero et al. (2008) also support this notion; in the local villages included in this study only dermatological uses were reported for both species.

Mastic (most of the uses of *Pistacia lentiscus* in the *iatrosophia* refer to the resin) and saffron (*Crocus sativus*) were traded on Cyprus during the Middle Ages (Heyd, 1879; Zeilinger, 1997). While both substances still had some importance in the local popular medicine in earlier decades (Arnold-Apostolides, 1985) each was reported for medicinal uses in only one monastery. Contrary to this, they seem to have maintained a wider importance in culinary contexts. Mastic and saffron are often used as spices in local traditional dishes (Hadjikyriakou, 2007) and for this purpose also sometimes reported in the monasteries. The same is true for *Laurus nobilis*; Only two monasteries reported medicinal uses for the species but twelve of them use bay leaves as a spice in food. As highlighted by Etkin (1996) various plants from different regions which are used today as food were first appreciated for their medicinal qualities.

In conclusion, in the monasteries important plants of the *iatrosophia* which cannot be obtained from local sources or such for which toxicological concerns exist are often substituted with local, readily accessible and safe plants. With reference to Cyprus, this development can be understood as a consequence of the modified role of herbal medicine in the today's health care system of the island and the influence of modern botanical or medicinal knowledge on the use of plants as medicines in the monasteries.

3.2.3. Historical consistency of plant uses

While many of the plants mentioned in the *iatrosophia* have lost their importance in the monasteries, those which are still appreciated as a source for medicines show, as a whole, a remarkable historical consistency in terms of their use for specific groups of ailments: Roughly half of all medicinal PUs of the monasteries (45.7% in FS and 56.3% in WQ) fall into the category 'Same use group' (Tables 4 and 5). Hence, the same plant was mentioned for the treatment of conditions of the same use group in the historical texts. When acting on the assumption that the historical consistency of plant uses is due to an influence of the *iatrosophia* texts, this result is particularly notable because today these texts are no longer in practical use in the monasteries. Therefore, the existence of other routes of knowledge transmission both within the monastic communities as well as between these and the outside world must be assumed. It is conceivable that the widespread use of these texts in the past has contributed to the conservation of this knowledge in the local traditions and that this knowledge is now transmitted independently from the *iatrosophia*.

The comparison of the PUs also shows that the monasteries have integrated knowledge not contained in the *iatrosophia*: 26.9% (FS) or 39.4% (WQ) of the PUs concerned taxa which were used in the historical texts but for the treatment of conditions of other use groups; 27.4% (FS) or 4.4% (WQ) of the PUs referred to taxa not mentioned in the historical texts. Cultures which were exposed to the influence of historical texts continue to adopt knowledge

Table 4
Medicinal plant uses (PUs) and use reports (URs) from the field study (FS) of the monasteries and their comparison to the *iatrosophia* texts based on the distribution over the twelve use groups.

Use group	Monasteries—field study (FS)				Comparison to the *iatrosophia* texts					
	# PUs	% PUs	# URs	% URs	Same use group		Other use group		Not in *iatrosophia*	
					% PUs	% URs	% PUs	% URs	% PUs	% URs
Cardiovascular & blood	39	9.8	61	9.7	2.6	1.6	53.8	42.6	43.6	55.7
Dermatological	14	3.5	15	2.4	71.4	73.3	7.1	6.7	21.4	20.0
Ears & eyes	7	1.8	10	1.6	57.1	40.0	42.9	60.0	0.0	0.0
Fevers	2	0.5	3	0.5	100.0	100.0	0.0	0.0	0.0	0.0
Gastrointestinal & hepatic	112	28.1	175	27.9	60.7	69.7	11.6	9.7	27.7	20.6
Gynaecological	5	1.3	7	1.1	40.0	42.9	20.0	14.3	40.0	42.9
Headache & migraine	14	3.5	21	3.3	14.3	9.5	64.3	71.4	21.4	19.0
Musculo-sceletal	8	2.0	14	2.2	37.5	57.1	62.5	42.9	0.0	0.0
Oral cavity	11	2.8	12	1.9	27.3	33.3	45.5	41.7	27.3	25.0
Respiratory tract	85	21.4	172	27.4	55.3	61.0	16.5	15.7	28.2	23.3
Urogenital	31	7.8	54	8.6	38.7	46.3	35.5	27.8	25.8	25.9
Various conditions	70	17.6	84	13.4	40.0	39.3	34.3	36.9	25.7	23.8
Total	398		628		45.7	51.1	26.9	23.9	27.4	25.0

Table 5
Medicinal plant uses (PUs) and use reports (URs) from the written questionnaire (WQ) of the monasteries and their comparison to the *iatrosophia* texts based on the distribution over the twelve use groups.

Use group	Monasteries—written questionnaire (WQ)				Comparison to the *iatrosophia* texts					
	# PUs	% PUs	# URs	% URs	Same use group		Other use group		Not in *iatrosophia*	
					% PUs	% URs	% PUs	% URs	% PUs	% URs
Cardiovascular & blood	84	16.0	104	15.5	8.3	9.6	89.3	88.5	2.4	1.9
Dermatological	49	9.3	68	10.1	77.6	85.3	10.2	5.9	12.2	8.8
Ears & eyes	11	2.1	19	2.8	36.4	21.1	63.6	78.9	0.0	0.0
Fevers	2	0.4	3	0.4	100.0	100.0	0.0	0.0	0.0	0.0
Gastrointestinal & hepatic	132	25.1	172	25.6	79.5	82.0	15.9	12.8	4.5	5.2
Gynaecological	4	0.8	5	0.7	50.0	60.0	50.0	40.0	0.0	0.0
Headache & migraine	0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Musculo-sceletal	17	3.2	23	3.4	41.2	52.2	58.8	47.8	0.0	0.0
Oral cavity	12	2.3	14	2.1	50.0	57.1	50.0	42.9	0.0	0.0
Respiratory tract	62	11.8	89	13.2	77.4	79.8	14.5	14.6	8.1	5.6
Urogenital	40	7.6	48	7.1	62.5	60.4	27.5	31.3	10.0	8.3
Various conditions	113	21.5	128	19.0	46.0	46.1	54.0	53.9	0.0	0.0
Total	526		673		56.3	59.1	39.4	37.0	4.4	3.9

also from other sources, this was shown by a study conducted in Campania (Southern Italy): Despite of the long lasting influence of Matthioli's *I Discorsi* a causal influence of this herbal on present plant knowledge could be demonstrated for only roughly 20% of the records on plant use (Leonti et al., 2010).

Presupposing an influence of *iatrosophia* texts we investigated the question if medicinal plant uses which were already mentioned in the historical texts would also be shared by a larger number of monasteries. However, statistical evidence suggests the existence of a link between historical consistency and popularity of medicinal plant uses in the monasteries only in the data from FS but not in those from WQ (Chi-squared goodness of fit test based on the proportion of URs in each of the two categories 'same use group' and 'other use group': FS, $p=0.02$; WQ, $p=0.17$. Expected frequencies were calculated assuming that the frequency with which a plant use is reported was independent from its historical use). Of all URs in FS, 51.1% are linked to taxa mentioned in the *iatrosophia* for the same use groups while they represent 45.7% of all *PU* (Table 4). The same comparison with the taxa mentioned for other use groups shows that the corresponding 23.9% of all URs represent 26.9% of all PUs. In WQ, the analogous percentages are 59.1% and 56.3% for taxa used for the same use groups or 37.0% and 39.4%, respectively, for taxa used for other use groups (Table 5). To better estimate a potential influence of the *iatrosophia* on medicinal plant knowledge in the monasteries a one-to-one comparison of individual plant uses would have to be conducted, taking into account parameters such as plant part used, mode of preparation and way of application. However, any conclusion about the influence of historical texts on present-day knowledge will always be afflicted with a considerable degree of uncertainty. As argued by Leonti et al. (2010) no statistical evidence, regardless of its strength, can prove the influence of or dependence on historical texts.

3.2.4. Importance of the medicinal use groups

In general terms, phytotherapeutic needs of the monasteries have changed since the times of the *iatrosophia*. The distribution of medicinal URs over the twelve use groups shows significant differences between the modern (FS or WQ) and the historical dataset, and this even after exclusion of the category cardiovascular & blood which was overrepresented in the monasteries (see below) (Chi-squared test for independence, FS or WQ: $p<0.000$) (Figs. 5 and 6).

In both the monasteries and the historical texts plants are used with a high frequency for gastrointestinal & hepatic (*iatrosophia*:

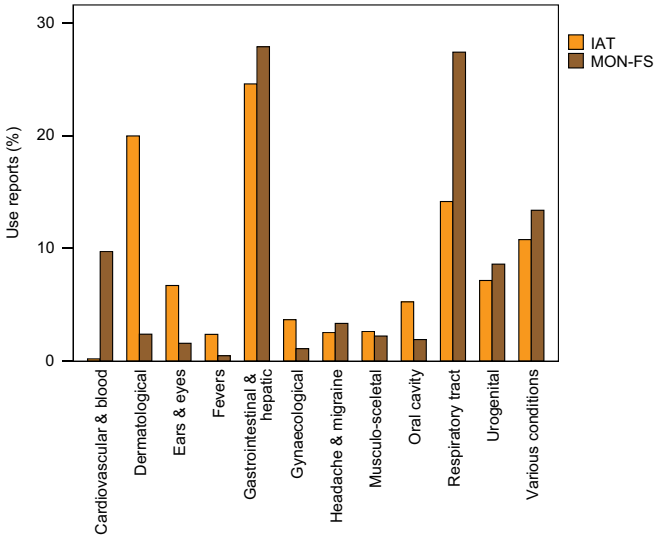

Fig. 5. Distribution (in percent) of use reports (URs) over the twelve medicinal use groups in the field study of the monasteries (MON-FS, $n=628$ URs) and the *iatrosophia* (IAT, $n=2014$ URs).

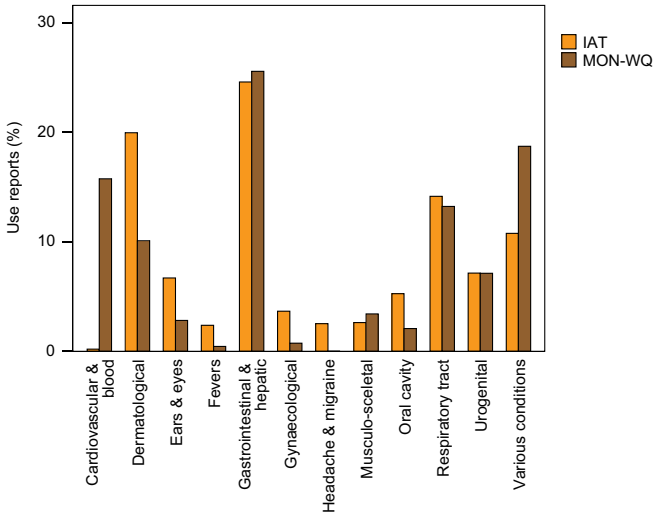

Fig. 6. Distribution (in percent) of use reports (URs) over the twelve medicinal use groups in the written questionnaire of the monasteries (MON-WQ, $n=673$ URs) and the *iatrosophia* (IAT, $n=2014$ URs).

24.6%; FS: 27.9%; WQ: 25.6%) as well as respiratory tract conditions (*iatrosophia*: 14.2%; FS: 27.4%; WQ: 13.2%). Gastrointestinal, and respiratory conditions belong to the most frequently cited medicinal uses of plants in many different cultures (Moerman, 1991; Heinrich, 1998).

The most conspicuous diachronic shift in the importance of use groups is the increase of uses for cardiovascular & blood disorders (*iatrosophia*: 0.2%; FS: 9.7%; WQ: 15.8%) and the decrease of dermatological uses (*iatrosophia*: 20.0%; FS: 2.4%; WQ: 10.1%). The drop of dermatological uses may reflect today's limited prevalence of skin diseases or infected wounds, both important dermatological uses in the *iatrosophia*. This is most likely due to improved hygiene standards and changed working conditions but also the availability of commercial pharmaceuticals. The spread of pharmaceutical products was also considered as one of the factors contributing to the abandonment of ancient plant uses in southern Italy (De Natale et al., 2009). The increased importance of cardiovascular & blood uses can be attributed to changes in the perception of health and disease based on modern concepts of medicine. The practical absence of applications linked to cardiovascular conditions in the *iatrosophia* corresponds to the situation in Matthioli's *I Discorsi* where cardiovascular uses do not appear as a use category (Leonti et al., 2010). This of course raises the question to what extent earlier people, in the absence of the possibilities of modern science, were able to understand cardiovascular symptoms or how much they knew about heart diseases (see Riddle, 1996) but also about the prevalence of cardiovascular complaints in general.

4. Conclusions

This is one of the first studies from the Mediterranean region which is based on a systematic ethnopharmacological analysis involving comprehensive datasets of historical and modern ethnographic data. An ethnobotanical field study was conducted in a representative number of Greek Orthodox monasteries on Cyprus and based on this data as well as such from a pre-existing dataset of historical *iatrosophia* texts continuity and change in medicinal plant use was explored.

First of all, the analysis of the data from the monasteries demonstrate that there is a core group of plants for which a high consensus exists among the monastic communities regarding their medicinal usefulness. The investigation of a subset of these plants suggests that various routes of knowledge transmission have been involved in the development of the medicinal plant knowledge of the monasteries. There are numerous parallels with *iatrosophia* texts in terms of plant use and certain of the medicines recorded can be found in identical form in the texts, this together indicates the historical depth of this knowledge. However, influence is evident not only of historical texts but also Western popular or evidence based herbal medicine and modern nutritional concepts. Furthermore, the medicinal applications of these plants represent common cultural knowledge, they are largely consistent with the practices in other Cypriot communities—local as well as expatriate. The findings of this study are in line with the notion that "widely used medicinal plants need to be abundant and accessible" (Stepp and Moerman, 2001) and also suggest that sustainable development programmes can have an influence on local pharmacopoeias. In general our results support Leonti (2011) who argued that historical or contemporary texts and, especially today, media or health-care programmes exert a strong influence on present folk medicinal knowledge.

The comparative analysis of medicinal plant use between the monasteries today and the historical *iatrosophia* texts shows similarities and differences on various levels. The majority of the plants used in the monasteries and the *iatrosophia* are the same. The relationship of the monasteries to the *iatrosophia* is further corroborated by the remarkable historical consistency in the monasteries' use of plants for specific groups of ailments when compared to the historical texts. On the other hand, the results also show that while the plants may still be the same in many instances their use has changed. The differences observed can be linked to the specific medical needs of the local communities at a particular point in time. Changes in the prevalence of diseases linked to lifestyle and working conditions, altered perceptions of health and disease as well as the introduction of a modern health care system on the island lead to an adaptation of medicinal plant usage. The similarities and differences observed in this comparative study are linked to the continuity and change in terms of 'traditional' knowledge as well as the adoption of new knowledge.

Overall, the study of the monasteries illustrates how ancient and contemporary knowledge on medicinal plant use become intertwined and thus provides the opportunity to look beyond the externally imposed dichotomy between the traditional and the modern. Moreover, we argue that a systematic diachronic approach can facilitate the understanding of the complex

processes involved in the development of medicinal plant knowledge. This allows us to highlight the cultural dynamics within the system and also qualify the emphasis placed on the loss of local or indigenous knowledge. Further comparable studies are needed in ethnopharmacology to better appreciate these underlying dimensions of medicinal plant use.

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Appendix. Supplementary material

Supplementary data associated with this article can be found in the online version at http://dx.doi.org/10.1016/j.jep.2013.08.026.

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