Emilia Romagna and Malta: A comparative ethnobotanical study

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Research

Abstract

Background: A comprehensive ethnobotanical study was conducted on two Mediterranean regions which crossed over in the past through several cultures. Although the two regions have distinctive geographical and cultural characteristics, the aim of this study was to determine potential ethnobotanical similarities between the two regions.

Methods: This desk research involved the thorough examination of the floral species that thrive in these two regions and ethnobotanical information collected from reliable sources. Once the information was collected, the data was sorted and organized into matrices and then analyzed statistically.

Results: Following a thorough search for common plants within the two regions, 193 taxa, distributed in 72 plant families, were identified. The three predominant families, Asteraceae, Lamiaceae and Apiaceae, were selected according to the popularity of medicinal uses of the taxa within the families (10.4 %, 7.8 % and 5.2 %, respectively). The popular therapeutic ratios for taxa within the Asteraceae, Lamiaceae and Apiaceae families varied between 0.14-1.00, 0.17-0.82 and 0.27-0.60, respectively. It was observed that the most targeted therapeutic system was the gastrointestinal system covering several ailments that included gastric disturbances, liver and biliary conditions, and intestinal problems.

Conclusions: It can be concluded that although, these two regions are distinct from each other, the two regional communities share the common understanding that the health status of an individual depends on the maintenance of the health of the digestive system. Today, several studies support this relationship, with scientific evidence and the use of natural products for their medicinal, nutraceutical and functionality in everyday life.

Key words: Ethnobotany, Folk medicinal plants, Malta, Italy, Asteraceae, Lamiacea, Apiaceae.

Background

Several researchers in different parts of the world had delved into the study of the relationship between communities and plants, to understand the importance and potential use of plants in today's world. This multidisciplinary research provides the basis for the discovery of new drugs (Agelet & Vallès 2003). Research is conducted either on a particular region or locality (Novias et al. 2004; Rivera et al. 2005; Akerreta et al. 2007, Maxia

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et al. 2008, Carrió & Vallès 2012, Nawash et al. 2014, Bulut et al. 2017) or on several regions or localities (González-Tejero et al. 2008, Hadjichambis et al. 2008, Pieroni & Cattero 2019) to compare and contrast medicinal plant use between different cultures.

Since antiquity the Mediterranean region was considered as a centre of cultural diversity and traditions. Amongst these cultures, prominent ones included the Egyptian civilization, the Phoenicians, the Greeks, the Romans, and the Arabs (Savo et al. 2010, https://www.academia.edu/22703833/Plants_history_and_cultures_in_the_Mediterranean_area). It was also considered as a centre of trade linking southern Europe, North Africa, and western Asia together. Trade of goods included several plants that have naturalized and formed part of the flora. Knowledge on the use of these plants has been transmitted horizontally between cultures and vertically from one generation to the next within a culture. Migration is another factor that has contributed to spreading of such knowledge. However, the density and abundance of certain taxa varied significantly from region to region and from country to country. Several taxa have evolved into genetically different chemotypes with different edible and therapeutic uses. This ultimately affected the popularity of plants for their use in tradition and instigates further research towards plant genetic resources (Laghetti et al. 2004).

The Mediterranean bioclimate is one of the five bioclimates traditionally recognized in Europe. This climate is defined as 'an extratropical climate with seasonal and daily photoperiodicity, with rainfall concentrated in the cold or relative cold seasons of the year, summer, the hottest season, being dry' (Emberger 1954). Other authors attempted to improve on this definition keeping Emberger's definition as the basis for their description (Di Castro 1981, Rivas-Martinez et al. 2011). Although the Mediterranean bioclimate is also described in several other regions, such as Australia, California, Chile and South Africa, the territory of the Mediterranean Basin is the largest area that represents this type of bioclimate (Sánchez-Mata & Morales 2016). This region is characterized by four major peninsulas (Italian, Iberian, Balkan, and Anatolian) on the southern European side connected eastwards to the Near East which is connected westwards to the North African region in a clockwise manner. In the Mediterranean region, plants have naturalized in different biomes namely, forests, woodlands, scrubs, and deserts. The diverse topography leads to a rich Mediterranean biome, which is characterized by forests, woodlands, and scrub. Greuter (1991) reported the presence of more than 24,000 floral taxa along the Mediterranean area, hence showing the suitability of the Mediterranean conditions to a vast range of organisms.

The histories of Malta and Italy cross at several points in time. In 218 B.C., Malta was passed on to the Roman Empire at the beginning of the Second Punic War. In 1091 A.D., Malta was invaded by the Normans and was officially part of the Kingdom of Sicily. Another important cross was during the rule of the Order of Saint John, particularly during the Great Siege of 1565 A.D. The Knights made the Italian language as the official language till 1798 A.D. During the British rule from 1800 A.D., political organizations were created, in part, to protect the Italian language in Malta.

The aim of this study is to determine any similarities and differences in the usages of medicinal plants belonging to two different geographical areas in two neighboring countries separated by sea.

Materials and methods

Study areas

The two geographic regions considered in this study are situated in two different countries, but both belong to the Mediterranean region (Figure 1). The Maltese Islands constitute a land area of 316 km^2. With a population of about 515,000, the population density is currently 1,282 inhabitants per km^2 (NSO 2020, https://nso.gov.mt/en/News_Releases/Documents/2020/07/News2020_114.pdf). The highest point is at 253 m above mean sea level.

With nine provinces within the Emilia-Romagna region (within the Italian peninsula), the total area is of 22,446 km^2. This region ranks sixth in Italy. The region comprises of plains (48%), hills (27%) and mountains (25%) with an altitude of more than 2,000 m above mean sea level. In 2019, the population of the region was estimated to be 4,459,577 (ISTAT 2011, http://dati.istat.it/) with a population density of approximately 200 inhabitants per km^2.

Figure 1. The Emilia Romagna region (Italy) and the Maltese Islands

Data collection

Ethnobotanical data was collected from several sources related to the two respective regions. For this research, information about medicinal plants usages was found in books and scientific articles published in journals and available on online platforms. Usages and traditions related to Emilia Romagna were researched in the library of Agriculture of Bologna (Lazzarini 1992 and 1996, Lanzara 1978, Pignatti 2003). On the other hand, in Malta, the books regarding this topic were mainly placed in the "Melitensia special collection", a particular section of the main library of the University. Some of the books that have been used, in fact, were old and without an English version (Lanfranco 1993, Penza 1969). Consequently, the information was translated from Maltese to English, with the help of some Maltese people. More recent studies conducted on the Maltese flora were also considered (Attard & Cuschieri 2009, Attard & Pacioni 2012, Attard et al. 2015, Caruana & Attard 2016). The first step was the compilation of the list of plants that were common to both regions omitting the others that occurred in only one of the regions.

Calculations and data analysis

Following the categorization of the plant species by family, the uses of each plant in the respective location were listed and transformed numerically to determine the popular therapeutic ratio, as a modification to the equation used by Bulut and Tuzlaci (2015), taken as number of common therapeutic uses/total number of therapeutic uses. The popularity index was determined from the graphs obtained for relationships between the two regions. Pearson correlation followed by Principal Component Analysis were conducted by plant family and by use. Statistical significance was considered at $p<0.05$.

Results and discussion

Plant families with ethnobotanical uses

The Maltese flora is made up of approximately 1264 vascular plants with 458 species used in folk medicine for the treatment of several diseases (Lanfranco 1975, 1993). In this case, 42% of the medicinal species were considered. On the other hand, within the Emilia-Romagna region, there are 3927 taxa (https://bbcc.ibc.regione.emilia-romagna.it/pater/search.do?type=bnb&page=1&re=load) with about 500 species used traditionally for medicinal purposes. This number is not precise, although realistic as it derives from bibliographic sources (Lazzarini 1992, Lazzarini 1996) and information obtained from the "Giardino delle erbe officinali Augusto Rinaldi Ceroni, Casola Valsenio (RA)", which collects, preserves, and cultivates plants of medicinal and aromatic interests and belongs to the Emilia-Romagna region (https://ilgiardinodelleerbe.it/). For this region, 39% of the medicinal species were considered in the present study. Table 1 represents a comparison of the ethnobotanical particulars of two regions. The Maltese region shows a medicinal plant density of 1.45 per km^2 whereas the Emilia-Romagna region has a density of 0.02 per km^2. The density of the medicinal flora within the two regions compares with the minimum and maximum densities within the Pyrenees region (min: 0.035, max: 1.68 per km^2) (Akerreta et al. 2007), but the Maltese medicinal flora density is almost three times higher than that of the eastern Mallorca region (0.51 per km^2) (Carrio & Valles 2012).

Table 1. Comparison of ethnobotanical particulars of two regions.

Region	Extension (km^2)	Population	Flora	MP	MP/km^2
Emilia-Romagna	22,446	4,459,577	3927	500	0.02
Malta	316	515,000	1264	458	1.45

MP: medicinal plants

Species from the Asteraceae, Lamiaceae and Apiaceae plant families

Following a thorough search for sources, the number of species in common between the two regions was 193 (Table 2). These species were distributed in 72 plant families. Due to the long list of species three plant families having the highest number of species were studied further. These include the Asteraceae, Lamiaceae and Apiaceae families (10.4 %, 7.8 % and 5.2 %, respectively). All the other families had on average approximately 0.5 - 2 % of species. To some extent, this goes in accordance with other studies. Akerrata and co-workers (2007), Hadjichambis and co-workers (2008) and Nawash and co-workers (2014) reported that the predominating botanical family was Asteraceae, considering that this family is well represented in the flora of several Mediterranean countries. Others quoted the Lamiaceae as the predominating botanical family (Novais et al. 2004; González-Tejero et al. 2008; Carrio & Valles 2012; Bulut et al. 2017). Whereas the studies mentioned above, listed the Asteraceae or Lamiaceae family in second place, only Rivera and co-workers (2005) quoted Apiaceae in the third position as reported in this current study. As stated by several authors (Johns et al. 1990; Bonet et al. 1999; Agelet & Valles 2001; Novais et al. 2004), the relative abundance of a plant reflects the extent of its potential popular use.

Table 2. List of the common medicinal species present in Malta and Emilia Romagna

Family	**Species**
Acanthaceae	*Acanthus mollis*
Alismaceae	*Alisma plantago aquatica*
Amaranthaceae	*Amaranthus blitum, Amaranthus graecizans, Amaranthus retroflexus*
Ampelidaceae	*Vitis vinifera*
Anacardiaceae	*Rhus coriari, Schinus mollea*
Apiaceae	*Amni majus, Amni visnaga, Anethum graveolens, Anthriscus cerefolium, Apium graveolens, Carum carvi, Conium maculatum, Coriandrum sativum, Daucus carota, Foeniculum vulgare, Cuminum cyminum, Petroselinum crispum, Oenanthe acquatica, Pimpinella anisum*
Apocynaceae	*Vinca major*
Araceae	*Arum italicum, Arum maculatum*
Araliaceae	*Hedera helix*
Asteraceae	*Achillea millefolium, Anthemis arvensis, Artemisa campestris, Artemisia alba, Artemisia dracunculus, Bellis perennis, Calendula arvensis, Calendula officinalis, Carlina vulgaris, Centaurea calcitrapa, Carthamus tinctorius, Cichorium intybus, Cnicus benedictus, Cynara scolymus, Eupatorium cannabium, Helianthus tuberosus, Helicrysum italicum, Inula*

	graveolens, Lactuca saligna , Lactuca virosa, Lavandula angustifolia, Matricaria chamomilla, Pulicaria dysenterica, Santolina chamaecyparissus, Senecio vulgaris, Sonchus asper, Taraxacum officinale, Tragopogon porrifolius, Xanthium spinosum
Boraginaceae	*Anchusa italica, Borago officinalis, Cynoglossum creticum, Echium vulgare, Symphytum officinale*
Brassicacae	*Eruca vesicaria*
Buxaceae	*Buxus sempervirens*
Capparidaceae	*Capparis spinosa*
Caprifoliaceae	*Lonicera caprifolium, Sambucus ebulus, Sambucus nigra*
Caryophyllaceae	*Arenaria serpyllifolia, Hernaria glabra, Silene vulgaris, Stellaria media*
Chenopodiaceae	*Beta vulgaris*
Chenopodiaceae	*Chenopodium album*
Ciperaceae	*Cyperus longus*
Convolvulaceae	*Convolvulus arvensis, Cuscuta epithymum*
Crucifereae	*Brassica napus, Brassica oleracea, Brassica rapa ssp. campestris, Capsella bursa pastoris, Cardamine hirsuta, Cheiranthus cheiri, Diplotaxis muralis, Lepidum sativum, Nasturtium officinale, Raphanus raphanistrum, Sinapis alba, Sisymbrium officinale*
Cucurbitaceae	*Ecballium elaterium*
Cupressaceae	*Cupressus sempervirens*
Cupulifereae	*Corylus avellana*
Cyperaceae	*Scirpus lacustris*
Dioscoreaceae	*Tamus communis*
Dipsacaceae	*Dipsacus sylvestris*
Dryopteridaceae	*Dryopteris filix-mas*
Equisetaceae	*Equisetum ramosissimum*
Ericaceae	*Arbutus unedo*
Euphorbiaceae	*Euphorbia helioscopia*
Euphorbiaceae	*Mercurialis annua*
Fagaceae	*Quercus ilex*
Fumariaceae	*Fumaria capreolata, Fumaria officinalis*
Geraniaceae	*Erodium cicutarium, Geranium robertianum*
Ginkgoaceae	*Ginkgo biloba*
Gramineae	*Agropyrum repens, Arundo donax, Avena fatua, Avena sativa, Cynodon dactylon*
Hyperiaceae	*Hypericum perforatum*
Iridaceae	*Gladiolus italicus, Iris germanica*
Juglandaceae	*Juglans regia*
Lamiaceae	*Ajuga reptans, Ballota nigra, Glechoma hederacea, Marrubium vulgare, Melissa officinalis, Mentha arvensis, Mentha pulegium, Mentha rotundifolia, Ocimum basilicum, Origanum majorana, Origanum vulgare, Rosmarinus officinalis, Salvia officinalis, Thymus vulgaris*
Lauraceae	*Laurus nobilis*
Leguminosae	*Anthyllis vulneraria, Lotus corniculatus, Medicago sativa, Ononis spinosa, Robinia pseudoacacia, Spartium junceum, Trifolium pratense, Trifolium repens, Trigonella foenum graecum*
Liliaceae	*Allium sativum, Asparagus acutifolius, Asparagus officinalis, Colchium autumnale, Muscari comosum, Ruscus aculeatos, Smilax aspera*
Linaceae	*Linum usitatissimum*
Lythraceae	*Lythrum hyssopifolia*
Malvaceae	*Althea officinalis, Malva rotundifolia, Malva sylvestris*
Moraceae	*Ficus carica, Morus alba, Morus nigra*
Nyctaginaceae	*Mirabilis jalapa*
Nymphaeaceae	*Nymphaea alba*
Oleaceae	*Fraxinus excelsior, Fraxinus ornus, Olea europea*
Orchideaceae	*Orchis morio*
Papaveraceae	*Chelidonium majus, Papaver rhoeas, Papaver somniferum*
Pinaceae	*Pinus halepensis*

Poaceae	*Hordeum vulgare*
Polygonaceae	*Polygonium aviculare, Polygonum lapathifolium, Rumex acetosa, Adiantum capillus veneris, Asplenium trichomanes, Ceterach officinarium*
Portulacaceae	*Portulaca oleracea*
Primulaceae	*Anagallis arvensis*
Punicaceae	*Punica granatum*
Phytolaccaceae	*Phytolacca decandra*
Ranuncolaceae	*Anemone coronaria, Clematis vitalba, Ranunculus arvensis*
Rosaceae	*Crataegus monogyna, Fragaria vesca, Mespilus germanica, Potentilla reptans, Prunus domestica, Rosa canina, Rubus ulmifolius, Sanguisorba minor*
Rubiaceae	*Asperula cynanchica, Galium aparine*
Rutaceae	*Ruta graveolens*
Salicacae	*Populus alba, Salix alba*
Scrophulariaceae	*Anthirrinum majus, Scophularia nodosa, Verbascum thapsus, Verbascum thapsus, Veronica anagallis-aquatica*
Simarubaceae	*Ailanthus altissima*
Solanaceae	*Atropa belladonna, Datura stramonium, Physalis alkekengi, Solanum nigrum*
Typhaceae	*Typha angustifolia, Typha latifolia*
Urticaceae	*Parietaria officinalis, Urtica urens*
Valerianaceae	*Centranthus ruber, Valeriana officinalis*
Verbenaceae	*Lippia citriodora, Verbena officinalis, Vitex agnus-castus*
Violaceae	*Viola odorata, Viola tricolor*
Zygophyllaceae	*Tribulus terrestris*

Asteraceae family

Table 3 represents the uses of the eighteen species within the two regions, together with the popular therapeutic uses and the respective ratio. It was observed that the popular therapeutic ratio for *Anthemis arvensis*, *Bellis perrenis*, *Inula graveolens* and *Tragopogon porrifolius* was zero, indicating that there were no common traditional uses for the two regions. On the other hand, in the case of *Carthamus tinctorius* and *Helianthus tuberosus* the popular therapeutic ratio was 1, indicating that these species were used for the same ailments in both regions. Figure 2 illustrates the popularity of *Asteraceae* plants by use. It is clearly indicated that six out of the eighteen species had a high popularity index in both regions, these include *Artemisia absinthium*, *Cichorium intybus*, *Taraxacum officinale*, *Cynara scolymus*, *Matricaria chamomilla* and *Achillea millefolium*. Despite a variation in the popular therapeutic ratio (0.14 – 1.00), these *Asteraceae* herbs are popular in both regions. Novais and co-workers (2004) mentioned, *Anthemis nobilis* as the most common Asteaceae species of Arrabida Natural Park (Portugal). Maxia and co-workers (2008) considered *Inula viscosa* and *Centaurea calcitrapa* as two important species in south-western Sardinia.

Table 3. The uses of the eighteen Asteraceae species within the two regions

Asteraceae	**MT**	**ER**	**Popular therapeutic ratio**
Achillea millefolium L.	antispasmodic, digestive, cholagogue, emmenagogue, antidiarrhoeic, anti-haemorrages, depurative, skin injuries and excoriations, increase appetite, surface veins	antispasmodic, digestive, cholagogue, emmenagogue, antidiarrhoeic, anti-haemorrages, depurative, skin injuries and excoriations, for toothache	0.73
Anthemis arvensis L.	stomachache, skin itching	antispasmodic, digestive, antipyrethic	0.00
Artemisia absinthium L.	antihelmintic, antimicrobial and antiseptic, insect repellent, anti-asthmatic, for hair, skin problems, toothache,	antihelmintic, antiinflammatory, antimicrobial and antiseptic, antidepressant, digestive, carminative	0.14

	cholagogue, emmenagogue, eyes		
Bellis perennis L.	stomachic, coughs	rheumatism, wounds and inflammation, diaphoretic, laxative	0.00
Calendula spp.	antispasmodic, jaundice, chilblains, heart problems	antispasmodic, emmenagogue, antibacterial and antifungal activity, sedative, hypertension, skin lesions, insect bites, erythema	0.13
Carthamus tinctorius L.	laxative	laxative	1.00
Centaurea calcitrapa L.	antipyretic	carminative, digestive, diuretic, antipyretic	0.25
Cichorium intybus L.	diuretic, digestive, stomachic, cholagogue, diabetes, antihaemorroids, aphrodisiac, skin problems	depurative, tonic, antipyretic, diuretic, digestive, stomachic	0.27
Cynara scolymus L.	diuretic, cholagogue, tonic, antiphyretic, diabetes, hypocholesterolaemic, rheumatism	diuretic, depurative, digestive, cholagogue, diabetes, hypocholesterolaemic	0.44
Eupatorium cannabium L.	laxative, diuretic, cholagogue, for colds, diaphoretic, insect repellent	laxative, diuretic, cholagogue	0.50
Helianthus tuberosus L.	diabetes	diabetes	1.00
Helichrysum italicum (Roth) G. Don fil.	antiasthmatic and for respiratory system	cough, colds and allergies, antiasthmatic and for respiratory system, headaches, liver problems, arthosis, skin problems, burns, depurative, diaphoretic	0.13
Inula graveolens (L.) Desf.	insect repellent	stomachic, cholagogue, cough, diaphoretic	0.00
Lactuca virosa L.	sedative	sedative, emollient, hypnotic	0.33
Matricaria chamomilla L.	stomachic, increase appetite, ulcers, antispasmodic, antiseptic, laxative, insomnia, skin problems, surface veins, eye inflammation	stomachic, headaches, antispasmodic, antiseptic, laxative, insomnia, skin problems, diaphoretic	0.50
Senecio vulgaris L.	sedative, emmenagogue, mouth problems	sedative, emmenagogue, purgative and antihelmintic (but cirrhosis)	0.50
Taraxacum officinale (L.) Weber ex F.H.Wigg.	increase appetite, digestive, cholagogue, depurative, laxative, diuretic, sedative, headaches	increase appetite, digestive, cholagogue, depurative, laxative, diuretic	0.75
Tragopogon porrifolius L.	coughs, skin problems	depurative, stomachic, astringent, metabolism booster	0.00

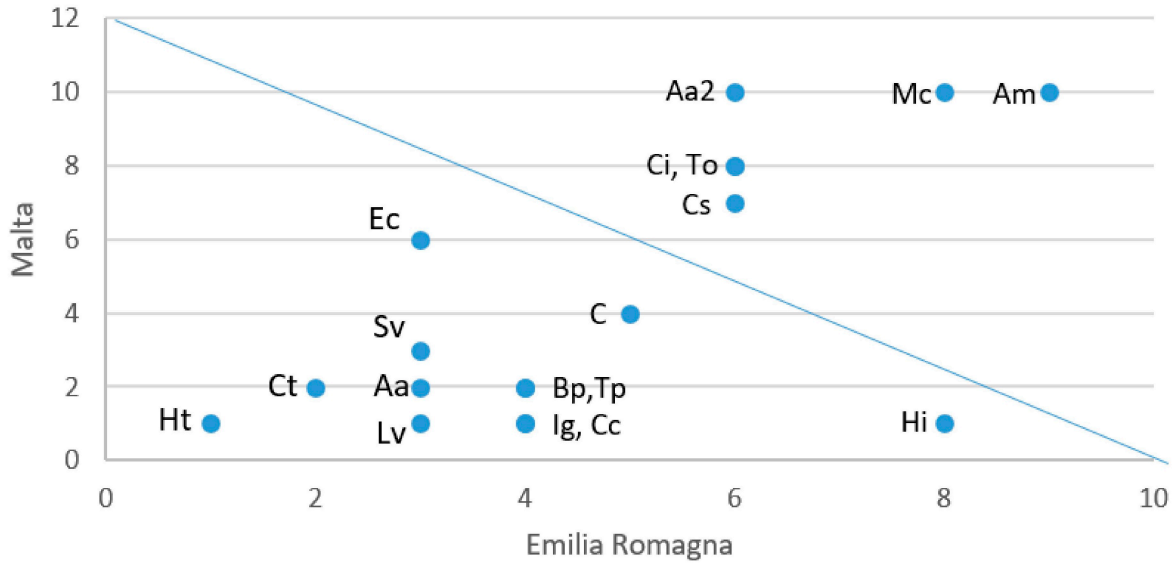

Figure 2. Asteraceae: Popularity by Use within the two regions

Lamiaceae family

Table 4 illustrates the uses of eleven species within the two regions. Within this group, none of the species scored zero with regards to the popular therapeutic ratio, indicating that there is a degree of commonality between the uses of these species within the two regions. On the other hand, none of the species had a popular therapeutic ratio of 1. The species with the lowest score was *Ocimum basilicum* (0.17) and the one with the highest score was *Thymus vulgaris* (0.82). Figure 3 shows the popularity index for the species, indicating a high popularity index for nine out of the eleven species. These include *Ballota nigra/Marrubium vulgare*, *Lavandula angustifolia*, *Mentha* spp., *Melissa officinalis*, *Origanum* spp., *Rosmarinus officinalis*, *Salvia officinalis*, and *Thymus vulgaris*. Despite a variation in the popular therapeutic ratio (0.31 – 0.82), these *Lamiaceae* herbs are popular in both regions. *Mentha* is amongst the predominating genera in Egypt, Morocco, and Spain, *Origanum vulgare* in Albania, *Rosmarinus officinalis* in Algeria and *Salvia officinalis* in Albania (González-Tejero et al. 2008). Novais and co-workers (2004) mentioned, *Melissa officinalis, Mentha pulegium*, *Phlomis purpurea* and *Rosmarinus officinalis* as the most common Lamiaceae species of Arrabida Natural Park (Portugal).

Table 4. The uses of the eleven Lamiaceae species within the two regions

Lamiaceae	**MT**	**ER**	**Popular therapeutic ratio**
Ajuga reptans L.	astringent, antidiarrhoeic, skin problems, toothache and sore throat, arthritis, rheumatism	astringent, antidiarrhoeic, skin problems, toothache and sore throat	0.67
Ballota nigra L. / *Marrubium vulgare* L.	digestive, antispasmodic, cholagogue, coughs, viral diseases, skin problems, metabolism booster, eye and ears conditions, rheumatism, antipyretic	digestive, antispasmodic, cholagogue, emmenagogue, sedative, coughs, diaphoretic	0.31
Glechoma hederacea L.	astringent, antidiarrhoeic, haemorrohids, respiratory system	astringent, antidiarrhoeic, haemorrohids, respiratory system, diuretic	0.80
Lavandula angustifolia Mill.	sedative, cholagogue, antispasmodic, antidiharroeic, carminative, insect repellent, antiseptic	sedative, cholagogue, antispasmodic, antidiharroeic, carminative, insect repellent, antiseptic, rheumatism, coughs	0.78
Melissa officinalis L.	sedative (for insomnia and stress), antispasmodic, carminative, emmenagogue, cicatrising role, antiinflammatory, joint and	sedative (for insomnia and stress), antispasmodic, carminative, emmenagogue, cicatrising role,	0.70

	muscular pain relief, hair loss, antipyretic, psoriasis	antiinflammatory, joint and muscular pain relief	
Mentha spp.	stomachache, antidiarrhoeic, antispasmodic, tonic, against liver problems and jaundice, rheumatism, sedative and to treat shocks, antiseptic, insect repellent	stomachache, antidiarrhoeic, antispasmodic, tonic, against liver problems and jaundice, rheumatism	0.67
Ocimum basilicum L.	insect repellent, antipyretic, kidney problems	antispasmodic, sedative, skin irritation, insect repellent	0.17
Origanum spp.	digestive, stomachic, carminative, tonic (stimulant), antispasmodic, diaphoretic, headache, expectorant, cholagogue, emmenagogue, antiseptic	digestive, stomachic, carminative, tonic (stimulant), antispasmodic, expectorant, sedative, antiseptic	0.58
Rosmarinus officinalis L.	digestive, cholagogue, emmenagogue, coughs, diaphoretic, sedative, joint and muscular pain relief, antiseptic, tonic, circulation, hair, antispasmodic	digestive, cholagogue, diuretic, emmenagogue, coughs, diaphoretic, joint and muscular pain relief, antiseptic, tonic, circulation, hair, insect repellent	0.71
Salvia officinalis L.	digestive, cholagogue, diuretic, diaphoretic, stop milk production, anti-asthmatic, antiseptic, skin problems	digestive, cholagogue, diuretic, diaphoretic, stop milk production, anti-asthmatic, antiseptic, skin problems, cicatrising role, mouth problems, hair	0.73
Thymus vulgaris L.	carminative, diaphoretic, depurative, emmenagogue, antidiarrhoeic, antispasmodic, antiseptic, skin (wounds and plagues), mouth problems, arthritis pain, headaches	carminative, diaphoretic, depurative, emmenagogue, antidiarrhoeic, antispasmodic, antiseptic, skin (wounds and plagues), mouth problems	0.82

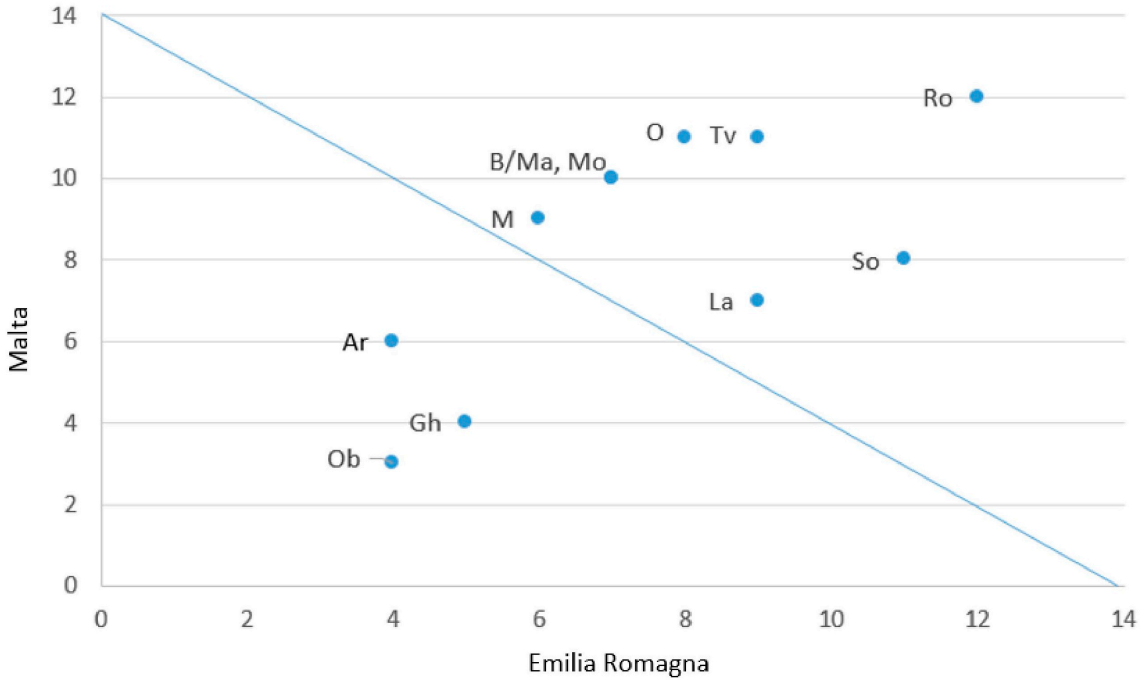

Figure 3. Lamiaceae: Popularity by use within the two regions

Apiaceae family

Table 5 represents the uses of nine species from the Apiaceae family within the two regions. Although all nine species are present in both regions, two species were unpopular in one of the two regions. *Coriandrum sativum* showed three uses in the Emilia-Romagna region but one medicinal use in Malta, while *Cuminum cyminum* had two medicinal uses in Malta, but one in the Emilia-Romagna region, with no overlaps for both species. The highest popular therapeutic ratio was exhibited by *Ammi majus* (0.60), whilst the lowest by *Foeniculum vulgare* (0.27). Figure 4 illustrates that only two out of the nine species had a high the popularity index, and these are *Foeniculum vulgare* and *Daucus carota*. However, both species exhibited a low popular therapeutic ratio (0.27 and 0.44, respectively), when compared between the two regions.

Table 5. The uses of the nine Apiaceae species within the two regions

Apiaceae	**MT**	**ER**	**Popular therapeutic ratio**
Amni majus L.	diuretic, carminative, stomachic, tonic, antiasthmatic	diuretic, carminative, stomachic	0.60
Anethum graveolens L.	carminative, stomachic, digestive, sedative, haemorrhoids	carminative, stomachic, digestive, galactagogue	0.50
Apium graveolens L.	carminative, diuretic, rheumatism, antiseptic (urinary tract), aphrodisiac	carminative, diuretic	0.40
Carvum carvi L.	carminative, digestive, skin problems (itching and parasites)	carminative, digestive, galactagogue, diuretic	0.40
Coriandrum sativum L.	carminative	antispasmodic, diaphoretic, digestive	0.00
Cuminum cyminum L.	increase appetite, high pressure	carminative	0.00
Daucus carota L.	eyes, diuretic, depurative, stomachic, antihelmintic	eyes, diuretic, depurative, stomachic, antidiarrhoeic for infants, galactagogue, carminative, emmenagogue	0.44
Foeniculum vulgare Mill.	carminative, digestive, eyes, throat infections, diuretic, galactagogue, emmenagogue, insect repellent, pain killer, skin problems	carminative, digestive, antispasmodic, diaphoretic, galactagogue, mmenagogue, depigmentant on skin, tonic in bath, expectorant	0.27
Petroselinum crispum (Mill.) Fuss*/Anthriscus cerefolium* (L.) Hoffm.	diuretic, carminative, depurative, emmenagogue, skin problems, chest irritation in lactating mothers, aphrodisiac	diuretic, carminative, depurative, emmenagogue	0.57

Therapeutic Systems

Table 6 represents the number of uses by therapeutic systems for the two regions. Each system represented several ailments. The heart and circulatory system were represented by hyper-cholesterolaemia, hypertension, jaundice, heart problems, varicose veins, chilblains, bleeding, and circulatory problems. The central nervous system was represented by sedation, antidepressant, and headaches, while the urinary system was represented by diuresis. The respiratory system was presented by asthma, dry and productive coughs, colds, respiratory allergies. The skin, nails and hair system were represented by insect bites, skin lesions, erythema, skin burns, scar formation, hair problems, psoriasis, and skin irritation. The musculoskeletal system was represented by arthritis, rheumatic disorders, joint and muscular pain, while the endocrine system was represented by diabetes, diaphoresis, pyrexia, and milk production disorders in nursing mothers. The reproductive system was represented by menstrual disorders and aphrodisiac. The gastrointestinal system was represented by loss of appetite, stomach upsets, gastric ulceration, liver and biliary problems, diarrhea, intestinal spasms, intestinal worms, and constipation.

In Table 6, it is clearly shown that the uses of herbs from the Asteraceae, Lamiaceae and Apiaceae families, are prominent towards gastrointestinal ailments, with an overall score of 89 and 77 for the Emilia-Romagna region and Malta, respectively. The same family ranking was observed in other studies (Bhardwaj et al. 2019). Conditions of the

musculoskeletal system and the eyes/ears/mouth origin were the least treated in these two regions (6 and 8, ER and MT; 4 and 10, ER and MT, respectively). Comparing the three plant families for the treatment of ailments, the overall decreasing ranking order by use is Lamiaceae, Asteraceae and Apiaceae (173, 163 and 81, respectively).

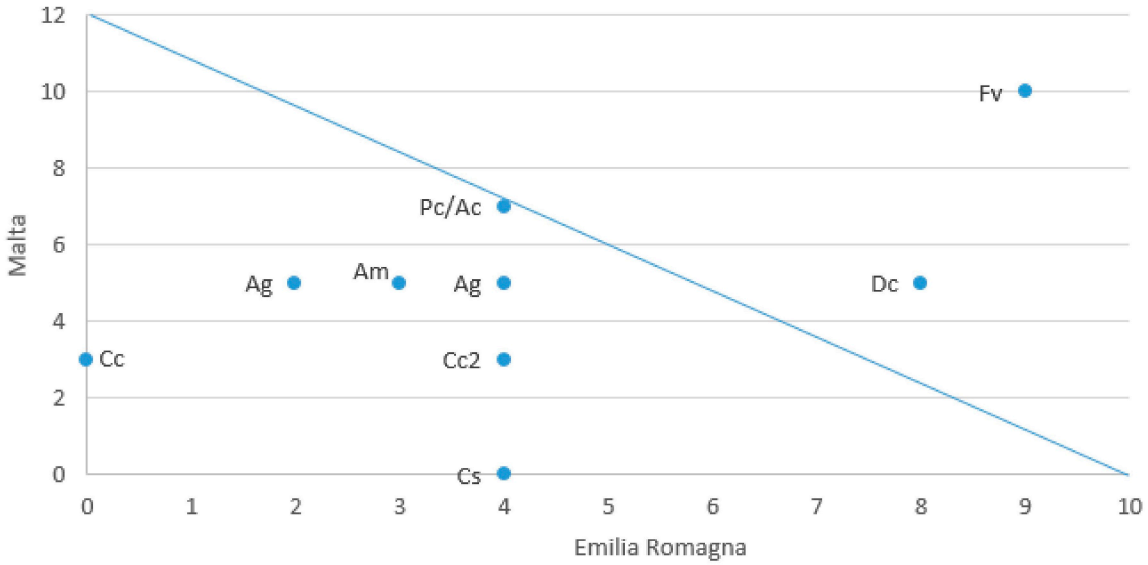

Figure 4. Apiaceae: Popularity by use within the two regions

Table 6. The number of uses by therapeutic systems for the three families within the two regions

	Asteraceae		Lamiaceae		Apiaceae	
By system	MT	ER	MT	ER	MT	ER
Circulatory System and Heart	8	3	2	2	2	0
Central Nervous System and Brain	5	8	6	5	1	0
Urinary System	4	5	2	3	5	5
Gastrointestinal Tract	27	39	31	30	19	20
Respiratory System	4	3	5	6	0	1
Skin, Nails and Hair	7	3	8	9	4	1
Eyes Ears and Mouth	4	1	3	2	3	1
Musculoskeletal System	1	2	6	4	1	0
Endocrine System	6	8	8	5	1	6
Reproductive System	4	3	4	4	4	3
For all the systems (eg. Antiseptic)	7	11	15	13	3	1
Total by region and family	77	86	83	90	43	38
Total by family	163		173		81	

Correlations by Uses and Therapeutic Systems

In order to determine the significance of correlations between the two regions in terms of herb uses and therapeutic systems, the data was subjected to Pearson's correlation and Principal Component Analysis (PCA). The correlation between the two regions for the Asteraceae, Lamiaceae and Apiaceae families was 0.953, 0.987 and 0.927, respectively. PCA by family (Figure 5a) shows that the two regions were clustered for each family. Species from the Asteraceae family showed the highest uses for most systems (particularly the CNS and GI system), whereas Lamiaceae scored second and Apiaceae showed the lowest uses except for the urinary system. This shows that plants within the three plant families have overall distinctive uses which concur in both regions. On the other hand, PCA by uses (Figure 5b) reveals that the gastrointestinal system is distinctive in the number of uses as compared to all the other systems, which are all clustered together. This goes in accordance with the study by González-Tejero and co-workers (2008), showing that in Albania, Egypt, Cyprus and Algeria, gastrointestinal ailments ranked

in the first position, while in Spain and Morocco, these ranked in the second place. In south-western Sardinia and Arrabida Natural Park (Portugal), Maxia and co-workers (2008) and Novais and co-workers (2004), respectively reported that the highest number of herbal uses were for the gastrointestinal system.

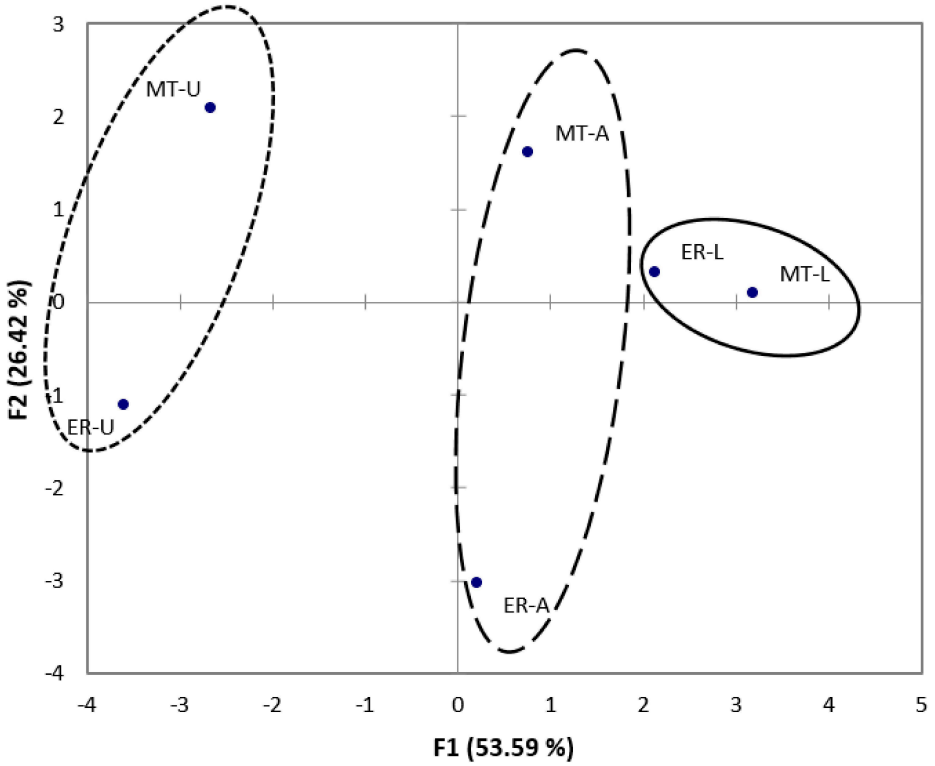

Figure 5a. Principal Component Analysis of the data - analysis of data by plant family and region

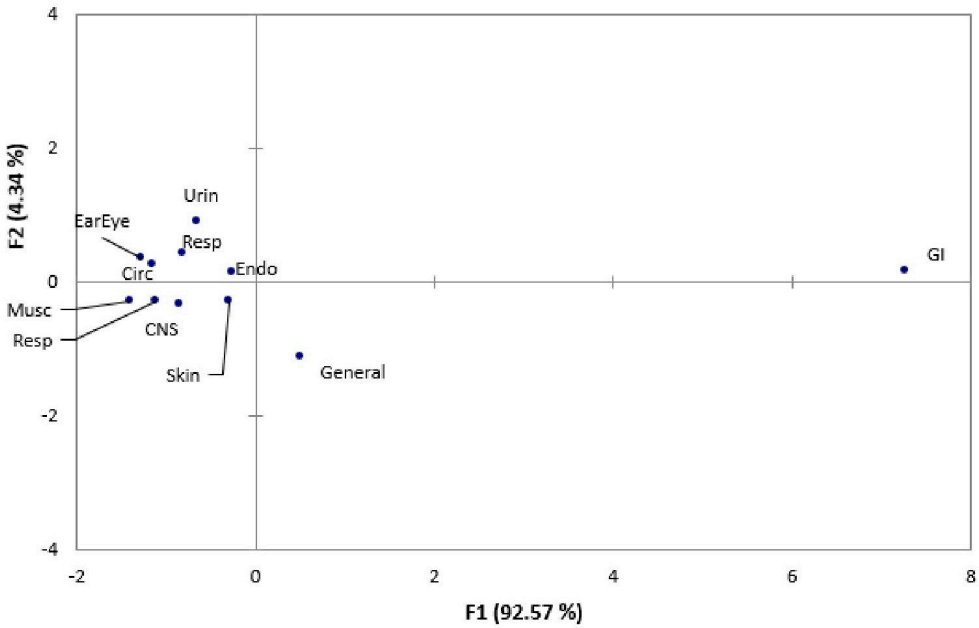

Figure 5b. Principal Component Analysis of the data - analysis of data by therapeutic use.

According to Bulut and co-workers (2017), gastrointestinal ailments ranked in the fourth position after shortness of breath, abdominal pain, and wound healing. The same was reported by Carrio and Valles (2012). It is well known scientifically that the overall health status of an individual depends on the composition of the diet and the microbiota of the gut (Rajoka et al. 2017). This shows that since antiquity, healers were aware of this relationship, hence the popularity of the use of herbal remedies for gastrointestinal problems. For Asteraceae species, the

treatment of gastrointestinal disorders relates to the presence of sesquiterpene lactones (Heinrich et al. 1998) whereas in Lamiaceae and Apiaceae species, the calming effects are exhibited by terpenoids (Okach et al. 2013) which may be present in essential oils (Sayed-Ahmad et al. 2017).

Conclusion

This study was conducted to determine whether the same plants were used for medicinal purpose in the past for two regions within the Mediterranean region and whether the traditional use of medicinal plants concur within these two regions. These two regions have different topographies which may be perceived as a potential diversification of their flora. Despite this, it can be concluded from this study, that a number of medicinal plants particularly in three plant families, Asteraceae, Lamiaceae and Apiaceae, were used in both regions. Moreover, it was also revealed that the most targeted therapeutic system was the gastrointestinal system that covers several ailments mainly gastric disturbances (hyperacidity, ulceration, and indigestion), liver and biliary conditions and intestinal problems (spasms, worms and constipation). In the tradition of these regions, it was well understood that the maintenance of a healthy digestive system influences the overall health of an individual. Nowadays, scientific evidence proves this (Hollister et al. 2014) and in fact apart from medicinal products, a number pre- and probiotics are placed on the market to achieve this effect.

Declarations

List of abbreviations: CNS - Central Nervous System; ER - Emilia Romagnia; GI - Gastrointestinal; ISTAT - Istituto Nazionale di Statistica; MT - Malta; NSO - National Statistics Office (Malta); PCA - Principal Component Analysis

Ethics approval and consent to participate: The study was a meta-analysis of secondary information obtained from bibliographic sources. Published information was analyzed statistically for any possible similarities. No human or animal subjects were used in this study. The request was submitted to the University of Malta Research Ethics Committee and was given the following ID: 15062020 9488.

Consent for publication: Not applicable

Availability of data and materials: The information utilized in this study, is all found in the bibliography cited within this study.

Competing interests: There are no financial and non-financial competing interests to declare.

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Authors' contributions: Flavia Galuzzo is the main author of the manuscript. She searched for the background information. Everaldo Attard is the Maltese supervisor for the student. He was involved in the interpretation and analysis of data obtained from Maltese sources. Diana di Gioia is the Italian supervisor for the student. She was involved in the interpretation and analysis of data obtained from Italian sources. All authors contributed equally in the writing of the manuscript.

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