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NATURAL VOLATILES & ESSENTIAL OILS

A Quarterly Open Access Scientific Journal

LAMIACEAE 2017

ABSTRACTS

NVEO

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NVEO
Natural Volatiles & Essential Oils

NVEO 2017, Volume 4, Issue 2

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NVEO

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A Quarterly Open Access Scientific Journal

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Scope

NVEO is a major forum for the publication of new findings and research into natural volatiles and essential oils. It is created by the Permanent Scientific Committee of ISEO (International Symposium on Essential Oils). The journal is principally aimed at publishing proceedings of the ISEOs, but is also a peer reviewed journal for publishing original research articles and reviews in the field of natural volatiles and essential oils including wide ranging related issues on the analysis, chemistry, biological and pharmacological activities, applications and regulatory affairs, etc.

Published four times per year, NVEO provides articles on the aromatic principles of biological materials such as plants, animals, insects, microorganisms, etc. and is directed towards furthering readers' knowledge on advances in this field.

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Welcome

We are glad to host you to at the International Symposium: Advances in Lamiaceae Science held on April 26-29, 2017 in Antalya, Turkey to enjoy interesting and informative lectures reporting the most recent developments in the field of Lamiaceae.

Lamiaceae is an important family encompassing aromatic plants such as mint, oregano, thyme, sage, melissa, lavender, satureja, basil, rosemary, sideritis, perilla, etc. which have been used and traded for their culinary as well as flavour and fragrance properties and biological activities, as well as those used in medicine such as skullcap among others. Two previous symposia on Lamiaceae were held in 1992 in Kew Gardens, London, UK and in 2006 in San Remo, Italy gathering scientists from all over the World to discuss scientific developments in the science of Lamiaceae. This is the third in a row as a follow up to the previous symposia with the same aim to discuss and review recent developments in the field with special emphasis to systematics, taxonomy, phylogeny, phytochemistry, agronomy, horticulture, ethnobotany, biological activities, culinary uses, industrial developments and trade, etc. The symposium is bringing together scientists, growers and traders from all over the World to contribute, discuss, exchange views and learn recent advancements in Lamiaceae science.

Antalya is a preferred seaside venue to visit in Turkey thanks to its natural beauties, historical and cultural richness blended with unmatched Turkish hospitality. Being on the outskirts of Taurus mountains, flora of Antalya is quite rich and diverse. Hundreds of five-star hotels and resorts offer excellent service and conference facilities. The International Airport of Antalya has direct links with all the major towns in Europe. This symposium is held in the 5-star Portobello Hotel on the Turkish Riviera.

The symposium offers a rich scientific program with 11 invited lectures given by prominent scientists; 21 oral and 79 poster presentations. Abstracts are published in a special issue of the quarterly open Access journal Natural Volatiles and Essential Oils (NVEO). I hope the symposium meets your expectations and contributes to the science of Lamiaceae.

Prof. Dr. K. Hüsnü Can Başer

President of the Organizing Committee of Lamiaceae 2017

Editor-in-Chief of NVEO

Committees

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Prof. Dr. Fatih Demirci, Secretary
Prof. Dr. Kenan Turgut
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Plenary Lectures
K. Hüsnü Can Başer, Northern Cyprus
Regine Classen-Bockhoff, Germany
İhsan Çalış, Northern Cyprus
Tuncay Dirmenci, Turkey
Bryan Drew, U.S.A.
Nativ Dudai, Israel
Füsun Ertuğ, Turkey
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Symposium Venue

Porto Bello Hotel, Resort & SPA
Address: Akdeniz Bulvarı 1. Sk. Konyaaltı, Antalya, Türkiye
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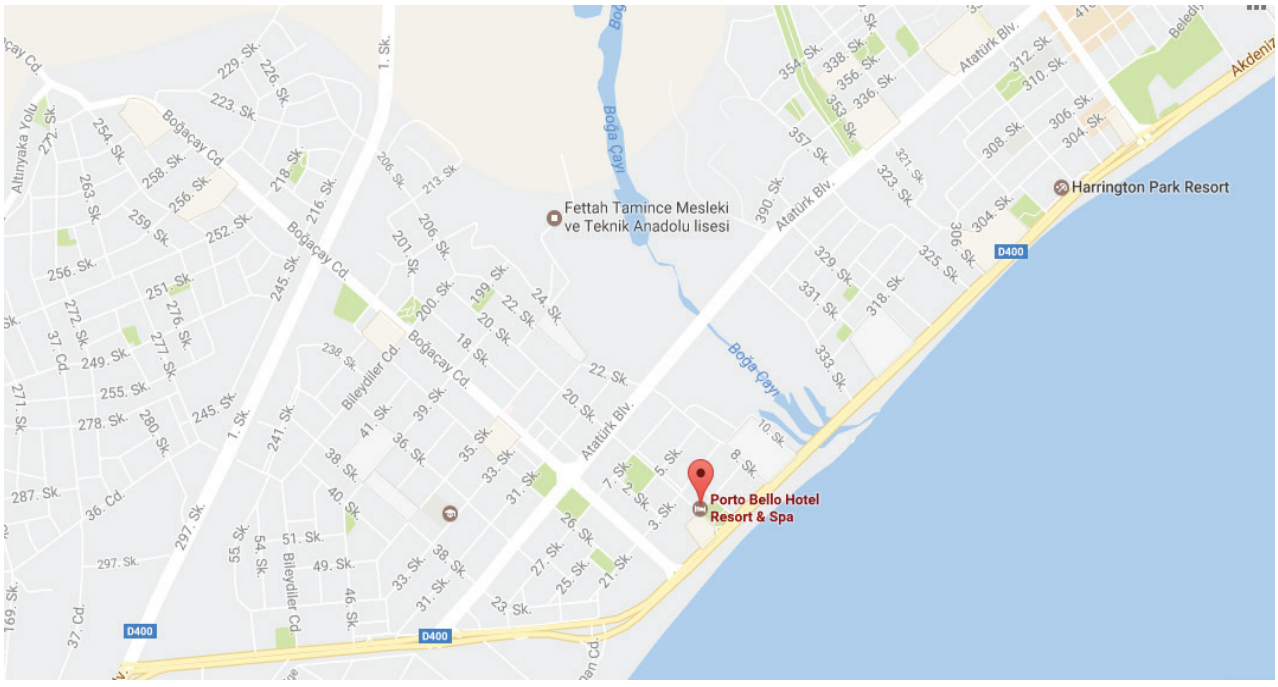

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President of LAMIACEAE 2017

Prof. Dr. K. Hüsnü Can Başer, khcbaser@gmail.com

Secretary of LAMIACEAE 2017

Prof. Dr. Fatih Demirci, demircif@gmail.com

Symposium Organizing Company

Bilkon Turizm
web: www.bilkonturizm.com.tr
e-mail: kongre@blkonturizm.com.tr
Addr: Cinnah Cad. Gelibolu Sk. No:3/11 06680 Kavaklıdere / ANKARA
Tel: 0090 312 466 1 466

General Information

Symposium Date & Venue

April 26-29, 2017 / Porto Bello Hotel, Antalya, Turkey

Official Language

Official language of the symposium is English.

Travel & Visa

Please contact the nearest Turkish Embassy or Consulate in your area to obtain the latest information about visa requirements and applications. For more information… http://www.mfa.gov.tr/visa-information-for-foreigners.en.mfa

Health and Insurance

The participants are requested to arrange their own insurance for health, travel and property. The Organising Committee will not accept any liability for personal injuries, loss or damage of property.

Currency and Money Exchange

The unit of currency is the Turkish Lira (TL). The exchange rates are published daily. Banks can exchange foreign currency and travelers' checks with your passport as proof of identity. The most widely accepted credit cards are Visa, Mastercard and American Express. Exchange offices in touristic places are generally open until midnight.

Banks

Banks are open Monday to Friday from 8:30 to 12:00 and from 13:30 to 17:00

Electrical Supply

The voltage in Turkey is 220 volts AC, 50Hz and the plugs are European two round pin type.

Scientific Programme

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11.00-11.40	PL 2: The diversity, chemistry and traditional uses of southern African Lamiaceae	Ben Erik van-Wyk
11.40-12.20	PL 3: Secondary metabolites from Lamiaceae plants of Turkey	İhsan Çalış
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14.30-14.50	OP 2: Morphological diversity of the relict endemic species *Dorystoechas hastata* Boiss. & Heldr. ex Bentham (Lamiaceae) from Antalya, Turkey	Ceren Selim
14.50-15.10	OP 3: Lamiaceae Taxa of Eskişehir	Atila Ocak
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Session 3	**Chair person: Tuncay Dirmenci**	
15.30-16.10	PL 5: Anatolian ethnobotanical heritage of the family Lamiaceae	Füsun Ertuğ
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Scientific Programme

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Scientific Programme

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10.40-11:00	OP 15: Physicochemical, antibacterial and antifungal properties of essential oils obtained from Basil (*Ocimum basilicum*) and Thyme (*Thymus serpyllum*) plants	Erman Duman
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11.20-11:40	OP 16: The effect of thyme essential oil added to quail diets on antioxidative metabolism in breast meat	Recep Gümüş
11.40:12:00	OP 17: Neurophysiological proof of preclinical and clinical effectiveness of extracts from *Oregano, Lavandula* and *Sideritis* on the brain	Wilfried Dimpfel
12.00-13.30	Lunch	
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13:50-14:10	OP 19: Treatment of ulcerative colitis disease with Rosmarinus officinalis	Anıl Yılmaz
14:10-14:30	OP 20: Chia (*Salvia hispanica* L.): An ancient crop suitable for modern nutrition	Dieter Paper
14:30-14:50	OP 21: Essential oil composition and morphological characteristics of *Cyclotrichium glabrescens* (Boiss. et Kotschy ex Rech. fil.) Leblebici endemic in Turkey	Murat Kursat
14.50-15.10	Coffee break	
15:10-15:40	Closing Ceremony	
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29th April 2017, Saturday		
09:00-13:00	Field Trip	

PLENARY LECTURES

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PL-01. Phylogenetic study of *Plectranthus*, *Coleus* and Allies (Lamiaceae): Taxonomy, distribution, and medicinal use

Alan Paton, Montfort Mwanyambo, Alastair Culham*

* Head of Science (Collections), Science Directorate, Royal Botanic Gardens Kew, TW9 3AB, UK

a.paton@kew.org

Subtribe Plectranthinae (Lamiaceae) is a palaeotropical group of over 450 species with mainly zygomorphic flowers and stamens which are contiguous at the point of insertion at the base of the lower corolla lip. It contains the medicinally and horticulturally important genus *Plectranthus*, which currently includes *Coleus* and *Solenostemon*. A phylogenetic analysis of the group is presented based on rps16, trnL-F and trnS-G regions of the chloroplast genome. *Plectranthus* as currently recognized is paraphyletic, a clade corresponding to *Coleus*, including *Solenostemon*, is sister to the rest of the group. Four endemic Madagascan genera, *Dauphinea*, *Madlabium*, *Perrierastrum* and *Capitanopsis* comprising a total of six species all belong to a single clade and are recognized under *Capitanopsis*, the earliest name. *Plectranthus s.s.* is sister to a clade comprising *Thorncroftia* and *Tetradenia*, the latter, uniquely in the Plectranthinae, having actinomorphic corollas and being usually dioecious. A group of other species currently recognized as *Plectranthus* form a clade separate from *Plectranthus s.s.* and is recognized as *Equilabium gen. nov.* The genera begin to diversify from mid to late Miocene. The Plectranthinae is found in dry woodland, montane grassland and evergreen forest margins. Shifts between habitats occur in most clades, though significantly fewer than if the changes were random. The distribution of the clades in the major habitats is examined. Migration in the Plectranthinae is from Africa to Madagascar and Asia, and there is no evidence of migration back to Africa. The phylogenetic pattern of medicinal use within Plectranthinae is weak and issues surrounding the use of the phylogeny to investigate medicinal use are discussed.

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PL-02 The diversity, chemistry and traditional uses of southern African Lamiaceae

Ben-Erik Van Wyk

National Research Chair in Indigenous Plant Use, Department of Botany and Plant Biotechnology, University of Johannesburg, Johannesburg, South Africa

Southern Africa is not only known for its high levels of plant diversity (ca. 20 000 species) and plant endemism (ca. 60%) but also for its cultural diversity, resulting in a rich ethnobotanical heritage. The Lamiaceae are relatively poorly represented in the subcontinent, but nevertheless comprise about 37 genera and 262 species. The temperate part of southern Africa (which includes the Cape Flora), usually accounts for a substantial part of the overall diversity in many plant families. However, in the case of Lamiaceae, the Cape Flora contributes only seven genera and 47 species. Well-known examples of diverse genera include *Ocimum* (16 spp.), *Plectranthus* (50 spp.), *Salvia* (27 spp.), *Stachys* (41 spp.) and *Syncolostemon* (36 spp.). Of the total of 262 species of southern African Lamiaceae, 39 species (ca. 15%) have been recorded as edible (often used as tea but hardly ever as culinary herbs), while 83 species (ca. 32%) have recorded uses in traditional medicine. These high levels of traditional use are well above the averages for the flora as a whole, estimated to be about 6% for food plants and 13% for medicinal plants. Amongst the most popular traditional medicines are *Ballota africana*, *Leonotis leonurus*, *L. ocymifolia*, *Marrubium vulgare*, *Mentha aquatica*, *M. longifolia*, *Ocimum americanum*, *Salvia africana-caerulea*, *S. africana-lutea*, *S. chamelaeagnea*, *S. dentata*, *S. repens*, *Stachys aethiopica*, *S. linearis*, *S. rugosa*, *Tetradenia riparia*, *Teucrium africanum, T. kraussii* and *T. trifidum*. Medicinal uses and pharmacological activities are mostly associated with diterpenes of the labdane and clerodane types, as well as volatile constituents. In general, the chemistry and ethnopharmacology of southern African Lamiaceae have remained scientifically poorly explored.

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PL-03. Secondary metabolites from Lamiaceae plants of Turkey

İhsan Çalış

Near East University, Faculty of Pharmacy, Department of Pharmacognosy, Nicosia, N. Cyprus
ihsan.calis@neu.edu.tr

The family Lamiaceae consists of approximately 200 genera of cosmopolitan distribution. The plants of Lamiaceae show a very rich diversity in respect to the structures of their secondary metabolites. They are rich in isoprenoids (mono-, sesqui-, di-, triterpenoids, steroids, phytoecdysteroids) in addition to iridoids, flavonoids, rosmarinic acid, chlorogenic acid caffeic acid derivatives. Volatile terpenoids and iridoid glycosides provide useful markers among the plants of Lamiaceae. Similarly, the caffeic acid derivatives have been of potential taxonomic value for the family. Moreover, many plants of this family have economic importance due to essential oil production throughout the world. Because of this rich structural diversity, Lamiaceae plants have been an attractive subject for drug discovery studies.

As one of the largest family in the flora of Turkey, Lamiaceae is represented by 46 genera. Endemism ratio is also very high (ca. 44%). The plants of this family have been classified into eight subfamilies; Ajugoideae (AJ), Chloanthoideae (CH), Lamioideae (LA), Nepetoideae (NE), Pogostemonoideae (PO), Scutellarioideae (SC), Teucrioideae (TE) and Viticioideae (VI) (Cantino et al., 1991). The selected species of these subfamilies have been the plant material of phytochemical and pharmacognostical studies using chromatographical separation techniques and modern spectroscopic methods for their structure elucidation.

Along the above mentioned lines, the phytochemical and biological activity studies have been performed on the plants selected from various subfamilies of Lamiaceae [*Ajuga* (AJ), *Eremostachys* (LA), *Galeopsis (LA), Lamium (LA), Leonurus (LA), Marrubium (LA), Molucella (LA), Phlomis (LA), Scutellaria (SC), Sideritis (LA), Stachys (LA), Teucrium (TE)*]. Most of these plants are also known as herbal drugs in traditional medicine and some of them are used as herbal tea in Turkey.

In this presentation, a brief summary will be given for the studies performed on the above mentioned Lamiaceae plants in respect to their phenolic compounds (caffeic acid derivetives, flavonoids) and isoprenoids (iridoids, triterpeneoids and steroids) during the last 30 years.

References

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PL-04 Systematic and bio-geographic overview of Lamiaceae in Turkey

*Ferhat Celep[1,] * and Tuncay Dirmenci[2]*

[1] Mehmet Akif Ersoy mah. 269. sok. Urankent C16 Blok, No: 53, Demetevler, Ankara
[2] Biology Education, Necatibey Education Faculty, Balıkesir University, Balıkesir-Turkey
* ferhat_celep@hotmail.com & dirmenci@balikesir.edu.tr. Authors have contributed equally.

Introduction

Turkey contains a great variety of biotic and abiotic diversity, i.e. climatic, edaphic, geographic & geologic, and pollinator diversity. These factors lead to Turkey is one of the important plant biodiversity center in the world with over 10 000 plant species with ca. 35 % endemism ratio. Exceptionally, Turkey is situated at the junction of three important phytogeographic regions, as Mediterranean, Irano-Turanian and Euro-Siberian (Circumboreal) phytogeographic regions. In regard to Lamiaceae, Turkey sits on one of the six regions of high Lamiaceae diversity as “Mediteranean and SW Asia”.

Materials and Methods

This is a comprehensive review on Turkish Lamiaceae members. Until 10th of February 2017, we investigated all published taxa from related literatures and webpages for Turkish Lamiaceae members. Based on the new data set, we produced new perspectives and informations on the family.

Results and Discussion

In Turkey, Lamiaceae is the third largest family based on the taxon number and fourth largest family based on the species number. The family has 46 genera and 782 taxa (603 species, 179 subspecies and varieties), 346 taxa (271 species, 75 subspecies and varieties) of which are endemic (ca. 44%). There are 28 hybrid species, 24 of which are endemic. *Phlomis* has 10 hybrids and all of them endemic and *Origanum* has 10 hybrids and 8 of which are endemic.The largest five genera based on the taxon number are *Stachys* (118 taxa), *Salvia* (107 taxa), *Sideritis* (54 taxa), *Phlomis* (53 taxa) and *Teucrium* (49 taxa). Approximately, 72% of the species are found in the largest 10 genera, on the other hand 15 genera has only one species. According to taxon endemism ratio, the highest five genera are *Dorystoechas* (1 taxon, 100%), *Lophantus* (1 taxon, 100%), *Sideritis* (54 taxa, 74%), *Drymosiphon* (9 taxa, 67%), and *Marrubium* (27, 63%). *Dorystoechas* and *Pentapleura* are monotypic genus. Phytogeographic distribution of the taxa are: 293 taxa in the Mediterranean (37.4%), 267 taxa in the Iran-Turan (36.7%), 90 taxa in the Euro-Siberian (Circumboreal), and 112 taxa in Unknown or Multiregional (14.3%) elements. 61% of the taxa are endemic in the Mediterranean phytogeographic region, 50% of the taxa are endemic in the Iran-Turan phytogeographic region, and 13 % of the taxa are endemic in the Euro-Siberian (Circumboreal) phytogeographic region. Some endemic taxa are widely distributed and their phytogeographic elements are not properly defined, the endemism ratio of these taxa are 13%. In Turkey, most of the taxa are concentrated in the Mediterranean, Central Anatolian and East Anatolian geographic regions. During the geological and climatic changes, the taxa may have moved to the Mediterranean region and Central / Eastern Anatolia and specialized in their phytogeographical regions.

Acknowledgments and References

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PL-05. Anatolian ethnobotanical heritage of the family Lamiaceae

Zafer Füsun Ertuğ
Orhangazi Cd. İznik, Bursa, Turkey
etnofertug@gmail.com

Introduction

Lamiaceae (Labiatae / *Ballıbabagiller* in Turkish) is among the largest families within Anatolian plant lore. Its ethnobotanical heritage is even larger and more significant as it contains many aromatic plants used for culinary and medicinal purposes. Many of its members have been taken into cultivation and grown for their edible leaves, seeds or tubers, but an even larger number of them are still gathered from nature for herbal teas, as salad greens, spices, distilling water or oil used in cosmetics and in folk medicine.

Materials and Methods

A large body of folk medicinal literature, and systematic ethnobotanical studies, including MA and Ph.D. theses has been reviewed while preparing an ethnobotanical bibliography of the Republican era (Ertuğ 2014: 381-420). This study revealed about 1500 publications, published between 1930- 2013 . Unfortunately going through this large amount of published literature, and producing a database for all taxa, uses, multi uses, and recipes, thus presenting comprehensive data for the entire family base was beyond our work capacity and requires the future efforts of dedicated young ethnobotanists.

Results and Discussion

In Turkey ethnobotanists have recorded about 1200 edible taxa in 81 families, and the Lamiaceae leads with 169 records, closely followed by Asteraceae with 166 edibles (Ertuğ, 2014). According to recent records, the Lamiaceae family is considered the third richest family for the number of endemic species, after Asteraceae and Fabaceae (Ekim, 2014). While the endemism rate of edible species is 2.8 % among all endemic species of Turkey (104 edible endemics/ 3649 endemic taxa), the endemism rate of Lamiaceae edibles is 8.6 %. Furthermore, the rate of endemism of edible species, such as teas and spices within the family of Lamiaceae, reaches 23.6% (Ertuğ 2014). Among those, *Sideritis, Salvia, Thymus* and *Origanum* species are represented with the highest numbers.

When we observe the Anatolian medicinal heritage, we see that Lamiaceae is also considered among the most popular families. In a check-list survey of medicinals used for treatment in Turkey, 1057 taxa in 113 families have been recorded, and Lamiaceae is the number one with 148 taxa, again followed by Asteraceae with 139 (Ahıskalı and Malyer, 2015). According to Naghibi and his friends (2005) out of the total 410 taxa of the mint family in Iran, 18% of the species are used for medicinal purposes. Anatolian people regarded many edibles also as curative, thus there is a great overlap between edibles and medicinals. Besides these two main categories of use, members of the mint family are considered to be the best bee-attracting plants, and thus provide an excellent source of pollen and nectar for honey bees and other pollinators, thus contributing to the farmers' activities by pollinating fruit trees, vegetables and other flowering plants.

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PL-06 Phylogenetics and divergence times in Lamiaceae

Bryan T. Drew
The University of Nebraska at Kearney, 2504 9th Ave, Kearney, NE 68849, USA
bdrewfb@gmail.com

The Lamiaceae (mint family), with over 230 genera and 7200 species, are one of the largest families of flowering plants and are of major importance worldwide both culturally and economically. Lamiaceae have been recognized as a family since the late 1700's (first as Labiatae). However, a series of morphological and phylogenetic studies during the past 25 years have redefined the breadth of the family and clarified many previously unanswered question regarding intrafamilial and intrageneric relationships. Harley et al. (2004) provided a comprehensive conspectus of the mints that synthesized morphological and phylogenetic data available at the time, and divided the family into seven subfamilies. Recently, Li et al. (2016) further clarified relationships within the family and described three additional families as well as several unranked clades. While our knowledge of Lamiaceae relationships has progressed dramatically in a relatively short time, the timing and patterns of divergence within Lamiaceae remain unclear. Here, phylogenetic relationships within Lamiaceae are estimated and summarized using a large chloroplast DNA dataset consisting of the entire *ycf1* gene, the *ycf1-rps15* spacer region, *trnL-F*, and *rpl32-trnL*. Using BEAST v 2.4, divergence times of major lineages within Lamiaceae are estimated, and patterns of diversification are explored.

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PL-07. The story of *Salvia*: Evolution and function of floral traits

Regine Claßen-Bockhoff
Institut für Spezielle Botanik, Johannes Gutenberg-Universität Mainz, Germany
classenb@uni-mainz.de

Introduction

Since more than 200 years, the staminal lever mechanism in *Salvia* is known as the classical example of dorsal pollination. The peculiar floral trait supported for decades the monophyly of the genus. However, today we know that *Salvia s.l.* is polyphyletic splitting into at least six clades each of generic rank. It is evident that parallel evolution plays a significant role in *Salvia s.l*. Most surprisingly, also the staminal lever mechanism evolved several times in parallel, raising the question of its evolutionary significance.

Materials and Methods

The talk summarises our research on *Salvia* aiming to understand the evolution and function of the specific pollen transfer mechanism. Investigations range from stamen development, floral force measurements and biomechanical experiments with artificial flowers and bees to field studies in bee- and bird-pollinated species and phylogenetic analyses.

Results and Discussion

The staminal lever mechanism most likely co-evolved with bee pollination. It contributes to pollen saving against excessive pollen collection, to precision of pollen transfer by deposing pollen on specific sites of the pollinator's body, to pollinator sharing without pollen mixing and to portioned pollen dispensing due to the reversibility of the movement. Reversibility is based on the versatility of the anther, precision is due to guiding elements around the join originating from the filament and connective. The force demands by the lever mechanism are generally low (2-10mN). However, experiments confirmed that honeybees and bumblebees are able to discriminate between minimal forces and only prefer the models with lever mechanism when these offer a better nectar reward. We preliminarily conclude that the lever mechanism is a barrier which gets selective value under competition. Bird pollination evolved several times in parallel, mainly in the new world associated with hummingbirds. This is confirmed by field studies, molecular and morphological data. Based on molecular data, *Salvia* s. l. should be split into six genera with *Salvia* s. str. distributed from SW Asia to Europe and South Africa. The origin of Salvia s. l. is most likely in Central Asia with repeated colonization events to the Mediterranean area, the New World, the Canary Islands and South Africa.

Acknowledgments and References

The following PhD and master students (all Mainz University) contributed to the work: Michael Crone (stamen development), Sascha Thimm, Markus Jerominek and Martin Grawert (force measurements), Janina Stöbbe (artificial flowers and experiments with bees), Lianka Cairampoma, Daniela Ott, Enikö Tweraser (bee pollination), Petra Wester (bird pollination), and Maria Will (old world phylogeny).

- References can be found on http://www.spezbot.fb10.uni-mainz.de/85.php

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PL-08. Essential Oils of Anatolian Lamiaceae – An Update

K. Hüsnü Can Başer[1*], Neşe Kırımer[2]

[1] Near East University, Faculty of Pharmacy, Department of Pharmacognosy, Nicosia (Lefkoşa), N. Cyprus, Mersin 10, Turkey

[2] Anadolu University, Faculty of Pharmacy, Department of Pharmacognosy, Eskişehir, Turkey

khcbaser@gmail.com

The family Lamiaceae is represented in Turkey by 782 taxa of which 346 taxa are endemic (44%). 24 of 28 hybrids discovered in the flora of Turkey are endemic. As a continuation of our reports on the essential oils of Lamiaceae plants of Turkey (1-3), here we review the most recent papers on essential oils of Turkish Lamiaceae. Data on 26 genera including *Ajuga, Ballota, Calamintha, Cyclotrichium, Dorystoechas, Hymenocrater, Hyssopus, Lallemantia, Lavandula, Marrubium, Melissa, Mentha, Micromeria, Nepeta, Ocimum, Origanum, Pentapleura, Phlomis, Rosmarinus, Salvia, Satureja, Scutellaria*, *Sideritis, Stachys, Teucrium, Thymbra, Thymus, Ziziphora* will be presented.

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PL-09. Bioactive di- and triterpenoids from some Lamiaceae family plants

Gülaçtı Topçu

Bezmialem Vakif University, Department of Pharmacognosy, 34093, Fatih-İstanbul, Turkey
gtopcu@bezmialem.edu.tr

Introduction

Anatolia is one of the most rich regions in the Lamiaceae family plants throughout the world. Since last over 30 years, some genera species belonging to Lamiaceae family have been studied by our group, particularly *Salvia, Sideritis, Teucrium, Ajuga, Nepeta* and *Lavandula* species and recently *Micromeria, Origanum* and some other species. In Turkey, the genus *Salvia* is represented by 96 species, and Anatolia is one of two gen centers of the *Sideritis* species with 46 species and high endemism ratio (78%). Until today, over 65 *Salvia*, 15 *Sideritis*, 12 *Nepeta*, 10 *Teucrium* species were investigated by our group for phytochemically, especially for their terpenoid compounds, and when possible for their biological activities. *Salvia* species are rich in abietane, *Sideritis* in kaurane, *Teucrium* in neo-clerodane diterpenoids while the other genera species were not rich particularly in any specific skeleton type of diterpenoids. However, almost all investigated species by our group contain oleanane, ursan and/or labdane type triterpenoids.

Materials and Methods

In our earlier years studies, the collected and dried plants were exhausted with the solvents from nonpolar to polar ones, subsequently. However, since last 10-15 years, bioactivity directed studies were carried out and the active extracts were then subjected to silicagel column chromatography, and obtained compounds from collected and combined fractions were purified by preparative TLC, small Si-gel or Sephadex column chromatography, and HPLC techniques. Structures of the isolated pure compounds were elucidated by 1D- and 2D-NMR and Mass and other spectroscopic methods. Diterpenoids were studied for mainly *in vitro* cytotoxic and antiviral activities and potential anti-Alzheimer activities (Ertaş et al.2009) while triterpenoids for anti-inflammatory, anti-viral and cytotoxic activities (Topcu et al., 2004). NF-Kappa B inhibitory activities were also investigated for the isolated triterpenoids particularly from *Salvia* species (Erman B & Topcu G. 2012 Patent PCT).

Results and Discussion

All the investigated *Salvia s*pecies were rich in abietanes, except of a few of them, and they were isolated particularly from their roots which have cytotoxic and antioxidant activities. Oleanolic acid and ursolic acid were found as the main abundant triterpenoids with cytotoxic and anti-inflammatory activities in most of Anatolian *Salvia* species as well as in some other Lamiaceae plants. From *Salvia* species, over 100 new abietane diterpenoids and about 30 new triterpenoids were obtained, from *Sideritis* species over 30 new ent-kauranes, from *Teucrium* species 25 new neo-clerodane diterpenoids by our group. *Ajuga* species afforded some terpenoids and steroids (Kökdil et al.2002), while *Nepeta* species were found to be rich in iridoid monoterpenoids nepetalactones besides some terpenoids.

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PL-10 Domestication and breeding of Lamiaceae aromatic plants

Nativ Dudai
The Unite of Medicinal and Aromatic Plants, Newe Ya'ar Research Center, Agricultural Research Organization
nativdud@gmail.com

Many of the *Lamiacea* e plant species are aromatic, rich in secondary metabolites, and are used as culinary herbs, medicinal plants, for essential oil production, as food additives or for natural preservative extracts. Traditionally, most of these plants were used to be collected in the wild. Yet, the modern industrial and agricultural standards together with the "back to nature" trend have led to the development of modern agricultural methods for cultivation of traditional medicinal and aromatic plants (MAP). The increased demand by the industry for uniform and high quality raw materials, together with the decrease in wild plant foraging, and legislative protection acts of wild plant species have necessitated the commercial cultivation of MAP species. The shortage in raw material from the wild has encouraged seed companies, researchers and farmers to select MAP varieties of interest. The goal of the industry is the breeding of MAP and the development of optimal agro-techniques for modern industrial production that would replace traditional methods. MAP breeding focuses on an array of high value traits such as content and composition of secondary metabolites, aroma, flavor, and bioactivity. The breeding process is based on the natural diversity and variation in the source germplasm. Hence, the first step in the breeding process is the creation of a germ-plasm collection by systematically collecting plant samples in the wild and expanding the available genotype diversity. Then, new combinations of traits that are likely not to occur in nature can be artificially produced. Furthermore, in some cases, interspecific crossing can be made , which combine traits desired by the consumer and the producer. Examples of oregano, sage, basil and rosemary breeding will be presented.

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PL-11. Cultivation of Lamiaceae species in Turkey

Kenan Turgut
Department of Field Crops, Faculty of Agriculture, Akdeniz University, 07058 Antalya
kturgut@akdeniz.edu.tr

Turkish flora is rich in essential oil bearing plants belong to Lamiaceae family and many of them are collected from the wild traditionally and commercially. Oregano is appeared to be the most important one in terms of natural diversity and also farming activities. In general, drugs obtained from wild plants are often of low quality and mixed with other species. Moreover, natural populations declined because of intense and insensible crafting. Cultivation of economically important wild plants seems to be the most convenient way for conservation of wild populations and improving quality of the products. Although, there have been some attempts on taking these plants in cultivation in recent years, a large amount are still picked up from the nature. Nevertheless, there are several good applications like oregano farming in Turkey. Oregano production was mostly dependent on the wild populations 20 years ago. After introduction of Turkish oregano (*Origanum onites)* in Denizli province as an alternative crop to tobacco, cultivated oregano has increased rapidly in Turkey and, dry production has reached to 7.000 tons in 2004 and 13.000 tons in 2015. The vast majority of the products are exported for supplying 80% of the world oregano demand. Also, *O. vulgare* subsp*. hirtum* and *O. minutiflorum* are grown in Turkey. After all, amount of wild harvested oregano has drop to 2 - 3 thousand tons each year. However, Anatolian sage (*Salvia fruticosa*) is still intensively collected (1.500 - 2.000 tons) from the wild flora and dried leaves are used as herbal tea and for essential oil production. In spite of that, cultivation of *S. fruticosa* has not been succeeded yet in the farmer's conditions due to its susceptibility to some soil borne diseases. On the other hand, common sage (*S. officinalis*) farming has been rising slowly recent years but amount of products (80 tons in 2015) is insufficient to meet domestic demand. Spearmint (*Mentha spicata*) production is very common in all regions of Turkey since it is traditionally used as fresh and dry culinary herb. In 2015, fifteen-thousand tons of fresh mint were produced in Turkey. However, peppermint (*M. piperita*) and corn mint (*M. arvensis*) production are very limited, therefore Turkey imports mint essential oils from other countries. Actually, Turkey has potential to produce both species for essential oil and menthol production. Recently, lavandin (*Lavandula hybrida*) farming has started and risen (400 tons in 2015) in Isparta province known as oil rose land. It seems that lavandin has been well-adapted to Isparta province, and produced satisfying quality of flowers. Lemon balm (*Melissa officinalis*) is very important ingredient for herbal tea and other sectors, but produced low amount (240 tons) in Turkey. Although rosemary (*Rosmarinus officinalis*) has a big potential for domestic herb and essential oil markets and also exportation, there is no statistical data on production of rosemary in Turkey. In fact, it is harvested from the wild flora of East Mediterranean region of Turkey.

There are several important problems for cultivation of MAPs in Turkey. These are; 1) lack of good planning and organization between the ministry, research organizations, industry and farmers, 2) shortage of well-adapted good cultivars, 3) absence of planting materials such as seed, seedling etc, 4) significant problems in postharvest applications (drying, threshing, storage etc). After all, Turkey has a great potential to produce MAPs since Turkey has very rich plant diversity, different climatic regions and human resources.

ORAL PRESENTATIONS

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OP-1. Molecular phylogenetics of *Hymenocrater* Fisch. & C.A. May. (Lamiaceae, Nepetoideae)

Fariba Serpooshan[1], Ziba Jamzad[2], Iraj Mehregan[1] and Taher Nejadsattari[1]*

[1] Department of Biology, Science and Research Branch, Islamic Azad University, Tehran, Iran,

[2] Research Institute of Forests & Rangelands, P. O. Box 13185-116, Tehran, Iran.

jamzad@rifr-ac.ir

Introduction

The genus *Hymenocrater* consists of 11 species confined to the Irano-Turanian Region of Central and Western Asia (Rechinger 1982; Jamzad, 2012). *Hymenocrater* has been recognized as a distinct genus in Lamiaceae since its first description and in subsequent works (Fischer & Mayer 1835, Bentham, 1848; Harley et al. 2004). We planned to study the phylogenetic relationship of *Hymenocrater* within Nepetinae by sequencing nuclear and plastid DNA.

Materials and Methods

In a phylogenetic study, using nuclear (nr ITS) and plastid (trnL-F) DNA sequence data belonging to 62 taxa were examined. The tree topologies obtained from Bayesian and Maximum Parsimony analyses were inferred considering the morphological traits.

Results & Discussion

The parsimony and Bayesian analysis of nuclear and plastid DNA produced congruent trees. The Nepetinae genera examined, showed to be monophyletic as it was indicated before (Drew & Systma 2012). Two main clades were observed. The genera *Nepeta*, *Hymenocrater*, *Marmoritis* and *Lophanthus* are placed in clade I. The genera *Agastache*, *Cedronella, Dracocephalum*, *Glechoma, Lallemantia*, *Meehania* and *Schizonepeta* fall in clade II. The phylogenetic inference of data obtained from the genera *Nepeta* and *Hymenocrater* revealed the close relationship between these two genera. Furthermore, those species of *Nepeta* that have previously been transferred to the genus *Lophanthus* and the examined species of the genera *Marmoritis* and *Lophanthus* are all included in *Nepeta* clade.

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OP-2. Morphological diversity of the relict endemic species *Dorystoechas hastata* Boiss. & Heldr. ex Bentham (Lamiaceae) from Antalya, Turkey

Ceren Selim[1], Songül Sever Mutlu[2], İsmail Gökhan Deniz[3]*

[1,2] Akdeniz University, Faculty of Architecture, Department of Landscape Architecture, Antalya, Turkey

[3] Akdeniz University, Faculty of Education, Department of Biology Education, Antalya, Turkey

cerenselim@akdeniz.edu.tr

Introduction

Dorystoechas hastata Boiss. & Heldr. ex Bentham is a relict endemic species belonging to the family Lamiaceae, containing many plant species with medicinal and aromatic properties due to intense volatile and aromatic oil contents. It has economic importance because of its above ground parts are raw materials for pharmacology and cosmetics (Deniz and Aykurt, 2016). The species is listed as VU (Vulnerable) in the IUCN Red List, because it is not cultivated and excessively harvested from the nature. *D. hastata* is known as "Çalba" in Antalya Province and at the same time consumed as herbal tea like sage. It is the only species in genus of *Dorystoechas* which is monotypic in the family Lamiaceae (Hedge, 1982). Its geographic distribution is defined as Beydağları Beach (Olympos) National Park and its near abroad (Peşmen, 1980). It differs from other species belonging to the Lamiaceae family with its growing range from sea level to 2000 meters elevation. The objective of the present study is to measure and determine variation in morphology of *D. hastata* which has a relict endemic character, among locations where species naturally grown in Antalya.

Materials and Methods

Field studies were carried out between March and July 2016, during which individuals were in the generative stage. The 60 genotypes, from 16 different locations (Beldibi, Göynük, Kesmeboğazı, Tahtalı, Üçoluk, Hisarçandır, Tünektepe, Gölcük, Hacısekiler, Termessos, Alakır, Sivridağ, Feslikan, Beycik, Söğütcuması, Altınyaka) representing the natural distribution areas of the species, were selected and studied. The morphological characters (plant length, plant width, leaf length, leaf width, petiole lenght, peduncle length, peduncle width, calyx width, calyx length, corolla width, corolla length, fruit width, fruit length, leaf color) were measured in ten randomly chosen flowers of each genotype per location. Some geographical traits (aspect and elevation), soil characteristics and GPS data were determined. The morphological data were analysed using analysis of variance procedures with PROC GLM (SAS release 8.0; SAS Institute, Cary, NC). Means were separated using Fisher's protected least significant difference ($P<0.05$) procedure. Least significant difference values are reported for population level at the 0.05 level. The PROC CORR procedure was used to perform correlation analyses to understand the amount and way of correlation among morphological and edaphic characters. Principal Component and Cluster Analyses (in NTSYS-PCv 2.01(Rolf, 1998)) were used to determine the relationship and pattern of variation between genotypes from different locations.

Results and Discussion

Significant differences were found among populations in terms of all morphological characteristics except for fruit and plant height. When the results of leaf and flower characteristics as a whole were evaluated, it is possible to say that genotypes belonging to the Beycik population have much rougher texture, larger flower heads, calyx, corolla and larger leaves than other populations. It is understood that the genotypes having the most delicate leaf texture and flower structure among the populations are in Üçoluk location. The results of the correlation analysis indicated that there are significant relationships between morphological characters of the genotypes and characteristics of the growing environment (altitude, aspect and edaphic factors). For instance, genotypes growing in soils with high iron and manganese contents were taller, and genotype width became smaller with increasing altitude. The results of the Principal Components and clustering analysis indicate that individuals within the species tend to cluster in terms of morphological characters. Beldibi, Alakır and Tahtali populations differ from other populations in terms of morphology.

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OP-3. Lamiaceae taxa of Eskişehir

Okan Sezer[1], Kurtuluş Özgişi[1], Derviş Öztürk[1], Ömer Koray Yaylacı[2], Atila Ocak[1], Onur Koyuncu[1]*

[1] Eskişehir Osmangazi University, Faculty of Science and Letters, Department of Biology, 26480, Eskişehir - Turkey

[2] Anadolu University, Faculty of Pharmacy, Department of Pharmaceutical Botany, 26470 Eskişehir - Turkey

aocak@ogu.edu.tr

Introduction

Lamiaceae, one of the three largest families of Turkey, is among the most important families in terms of economics, abundance of endemic taxa and richness of aromatic compounds. For this reason, its members have been used both in the pharmaceutical industry and traditional medicine for many years for therapeutic purposes. The number of medicinal and aromatic plant species in which domestic and foreign trade carried out in 2005 was determined as 347 taxa. 139 of these taxa are exported all around the world (Özgüven et al., 2005; Uyanık et al., 2013). Lamiaceae family are represented by 45 genera, 565 species and 735 taxa in Flora of Turkey. Also, Turkey is accepted as an important gene center (Başer, 1993). Lamiaceae is among the families with the highest number of endemic species in Turkey and the endemism rate is 45% (Güner et al., 2000). With this study, it is aimed to establish the database of studies carried out on this family by putting the floristic diversity of Lamiaceae taxa showing natural distribution within the borders of Eskişehir province.

Materials and Methods

Plant specimens were collected from Eskişehir province between 1997-2016 years. Collected plant specimens were identified and prepared according to the herbarium tecniques. The Flora of Turkey and the East Aegean Islands (Davis 1965-85; Davis et al., 1988; Güner et al., 2000)have been used for identification of plant specimens.

Results and Discussion

At the end of this study, 111 species, 11 subspecies and 5 varieties belongs to 28 Lamiaceae genera were identified from Eskişehir province. The percentages of the phytogeographical origins of these 117 taxa were 22 (18.80 %) Euro-Siberian, 43 (36.75 %) Irano-Turanian, and 15 (12.82 %) Mediterranean. The other 37 taxa (31.63 %) are either multi-area elements or single elements which have not yet been accepted as members of any phytogeographical area. 32 of them are endemic plants peculiar to our country and its endemism rate is 27,35 %.

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OP-4. Molecular characterization of some Sage species (*Salvia* spp.) with microsatellite markers in flora of Hatay, Turkey

Nadire Pelin Bahadırlı[1], Filiz Ayanoğlu[1], Canan Yüksel[2], Ali Ergül[2]*

[1] Mustafa Kemal University, Faculty of Agriculture, Department of Field Crops, 31034, Hatay, Turkey

[2] Ankara University, Biotechnology Institute, 06100, Ankara, Turkey

pelinbahadirli@gmail.com

Introduction

Salvia genus has 97 species, 4 subspecies and 8 varieties in Turkey (Davis, 1988). *Salvia* species are widely used in cosmetics, landscape architecture, alternative medicine and medicine. The widespread use of molecular markers cause increase in medicinal and aromatic plants studies, especially endemic species. One of the most preferred molecular marker SSR (Simple Sequence Repeat) has many advantages because of its simplicity, locus specific, codominant inheritance, high polymorphism and reproducible features. The aim of this study is to reveal the genetic diversity among 91 *Salvia* genotypes (*S. pilifera*, *S. verbenaca*, *S. tomentosa*, *S. aramiensis*, *S. virgata*, *S. napifolia*, *S verticillata subsp. amasiaca, S. sclarea*, *S. microstegia*, *S. multicaulis*, *S. sericeo tomentosa*, *S. viridis*, *S. fruticosa*, *S. cassia*, *S. palaestina*, *S. viscosa*, *S. sericeo-tomentosa var. hatayica*, *S. tigrina*, *S. aucheri*, *S. pinnata*, *S. glutinosa*) spreading in Hatay region using SSR markers.

Materials and Methods

In this study, total of 91 sage genotypes (19 different species and 2 sub-species) obtained from different locations in province of Hatay were analyzed. DNA was extracted from the sage leaf tissue with DNA isolation kit. Determination of microsatellite polymorphism was performed with genomic SSR markers: SoUZ22, SoUZ23, SoUZ24, SoUZ25, SoUZ28 and SoUZ29 (Radosavljevic et al., 2012). PCR products were electrophoresed in CEQ 8800XL capillary DNA analysis system. A neighbor joining tree was constructed from Nei's genetic distance using NTSYS-pc. Number of alleles (n), allele frequency, expected (He) and observed (Ho) heterozygosity, estimated frequency of null alleles (r) and polymorphism information content (PIC) were calculated for each locus using the program "Cervus" 3.0. Proportion of shared alleles was calculated by the program Microsat (version 1.5). These data were then converted into a similarity matrix to determine genetic similarity among sage genotypes.

Results and Discussion

The allele numbers which were observed from the loci range between 18 to 34. The highest allele number was observed from SoUZ028 loci and the lowest allele number was observed from SoUZ023 loci. Allele size ranged between 96 bp and 247 bp. When we look through the dendogram tree, all the plant samples collected from 91 locations are clustered into 7 main groups. As a result of the genetic similarity index examination, the highest similarity with the value of 0.67 was recorded between Sto/76 (*Salvia tomentosa*) and Spi/213 (*Salvia pilifera*). In the study, it was determined that very rich genetic variability existed even among the plants of the same species that were sampled from different locations. This information makes that *Salvia* species valuable genetic source for incorporation into breeding programs.

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OP-5. A new identification key for the Lamiaceae genera in Turkey

Narin Sadıkoğlu

Department of Pharmacognosy, Faculty of Pharmacy, University of Inönü 44280 Malatya-Turkey
narin@inonu.edu.tr

Introduction

Turkey has a rich and important flora with 11.707 vascular plant taxa of which 31,82% is endemic (Güner, 2012). Nowadays, Lamiaceae family is represented by approximately 8602 taxa belonging to 245 genera in the world (The Plant List, 2013), and in Turkey it comprises 45 genera with 766 taxa, endemizm ratio is 43% (Güner, 2012; Özhatay, 2013). Members of this family occur in mainly Mediterranean area (Hedge, 1992). In recent years, due to increase in molecular and systematical research, amount of taxa and taxonomic categories are changed rapidly. The related publications have been examined and a new multi-access key for the science was arranged. A multi-access key is more useful compared to a dichotomic key. In Flora of Turkey and the East Aegean Islands (Davis, 1965-1985), identification keys are prepared as dichotomic except for Umbelliferae, Compositae and Gramineae. The key was first presented in the author's PhD Thesis (Sadıkoğlu, 2005). It has since then rearranged with the additional taxa (Güner, 2012; Özhatay, 2013).

Materials and Methods

The different groups of characters like number of stamen, colour and presence of upper lip of corolla, exserting of the stamens beyond upper lip of corolla or not, indumentum, calyx lenght and plant's life are included in 7 groups, each symbolised by a letter. Then by selecting an applicable letter about representing the character from each of these groups, a 7-lettered formula is produced. If it covers more than one genus, additional characteristics are added and prepared a key to genera.

Results and Discussion

Since the publication of the Flora of Turkey, many taxa are added to the Turkish flora and status of some species have been made synonyms. The key of Lamiaceae is not sufficient to identify some genera. For this reason, a new revised identification key is necessary in Turkey. When the material is incomplete, all states of the missing characters can be tried and with the aid of the supplementary notes it will be possible to identify the genus in the multi-access key. This method of identification has several advantages over a dichotomizing key. A multi-access key useful for large families and helpful for easily identifying the specimens without a few identical features is arranged for the first time for Lamiaceae.

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OP-6. Taxonomic revision of *Teucrium* L. (Lamiaceae) members growing in Turkey based on nuclear and chloroplast DNA data

Taner Özcan, Tuncay Dirmenci*
Biology Education, Necatibey Education Faculty, Balıkesir University, Balıkesir-Turkey
ozcant@balikesir.edu.tr

Introduction

Teucrium is a remarkable genus in the Lamiaceae because of completely lackness in the upper lip of the corolla, and this is a distinctive character compared with the other members of Lamiaceae (Ekim, 1982). *Teucrium* has been divided into ten sections all over the world. The calyx shape and the inflorescence structure are used to identify the sections and distinguish these sections from the each other (McClintock & Epling 1946). In Turkey, as a Mediterranean country, the eight sections of the genus *Teucrium* consist of 49 taxa (36 species) with the recent addition (records and reinstatement) and 18 of them are endemic to Turkey (Dinç & Doğu 2016).

Materials and Methods

Plant materials were collected during field trips in 2009-2015. Fresh leaves were dried using silica gel. Qiagen or Sigma DNA isolation kits were used for the genomic and chloroplast DNA isolation procedures. The internal transcribed spacer (ITS) region of the nuclear ribosomal DNA (nrDNA) and tRNA(Leu)-tRNA(Phe) region of the chloroplast DNA sequences were used for molecular analysis of the Teucrium species. All the genus members growing in Turkey except *T. haradjanii* were examined in this study. Obtained DNA sequences were edited using Sequencher 4.9 and aligned with MUSCLE (Clustal W) online software. Edited and aligned data were used to acquire phylogenetic trees.

Results and Discussion

After the molecular analysis, some morphological classification shortcomings and problems were tried to solve. While molecular data were based on this study, we took into account the morphological observations. Notably, trnL-F DNA data displayed more accurate positions of the sections as phylogenetically. ITS DNA data gave us significant interspecific information. According to our results, section *Teucrium* members are divided into two clades as partitioned and entire leaves. *T. multicaule* is more close to *T. pestalozzae* and *T. ekimii* not the members with partitioned-leaves (*T. orientale* group). *T. aladagense* has more similar DNA with *Isotriodon* members, not *Stachyobotrys*. *Isotriodon* members divided into two main clades according to our data. *Teucrium* sections with toothed leaves show transition with each other.

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OP-7. Chemotype variation in *Lamiaceae* species: A case report on chemotype variations in three populations of *Lamium purpureum* L. from İstanbul

Hüseyin Servi[1], *Kaan Polatoğlu*[2*]

[1] Yıldız Technical University, Graduate School of Science, Department of Organic Chemistry, Istanbul, Turkey

[2] İstanbul Kemerburgaz University, Faculty of Pharmacy, Department of Analytical Chemistry, Istanbul, Turkey

kaan.polatoglu@kemerburgaz.edu.tr

Introduction

Chemotype variation is an important fact that should be considered in all aspects related to natural products. However there are serious problems on definition, identification and determination of the chemotypes. These problems were discussed in a previous report (Polatoglu, 2013). In the current research we have attempted to determine the occurence rate of a chemotypes on a model organism. Three individual populations of *Lamium purpureum* L. growing in different habitats were investigated.

Materials and Methods

Ten individual L. *purpureum* specimens were collected from Başakşehir, Davutpaşa and Şişli locations in İstanbul. The leaves of plant specimens were extracted in *n*-hexane and the produced extract was filtered and analysed by GC-MS using the splitless mode. The GC-MS analysis was performed with an Agilent 5977 MSD system operating in EI mode.

Results and Discussion

L. purpureum samples collected from Başakşehir location were characterized with high amounts of nonacosane 29.5-45.2%, hentriacontane 28.7-40.2% and heptacosane 6.0-10.8%. The minor components of Başakşehir samples differed with β-elemene and germacrene D content in a couple of samples. Şişli samples were also characterized with nonacosane 19.6-42.8%, hentriacontane 22.8-40.7% and heptacosane 0.9-10.3%. However some of the samples also contained high amounts of eicosane 6.3-10.0%, octadecanal 6.1-7.0%, β-elemene 6.3-8.0% and germacrene D 4.7-5.7%. In one sample from Davutpaşa location, volatiles were characterized with high amounts of nonacosane 32.6%, hentriacontane 28.7% and heptacosane 7.0%. All the other samples from Davutpaşa were characterized with high amounts of octadecanal 9.6-22.4%, eicosanal 15.8-45.1%, nonacosane 8.5-27.3%, hentriacontane 5.3-25.6% and heptacosane 0.6-6.2%. Current finding supports the occurrence of chemotypes present within a plant population as previously reported (Baser et al., 1993).

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OP-8. Chemical profiling of Algerian *Ballota nigra* L. (Lamiaceae) extract and its antioxidant and antibacterial activities

*Ahmed Boukeloua**
Department of Biology, University of Oum El Bouaghi, Oum Bouaghi 04000, Algeria
ahmedcte@yahoo.fr

Introduction

Ballota nigra L. is a plant belonging to the family Lamiaceae, generally used in North Algeria. It contains tannins, essential oils, organic acids, alkaloids, pectins, minerals and vitamins, and it is used as a calming agent against nervous disorders, hysterical conditions and related disorders, as a sedative, antispasmodic and repair medication.

Materials and Methods

In the current research, the chemical composition and biological activities of different extracts (hexane, methanol, and water) obtained from aerial parts of *B. nigra* were compared. They were characterized by their total phenolics and flavonoids. LC-MS/MS was used to determine the chemical profile of methanol extract, while GC-MS was used to determine the fatty acids of the hexane extract. Antimicrobial and antioxidant activities were studied for all of the extracts.

Results and Discussion

The methanol extract was the richest in terms of total phenolic and flavonoid contents but not more than standard controls results. The LC-MS/MS results showed that the four most prevalent components were tannic acid, gallic acid, aconitic acid and chlorogenic acid. Some minor acids were also detected. The content of kaempherol and hesperidin were the major flavonoids identified. The two main fatty acids were found as oleic acid (31.4%) and palmitic acid (18.5%). All of the extracts showed potential antioxidant activity in four tested methods. Furthermore, the methanol extract of *B. nigra* showed moderate antimicrobial activity against *Candida albicans*. Results of the current study showed that *B. nigra* may be used as a food supplement.

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OP-9. Pharmacognostical investigation on *Salvia cassia*

Burcu Sen-Utsukarci [1], Bahar Gurdal [2], Merve Bilgin [3], Dilek Satana[4], Betul Demirci [5], Nur Tan [1], Afife Mat [1]*

[1] Istanbul University, Faculty of Pharmacy, Department of Pharmacognosy, Istanbul, Turkey

[2] Istanbul University, Faculty of Pharmacy, Department of Pharmaceutical Botany, Istanbul, Turkey

[3] University of Istanbul Yeni Yuzyil, Faculty of Pharmacy, Department of Pharmaceutical Microbiology, Istanbul, Turkey

[4] Istanbul University, Faculty of Medicine, Department of Microbiology and Clinical Microbiology, Istanbul, Turkey

[5] Anadolu University, Faculty of Pharmacy, Department of Pharmacognosy, Eskisehir, Turkey

burcusn@gmail.com

Introduction

Salvia species, known as '"adacayi", are used as antiseptic, stimulant, diuretic and for wound healing in traditional medicine in Turkey (Baytop, 1999). Previous studies on *Salvia cassia* are quite a few. Therefore, the present study was conducted on the antibacterial, antimycobacterial and antifungal activities of various extracts (petroleum ether (PE), chloroform (CHL) and ethanol (EtOH) extracts; infusion and decoction) and essential oil from the aerial parts of *S. cassia* and the chemical composition of its essential oil (EO).

Materials and Methods

The antibacterial activity was determined against *Bacillus subtilis*, *Staphylococcus aureus*, methicillin resistant *Staphylococcus aureus* (MRSA), *Pseudomonas aeruginosa* and *Enterococcus faecalis* by standard microbroth dilution method modified with rezasurin. The antimycobacterial activity was analyzed against five *Mycobacterium tuberculosis* (sensitive-, resistant-standard strains and multidrug resistance clinical isolate) strains and the antifungal activity was compared with two dermotophytes (*Microsporum gypseum* and *Trichophyton mentagrophytes* var. *erinacei*) and three *Candida* species by the broth microdilution method. The composition of EO was analyzed by GC-MS (Sarker et al., 2007; CLSI, 2006; Tan et al., 2016).

Results and Discussion

The EO had a very good activity against *B. subtilis* (0.3 mg/mL) and good activity against *S. aureus,* methicillin resistant *S. aureus* (MRSA) and *E. faecalis* (0.6 mg/mL) and a weak activity against *P. aeruginosa*, while the PE, CHL and EtOH were active against *B. subtilis and S.aureus* (0.6 mg/mL), and only EtOH showed a weak activity against *P. aeruginosa*. All samples were active in the antimycobacterial and antifungal tests with the MIC values between 50-400 µg/ml. The EO was the most active samples against all *Mycobacterium* strains, dermatophytes and *Candida* species (MICs=0,1-6,25 µg/ml). Because of the high activity of EO, its composition was analyzed by GC-MS, and the major compound was found caryophyllene oxide (22.3%), which was also found the major components of the essential oil from an other, antimicrobial plant, *Ballota pseudodictamnus* (Couladis et al., 2002).

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OP-10. Phenolic content and activity of *Chilocalyx* section of *Origanum*

Sema Çarıkçı, Turgut Kılıç[1], Tuncay Dirmenci[2], Hasibe Yılmaz[3], Ahmet C. Gören[3], Turan Arabacı[4]*

* Chemistry Department/Faculty of Art&Science, Balıkesir University, Turkey

[1] Science Education Department/ Faculty of Necatibey Education, Balıkesir University, Turkey

[2] Biology Education Department/Faculty of Necatibey Education, Balıkesir University, Turkey

[3] TUBITAK National Metrology Institute (UME), Department of Chemistry, Gebze-Kocaeli, Turkey

[4] Department of Pharmaceutical Botany, Faculty of Pharmacy, İnonu University, Malatya, Turkey

carikci@balikesir.edu.tr

Introduction

Origanum species are one of the popular species used as spices "oregano" all over the world for flavoring of food products or as herbal tea, as well as in perfumery for their spicy fragrance. The *Origanum* species grown mostly in the east Mediterranean region and are used as anti-diabetic, carminative, tonic, digestive, stimulant, expectorant, menstrual regulator, diuretic, and for respiratory problems such as asthma[1]. The genus *Origanum* is a member of the family Lamiaceae and represented by 23 species (26 taxa) and 7 hybrids in Turkey, 20 of which are endemic[2,3]. In this study, phenolic content, antioxidant activity and anticholinesterase activity of three endemic species belonging to sect. *Chilocalyx* of *Origanum* were investigated.

Materials and Methods

Origanum bilgeri P.H. Davis, *O. minutiflorum* O.Schwarz & P.H. Davis and *O. vogelii* Greuter & Burdet collected from southern parts of Anatolia. The plant samples were extracted with chloroform (C), acetone (Ac) and methanol (M). The extracts were analyzed LC-MS/MS and determined quantitative amounts of the phenolic compounds. The inhibition of lipid peroxidation, Cu^{2+} and DPPH scavenging and anticholinesterase activity (AChE and BChE inhibitory activities) of the extracts were carried out.

Results and Discussion

Metanolic extracts of *O. vogelii* and *O. minutiflorum* and acetone extract of *O. bilgeri* were found as rich in phenolics. Kaempferol and rosmarinic acid were determined as the main compound of *O. bilgeri*, *O. vogelii* and *O. munitiflorum*, respectively. *O. minutiflorum* was determined as the species with strongest antioxidant activity. Especially, acetone and methanol extracts showed good activity. *O. minutiflorum* also showed good inhibitory activity against acetyl cholinesterase and butyryl cholinesterase enzymes.

Acknowledgments

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OP-11. Examination of the change in the components of volatile oil of medical sage (*Salvia officinalis* L.*)* which is grown in different locations

Hasan Basri Karayel[1], Mevlüt Akçura[2], Yakup Budak[3], İsmail Karabulut[4]*

[1] Dumlupınar University. Gediz Vocational Shool, Medical and Aromatic Plants Department. Kütahya, Türkiye.

[2] Çanakkale 18 Mart University, Faculty of Agriculture, Farm Plants Department, Çanakkale, Turkey

[3] Gaziosmanpaşa University, Faculty of Science and Literature, Chemistry Department. Tokat, Turkey

[4] Dumlupınar University. Gediz Vocational Shool, Medical Promotion and Marketing Department. Kütahya, Türkiye.

kbasri23@hotmail.com

This study was conducted simultaneously in Çanakkale, Balıkesir and Kütahya locations in order to define the effect of location on the volatile oil components, volatile oil rate and volatile oil quality in Medical Sage (*Salvia officinalis* L.) plant in 2015 growing season. Field experiments were repeated in 3 replicates according to randomized block design. The seedlings were planted by a horizontal distance of 30 cm and vertical distance of 50 cm. The volatile oils of the parts of *Salvia officinalis* L. Which are over the soil were examined. These plants' volatile oils were obtained by hydrodistillation method (GC_MS/FID) and the volatile oil rates in three different locations were measured as %0.99, %1.23, %1.85, respectively. The basic components of the volatile oil were determined as follows; α-thujone % 26,35, % 38,39, % 29,84, β-thujone % 29,20, % 12,26, % 9,07, camphor %5,60,%13,90, % 23,24, 1,8-cineole % 7,75, % 7,81, %6,57, viridiflorol%5,55, %4,38, %2,65. The highest volatile oil rate of the Medical Sage was reached in Kütahya location by a %1.85 rate. As a result of the study it was found out that volatile oil components are comparatively richer in terpenes and the amount of volatile oil differs according to the ecological factors.

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OP-12. Research into some plants belonging to the Lamiaceae family cultivated under Bornova ecological conditions

*Çiğdem Sönmez**
University of Ege, Faculty of Agriculture, Department of Field Crops, İzmir-Turkey
cigdemsnmz@gmail.com

Abstract

This report summarizes the agronomic and breeding practices conducted on some Lamiaceae family plants in University of Ege, Faculty of Agriculture, Department of Field Crops. In the studies on cultivation techniques carried out on especially *Salvia officinalis* L., *Salvia fruticosa* Mill., *Origanum onites* L., *Rosmarinus officinalis* L., *Lavandula angustifolia* Mill., *Melissa officinalis* L., and *Mentha* species involved in this group of which the yield characteristics, as well as the quality characteristics such as volatile oil content and volatile oil content, have been determined. In breeding studies, *Origanum onites* L. and *Salvia fruticosa* Mill. were specified with a wide variety in different originated plants. Especially, in the species of *Origanum onites* L. different chemotypes have been found. While the majority of plants were identified as carvacrol type, the main compounds of some plants were thymol and linalool types. When all the findings are evaluated in general, it has been concluded that the plants studied belonging to the family Lamiaceae can be successfully cultivated in terms of both yield and quality in Bornova ecological conditions.

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OP-13. Comparison of extraction methods of *Sideritis trojana* Bornm. In terms of enzyme inhibition, antioxidant activity and phenolic profile

Engin Celep[1], Merve Seven[2] Selin Akyüz[1], Yiğit İnan[1], Erdem Yeşilada[1]*

[1] Yeditepe University, Faculty of Pharmacy, Department of Pharmacognosy, Istanbul, Turkey

[2] Yeditepe University, Faculty of Engineering, Department of Genetics and Bioengineering, Istanbul, Turkey

ecelep@yeditepe.edu.tr

Introduction

The genus *Sideritis* of Lamiaceae comprises more than 150 species, mainly distributed in hot zones of Northern hemisphere. Turkey, together with Spain, possesses the highest number of different species. The genus includes 46 different species, 31 of which are endemic (Erkan et al., 2011).

Sideritis species, known as "dağ çayı" (mountain tea) in Turkish, have long been traditionally used as either infusion or decoction for the treatment of gastrointestinal, respiratory and urogenital disorders and also against cough and hypertension. *S. trojana* is an endemic species, mainly found in the mythological Mount Ida (Kazdağı). Likewise, its aerial parts are traditionally consumed as infusion or decoction (Kirmizibekmez et al., 2012). In the light of these data, it has been planned to investigate the differences in phenolic content, antioxidant capacity and diabetes-linked enzyme inhibition between infusion and decoctions forms. In addition, alcoholic extract and ultrasound-assisted extracts were included in the study for comparative purposes. The phenolic content of the samples were examined with HPLC-DAD system using p-coumaric acid, gallic acid, rosmarinic acid and rutin as reference substances. Furthermore total phenolic, flavonoid, phenolic acid, proanthocyanidin and saponin contents were calculated. Inhibition of enzymes alpha-glucosidase and alpha-amylase were performed for evaluating antidiabetic activity. *In vitro* antioxidant activities of the samples were measured with DPPH radical scavenging, cupric ion reducing and total antioxidant capacity tests.

Materials and Methods

S. trojana Bornm. was collected from Bayramic, Canakkale, Turkey, in June 2010 at ca 1700 m height. The plant material was identified by Dr. G. Akaydin (Hacettepe University, Department of Biology Education, Beytepe, Ankara, Turkey) and a voucher specimen (YEF 10002) has been deposited at the Herbarium of the Department of Pharmacognosy, Faculty of Pharmacy, Yeditepe University, Istanbul, Turkey. Total phenolic, flavonoid, proanthocyanidin, phenolic acid and saponin contents were spectrophotometrically measured according to previously published methods (Celep et al., 2013). HPLC-DAD analysis of the samples were conducted using 1100 Agilent HPLC system and Agilent Zorbax Eclipse XDB-C18 4.6*250 mm column with 0.1% formic acid and acetonitrile as mobile phase. All of the *in vitro* antioxidant assays were employed according to methods described earlier (Celep et al., 2015).

Results and Discussion

The phytochemical content and related antioxidant activity of the samples are directly influenced by the extraction method and the solvent chosen for the process. Besides, all of the extracts displayed good enzyme inhibitory activities on α-amylase and glucosidase. These findings confirmed different extracts prepared from *S. trojana* could be referred as a good source for the management of oxidative stress and the treatment of diabetes.

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OP-14. Free radical scavenging and enzyme inhibitory activities of *Teucrium polium* L.

Gülmira Özek[1], Süleyman Yur[2], Fatih Göger[1,2], Münevver Arslan[3], Temel Özek[1,2,]*

[1] Anadolu University, Department of Pharmacognosy, Faculty of Pharmacy, 26470-Eskişehir, Turkey [2]

[2] Anadolu University, Medicinal Plant Drug and Scientific Research Center (AUBIBAM) 26470-Eskişehir, Turkey

[3] Forest Soil and Ecology Research Institute, Eskişehir Turkey

tozek@anadolu.edu.tr

Introduction

Teucrium polium L. (Lamiaceae) is a wild-growing flowering plant used commonly in folk medicine for diverse purposes and also as a spice and refreshing beverage in different countries [1]. The present work is dedicated to the evaluation of *T. polium* volatile and non-volatile products obtained by hydrodistillation (HD) and accelerated solvent extraction (ASE) methods. ASE method is categorized as "green technology", reducing the amounts of extraction time, sample and solvent required.

Materials and Methods

The extraction of *T. polium* was performed with aqueous methanol (60%) by using accelerated solvent extraction system (Dionex ASE 200) for 17 min at 129°C. The extract was fractionated using column chromatography technique (Sephadex). The total phenol content in the extract was spectrophotometrically measured using Folin-Ciocalteu reagent [2]. The oil and extract were evaluated for hypoglycemic activity against α-amylase enzyme using the iodine/potassium iodide method [3]. The scavenging effect of the samples on DPPH free radicals was determined using a modified method of Brand-Williams [4]. Trolox equivalent antioxidant capacity of the extract and the oil was estimated towards to $ABTS^{\bullet+}$ according to Re [5].

Results and Discussion

The α-amylase was potently inhibited (*Inh%* 60.0±2.4) by the extract of *T. polium*. The extract demonstrated significant free radical scavenging activity (IC_{50}=0.063 mg/mL) against DPPH radicals. The Trolox equivalent antioxidant potential for the extract was found as 1.52±0.19 mM. The total phenols content was measured as 0.39±0.02 gallic acid equivalent mg/mL. According to LC-MS/MS analysis, the main constituent of the extract was determined as a phenylethanoid type glycoside with 769 $(M-H)^-$ molecular weight. However, the oil was found inactive in this test. The present work is the first contribution about antidiabetic potential of *T. polium* extract obtained with pressurized solvent.

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OP-15. Physicochemical, antibacterial and antifungal properties of essential oils obtained from basil (*Ocimum basilicum*) and thyme (*Thymus serpyllum*) plants

Erman Duman, Ahmet Şükrü Demirci, Sabire Duman*

[1] Department of Food Engineering, Faculty of Engineer, Afyon Kocatepe University, 03200 Afyonkarahisar, Turkey

[2] Department of Food Engineering, Faculty of Agriculture, Namık Kemal University, 52000 Tekirdağ, Turkey

[3] Department of Nutrition and Dietetic, Faculty of Medicine, Afyon Kocatepe University, 03200 Afyonkarahisar, Turkey

eduman@aku.edu.tr

In this research, we have investigated, in detail the physico-chemical and antimicrobial properties of basil (*Ocimum basilicum*) and thyme (*Thymus serpyllum*) plants collected from different locations (İzmir-Ödemiş, Gaziantep-Yusufeli). Ocimum basilicum essential oil contained in estragole (54,4 %), methyleugenol (10,8 %), linalool (9,1 %) and 1,8-cineole (6,0 %). As main constituents *Thymus serpyllum* essantial oil contained were found carvacrol (52,7 %), ocimene (21,9 %), gamma-terpinene (9,34 %), caryophyllene (2,0 %) and alpha-terpinene (1,9 %). Other parameter and their ranges inclued heavy metal contents (0-174,805 mg / kg), essential oils (1,1-1,7%), refractive index (1,506-1,509), color (0,4-3,9-0-0,1 and 1,0-9,0-0-0,1), viscosity, oxidative stability on sunflower oil, total phenolic content . In addition, these essential oils applied on three different molds (*Aspergillus parasiticus* NRRL 3357, *Aspergillus parasiticus* DSM 5771 and *Zygosaccharomyces rouxii* ATCC 28253) and 6 bacteria (*Escherichia coli* ATCC 25922, *Escherichia coli O157: H7*, *Listeria monocytogenes* ATCC 7644 , *Salmonellaentericasubsp.entericasero var. Enteritis* ATCC 13076, *Staphylococcus aureus* ATCC 2592). Essantial oils were found to be effective at different rates on the specified microorganisms.

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OP-16. The Effect of Thyme essential oil added to quail diets on antioxidative metabolism in breast meat

Recep Gümüş[1], Nazlı Ercan[2], Halit İmik[3]*

[1] Department of Animal Nutrition and Nutritional Disorders, Faculty of Veterinary Medicine, Cumhuriyet University, Sivas

[2] Department of Biochemistry, Faculty of Veterinary Medicine, Cumhuriyet University, Sivas, Turkey.

[3] Department of Animal Nutrition and Nutritional Disorders, Faculty of Veterinary Medicine, Ataturk University, Erzurum

This study was conducted to determine the effect of diets containing different levels thyme essential oil *(Thymus vulgaris)* on antioxidative metabolism in breast meat of quails. A total of 200 sixteen-days-old Japanese quails *(Coturnix coturnix japonica)* were used in the study. Animals were divided into 4 groups; Control group was fed only basal diet but 150, 300 and 450 mg/kg thyme essential oil were added to diet of groups Thyme1, Thyme2 and Thyme3, respectively. At the end of study (51 days old), ten quails were selected randomly from every group and decapitated. The analyses were made on their breast meat. The groups did not differ for catalase (CAT) activity. In thyme groups, glutathione peroxidase (GPx) activity was significantly higher than the group of Control ($P < 0.05$). However, the superoxide dismutase (SOD) activity was significantly higher in only group Thyme2 ($P < 0.05$). It was determined that the level of malondialdehyde (MDA) decreased in the Thyme1 and Thyme3 groups ($P < 0.05$). In conclusion, thyme essential oil had a marked effect on the antioxidant metabolism in breast meat.

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OP-17. Neurophysiological proof of pre-clinical and clinical effectiveness of extracts from oregano, lavandula and sideritis on the brain.

Wilfried Dimpfel
Justus-Liebig-University Giessen, Germany c/o NeuroCode AG, Wetzlar, Germany
Wifried.Dimpfel@pharma.med.uni-giessen.de

Introduction

Neurophysiological methods have been widely used in providing evidence for the effectiveness of drugs acting on the brain. The present overview deals with data from preclinical and clinical experiments obtained in the presence of extracts from different Lamiaceae, namely from Oregano, Lavandula and Sideritis. Oregano is an important culinary herb, used for the flavor of its leaves. Lavandula likewise is used as a culinary herb and is thought to be effective against anxiety. Sideritis is sold as Greek mountain tea and extracts were prepared from different species like *Sideritis scardica* or *Sideritis euboa*.

Materials and Methods

Preclinical characterization of the extracts involved quantitative EEG from depth electrodes in freely moving rats and analysis of population spike amplitudes in rat hippocampus slices in vitro. Signals from single rats were processed by Fast Fourier Transformation (FFT) and chopped into hourly intervals of recording. Group values were analyzed with respect to spectral power in four deep brain areas before and after oral exposure to the extract. Hippocampal slices in vitro were obtained by conventional techniques.

Clinical characterization of the effectiveness was undertaken by using 17 channel quantitative EEG under different recording conditions. Spectral power was determined in 17 brain areas on the base of 6 frequency ranges.

Results and Discussion

Oregano extract attenuated alpha1, alpha2 and beta1 waves representing an activation of serotonergic, dopaminergic and glutamatergic neurotransmission in the brain of freely moving rats. Linear discriminant analysis projected Oregano data into the vicinity of antidepressant and neuroprotective reference compounds. Lavandula extract induced time dependent increases of delta and alpha1 spectral power in frontal cortex and hippocampus in this model. Analysis of human EEG revealed also increases of alpha1 spectral power indicative for a calming activity (on line real time video clip). *Sideritis euboa* extract induced significant increases of spectral power within all frequency ranges only in the frontal cortex of rats from the second hour after administration on, whereas *Sideritis scardica* extract attenuated spectral power in all frequency ranges already during the first hour. *Sideritis scardica* extract increased long term potentiation (LTP) in the hippocampus slice in vitro due to an interaction with the glutamatergic AMPA receptor. Clinically, Sideritis extract enhanced alpha and beta spectral power during performance of the d2-concentration test in subjects suffering from mild cognitive impairment. Psychometric performance of the d2-concentration test was significantly better in the presence of Sideritis than of placebo.

These results provide evidence that extracts from special Lamiaceae change electric brain activity in rats and humans. They can therefore be used as food supplements for therapeutic intervention.

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OP-18. Assessment of *Salvia pisidica* Boiss. & Heldr. ex Benth. and *Salvia potentillifolia* Boiss. & Heldr. ex Benth. for antioxidant and antidiabetic properties

Gulmira Özek
Anadolu University, Department of Pharmacognosy, Faculty of Pharmacy, 26470 Eskisehir, Turkey
gozek@anadolu.edu.tr

Introduction

Genus *Salvia* (Lamiaceae) is represented by 95 species in Turkey, which are classified into seven sections. In Anatolian folk medicine, *Salvia* species are used as infusion (1–5%) for wound healing and in alleviating stomach, liver, and rheumatism pains and for treating the common cold. The aim of this study was to determine total phenolics, antioxidant and antidiabetic activities of *Salvia pisidica* Boiss. & Heldr. ex Benth. and *S. potentillifolia* Boiss. & Heldr. ex Benth. in an attempt to contribute to the use of these as alternative natural products.

Materials and Methods

The flowering aerial parts of *S. pisidica and S. potentillifolia* were subjected to hydrodistillation in Clevenger-type apparatus to yield essential oils (EO's) as well as to accelerated solvent extraction (in ASE 300 system) with 60% methanol to yield extracts (ME's). The species were identified by Dr. Arslan M. (Forest Soil and Ecology Research Institute). The oils were analyzed with GC-FID and GC/MS techniques. The total phenol content in ME's was determined with spectrophotometric method. The EO's and ME's were investigated for antidiabetic potential *via* inhibition of α-amylase enzyme using the iodine/potassium iodide method (1). The scavenging effect of the samples on DPPH free radical was determined using a modified method of Brand-Williams (2). Trolox equivalent antioxidant capacity of the samples was estimated towards to $ABTS^{\bullet+}$ according to the procedure described by Re (3).

Results and Discussion

The oils of *S. pisidica* (Inh% 59.91 ± 3.74) and *S. potentillifolia* (Inh% 59.27 ± 4.71) as well as their extracts (Inh% 60.91 ± 2.32 and 67.44 ± 6.41, respectively) demonstrated noteworthy inhibitory potential against α-amylase. An antioxidant activity of ME's significantly higher than the EO's. In TEAC assay, the extracts of *S. pisidica* and *S. potentillifolia* scavenged $ABTS^{+\cdot}$ radical as 2.71 mM and 2.86 mM of Trolox, while the EO's were inactive. In DPPH assay, *S. pisidica* (IC_{50}=39 mg/mL) and *S. potentillifolia* (IC_{50}=31 mg/mL) extracts showed significant antioxidant activity, while the oils were found inactive. The present work is the first contribution about antidiabetic potential of *S. pisidica* and S. *potentillifolia*.

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OP-19. Treatment of ulcerative colitis disease with *Rosmarinus officinalis*

Anil Yilmaz[1], Fatih Uckaya[2], Nihan Bayindir[3], Ali Toprak[4], Eray Metin Guler[5], Mukaddes Esrefoglu[3], Gulacti Topcu[1]*

[1] Department of Pharmacognosy, Faculty of Pharmacy, Bezmialem Vakif University, 34093, Fatih, Istanbul, Turkey.

[2] Department of Biochemistry, Faculty of Pharmacy, Bezmialem Vakif University, 34093, Fatih, Istanbul, Turkey.

[3] Department of Histology, Faculty of Medicine, Bezmialem Vakif University, 34093, Fatih, Istanbul, Turkey.

[4] Department of Biostatistics, Faculty of Medicine, Bezmialem Vakif University, 34093, Fatih, Istanbul, Turkey.

[5] Department of Biochemistry, Faculty of Medicine, Bezmialem Vakif University, 34093, Fatih, Istanbul, Turkey.
yilmaza@bezmialem.edu.tr

Introduction

Rosmarinus officinalis L. (Lamiaceae) is a perennial aromatic herb native to the Mediterranean area including south of Turkey. *R. officinalis* has been used in folk medicine for the treatment of respiratory disorders, stomach problems and inflammatory diseases (Al-Sereiti et al., 1999). *R. officinalis* possesses several pharmacological activities, such as hepatoprotective, antibacterial, antithrombotic, antiulcerogenic, diuretic, antidiabetic, antinociceptive, anti-inflammatory, antitumor and antioxidant. Ulcerative colitis (UC) is a chronic and inflammatory disorder of the gastrointestinal tract. The symptoms are superficial mucosal inflammation, rectal bleeding, diarrhoea, and abdominal pain. In the present study, healing effect of *R. officinalis* on UC disease was investigated through *in vivo* antioxidant and anti-inflammatory activities and histopathological analysis overall for the first time.

Materials and Methods

In vitro antioxidant activity of the methanol extract of *R. officinalis* was investigated by DPPH free radical scavenging, ABTS cation radical scavenging and cupric reducing antioxidant capacity assays. UC disease was inflicted on Wistar albino rats by trinitrobenzene sulfonic acid. The rats with UC were fed with the methanol extract of *R. officinalis*. The healing effect was determined by *in vivo* antioxidant and anti-inflammatory methods. Also, the intestines were histopathologically studied. Besides, toxicological effects of *R. officinalis* were histopathologically examined on kidney and liver tissues of the rats. In addition to this, biochemical parameters of serum samples were studied.

Results and Discussion

The methanol extract of *R. officinalis* showed high *in vitro* and *in vivo* antioxidant activities and *in vivo* anti-inflammatory activity. Also, histopathological analysis of intestines, liver and kidney revealed that the methanol extract of *R. officinalis* has a significant healing capacity on UC disease with minimal vacuolization, congestion and sinusoidal dilatation on liver and vacuolization, tubular degeneration, congestion, and glomerulosclerosis on kidney. The values of general blood analysis and hemogram of the rats treated with *R. officinalis* were found to be in the range of reference values.

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OP-20. Chia (*Salvia hispanica* L.): An ancient crop suitable for modern nutrition

Dietrich Paper
AcanChia UG&Co.KG, Vilstalstraße 88, 92245 Kümmersbruck, Germany
dpaper@acanchia.com

Chia (*Salvia hispanica L.*) seeds have been used as staple food in Mesoamerican civilizations (*e.g.* Aztecs). Although they have become a forgotten crop for centuries, today we rediscovered that chia seeds are a good crop to fortify our "bad" food. Chia seeds have a high nutritional composition. They are relatively high in protein, soluble and non-soluble fiber, vitamins and minerals. Chia seeds are a great source of omega-3 fatty acids – especially α-linolenic (ALA). They contain no starch, are gluten-free and GMO-free.

The content of fatty oil in chia seeds is around 30 percent. The chia oil is rich in ALA, which contribute to the stabilization of the cholesterol level in the blood. ALA has a key role preventing cardiovascular disease, decreasing the cardiac rhythm and the risk of stroke. A sufficient intake of ALA leads to reduced production of arachidonic acid and an enhanced production of EPA & DHA (long-chain omega-fatty acids).

The recommended dosage for omega-3 is 10 to 15 g of chia seeds per day (one or two spoonful). Three grams of ALA (15 g of chia seeds) can be converted to 150 mg of EPA, which represents 60 percent of the recommended daily intake. Typically, the ratio of omega-3: omega-6 is around 3: 1, but according to our experimental data in some species of chia the ratio is found 4:1.

Chia seeds are able to adsorb water – up to 14 times. The high water binding capacity is due to the high content of fiber. The fiber content decreases the blood cholesterol level, slow the breakdown of sugars and therefore decrease level of glucose in the blood.

The gel formation of chia seeds provides satiety, a good signal for weight management.

Chia seeds and processed seeds (*e.g.* chia flour, chia oil, chia protein powder) can be added to other food, to improve their properties, via increase of proteins, omega-3, fiber and the reduction of the glycemic index of food.

Within this presentation it is aimed to review the current chia knowledge along with our academic and commercial experiences.

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OP-21. Essential oil composition and morphological characteristics of *Cyclotrichium glabrescens* (Boiss. et Kotschy ex Rech. fil.) Leblebici endemic in Turkey

Mine Kurkcuoglu[1], Sevim Kucuk[2], Murat Kursat[3], K.Hüsnü Can Baser[4]*

[1] Anadolu University, Faculty of Pharmacy, Department of Pharmacognosy, 26470, Eskişehir, Turkey.

[2] Anadolu University, Faculty of Pharmacy, Pharmaceutical Botany, 26470, Eskişehir, Turkey.

[3] Bitlis Eren University, Faculty of Science and Arts , Department of Biology, Bitlis, Turkey.

[4] Near East University, Faculty of Pharmacy, Department of Pharmacognosy, Lefkoşa (Nicosia), N. Cyprus, Mersin 10, Turkey

mkurkcuo@anadolu.edu.tr

Cyclotrichium (Boiss.) Manden. et Scheng. (Lamiaceae) is represented in Turkey by six species. Two species are endemic in Turkey, namely, *Cyclotrichium glabrescens* (Boiss. et Kotschy ex Rech. fil.) Leblebici and *C. niveum* (Boiss.) Maden. et Scheng. They are aromatic perennial subshrubs used as spices or herbal teas in traditional Turkish medicine. *C. glabrescens* is locally known as “kelçekme” (1,2).

The aerial parts of *C. glabrescens* (Lamiaceae) was water distilled for 3 h using a Clevenger-type apparatus. The essential oil was analyzed by GC-FID and GC-MS simultaneously. The main constituents were identified as bicyclogermacrene (22.5%), spathulenol (14.3%) and elemol (7.5%) for *C. glabrescens.* 64 constituents, representing 96.9% of the total components in the oil, have been identified in the essential oil. Morphological characteristics of *C. glabrescens* have been investigated.

To the best of our knowledge, this is the first scientific study on this species.

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POSTER PRESENTATIONS

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PP-1. Effects of different doses of nitrogen on some agronomic and quality characters of thyme (*Thymbra sintenisii*)

Fatma Çiğdem Sakinoğlu Oruç[1]

[1] Düzce Üniversitesi Çilimli Meslek Yüksekokulu Bitkisel Ve Hayvansal Üretim Bölümü Çilimli/ Düzce

cigdemsakinoglu@duzce.edu.tr

Abstract

In this study, we aim to determine the appropriate dose of nitrogen as pointed thyme pot experiment under greenhouse conditions in Düzce climatic conditions. Ammonium Sulfate, Ammonium Nitrate and Urea fertilizer in 4 replicates using a trial was set. In this study, plant height, green herbage yield, drug herbage yield, characteristics such as drug leaf yield was investigated.

As a result, from 11.96 to 15.8 cm plant height, green herbage yield 1794,0-3725,0kg / da, drug herbage yield from 253.0 to 529.0 kg / ha, drug leaf yield from 89.0 to 372, 0 kg / ranged.

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PP-2. Variation on macro and micro nutrients content of *Salvia* spp. in nature and culture conditions

Filiz Ayanoğlu[1], Veli Uygur[2], Nadire Pelin Bahadırlı[1], Oğuzhan Koçer[3]*

[1] Mustafa Kemal University, Faculty of Agriculture, Field Crops Department, 31034, Hatay/Turkey

[2] Süleyman Demirel Univ., Faculty of Agriculture, Soil Sci. and Plant Nutrition, 32260, Isparta/Turkey

[3] Mustafa Kemal University, Institute of Science and Technology, 31034, Hatay /Turkey

filizayanoglu@gmail.com

Introduction

The genus *Salvia* (Lamiaceae) is represented in Turkey by 97 species, of which 45 are endemic (Davis 1988). Hatay flora is very rich in *Salvia* genus (Doğan et al., 2008). Some of *Salvia* species are collected, used and traded. There are many studies to determine macro and micro element contents of wild medicinal plants and the characteristics of the soil that they grow up (Chapin, 1980; Ayanoğlu ve Özkan, 2000). The aim of the study was to determine the macro and micro element contents of *Salvia* species their growing soils in nature and cultural conditions.

Materials and Methods

In the study, 16 *Salvia* species (*S. pilifera, S.aucheri, S. glutinosa, S.verbenaca, S. verticillata subsp.amasiaca, S. tomentosa (6), S.microstegia, S. multicaulis, S. aramiensis (3), S. sericeo-tomentosa, S. fruticosa, S. cassia, S. palaestina, S. sclarea, S. virgata, S. viridis*) were collected from 23 different locations. *S. officinalis* and *S. fruticosa* were used as controls. P, K, Ca, Mg, Na, Fe, Cu, Mn and Zn in plant samples were determined in ICP. Plant and soil nitrogen analyzes were carried out by the Kjeldahl method. In soil analyzes, available phosphorus and organic carbon were determined, pH and EC measurements were made. Fe, Mn, Cu and Zn contents of the soils were determined by ICP by the extraction with DTPA. Ca, Mg, Na, and K were determined by flame photometer and ICP.

Results and Discussion

N contents of plants were 0.653-1.741% in nature and 0.796-2.679% in culture; Ca in nature (0.83-5.36%), and in culture (0.68-1.67%); Mg in nature (0.36-1.78%) and in culture (0.47-1.46%), Na in nature (0.03-1.14%) and in culture (0.04-0.83%), Mn in nature (10.5-131.0 mg /kg), and in culture (8.75-62.0 mg/kg), Cu in nature (2.00-14.25 mg/kg) and in culture (1.00-11.5 mg / kg). Zn was determined in nature (24,39 mg / kg) and in culture (17,80 mg / kg). The plants accumulated 2 times more K in culture than nature environment. In the study, severe P (918 mg/kg) deficiency was detected in native plants. Fe was found to be very high in nature and culture conditions and almost 10 times more values (2660 mg / kg) were obtained than other cultivated plants. As a result, N, Mg, K, P, Fe, Cu contents of plants increased as a result of cultivation; Ca, Na, Mn and Zn content decreased.

Acknowledgements

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PP-3. Determination of ontogenetic variability on herb yield, essential oil content and components of *Salvia tomentosa* Mill. Genotypes

Filiz Ayanoğlu[1], Durmuş Alpaslan Kaya[1], Ahmet Mert[1], Ercüment Osman Sarıhan[2]*

[1] Mustafa Kemal University, Faculty of Agriculture, Field Crops Department, 31034, Hatay/Turkey

[2] Usak University, Faculty of Agriculture and Natural Sciences, 64200, Uşak/Turkey
filizayanoglu@gmail.com

Introduction

The information obtained from different literatures shows that there are about 20 *Salvia* species native to flora of Hatay province (Davis 1988, Doğan et al., 2008). Some of these species are collected and traded by local people. The cultivation of medicinal plants is important for the protection of natural flora and standardization of crops. There are few agricultural studies on *S. tomentosa* Mill.. Studies on the agriculture of Salvia species have focused on several species. (Ceylan, 1997). Surveys conducted in the region show that there is a large variation in *S. tomentosa* Mill.. The aim of the study was to investigate agricultural and quality aspects and ontogenetic variability of S. tomentosa collected from different locations in Hatay province.

Materials and Methods

In the study, 6 genotypes (*S. tomentosa* Mill.) from different locations Gümrük-Yayladağı (1), Karaksı-Antakya (2), Musa Dağı-Samandağ (3), Kömürçukuru-Belen (4) Kuruyer-Altınözü (5), Simon Manastırı-Samandağı (6) of Hatay province were collected. Genotypes were propagated by stem cuttings. Field trial was conducted for two years with three replications. Plants were harvested at three times (Pre-flowering, Full flowering and Autumn) for each year. Fresh herb yields (kg/da), dry herb yields (kg/da), dry leaf yields (kg/da) were determined. Essential oil yield (l/da), essential oil content (%) and components (%) of *S. tomentosa* Mill. genotypes were also examined for two years at three harvest with three replication. Plants were hydro-distillated for two hours by clavenger apparatus and identified by GC/MS (Thermo-scientific).

Results and Discussion

In the study, the highest fresh herb yield (3893,76 kg/da), the highest dry herb yield (1167 kg/da) and the highest dry leaf yield (646,79 kg/da) were obtained from the Genotype 3 harvested during the full flowering period in the second year of the experiment. The highest essential oil content (2.35%) and yield (9,08 l/da) were obtained from the Genotype 3 harvested in fall in the second year of the experiment. While β-pinene was generally identified as the main component in genotypes of *S. tomentosa* Mill., α-pinene was the main component in some genotypes especially in fall. In flowers, B-pinene was obtained at a higher rate than leaves. The highest β-pinene ratio (40,32%) in the experiment was obtained from the Genotype 2 harvested at pre-flowering period. Experiment once again revealed that there is a great variation in the agricultural characteristics and quality aspects within *S. tomentosa* genotypes.

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PP-4. A new hybrid of *Origanum* L. (Lamiaceae) from Turkey: *O.* × *aytacii* Dirmenci & Yazıcı

Tuncay Dirmenci[1], Taner Özcan[1], Türker Yazıcı[1], Sevcan Çelenk[2],*

[1] Department of Biology Education, Necatibey Education Faculty, Balıkesir University, Balıkesir, Turkey

[2] Department of Biology, Faculty of Arts and Sciences, Uludag University, Görükle Campus, Bursa, Turkey

Introduction

The genus *Origanum* L. (Lamiaceae, subfam: Nepetoideae, tribe: Mentheae, subtribe: Menthineae) comprises 43 species (51 taxa) and 15 hybrids worldwide (http://apps.kew.org; Ietswaat 1980;1982, Dirmenci et al. 2016a,b,c,d). The species are mainly concentrated in the temperate regions of the Mediterranean area. 23 species (26 taxa), eight hybrids have recorded in Turkey which has the most species and 20 of which are endemic (Ietswaart 1982; Davis et al. 1988; Güner et al. 1998; Dirmenci et al. 2016a; 2016b; 2016c; 2016d). The primary purpose of this study is introducing similarities and differences of *Origanum* × *aytacii* Dirmenci, & Yazıcı and its ancestors with using morphological, palynological and molecular characters.

Materials and Methods

The specimens belonging to new hybrid were collected from Denizli province between 2014 and 2016 years by the first and third authors. The collected specimens were studied as morphologically, palynologically and molecularly. Woodhouse and SEM photos were obtained from the palynological studies, ITS nrDNA and rpl32-trnL cpDNA region data were analyzed. Moreover, morphological characters of the new species and its allies were illustrated with drawing and using a stereo microscope.

Results and Discussion

The hybrid occurs between *O. sipyleum* L. (Sect. *Anatolicon* Benth.) and *O. vulgare* L. subsp. *hirtum* (Link) Ietsw. (Sect. *Origanum*) whose distribution areas are overlapped. *O. × aytacii* is similar and have intermediate characters as habitus, spicules, bracts, calyx, corolla and stamens between its parents. *Origanum* × *aytacii* differs from *O. sipyleum* in that its stems glabrous to puberulent, scabridolous or hirtellous (not tomentellous only at base and otherwise glabrous), leaves herbaceous, green, scarcely to densely scabridolous on both surface and punctate on upper surface (not more or less leathery, glaucous, scabridulous on veins beneath and margins, not punctate on upper surface), calyx 3-4 mm (not 4-7 mm). It differs from *O. vulgare* subsp. hirtum, calyx 2-lipped to 2/5, upper lip 3-teeth, lower lip 2-teeth (not regular), corolla pink (not white). *O.* × *aytacii* has 12 polymorphic loci, and these 12 loci are separated *O. sipyleum* and *O. vulgare* L. subsp. *hirtum* at specific level.

Acknowledgements

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PP-5. A new hybrid of *Origanum* L. (Lamiaceae) from Turkey: *O.* × *malyeri* Dirmenci & Yazıcı

Tuncay Dirmenci[1], Türker Yazıcı[1], Taner Özcan[1]*

[1] Department of Biology Education, Necatibey Education Faculty, Balıkesir University, Balıkesir, Turkey

Introduction

The genus is represented by 23 species (26 taxa), 14 of which are endemic, in Flora of Turkey (Ietswaart 1982, Duman 2000). The species are classified into eight sections; Sect. *Amaracus* (Gleditsch) Vogel (4 species), Sect. *Anatolicon* Benth. (2 species), Sect. *Breviflamnetum* Ietsw. (8 species), Sect. *Longitubus* Ietsw. (1 species), Sect. *Chilocalyx* (Briq.) Ietsw. (3 species), Sect. *Majorana* (Mill.) Benth. (3 species), Sect. *Origanum* (1 species, four taxa), Sect. *Prolaticorolla* Ietsw. (1 species) (Ietswaart 1980; 1982). Mediterranean area is the main origin of the species. Endemic species are concentrated to Mediterranean area, in Turkey.

Materials and Methods

The specimens belonging to new hybrid were collected from Çamlıyayla district, İçel province in 2015 by the first two authors. The collected specimens were studied as morphologically and molecularly. ITS nrDNA and rpl32-trnL cpDNA region data were analyzed. Moreover, morphological characters of the new species and its allies were illustrated with drawing and using a stereo microscope.

Results and Discussion

The hybrid occurs between *O. boissieri* (Sect. *Amaracus* (Gled.) Vogel) and *O. vulgare* subsp. *hirtum* (Sect. *Origanum*.) whose distribution areas are overlapped. *O.×malyeri* Dirmenci & Yazıcı is similar and has intermediate characters as habitus, spicules, bracts, calyx, corolla and stamens between its parents. It is distinguished from *Origanum boissieri* stems densely hirtellous (not villous), leaves glabrous to sparsely hirtellous and punctate (not slightly hirsute and punctate), calyx 2-lipped to ½ and 3.5-4 mm (not 2-lipped to 3/5 and 4-6 mm), corolla not saccate (saccate). It can be distinguished from *O. vulgare* subsp. *hirtum* by its leaves margins ciliate (not ciliate), calyx 2-lipped to ½ (not regular), corolla pink (not white). According to molecular results, *O.* × *malyerii* is more similar to *O. vulgare* subsp. *hirtum* than *O. boissieri.*

Acknowledgements

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PP-6. Root and stem anatomy of *Clinopodium acinos* (Lamiaceae)

Ayla Kaya
Anadolu University, Faculty of Pharmacy, Pharmaceutical Botany, 26470 Eskişehir-Turkey
aykaya@anadolu.edu.tr

Introduction

A group of Lamiaceae that has caused confusion over its generic boundaries are those species belonging to the complex surrounding the genera *Satureja*, *Calamintha*, *Micromeria*, *Clinopodium* and *Acinos*. *Clinopodium acinos* (L.) Kuntze previously treated as *Acinos arvensis* (L.) Moench in Flora of Turkey, is a erect or ascending perennial herb which grows in 0-2000 m in Turkey (Davis and Leblebici, 1982).

Materials and Methods

Plant material was collected from Kırklareli. Living material was stored in 70% alcohol for anatomical studies. Manuel cross sections were made from middle part of root and stem. All sections were examined using Leitz SM-LUX binocular microscope with drawing tube.

Results and Discussion

The root is orbicular in outline in cross-section. The seconder tissues is only observed in root anatomy of species. The stem is almost square in shape and contain non-glandular and glandular hairs in transverse sections. The vascular bundles are well-developed at the corners of the stem. Metcalfe and Chalk (1950) pointed out that the stems of the family Lamiaceae species are quadrangular and the collenchymatic tissue covers a broad area at the corners and sclerenchymatic tissue surrounds the vascular tissue, and these characteristics are diagnostic value.

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PP-7. Trichome morphology in Lamiaceae family

Ayla Kaya, Merve Konya*
Anadolu University, Faculty of Pharmacy, Pharmaceutical Botany, 26470 Eskişehir-Turkey
aykaya@anadolu.edu.tr

Introduction

Trichomes are small protrusions of epidermal origin on the surfaces of leaves and other organs of many plants. Plant trichomes come in a variety of shapes, sizes and cellular composition. Glandular trichomes, produce large amounts of specialized (secondary) metabolites of diverse classes. Glandular trichomes of Lamiaceae are among the most investigated secretory structures.

Materials and Methods

In this compilation, trichome morphology of plants belonging to Lamiaceae family is being examined by using over 150 sources. Trichome structure of family are supported by scanning electron microscopy (SEM), light microscopy photographs and drawing pictures.

Results and Discussion

Trichomes of the family are divided into three categories: non-glandular, glandular and mixed trichomes according to research results. And these trichomes can be also seperated into subgroups as nonglandular trichomes; simple and branched, glandular trichomes; capitate and peltate and mixed trichomes; branched and star-shaped. The presence and absence of peltate (Labiatae type) and capitate glandular trichomes have a taxonomic value at the species level (Metcalfe and Chalk 1950).

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PP-8. Seasonal variation in essential oil composition of rosemary (*Rosmarinus officinalis* L.) under Mediterranean climate condition

Begum Tutuncu[1], Huseyin Basim[2], Ali Turgut[2], Kenan Turgut[1]*

[1] Akdeniz University, Faculty of Agriculture, Department of Field Crops, 07058 Antalya, Turkey

[2] Akdeniz University, Faculty of Agriculture, Department of Plant Protection, 07058 Antalya, Turkey

Rosemary (*Rosmarinus officinalis* L.) is an important aromatic species in the Mediterranean region and it is widely used as aromatic herb, essential oil production and ornamental plant. Rosemary is an evergreen perennial shrub, so harvesting time could be important in terms of essential oil composition [1]. The aim of the study was to investigate seasonal variation in essential oil composition of rosemary in the condition of Mediterranean climate. Essential oils obtained by hydrodistillation of the dried leaves of *Rosmarinus officinalis* L. samples were investigated by GC-MS. Samples were collected from cultivated rosemary plants in April, July, October and January as corresponding four seasons in Antalya. In total, 32 constituents were identified representing 98% of the oils. Camphor (22.82%), borneol (18.79), 1,8 cineole (11.68%), alpha-pinene (10.52%) and L-verbenone (7.61%) were found to be the major components in the essential oil. However, their levels revealed significant seasonal variations. Camphor was the highest in spring and in summer (25.73% and 25.63% respectively); borneol and 1,8 cineole were superior in autumn (27.55% and 18.82% respectively); alpha-pinene was the highest in summer (13.56%). On the other hand, L-verbenone did not appear in autumn and in winter, found in spring (12.94%) and summer (13.72%). These results showed that essential oil composition of rosemary was varied considerably according to different seasons.

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PP-9. Comparative anatomical and micromorphological studies on *Teucrium ekimii* H.Duman

İlker Genç[1] , Gülay Ecevit Genç[1], Taner Özcan[2], Tuncay Dirmenci[2]*

[1] İstanbul Üniversitesi, Eczacılık Fakültesi, Farmasötik Botanik Anabilim Dalı, 34116 Beyazıt / İstanbul

[2] Department of Biology Education, Faculty of Necatibey Education, Balıkesir University, Balıkesir, Turkey.

gencilker1@gmail.com

Introduction

The genus *Teucrium* is comprised of 250 species in the world. Species of the genus is densely present in the Mediterranean Basin. *Teucrium* L. was represented with 36 species in Turkey which is a large and polymorphic genus (1-5). In this study, the anatomical and micromorphological features of the leaves and stems of *T. ekimii* were investigated. 11 (14 taxa) of 36 species grow in Turkey. belong to sect. *Teucrium. T. ekimii* is one of the sect. *Teucrium* members. Its leaves are linear, oblanceolate or obcordate, 7.0-19 × 1.5-5.0 mm in size; it has 2-4 flowers; bluish and rare hairy corolla and a 2.0-2.7 × 1.2-1.4 mm in size and glandular and eglandular hairy nutlet (Özcan, doctorate thesis).

Materials and Methods

T. ekimii samples were collected from Antalya in Turkey. Voucher specimens are stored at the herbarium of ISTE. For SEM analysis several (or at least three) samples were prepared. The samples were mounted on stubs and coated with gold after they were studied with an FEI Quanta 450 FEG-EDS scanning electron microscope.

Results and Discussion

The epidermis at both surfaces of the leaves is single layered. The epidermis consisting of ovoid, quadrate and rectangular cells is present at both surfaces of the leaves. The upper epidermis cells are larger than the lower ones. The upper cuticle layer is fairly thicker than the lower one. Lower leaf surface is densely covered by the indumentum built of subsessile glandular and multicellular long eglandular hairs. The upper leaf surface is covered by multicellular long eglandular hairs. Leaves are dorsiventral and hypostomatic. Under the upper epidermis, there is a palisade parenchyma formed by 2 layers. Spongy parenchyma cells are 2–3 layered under the lower epidermis. A vascular bundle is present in the central part of the vein with phloem facing the lower epidermis and xylem facing the upper epidermis. The midrib is rich in collenchymatic elements. There are 5–6 layered collenchyma below the midrib and 2–3 layered collenchyma above the midrib.

Nutlets are light brown, obovate-broadly elliptic, 2-2.7 long, 1.2-1.4 mm wide, longitudinal ridges and alveolate, alveoli deep with subsessile glandular and multicellular eglandular trichomes.

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PP-10. Essential oil composition and antimicrobial activity of *Salvia verticillata subsp. amasiaca* L.

Gökalp İşcan[*1,2], *Betül Demirci*[1], *Elif Dündar*[3], *Yavuz Bülent Köse*[3]

[1] Anadolu University, Faculty of Pharmacy, Department of Pharmacognosy, Eskisehir, Turkey.

[2] Anadolu University, Yunus Emre Vocational School of Health Services, Eskisehir, Turkey.

[3] Anadolu University, Faculty of Pharmacy, Department of Pharmaceutical Botany, Eskisehir, Turkey.

giscan@anadolu.edu.tr

Introduction

The genus *Salvia* L. (Lamiaceae) represented approximately 960 all over the world while there are 99 species 55 of which are endemic in Flora of Turkey (Güner et al., 2012). *Salvia* species include annual, biennial, or perennial herbs, along with woody subshrubs. *Salvia* species can be use in preparations for many purposes, for example, antispasmodic, antiseptic, astringent, respiratory-tract disorders, gastrointestinal disorders, and in mouthwashes for the mouth and throat and it features prominently in the pharmacopoeias of many countries throughout the World (Imanshahidi and Hosseinzadeh, 2006).

Materials and Methods

Hydrodistilled essential oil of *Salvia verticillata* L. were analysed by Gas Chromatography-Mass Spectrometry and FID coupled GC system. Both oil and the methanol extract were tested for their antimicrobial activity against ten bacteria species and eight different *Candida* strains, by using CLSI M7-A7 and M27-A2 protocols.

Results and Discussion

According to GC/MS results, β-caryophyllene (26.6%), germacrene D (15.7%), α-humulene (8.2%), β-phellandrene (5.2%), α-gurjunene (5.0%), β-pinene (3.9%) and limonene (3.6%) were found as major constituents of the essential oil. Both oil and the methanol extract of the S. *verticillata* showed weak antimicrobial effects (250 to >2000 µg/mL, MIC) when compared to standard agents.

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PP-11. Comparative anatomical studies on *Teucrium alyssifolium* Stapf., *Teucrium brevifolium* Schreb. and *Teucrium pestalozzae* Boiss.

Betül Büyükkılıç[1,2], Gülay Ecevit Genç[1], Taner Özcan[3], Tuncay Dirmenci[3]*

[1] İstanbul Üniversitesi, Eczacılık Fakültesi, Farmasötik Botanik Anabilim Dalı, 34116 Beyazıt / İstanbul

[2] Bezmialem Vakıf Üniversitesi, Eczacılık Fakültesi, Farmasötik Botanik Anabilim Dalı, 34093 Fatih / İstanbul

[3] Department of Biology Education, Faculty of Necatibey Education, Balıkesir University, Balıkesir / Turkey.

gulecevit@gmail.com

Introduction

Teucrium L. was represented with 49 taxa (36 species) in Turkey which is a large and polymorphic genus (1-5). Especially leaf anatomy is importance for the classification of the genus (5). *Teucrium* species has traditionally been used in Turkey for abdominal pain, stomachache, common cold, high fever, antipyretic, rheumatic pain (6). In this study, the anatomical features of the leaves and stems of *T. alyssifolium* Stapf. (endemic), *Teucrium brevifolium* Schreb. and *Teucrium pestalozzae* Boiss. (endemic) are investigated.

Materials and Methods

T. pestalozzae samples were collected from Burdur, *T. brevifolium* and *T. alyssifolium* samples were collected from Muğla in Turkey. Voucher specimens are housed at the herbarium of ISTE. Permanent microscopic preparations were made of plant material fixed in the field of 70 % alcohol. Cross sections of the plant leaves and stems taken by free-hand and stained with Sartur solution. Several slides were made and photographed for each species with the aid of a light microscope (Olympus BH-2 and Canon A 640 digital camera).

Results and Discussion

The cuticle layer is on the both side, and equal thickness of the epidermis at *T. alyssifolium* and *T. brevifolium* leaves. But *Teucrium pestalozzae* leaves upper cuticle layer is fairly thicker than the lower one. The upper epidermis cells are larger than the lower ones as *Teucrium brevifolium* leaves. There are long and thin-walled two cellular hairs on both sides of the *Teucrium alyssifolium* epidermis. Also, upper epidermis covered with low-density trichome. The stem is rectangle shaped all species. The cortex, consisting of different count layered, is located under the collenchyma. Phloem and xylem members are conspicuous. The pith is present at the middle of the stems and is filled up with large orbicular parenchymatic cells.

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PP-12. Comparative micromorphology of *Origanum* L. [Sect. Amaracus (Gleditsch) Vogel] species

Gülay Ecevit Genç[1], Türker Yazıcı[2], Tuncay Dirmenci[2]

[1] İstanbul Üniversitesi, Eczacılık Fakültesi, Farmasötik Botanik Anabilim Dalı, 34116 Beyazıt / İstanbul

[2] Department of Biology Education, Faculty of Necatibey Education, Balıkesir University, Balıkesir, Turkey.

Introduction

The genus is represented by 23 species (26 taxa), 14 of which are endemic, in Flora of Turkey (Ietswaart 1982, Duman 2000). The species are classified into eight sections; Sect. *Amaracus* (Gleditsch) Vogel (4 species), Sect. *Anatolicon* Benth. (2 species), Sect. *Breviflamnetum* Ietsw. (8 species), Sect. *Longitubus* Ietsw. (1 species), Sect. *Chilocalyx* (Briq.) Ietsw. (3 species), Sect. *Majorana* (Mill.) Benth. (3 species), Sect. *Origanum* (1 species, four taxa), Sect. *Prolaticorolla* Ietsw. (1 species) (Ietswaart 1980; 1982). Mediterranean area is the main origin of the species. Endemic species are concentrated to Mediterranean area, in Turkey. Sect. Amaracus has only 4 endemic species *O. boissieri* Ietswaart*, O. aylinae* Dirmenci & Yazıcı*, O. saccatum* P.H. Davis and *O. solymicum* P.H. Davis.

Materials and Methods

O. boissieri, O. aylinae, O. saccatum and *O. solymicum* used for this study were collected from natural habitats and different localities in Turkey by the authors. The aerial parts of (nutlets, leaves, bracts, petals and stems) were preliminarily observed using a light microscope to make sure that they were of normal size and maturity. For scanning electron microscopy (SEM) analysis, at least 5 samples were prepared. The samples of aerial parts were mounted on stubs and coated with gold before they were studied with an FEI Quanta 450 FEG-EDS scanning electron microscope.

Results and Discussion

In the present study, 2 different glandular trichomes (capitate and peltate) and 2 different eglandular trichomes (short and long multicellular) were observed on the leaves. Peltate hairs are generally seen on the leaves, petals and bracts of all taxa. Peltate trichomes are seen on the bracts of four taxa. Bracts of *O. boissieri* also have capitate and short multicellular eglandular trichomes. On stem, capitate trichomes are seen O. boissieri and *O. aylinae*; long multicellular eglandular trichomes are seen all of the taxa expect *O. solymicum*; peltate trichomes are seen only O. aylinae.

Peltate trichomes and short multicellular eglandular trichomes are seen on the petals of four taxa. Capitate trichomes are seen on the petals of all taxa expect *O. aylinae.* Peltate trichomes are seen on the leaves of all taxa. Also, there are capitate and long multicellular trichomes on the leaves of O. aylinaeand short and long multicellular trichomes on the leaves of O. saccatum.

The nutlets of *O. boissieri* and O. *saccatum* showed discoid patterns with some radiating ridges; the circles. Show broken wrinkles. *O. aylinae* and O*. solymicum* have ruminate-discoid surface pattern.

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PP-13. Phylogenetic relationship of *Micromeria* Benth. (Lamiaceae) species growing in Turkey

Taner Özcan[1], Tuncay Dirmenci[1], Turan Arabacı[2]*

[1] Department of Biology Education, Necatibey Education Faculty, Balıkesir University, Balıkesir, Turkey

[2] Department of Pharmaceutical Botany, Faculty of Pharmacy, İnonu University, Malatya, Turkey

ozcant@balikesir.edu.tr

Introduction

Genus *Micromeria* Benth. belongs to the family Lamiaceae; subfamily Nepetoideae; tribe Mentheae and subtribe Menthinae (Harley et al., 2004); is comprised of ca. 54 species with 32 subspecies and 13 varieties and is a taxonomically complex genus (Brauchler et al. 2008). A recent molecular analysis has been revealed that *Micromeria* is polyphyletic and members of the sect. *Pseudomelissa* Benth. are closely related to the genus *Clinopodium* L. In 2006, the species of *Micromeria* sect. *Pseudomelissa* were transferred to the genus *Clinopodium*. After this transfers, the genus *Micromeria* s.str. is now represented in Turkey by eight species and 13 taxa, eight of which are endemic (Arabacı et al., 2010; Dirmenci 2012). The main purposes of this study were to discuss the phylogenetic relationships and to determine the phylogenetic position of the other Turkish *Micromeria* species.

Materials and Methods

The plant materials were collected from different parts of Turkey during to revisionary study of *Micromeria* between 2005 and 2008 years. Seven taxa transferred to *Clinopodium* genus (which was named as the sect. *Pseudomelissa* before) and 11 taxa belonging to the sect. *Micromeria* were examined in this study. Pre-prepared herbarium materials were used for DNA isolation. Qiagen DNA isolation kit was utilized for this purpose, and isolated DNAs were used for the standard PCR procedure. Amplified nuclear ITS and chloroplast tRNA(Leu)-tRNA(Phe) DNAs were sequenced, and after that, they were edited using Sequencher program. PAUP* was used obtaining phylogenetic trees from Clustal W alignments.

Results and Discussion

Turkish *Micromeria* species' nrITS region and cptRNA(L)-tRNA(Ph) DNA sequences have been achieved for the first time in this study. Some *Clinopodium* members which belong to sect. *Pseudomelissa* in the Flora of Turkey apparently belongs to genus *Clinopodium* as molecularly.

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PP-14. Pollinator observations of some *Teucrium* L. (Lamiaceae) species

Taner Özcan[1], Tuncay Dirmenci[1], Ferhat Celep[2]*

[1] Biology Education, Necatibey Education Faculty, Balıkesir University, Balıkesir-Turkey

[2] Mehmet Akif Ersoy mah., 269. sok., Urankent Prestij Konutları, 2C No: 53 Demetevler, Ankara

ozcant@balikesir.edu.tr

Introduction

Pollination biology is one of the important subjects in plant ecological studies to understand pollination syndromes, plant speciation mechanism, plant distribution patterns and so on. *Teucrium* is one of the most interesting genera in Lamiaceae due to its different color and size of the flowers and reduced/deeply divided upper lip of corolla (McClintock & Epling 1946). Until now, pollination ecological studies on the genus is very scarce. The main purposes of this study are to show our preliminary observation results of some *Teucrium* species and to explain pollination mechanism of the studied species briefly (Herrera, 1986; Shmida & Dukas 1990).

Materials and Methods

Eight *Teucrium* taxa (Sect. *Teucrium*: *T. alyssifolium* Stapf, *T. pseudaroanium* Parolly, Erdag & Nordt, *T. sandrasicum* O.Schwarz; Sect. *Chamaedrys* Mill.: *T. chamaedrys*, *T. divaricatum* Sieber ex Benth., *T. flavum* subsp. *hellenicum* Rech.f.; Sect. *Polium* Mill.: *T. polium* L. and *T. montanum* L.) were investigated in their natural habitats to determine their pollination process. Plant specimens and pollinators were photographed to make further analysis, and morphological properties of their flowers were noted.

Results and Discussion

As most of the Lamiaceae members, *Teucrium* has nototribic (dorsal) pollination mechanism by chiefly bees. The members of the Sect. *Teucrium* have elongated lower lip of corolla, elongated and curled (like an arc) stamens and ovary. The main pollinators of *T. alyssifolium*, *T. pseudaroanium*, *T. sandrasicum* species are observed as honeybees and some beetles (Coleopterans). Pollen grains are deposited on the back of the honeybees. Corolla size in *T. chamaedrys*, *T. divaricatum* and *T. flavum* subsp. *hellenicum* is smaller and narrower than the sect. *Teucrium* members. Stamens and ovaries are curved but not elongated as long as sect. *Teucrium*. The main pollinators of *T. chamaedrys*, *T. divaricatum* and *T. flavum* subsp. *hellenicum* are little honeybees and may be some flies. *T. polium* and *T. montanum* have the smallest corollas among the examined species. *T. montanum* has shorter hairs in its corolla. The main pollinators of these species could be small bees, small beetles, wasps, and flies.

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PP-15. Nutlet pericarp anatomy of some Turkish *Teucrium* L. (Lamiaceae) members

Taner Özcan[1], Mehmet Cengiz Karaismailoğlu[2], Tuncay Dirmenci[1], Osman Erol[2]*

[1] Biology Education, Necatibey Education Faculty, Balıkesir University, Balıkesir-Turkey

[2] Biology Department, Faculty of Science, Istanbul University, İstanbul-Turkey

ozcant@balikesir.edu.tr

Introduction

Teucrium L. genus has been divided into ten sections all over the world. These sections can be separated taking into account their calyx shapes and inflorescence structures (McClintock & Epling 1946, Tutin & Wood 1972). Eight sections' members grow in Turkey and these sections consist of 49 taxa (36 species) with the recently addition (records and reinstatement) (Dinç & Doğu 2016). Pericarp is a distinctive character in the Lamiaceae family (Ryding, 2009). 30 members from seven section members of *Teucrium* were examined in this study.

Materials and Methods

The dry nutlets of 30 taxa of *Teucrium* were used for the anatomical studies. The samples were collected from natural populations and herbarium specimens, the ripe nutlets of each taxon were taken from the 10-15 plants. The cross sections from the middle of the nutlets were done with a full automatic microtome (Thermo Shonda Met Finesse). The materials were placed in FAA for a minimum of 24 h, dehydrated through an ethanol and xylene series, and dyed with hematoxylin (harris-RRSP67-E) in a dyeing apparatus (ASC 720 Medite), and were coated by Entellan to observe anatomical structures (Karaismailoglu, 2015). The anatomical characters (including exocarp, mesocarp, endocarp and endosperm structures) were observed and photographed using Olympus CX21FS1 microscope and Kameram Imaging Software. Data analysis was carried out with SPSS computer program, and Duncan's multiple-range test was used to identify the statistical importance of distinctions among the data. Dendograms were obtained using PAUP*. Relationships of the members were interpreted on the dendogram.

Results and Discussion

Accordingly, pericarp thickness in all the studied taxa varies even in intraspecific level. It has ranged from 81.84 to 168.65 µm. The exocarp layer of the pericarp has one or two layers of thin or thick cell wall. Also, endocarp has one layer, and it is usually collapsed in examined taxa. Furthermore, they contain more thrived palisade sclerenchyma. These results are useful to examine infrageneric or intergeneric correlations and compatible with previous studies, including nutlet anatomy, in the Lamiaceae (Ryding, 2009). According to the results obtained from this investigation, pericarp features such as structure and thickness can be utilized as additional characters to support the current identification. Especially, results are very helpful for the sectional classification of *Teucrium* genus and also can be used to separation of some close species.

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PP-16. Volatile compounds in aerial parts of Iranian shade-dried Pennyroyal (*Mentha pulegium* L.) using purge and trap extraction system

Asghar Amanpour[1]*, Gamze Guclu[2], Hasim Kelebek[3], Serkan Selli[1,2]

[1] Department of Biotechnology, Institute of Natural and Applied Sciences, Cukurova University, 01330 Adana, Turkey

[2] Department of Food Engineering, Faculty of Agriculture, Cukurova University, 01330 Adana, Turkey

[3] Department of Food Engineering, Faculty of Engineering and Natural Sciences, Adana Science and Technology University, Adana, Turkey

Introduction

Mentha pulegium L., generally known as pennyroyal, is a perennial aromatic herbaceous plant depending on the Lamiaceae family (mint). Pennyroyal grows extensively in humid and moist regions and water banks and distributes across central, southern, and western Europe, north Africa, western Asia, and the Mediterranean countries. Aerial sections of this plant entail an extensive variety of secondary metabolites including tannins, resins, pectins, bitter principles and essential oil. The whole plant and its essential oil keep a distinctive and deep minty aroma. It has been used in folk medicine, culinary preparations, perfumery or cosmetics, pharmaceutical products and as an insect repellent (Mounira et al. 2011).

Materials and Methods

The aerial part of pennyroyal were collected in June 2016 from northwest region of Iran, Tabriz district. The collected specimens were air-dried in the shade at room temperature (25 °C) for two weeks and protected from light for later analysis. A purge and trap extraction system was applied to isolate the aromatic extracts. Afterwards, the extracts of powdered pennyroyal samples to characterize aroma profiles were analyzed by gas chromatography (GC) coupled with a flame ionization detector (FID) and mass spectrometry (MS). The detail of the above-mentioned extraction technique and GC-MS conditions were explained in our previous research (Amanpour et al., 2016).

Results and Discussion

A total of 29 volatile compounds were detected. Between these compounds, terpenes (21) were the overwhelmingly biggest volatile compounds, followed by alcohols (4), volatile acids (3) and ketone (1). And, pulegone (210.6 µg/g) with 30.3 percent, followed by menthone (178.5 µg/g), 1,8-cineole (74.4 µg/g), isomenthone (44.8 µg/g), *(Z)*-piperitone oxide (36.6 µg/g) and piperitenone oxide (30.9 µg/g) were demonstrated as the most prevailing volatiles. Majority of these compounds were reported by previous investigations. Furthermore, healing features of these aromatic compounds have been attributed to the presence of several oxygenated monoterpenes, involving menthone, menthol, pulegone, piperitone oxide, piperitenone, and carvone. Previous investigations have indicated that volatile oil of *M. pulegium* alters within and among geographic-climatic zones. Pulegone (17.5–70.2%) forms the main volatile compound of this oil (Mounira et al. 2011).

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PP-17. Chemical profiling of Algerian *Ballota nigra* L. (Lamiaceae) extract and its antioxidant and antibacterial activities

*Ahmed Boukeloua**
Department of Biology, University of Oum El Bouaghi, Oum Bouaghi 04000, Algeria
ahmedcte@yahoo.fr

Introduction

Ballota nigra L. is a plant belonging to the family Lamiaceae, generally used in North Algeria. It contains tannins, essential oils, organic acids, alkaloids, pectins, minerals and vitamins, and it is used as a calming agent against nervous disorders, hysterical conditions and related disorders, as a sedative, antispasmodic and repair medication.

Materials and Methods

In the current research, the chemical composition and biological activities of different extracts (hexane, methanol, and water) obtained from aerial parts of *B. nigra* were compared. They were characterized by their total phenolics and flavonoids. LC-MS/MS was used to determine the chemical profile of methanol extract, while GC-MS was used to determine the fatty acids of the hexane extract. Antimicrobial and antioxidant activities were studied for all of the extracts.

Results and Discussion

The methanol extract was the richest in terms of total phenolic and flavonoid contents but not more than standard controls results. The LC-MS/MS results showed that the four most prevalent components were tannic acid, gallic acid, aconitic acid and chlorogenic acid. Some minor acids were also detected. The content of kaempherol and hesperidin were the major flavonoids identified. The two main fatty acids were found as oleic acid (31.4%) and palmitic acid (18.5%). All of the extracts showed potential antioxidant activity in four tested methods. Furthermore, the methanol extract of *B. nigra* showed moderate antimicrobial activity against *Candida albicans*. Results of the current study showed that *B. nigra* may be used as a food supplement.

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PP-18. Chemical composition of essential oil from *Thymbra spicata* subsp*. spicata*

Züleyha Özer[1], Turgut Kılıç[2], Sema Çarıkçı[3]*

[1] Medicinal and Aromatical Plants Programme, Altinoluk Vocational School, Balikesir University, Altinoluk, Edremit-Balikesir, Turkey

[2] Department of Science Educations, Necatibey Education Faculty, Balikesir University, Altieylül-Balikesir, Turkey

[3] Department of Chemistry, Faculty of Sciences and Arts, Balikesir University, Balikesir, Turkey

zuleyhaozer@balikesir.edu.tr

Introduction

The genus *Thymbra*, which belongs to the family Lamiaceae (Labiatae), is represented by 4 species in the flora of Turkey. *Thymbra spicata* L. is a perennial plant known as "Kekik, Zahter or Sater" in Turkey. Dried herbs of *Thymbra* are used as herbal tea, condiment and folk medicine for treating asthma, colic, bronchitis, coughs in addition to uses in food industry for flavoring, aroma and preservation agents in Turkey (Akın et al., 2010; İnan et al., 2011).

Materials and Methods

The aerial parts of *Thymbra spicata* were collected from Balikesir, Edremit, in June 2014. The species were identified by Assoc. Prof. Dr. Selami Selvi of Balikesir University (SS 1302). The aerial parts of *Thymbra spicata*, which were air-dried in shade were chopped into small pieces and subjected to hydro distillation with water for 4 h, using a Clevenger-type apparatus to produce the essential oil (0.5 g from 25 g of the dried aerial parts, yield 2 % w/w). GC-MS was conducted on Thermo Electron Trace 2000 GC model gas chromatography and Thermo Scientific TSQ GC-MS/MS. A Phenomenex DB5 fused silica column (30 m x 0.32 mm, with 0.25 µm film thickness) was used with helium as a carrier gas at 1mL/min flow rate (20 psi). The GC oven temperature was kept at 60 ^{0}C for 10 min and programmed to 220 ^{0}C at a rate of 4 ^{0}C/min increment and then kept constant at 220 ^{0}C for 15 min (Gören et al., 2011).

Results and Discussion

GC/GC-MS analyses of the oil, representing 99 of the components, resulted in 32 compounds. Content of the essential oil was found to be rich in oxygenated monoterpene. Carvacrol (86.1%) was determined as the main component, and this study demonstrated the presence of *Thymbra spicata* in carvacrol chemotype. Carvacrol has been shown to have prostaglandin inhibitory effects, analgesic activities, and prostaglandin inhibition is known to exert analgesia (Aydın et al., 1996).

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PP-19. Karyological studies of genus *Origanum* (Lamiaceae) section *Amaracus* from Turkey

Esra Martin[1], Tuncay Dirmenci[2], Türker Yazıcı[2]*

[1] Biotechnology Department, Faculty of Science, Necmettin Erbakan University, Turkey

[2] Biology Education Department, Necatibey Education Faculty, Balıkesir University, Balıkesir, Turkey

esramartin@gmail.com

Introduction

Origanum L. sect. *Amaracus* (Gled.) Benth. is comprises seven species worldwide. The species concentrated in Mediteranean area of Turkey, Greece and Cyprus. Four species were record from Turkey and all of them are endemic. The main characteristic of Sect. *Amaracus* is clearly saccate corolla.

Materials and Methods

Root-tip meristems were provided from seed by germinating them on wet filter paper in Petri dishes at room temperature. Firstly root tips pretreated for 16 h in α-monobromonaphthalene at 4°C, fixed in 3:1 absolute alcohol/glacial acetic acid, then the root tips were hydrolyzed with 1 N HCl for 12 min at room temperature and stained with 2% aceto-orcein for 3 h at room temperature. Stained root tips were squashed in a drop of 45% acetic acid and permanent slides were made by mounting in Depex. The karyotypes were measured by Software Image Analyses (Bs200ProP) loaded on a personal computer. Ideograms of these taxa were arranged in decreasing length.

Results and Discussion

Origanum boissieri consists of *Origanum ayliniae*, *Origanum saccatum* and *Origanum solymicum* taxa in the *Amaracus* section. *Origanum boissieri* were studied from samples 4319 and 4501. The diploid chromosome number of both plant samples was determined as 2n = 30. These two plants also grow naturally in the province of Mersin. Karyotype analyzes of both plant samples were made via the Image Analysis System. If it is to be compared; the mean chromosome length of sample 4319 was 0.65 µm while the mean chromosome length of sample 4501 was 0.48 µm. The length of the haploid chromosome is, for example, 19.44 µm for sample 4319 while 14.48 µm for sample 4501. The relative length was also different for both plant samples. Accordingly, the relative length of the sample 4319 ranges from 3.97 to 9.82. The relative length of the sample 4501 ranges from 3.24 to 11.11. *Origanum ayliniae* taxon was collected from the Dilek peninsula of Aydın province and studied from single location and the number of somatic chromosomes was 2n = 30. *Origanum saccatum* taxon were studied from samples 4342 and 4522. The diploid chromosome number of both plant samples was determined as 2n = 30. These two plant examples naturally grow in the province of Antalya. Karyotype analyzes of both plant samples were made via the Image Analysis System. If it is to be compared; the mean chromosome length of sample 4342 was 0.55 µm while the mean chromosome length of sample 4522 was 0.33 µm. In terms of haploid chromosome length, the 4342 sample is 17.17 µm, whereas the 4522 sample is 10.13 µm. The relative length was also different for both plant samples. Accordingly, the relative length of the sample 4342 ranges from 3.08 to 10.19. The relative length of the sample 4522 ranges from 3.85 to 11.05. *Origanum solymicum* taxon were studiedfrom samples 4347 and 4520. The diploid chromosome number of both plant samples was determined as 2n = 30. These two plant examples naturally grow in the province of Antalya. Karyotype analysis of the plant sample 4347 was made via the Image Analysis System. The number of diploid chromosomes was determined for plant number 4520. The average chromosome length of 4347 was 0.54 µm, the length of the haploid chromosome was 16.22 µm, and the relative length ranged from 2.77 to 9.83.

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PP-20. Karyological studies of genus *Origanum* (Lamiaceae) section *Longitubus* from Turkey

Esra Martin[1], Tuncay Dirmenci[2], Turan Arabaci[3]*

[1] Biotechnology Department, Faculty of Science, Necmettin Erbakan University, Konya, Turkey

[2] Biology Education Department, Necatibey Education Faculty, Balıkesir University, Balıkesir, Turkey

[3] Pharmaceutical Botany Department, Pharmacy Faculty, İnönü University, Malatya, Turkey

esramartin@gmail.com

Introduction

Origanum L. sect. *Longitubus* Ietsw. is monotypic section with *Origanum amanum* Post. It is characterized by long corollas (to 40 mm), 2-lipped calyx and very short stamina filaments (c. 1/50 × corolla). *O. amanum* endemic to Amanos mountains, Turkey.

Materials and Methods

All samples were collected from wild populations from Turkey. Collected specimens were deposited in Balıkesir University. All karyological observations were carried out on root tips. Root-tip meristems were provided from seed by germinating them on wet filter paper in Petri dishes at room temperature. Firstly root tips pretreated for 16 h in α-monobromonaphthalene at 4°C, fixed in 3 : 1 absolute alcohol/glacial acetic acid, then the root tips were hydrolyzed with 1 N HCl for 12 min at room temperature and stained with 2% aceto-orcein for 3 h at room temperature. Stained root tips were squashed in a drop of 45% acetic acid and permanent slides were made by mounting in Depex. For karyotype analysis the photographs enlarged 10 ×100 were taken using a microscope with a camera attachment. The karyotypes were measured by Software Image Analyses (Bs200ProP) loaded on a personal computer. Ideograms of these taxa were arranged in decreasing length.

Results and Discussion

The number and size of the chromosomes in the *Origanum* genus which belongs to *Longitubus* section were studied using the Image Analysis System. The *Longitubus* section consists of *Origanum* amanum taxon. *Origanum amanum* was studied from sample of 4514-a. The number of diploid chromosomes of the taxon was 2n=30. This plant is an endemic taxon that naturally grows in the Amanos Mountains within the boundaries of Osmaniye province. The karyotype analysis of the taxa was done via the Image Analysis System. The mean chromosome length of sample 4514-a was 0.56 µm and the length of the haploid chromosome was 16.92 µm. The relative size varies between 4.31 and 11.28. *Origanum amanum* taxon was first reported by Lepper in 1970 as chromosome number 2n=30 (Lepper, 1970; Ietswaart, 1980). The number of chromosomes we have obtained as a result of the chromosome preparations made in the project is consistent with the literature. But only the number of chromosomes in this taxonomy is expressed in the literature, and with this project the karyotype analysis of this taxon was introduced for the first time.

Acknowledgements

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PP-21. Taxonomical characteristics of *Dracocephalum moldavica* L., *Ocimum basilicum* L. and *Agastache rugosa* (Fisch.&C.A.Mey) Kuntze (Lamiaceae) used for cardiovascular diseases in Uygur Medicine

Nuerbiye Aobuliaikemu[*1], *Mine Koçyiğit*[1]
Istanbul University, Faculty of Pharmacy, Department of Pharmaceutical Botany, Istanbul, Turkey.
nuerbiye@gmail.com

Introduction

The origin of the Uighur medicine can be traced back to Saka (Scythians) medicine which is at the same period of Hippocrates. Traditional Uygur Medicine (TUM) has about 2500 year history started from Doctor Hazibay (BC450- 330). Nowadays it has formed a complete system of medical and research institutions, and become one of the 30 other ethnic groups traditional medicine at northwest of China in Xinjiang Uyghur Autonomous Region.(Upur et. al. 2016).

TUM divided cardiovascular diseases according to the disease causes and symptoms into different several types, principle of treatment and medication will be so different from each other, and it has achieved effective results (Miernisha et al. 2016; Maiwulanjiang et al. 2013).

The genus of *Dracocephalum* includes 4 species in Turkey and they are perennial often suffrutescent herbs. *D. moldavica* doesn't present in Turkey. *Ocimum basilicum* is cultivated in Turkey and it is annual herb. The genus of *Agastache* doesn't consist any species in Turkey (Davis et al. 1982).

Materials and Methods

In this study, active ingredients, morphological and anatomical characteristics of three used frequently plants in cardiovascular diseases *Dracocephalum moldavica, Ocimum basilicum* and *Agastache rugosa* which are selected. The investigated 3 species were collected from from Karakash, Hotan, Xinjiang. The species kept in Faculty of Pharmacy Istanbul University (ISTE).

Results and Discussion

Ocimum basilicum has 2-3 collenchyma layers at the corner s of stem, epidermis is smooth and the species has uniform glandular trichome. Epidermis is papillose in *Dracocephalum moldavica* and *Agastache rugosa*. *D. moldavica* has 3-4 collenchyma layers and two types glandular trichome while *A. rugosa* has 5-8 collenchyma layers and . uniform glandular trichome.

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PP-22. A palynological study of the Genus *Prunella* L. (Lamiaceae)

Sevcan Çelenk[1], Tuncay Dirmenci[2], Taner Özcan[2], Fatih Satıl[2], Hulusi Malyer[1]*

[1] Department of Biology, Faculty of Arts and Sciences, Uludag University, Bursa, Turkey

[2]Department of Biology Education, Necatibey Education Faculty, Balıkesir University, Balıkesir, Turkey

sevcancelenk@uludag.edu.tr

Introduction

Prunella L. (Lamiaceae) comprises 8 species (12 taxa) and 5 hybrids worldwide (http://apps.kew.org). Four species was recorded in Turkey (Dirmenci 2012). Investigations of pollen morphology have been essential as an aid to classification within Lamiaceae. Pollen morphology of Lamiaceae has been studied since Erdtman (1945) suggested a division of the family into two subfamilies based on number of nuclei and aperture number in the pollen grains (Erdtman 1945; Harley et al. 1992; Harley 1992; Abu-Asab and Cantino 1994).

Materials and Methods

The pollen morphology of eight taxa of the genus *Prunella* L. was studied and documented in detail using light microscopy (LM) and scanning electron microscopy (SEM) in this study. Pollen grains for examination by LM were prepared according to the Erdtman (E) method (Erdtman 1960). Polar axis (*P*), equatorial axis (*E*), Colpus length (Clg) and width (Clt), apocolpium diameter, exine thickness and mesocolpium were measured on the non-acetolyzed pollen grains. Results are expressed as mean ± standard deviations. The measured polar axis and equatorial diameter were based on at least 30 samples and other characters on approximately 20 under the LM. All of the measurements were done using CARNOY 2.0 (Schols et al. 2002). For SEM, pollen grains were transferred directly to a stub with double-sided tape and images were obtained using an XL–30 ESEM-FEG/PHILIPS microscope. The pollen terminology, in general, follows Faegri and Iversen (1975), Harley et al. (1992) and Punt et al. (2007). Pollen grains of the 8 recognized taxa of the genus *Prunella* were mostly taken from herbarium material.

Results and Discussion

Prunella L. pollen grains are small to large in shape and hexacolpate with granular colpi membranes. In examinations of exine ornamentation with SEM, the bireticulate sculpture was identified. The bireticulate exine ornamentation is characterized by different characteristics of the primary muri shape (elongate, irregular or circular), the thickness of muri wall and secondary reticulum. Pollen morphology within the genus is compared with infrageneric relationships.

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NVEO
Natural Volatiles & Essential Oils

PP-23. The Effects of *in vitro* simulated digestion on the antioxidant activity of *Lavandula stoechas* ssp. *stoechas*

Selin Akyüz[1], Engin Celep[1], Erdem Yeşilada[1]*

[1]Faculty of Pharmacy, Department of Pharmacognosy, Yeditepe University

selin.akyuz@yeditepe.edu.tr

Introduction

Lavandula genus is an important member of the family *Lamiaceae*. In Turkey, mainly two species, *Lavandula stoechas* and *Lavandula angustifolia*, are found wild or cultivated (Gören et al., 2002). L. stoechas is an evergreen shrub, it usually grows up to one meter high with spike, violet flowers. The consumption of oxygen by cells leads to the formation of a series of reactive oxygen species (ROS). Excessive production of ROS leads to oxidative stress, which is a result of imbalance between the antioxidant system (Celep et al., 2012)." An antioxidant is a substance that, when present at low concentrations compared to those of an oxidizable substrate, significantly delays or prevents oxidation of that substrate (Halliwell, 1990)". In addition, *in vitro* digestion procedures mimic the biochemical and physicochemical conditions encountered in the upper GI tract (McDougal et al., 2005). There are many studies on biological effect of essential oil of *L. stoechas*, but the scientific data about aerial part of *L.stoechas* is limited. For this reason, this study was designed to investigate the antioxidant activity of aerial part of *L. stoechas*. An *in vitro* digestion method was also applied to simulate the possible changes in the activity following the oral intake.

Materials and Methods

The aerial part of *L. stoechas* L. subs. *stoechas* was collected from Kayışdağı, western Turkey in June 2016. A voucher specimen was deposited in the Herbarium of Faculty of Pharmacy, Yeditepe University. The aerial parts were dried under shade at room temperature. *In vitro* digestion simulation method was performed according to the methodology, previously described with some slight modifications (McDougal et al., 2005). Phenolic Profile; the total phenolic and flavonoid contents of samples were measured using previously published methods. Antioxidant Activity; The antioxidant capacities (TOAC) were evaluated by using the following methods: DPPH radical scavenging activity, CUPRAC (metal reducing activity) and total antioxidant capacity (Celep et al., 2012).

Results and Discussion

According to *in vitro* digestion method, the digestion process directly affects the antioxidant activities of the samples. According to CUPRAC and DPPH tests, the highest activity was shown by IN fraction and for TOAC, non-digested fraction was higher than others. In addition, the results of the total phenolic and flavonoid content tests are different as well. In our study, IN fraction had the highest total phenolic content while post-gastric fraction had the highest total flavonoid content.

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PP-24. The effects of in vitro simulated digestion on the bioaccessibility of Rosmarinic acid from *Lavandula stoechas* ssp. *stoechas by using HPTLC*

Yiğit İnan[1], Engin Celep[1], Erdem Yeşilada[1]*

[1] Faculty of Pharmacy, Department of Pharmacognosy, Yeditepe University, Atasehir, Istanbul, Turkey

yigit.inan@yeditepe.edu.tr

Introduction

Rosmarinic acid (RA), an ester of caffeic acid and 3,4-dihydroxyphenyllactic acid, is a natural phenolic compound commonly found in many Lamiaceae herbs such as *Rosmarinus officinalis*,*Lavandula stoechas,*etc. which has been known for its multiple biological activities such as antioxidant, antiinflammatory ,antiviral and antibacterial. (Peterson et al., 2003)

In vitro digestion models are widely used for predicting compound bioaccessibility due to a lot of advances in respect to the in vivo models, since they are relatively cheap and simple, more rapid, are not subject to ethical restrictions, conditions can be controlled, and results are reproducible (L.Gayoso et al., 2016).Although, the essential oil of *L. stoechas* has been studied numerously, the aerial parts of the *L. stoechas* has limited scientific data.For this reason, this study was performed to investigate how *in vitro* gastrointestinal digestion method effects RA's bioaccessibility by using HPTLC following the oral intake.

Materials and Methods

Aerial parts of *Lavandula stoechas* L. subs.s*toechas* were collected from Kayışdağı, western Turkey in June 2016. A voucher specimen was deposited at the Herbarium of Faculty of Pharmacy, Yeditepe University. The aerial parts were dried in the shade at room temperature. *In vitro* digestion simulation method was performed according to the method described by Celep E. with some slight modifications (Celep E.et al., 2015). *In vitro* digestion method consists of two steps including both gastric and intestinal phases. All HPTLC instruments and chambers were from CAMAG (Muttenz, Switzerland) and instruments were controlled by winCATS Software 1.4.7 (CAMAG, Muttenz, Switzerland).

Results and Discussion

The digestion process directly effects the bioaccessibility of RA, considering *in vitro* digestion method. Altough, the non-digestive and post gastric fractions have high amount of RA , IN fraction has lower amount RA which results in low bioaccesibility after absorbtion from the large intestine. Despite the fact that, RA decreased in the bioaccessible fractions of *L.stoechas*, it still has remarkable quantity of RA and may show good activity further studies.

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PP-25. Floral traits select for pollinators in Andean *Salvia s.l.*

Lianka Cairampoma[1], Juan A. Tello[2], Regine Claßen-Bockhoff[1]*

[1] Institut für Organismische und Molekulare Evolutionsbiologe, Johannes Gutenberg-Universität Mainz

[2] Museo de Historia Natural, Universidad Nacional Mayor de San Marcos, Lima-Peru

*lcairamp@uni-mainz.de, classenb@uni-mainz.de

Introduction

Floral diversity has often been attributed to specialization to pollinators. Correspondingly, changes in floral traits (e.g. nectar, color, smell, morphology) might indicate a change of pollinators. The Andes is one of the diversity centers of *Salvia*. At many places, bee and bird pollinated species co-occur and overlap in their flowering season, creating the potential for interspecific pollen flow. The aim of this study was to identify specific floral traits that allow sympatric species to coexist and specialize on pollinators.

Materials and Methods

Field work was conducted on three sympatric *Salvia* species in the Central Andean Mountains of Peru (~3000 masl) during dry and wet seasons. We combined morphometric analyses, nectar and sugar concentration, color and scent analyses to characterize the floral syndromes of each species. Data on pollinators (frequency of visits, behavior and morphometry) were analyzed statistically and compared with floral traits in order to find some correlations between them.

Results and Discussion

Salvia cruikshanksii Benth. and *S. tafallae* Benth. exhibit small blue melittophilous flowers (< 1.5cm), while *S. tubiflora* Sm. has large red ornithophilous flowers (≤ 4.3cm). Floral color perception, nectar volume, sugar concentration and visitation patterns agree with the bee and bird pollination syndromes. While *S. tubiflora* is exclusively pollinated by hummingbirds, *S. cruikshanksii* and *S. tafallae* are pollinated by bees, but, interestingly, they do not share a single bee. Although the floral morphometric data in the melittophilous species only vary less than 1mm, they are statistically significantly different. The same was found with scent emission and color perception. Finally, morphometric analyses on pollinators and flowers showed a correlation between their proportions underlining their close mechanical fitting. The results clearly show that the three *Salvia* species are closely adapted to their pollinator guilds, and, even more, that the two bee pollinated species are specialized to different bee species. Minute differences in floral traits allow the species to co-exist without pollen mixture.

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PP-26. Pollination and hybridization in co-existing *Satureja* species from Croatia

Joshua Wachlin[1], Boštjan Surina[2,3], Regine Claßen-Bockhoff[1]*

[1] Institut für Organismische und Molekulare Evolutionsbiologie, Johannes Gutenberg-Universität Mainz, Germany

[2] Faculty of Mathematics, Natural Sciences and Information Technologies, University of Primorska (Koper, Slovenia)

[3] Natural History Museum Rijeka, Rijeka, Croatia

jwachlin@students.uni-mainz.de, classenb@uni-mainz.de

Introduction

The two *Satureja* taxa *S. montana* ssp. *variegata* Host P.W. Ball and *S. subspicata* ssp. *liburnica* Šilić share distribution areas in NW-Adriatic. A putative hybrid between the two taxa was first mentioned by Justin (1904) and later named *Satureja* x *karstiana* Justin ex Teyber. The diagnosis by Teyber (1910) listed intermediate corolla colour and stem morphology as well as low pollen viability. In the present study, a mixed population assemblage has been investigated in NW-Croatia. The aims were (i) to characterize the reproductive ecology of the *Satureja* taxa, (ii) to reconstruct the hybridization process and (iii) to confirm the hybrid origin of *S.* x *karstiana*.

Materials and Methods

The study comprises floral biology, flower morphometry, pollination ecology and reproductive biology of the three taxa and bidirectional crossing experiments.

Results and Discussion

All three taxa showed a mixed mating system with auto-, geitono-, and xenogamous seed set to varying extents. Xenogamy was favoured. The flowers of *S.* x *karstiana* were morphologically intermediate to the parental taxa in the majority of traits, being closer to *S. m.* ssp. *variegata* than to *S. s.* ssp. *liburnica*. *S.* x *karstiana* yielded very low seed set across all treatments. This can be explained by its extremely low pollen viability (20.5%) significantly differing from that in the parental taxa. The predominant pollinator, *Apis mellifera,* visited all three *Satureja* taxa indistinctively (Constancy Index = 0.501), thus facilitating hybridization. Sites of pollen deposition and stigma contact were similar among the two parental *Satureja* taxa. Interspecific bidirectional crossing of *S. m.* ssp. *variegata* and *S. s* ssp. *liburnica* resulted in viable seeds in both taxa. The offspring mostly showed the known hybrid phenotype. However, seed set was considerably higher, when *S. m.* ssp. *variegata* received pollen from *S. s.* ssp. *liburnica* (26.69%) than vice versa (6.15%), suggesting *S. m.* ssp. *variegata* might be favoured as the pollen receptor. Altogether, *Satureja* x *karstiana* could be confirmed as the hybrid of *S. m.* ssp. *variegata and S. s.* ssp. *liburnica*. Low pollen viability, intermediate flower morphology and very low seed set corroborate its hybrid nature.

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PP-27. How blue *Salvia s.l.* flowers exclude bees

Lianka Cairampoma[1], Sandra Haag[1], Petra Wester[2], Jürgen Schramme[3], Christa Neumeyer[3], Regine Claßen-Bockhoff[1]**

[1] Institut für Organismische und Molekulare Evolutionsbiologie, Johannes Gutenberg-Universität Mainz

[2] Institut für Sinnesökologie, Heinrich Heine-Universität Düsseldorf

[3] Institut für Entwicklungbiologie und Neurobiologie, Johannes Gutenberg-Universität Mainz

*lcairamp@uni-mainz.de, classenb@uni-mainz.de

Introduction

According to the concept of floral syndromes, flower colours evolved in adaptation to the visual systems of the pollinators. In *Salvia* sensu latu, bird pollination (with predominantly red flowers) evolved several times in parallel from (mainly blue) bee-pollinated species (Wester and Claßen-Bockhoff 2011). The finding that many plant taxa shifted from bee to bird pollination in the course of evolution raises the question how easily colours can be changed and how far the pollinators depend on colours.

Materials and Methods

We analysed the spectral reflectance in 59 *Salvia* species, among them 26 bee flowers and 33 bird flowers including representatives of each clade with bee and bird flowers (i.e. *Salvia* sensu strictu, *Salvia* subgen. *Audibertia*, *Salvia* subgen. *Calosphace*). We characterized the flower perception by bees using a chromaticity map, based on sensitivity functions of *Apis mellifera*. We used principal component analysis (PCA) and UPGMA euclidean distance to identify character combinations among the species.

Results and Discussion

All bee flowers were placed in the blue sector of the hexagon model. The bluish, violet and purple bird flowers were arranged close to the blue bee flowers. In contrast, the bright red bird flowers (12 species) appeared in the centre of the hexagon. They are achromatic to bees, being more difficult to detect against the background. Interestingly, the PCA clearly showed that the blue bee and blue bird flowers group differently when morphological data are added. We conclude that bees are attracted by colour, but excluded by flower construction. The change from blue to red flowers is interpreted as an adaptation to reduce nectar and pollen theft by bees and increase the signal function of the flowers directed to birds.

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PP-28. Effects of *Salvia* species on the central nervous system: Possible therapeutic implications

Nagehan Saltan[,1], Nazlı Turan[2], Özgür Devrim Can[2]*

[1] Anadolu University, Faculty of Pharmacy, Department of Pharmaceutical Botany, Eskişehir, Turkey
[2] Anadolu University, Faculty of Pharmacy, Department of Pharmacology, Eskişehir, Turkey
ndagdeviren@anadolu.edu.tr

Introduction

Salvia L. is a genus consisting of over 900 species in the Lamiaceae family. Many of the *Salvia* species have traditional use against pain, infections, throat inflammation, bronchitis, coughs, asthma, dementia, mood disorders, gastrointestinal ailments, vascular complaints and angina. Ethnopharmacological studies have confirmed the potential of some *Salvia* plants. Nowadays, some of the *Salvia* species draw attention due to their remarkable effects on the central nervous system (CNS). In this study, we reviewed the preclinical and clinical studies reporting the effects of *Salvia* species on emotion and cognition, as well as in vitro studies examining the molecular mechanisms underlying these central effects. We aimed to evaluate therapeutic potentials of *Salvia* species on CNS related disorders.

Materials and Methods

We searched for the electronic databases to collect data. Used keywords were as follows: "*Salvia* AND cognition", "*Salvia* AND nootroptic", "*Salvia* AND convulsion", "*Salvia* AND emotion", "*Salvia* AND anxiety", "*Salvia* AND depression", "*Salvia* AND psychosis" and "*Salvia* AND addiction". By using these key words, we reached 109 papers published between 1970 and 2017. We only focused on in vitro studies, case reports, pre-clinical and clinical papers related to the effect of *Salvia* species on the CNS. Papers which do not justify these criterion eliminated.

Results and Discussion

Reviewed reports provide preliminary evidence for confirming that extracts or essential oils prepared from *Salvia* species such as *S. officinalis* L., *S. lavandulifolia* Vahl., *S. miltiorrhiza* Bunge, *S. sahendica* Boiss. et Buhse, have nootropic potential against cognitive impairments including Alzheimer's disease. Antioxidant, anti-inflammatory and neuroprotective capacities of these species, as well as AChE inhibitory abilities, seem to be underlying mechanisms of this activity (Miroddi et al., 2014). *S. elegans* Vahl, *S. sclarea* L., and *S. verticillata* L. have been reported for their antidepressant-like effects whereas *S. elegans*, *S. sclarea*, *S. miltiorrhiza*, and *S. cinnabarina* M. Martens et. Galeotti reported for their anxiolytic-like activities. Among the *Salvia* species, *S. divinorum* Epling et. Jativa (Salvinorin A) has recently become a focus of attention due to its hallucinogenic activity (Butelman and Kreek, 2015). *S. verticillata* and *S. miltiorrhiza* (tanshinone IIA) are two *Salvia* species reported for their anticonvulsant activities. In conclusion, results of the scientific reports seem to confirm that some *Salvia* species and their specific bioactive components have notable activity potential on affective, cognitive, and neurological disorders. However, further detailed clinical studies focusing on efficacy and toxicity of these plants, are needed to accept them as therapeutic options for CNS disorders.

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PP-29. *Lavandula angustifolia* Miller (Lamiaceae): Its therapeutic potential on affective disorders

Özgür Devrim Can[1], Nafiz Öncü Can[2], Nagehan Saltan[,3], Yusuf Öztürk[1]*

[1] Anadolu University, Faculty of Pharmacy, Department of Pharmacology

[2] Anadolu University, Faculty of Pharmacy, Department of Analytical Chemistry

[3] Anadolu University, Faculty of Pharmacy, Department of Pharmaceutical Botany

ndagdeviren@anadolu.edu.tr

Introduction

Lavandula L. is a genus of 45 identified species in the Lamiaceae family. *Lavandula angustifolia* Mill. (Lavender or "English Lavender") is found natively in South Europe, Mediterranean countries of Northern Africa, France, Bulgaria, England, America and Austria. This plant has been traditionally used for the management of gastrointestinal and nervous system disorders, as well as some inflammatory diseases. Lavender preparations have been reported to possess antioxidant, antibacterial, anti-allergic, spasmolytic, anticonvulsant, local anesthetic, sedative effects, so far (Hajhashemi et al., 2003). Today, Lavender attract great deal of attention due to its therapeutic potential on emotional disorders. Therefore, we reviewed previous literature reporting the effect of Lavender on depression, anxiety, and bipolar disorders, with the aim of evaluating therapeutic potential of Lavender on affective disorders. Possible mode of actions were also investigated.

Materials and Methods

We searched the electronic databases to collect the data. Used keywords were as follows: "*Lavandula* AND mood", "*Lavandula* AND emotion", "*Lavandula* AND depression", "Lavender AND depression", "*Lavandula* AND anxiety", "Lavender AND anxiety", "*Lavandula* AND bipolar disorder". By using these key words, we reached and reviewed more than 90 papers published between 1989 and 2017. We only focused on *in vivo* pre-clinical studies, case reports, and clinical papers related to the effect of Lavender on affective disorders. Papers which do not justify these criteria are eliminated.

Results and Discussion

An important part of the papers suggested the efficacy of Lavender preparations (oil, tea, tincture) and aromatherapy (inhalation, massage) against anxiety, agitation, aggression, and depressive behaviors. Silexan, orally administered *Lavandula* oil preparation, is used for the treatment of anxiety and related sleep disorders. Activation of serotonergic 5-HT_{1A} receptors, modulation of voltage dependent calcium channels and decrease in enhanced c-fos expression have been suggested as possible pharmacological mechanisms underlying the anxiolytic effect. Besides infusions, extracts, and essential oils prepared from Lavandula have been suggested to useful in the management of mild to moderate depression. Our search indicated that effect of *Lavandula* on bipolar disorder has not been investigated, yet. In summary, literatures provides some preliminary evidence supporting the beneficial effects of Lavender preparations. On the other hand, some other papers suggests bidirectional effect profile for the Lavender preparations. Some of them even suggested ineffectiveness of them. Therefore, further detailed clinical studies are needed to identify certain therapeutic efficacy of Lavender preparations.

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PP-30. Genetic diversity determination using DNA markers in some *Sideritis* L. species, distributed in natural flora of Antalya

Ahu Çınar, Safinaz Elmasulu[1], Ismail Gökhan Deniz[2], Kenan Turgut[3], Mehmet Karaca[3]*

[1] Association for the Conservation of Antalya Orchids and Biodiversity, Antalya, Turkey

[2] Akdeniz University, Faculty of Education, 07059 Antalya, Turkey

[3] Akdeniz University, Faculty of Agriculture, 07059 Antalya, Turkey

ahu.cinar@tarim.gov.tr

Introduction

Lamiaceae family is one of the largest flowering plant families in the world represented by 224 genera and 5.600 species. Turkey is an important gene center for the family with 45 genera, 565 species and 765 taxa. The genus *Sideritis* comprises more than 150 species in the family Lamiaceae, distributed in the world, especially in the Mediterranean basin. *Sideritis* is represented by 53 taxa of which 40 taxa are endemic to Turkey (Güner et al., 2012). The genus *Sideritis* has a high endemism ratio(%78). *Sideritis* species are traditionally used as herbal tea and medicinal purposes in Turkey.

Materials and Methods

Considering taxonomic difficulties to identify some species of the genus *Sideritis* using morphological keys, genetic relationships were tried to determine using DNA sequence analysis method. 17 *Sideritis* taxa, naturaly distributed in Antalya province were sampled from 34 locations and leaf samples from plant genotypes were taken for DNA analysis.

Forward and reverse primers belonging to chloroplast (*trn*T and *trn*L) and nuclear ribosomal gene (5.8 S) were used in DNA sequence analysis. The obtained sequence data were matched by using Sequencher 4.9 package. This sequenced gene regions were examined for interspecific releationships. Phylogenetic Analysis Using Parsimony (PAUP) package was used for generating phylogenetic clusters. Neighbor joining, UPGMA, maximum parsimony and maximum likelihood statistical analysis were realized.

Results and Discussion

According to the obtained results, a successful discrimination at the level of section was made with chloroplast primers however discrimination at the level of species was not accomplished. To obtain more precise results to overcoming taxonomical problems in *Sideritis* more number primers or new generation sequencing Technologies should be employed.

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PP-31. Total phenolics of *Origanum saccatum* L. and *Origanum solymicum* L. from natural flora of Antalya

Ahu Çınar, Safinaz Elmasulu[1], Ismail Gokhan Deniz[2], Arzu Bayır Yeğin[3]*

[1]Association for the Conservation of Antalya Orchids and Biodiversity, Antalya, Turkey

[2]Akdeniz University, Faculty of Education, 07059 Antalya, Turkey

[3]Bati Akdeniz AgriculturalResearchInstitute, Aksu, 07113,Antalya, Turkey

ahu.cinar@tarim.gov.tr

Introduction

The *Origanum* species have been used as spices and herbal remedies in traditional medicine. The genus is represented in Turkey by 27 species or 30 taxa, 15 being endemic toTurkey (Güner et al., 2012). *Origanum saccatum* and *Origanum solymicum* are endemic species distributed in Antalya region.

Materials and Methods

14 *Origanum saccatum* and 6 *Origanum solymicum* materials were sampled from different locations. In order to analyse total phenolic in *Origanum* (leaf and flowers), 0.25 g of powdered materials were processed. The ethanol extraction was performed with 25 mL of 70% ethanol at room temperature for 24 h with a shaker (Petreska et al. 2011). The total phenolic content was measured to the Folin–Ciocalteu method (Spanos et al. 1990). Ethanol extractions were Centrifuged and 100 µl extracts taken, nine hundred microlitres of water were added. 5 ml of 1:10 diluted Folin–Ciocalteu reagent and 4 ml of sodium carbonate (75 g/l) added to extracts. After 2 h of incubation in the dark at room temperature, the absorbance at 765 nm was measured.

Results and Discussion

The total amount of phenolic compounds varied in the range of 44.0-77.5mg GAE/g for *O. saccatum* and 45.2-61.2mg GAE/g for *O. solymicum*. Average value for *O. saccatum* species was 58.02mg GAE/g and 55.77mg GAE/g for *O. solymicum.* The highest value at the level of location was obtained from *O. saccatum* in Akseki-Center (370m) location. In *O. solymicum* samples, highest value at the level of location was obtained from Kemer-Çukuryayla (1160m). As a result of the Pearson correlation analysis, there was no statistically significant relationship between the altitude and the total amount of phenolic material.

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PP-32. Determination of aromatic compounds of *Origanum saccatum* L. distributed in natural flora of Antalya

Ahu Çınar, Safinaz Elmasulu[1], Ismail Gökhan Deniz[2]*

[1] Association for the Conservation of Antalya Orchids and Biodiversity, Antalya, Turkey

[2] Akdeniz University, Faculty of Education, 07059 Antalya, Turkey

ahu.cinar@tarim.gov.tr

Introduction

The genus *Origanum* L. is represented in Turkey by 27 species or 30 taxa, 15 being endemic toTurkey (Güner et al., 2012). *Origanum saccatum* L. is one of the endemic species which is distributed in the Mediterranean region, especially in the eastern part of Antalya. *Originum saccatum* L., which belongs to the section *Amaracus*, is generally poor in essential oil.

Materials and Methods

Plant material was collected from 14 different location of East Antalya, listed in Table 1 with their altitutes and locations. The volatile aroma composition of the samples was determined using the headspace method, attached to the GC-MS device, (Kafkas vd., 2006). Flavor analysis was carried out by placing 3 g of sample in GC-MS /Headspace vials. The obtained peaks were diagnosed using Wiley, Flavor library scanning software.

Sample No	Altitute	Location	Sample No	Altitute	Location
1	370 m	Akseki-Center	**8**	130 m	Gazipaşa
2	1220 m	Akseki-Cevizli	**9**	830 m	Gündoğmuş-Güzelbağ
3	880 m	Akseki-Gümüşdamla	**10**	660 m	Gündoğmuş-Güzelbağ
4	1340 m	Alanya	**11**	560 m	Gündoğmuş-Güzelbağ
5	1150 m	Alanya	**12**	860 m	Güdoğmuş-Güzelsu
6	1020 m	Alanya	**13**	950 m	Güdoğmuş-Köprülü
7	320 m	Gazipaşa	**14**	200 m	Köprülü Canyon

Table 1 Altitutes and locations of plant samples

Results and Discussion

When the results were evaluated, a total of 16 aroma components were determined in the samples. In all the samples, p-cymenewasdetected as the main component in the range of 67.51% - 92.58%. Following p-cymene, gamma-terpineneand beta-myrcene components were found to be high.

As a result of the Pearson correlation analysis, relationship between the altitude and p-cymene was found at 5% level as statistically significant and positive correlation where as relationship between the altitude and gamma-terpinene was found at 5% level statistically significant and negative corelation. However, the relationship between altitude and beta-myrcene was not statistically significant.

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PP-33. Evaluating RAPD and ISSR markers to distinguish carvacrol and thymol chemotypes of *Origanum vulgare* L.

Emel Sözen, Yelda Çalımlı, Muhip Hilooğlu*
Anadolu University, Science Faculty, Biology Department, Yunusemre Campus, 26470, Eskişehir, Turkey
esozen@anadolu.edu.tr

Introduction

The plant *Origanum vulgare* L. (Lamiaceae) has a great economic importance because it has been widely used in agricultural, pharmaceutical and cosmetic industries as culinary herb, flavoring substances in food products, perfumery and alcoholic beverages for its fragrance (Aligianis et al., 2001). Methods for quick and accurate identification of genotypes and the evaluation of the genetic variation suggested to be beneficial for the certification of cultivars with specific medicinal properties (Maliga-cattani et al., 2009). DNA-based molecular markers have been utilised in the fields of taxonomy, physiology, genetics and also authentication of plant species of medicinal importance. Among them RAPD (Williams et al., 1990) and ISSR (Zietkiewicz et al., 1994) are dominant markers and preferred due to low cost and simplicity of their analysis. In this study, we aimed to evaluate efficiency of RAPD and ISSR markers to distinguish five carvacrol and three thymol chemotypes of *Origanum vulgare* L.

Materials and Methods

Plant samples for each chemotype of *Origanum vulgare* were obtained from Atatürk Horticultural Central Research Institute, Yalova, Turkey. Total genomic DNA was isolated using Qiagen DNA extraction Kit. 5 ISSR and 7 RAPD primers were used for PCR reactions. PCR products were run on 1.4% agarose gel and digitally photographed. A binary matrix was produced by scoring each amplified fragment as present (1) or absent (0) from each chemotype. The matrix was used to produce an input file and analyzed using the software programs; POPGENE 1.32, GenAlex, NTSYS and Structure.

Results and Discussion

A total of 117 and 84 bands were amplified by using 7 RAPD and 5 ISSR primers, respectively. In RAPD analysis, percentage of polymorphic bands (PPB) were 70.09% in carvacrol chemotypes, 59.83% in thymol chemotypes, whereas in ISSR analysis PPB values were 65.48% in carvacrol chemotypes and 59.52% in thymol chemotypes. RAPD band profiles were more informative than that of ISSR. Carvacrol and thymol chemotypes were grouped separately in the UPGMA dendrogram. Although preliminary, the data obtained from this study indicate the distinction amongst the carvacrol and thymol chemotypes to some degree on the basis of the RAPD profiles. The efficiency of these molecular markers for genotype identification in other aromatic and medicinal plants were also reported (Manica-Cattani, 2009). In conclusion, RAPD and ISSR markers could be used for identification of different chemotypes of *O. vulgare* L.

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PP-34. Cytotoxic activity of some *Salvia* species infusions on A549 and MCF7 cell lines

Esra Köngül[1], Gökçe Şeker Karatoprak[1], Leyla Paşayeva[1], Müberra Koşar*[2]

[1] Erciyes University, Faculty of Pharmacy, Department of Pharmacognosy, Kayseri, Türkiye

[2] Doğu Akdeniz University, Faculty of Pharmacy, Department of Pharmacognosy, Gazimağusa, K.K.T.C.

eczesr@gmail.com

Introduction

Salvia is the largest genus of Lamiaceae with over 1000 species (Bahadori et al., 2017). In Turkey, this genus is represented by approximately 100 species and 52 of them are endemic (Gulsoy Toplan et al., 2017). *Salvia* species are traditionally used in the treatment of many different diseases ranging from minor disease to cancer all over the world (Russo et al., 2013). Several phytochemical studies have shown that *Salvia* species are rich in terpenoids and phenolic compounds (Al-Qudah et al., 2014). In this study, infusions of 4 Turkish *Salvia* species (*Salvia verticillata* L., *S. virgate* Jacq., *S. aramiensis* Rech. fil. and *S. halophila* Hedge) were tested for their cytotoxic activity against two different cancer cell lines (A549 and MCF7). Phenolic compositions were investigated by using LC-MS/MS. The quantity of rosmarinic acid which is the major phenolic compound of infusions was determined with HPLC.

Materials and Methods

Cytotoxic activity of each samples against A549 (human lung epithelial carcinoma, ATCC®CCL-185™)and MCF7 (human breast epithelial adenocarcinoma, ATCC® HTB-22™) cancer cell lines were examined with using MTT test (Lapidot, 2002) at during 48 h of incubation. LC-MS/MS analyses were carried out to determine phenolic compositions of infusions. The qualitative–quantitative analyses of the infusion carried out using respectively LC-MS/MS and HPLC. (Küpeli Akkol et al., 2008).

Results and Discussion

Infusion of *Salvia virgata* was found to be more cytotoxic against A549 with 92% cell viability inhibition than others however *S. verticillata infusion* was found more cytotoxic against MCF-7 cell line. LC-MS/MS analyses showed that the phenolic contents of these different *Salvia* species were so similar except *S. halophila*. Rosmarinic acid was determined to be the major phenolic compound in infusions of *S. verticillata*, *S. virgata*, *S. aramiensis* (respectively 366.067±6.022, 330.35±7.713, 14.319±0.589 µg/mL infusion) with HPLC analysis.

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PP-35. Cytotoxic activity of *Salvia virgata* Jacq. on A549 and MCF7 cell lines

Gökçe Şeker Karatoprak[1], Esra Köngül[1], Leyla Paşayeva[1], Müberra Koşar[2]*

[1] Erciyes University, Faculty of Pharmacy, Department of Pharmacognosy, Kayseri, Türkiye

[2] Doğu Akdeniz University, Faculty of Pharmacy, Department of Pharmacognosy, Gazimağusa, K.K.T.C.

eczesr@gmail.com

Introduction

Salvia is one of the most widespread members of the Lamiaceae family with over 1000 species all around the world (Koşar et al., 2008 and Bahadori et al., 2017). In Turkey, this genus is represented by approximately 100 species and 52 of them are endemic (Gulsoy Toplan et al., 2017). *Salvia virgata* Jacq. is a widespread plant in Turkey and its leaves are used for the treatment of skin diseases and wounds (Baytop, 1999 and Koşar et al., 2008). In this study, 70% methanol and water extracts of *S. virgata* were tested for their cytotoxic activity against two different cancer cell lines (A549 and MCF7). Both extracts were investigated for their qualitative–quantitative phenolic compositions by using HPLC-DAD.

Materials and Methods

Cytotoxic activities of each extracts against A549 (human lung epithelial carcinoma, ATCC®CCL-185™)and MCF7 (human breast epithelial adenocarcinoma, ATCC® HTB-22™) cancer cell lines were examined with using MTT test (Lapidot, 2002) at during 48 h of incubation. The qualitative–quantitative analyses of the extracts carried out using HPLC-DAD (Küpeli Akkol et al., 2008).

Results and Discussion

Water extract of *Salvia virgata* was found more cytotoxic than 70% methanol extract against MCF-7 cell line (IC_{50}: 701,2 ± 61,3 and 979,15 ± 0,55 µg/mL). Also water extract was found more cytotoxic against A549 cell line at 2000 µg/mL concentration with %56 cell viability inhibition.Gallic, *p*-OH-benzoic, caffeic, *o*-coumaric, rosmarinic acids, luteolin-7-*O*-glycoside, and luteolin were identified in 70% metanol and water extracts with HPLC-DAD analyses**.** Rosmarinic acid was the main compound in both extracts. The rosmarinic acid concentration of methanolic extract was found as 66.94 ± 0.47 mg/g (w/w) and water extract 26.81 ± 0.05 mg/g (w/w).

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PP-36. GLUT4 translocation test for organic extracts of *Rosmarinus officinalis* L., Lamiaceae: in vitro evaluations of their anti-diabetic activity and cytotoxicity

Sleman Kadan[1,2], Bashar Saad[1] and Yoel Sasson[2], Hilal Zaid[1*]*

[1] Qasemi Research Center- Al-Qasemi Academy, P.O Box 124, Baqa El-Gharbia 30100, Israel.

[2] Casali Center for Applied Chemistry, Institute of Chemistry, The Hebrew University of Jerusalem, Givat Ram, Jerusalem 91904, Israel.

hilal.zaid@gmail.com

Introduction

Rosemary (Rosmarinus officinalis L., Lamiaceae) is a woody perennial herb, native to the Mediterranean region, but is now cultivated all over the world as an ornamental and aromatic plant. The leaves of rosemary are commonly used for flavoring foods as a condiment, but this plant has also been widely used for different medicinal purposes, such as, anticancer, antidiabetic, anti-inflammatory and antinociceptive, antioxidant.

Diabetes is a metabolic disease usually caused by a combination of hereditary and environmental factors, which result in hyperglycemia and other classical symptoms, especially polyuria, polydipsia and polyphagia. Eventually, hyperglycemia leads to serious damage in blood vessels.

The aim of this study was to evaluate the role of glucose transporter-4 (GLUT4) in the anti-diabetic effects of the aerial parts of Rosemary methanol, hexane and cichloromethane.

Materials and Methods

The air-dried aerial parts of Rosmarinus officinalis L. were ground, 10 g of the powder were then packed in the thimble of the Soxhlet apparatus and were extracted with 150 ml methanol (MeOH), dichloromethane (DCM) or hexane, and then refluxed for 24 hours to give a dark green extract.

The extracts anti-diabetic activity was examined by measuring the relative amount of GLUT4 translocation to the plasma membrane in the presence and absence of insulin. L6 muscle cells, stably expressing myc-tagged GLUT4, were utilized. These cells have been repeatedly shown to display insulin regulated GLUT4 traffic. L6 myoblasts were pre-treated with increasing concentrations of Rosemary extracts for 20h, followed by 3h serum-deprivation and insulin stimulation for 20 min and then GLUT4myc levels at the plasma membrane was determined. Toxicity of the extracts was determend by MTT and LDH leakage assays.

Results and Discussion

Cytotoxic and anti-diabetic properties of the extracts were evaluated using L6-GLUT4myc muscle cells stably expressing myc epitope at the exofacial loop (GLUT4). No cytoxic effects were observed in treated cells up to 0.25 mg/ml extract as measured with MTT and LDH-leakage assays. GLUT4 translocation to the plasma membrane was elevated by 2.5 and 5.5 folds (-/+ insulin) after treatment with Rosemary extracts for 20 h

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PP-37. Chemical composition and bioactivity of essential oil of *Origanum acutidens* endemic in Turkey

Turgut Kılıç, Sema Çarıkçı[1], Tuncay Dirmenci[2], Hasibe Yılmaz[3], Ahmet C. Gören[3], Turan Arabacı[4]*

[*] Science Education Department/ Faculty of Necatibey Education, Balıkesir University, Balikesir, Turkey

[1] Chemistry Department/Faculty of Art&Science, Balıkesir University, Balikesir,Turkey

[2] Biology Education Department/Faculty of Necatibey Education, Balıkesir University, Turkey

[3] TUBITAK National Metrology Institute (UME), Department of Chemistry, Gebze-Kocaeli, Turkey

[4]Department of Pharmaceutical Botany, Faculty of Pharmacy, İnonu University, Malatya, Turkey

tkilic@balikesir.edu.tr

Introduction

The genus *Origanum* is member of Lamiaceae family and is represented by 23 species (26 taxa) and 8 hybrids in Turkey, 20 of which are endemic (Başer 2002; Dirmenci et al., 2016). The species is a perennial shrub and herbaceous plantwhich grows wild in western and southern Turkey and other Mediterranean countries. Many species which belong to the genus *Origanum* L. are used as spices or herbal tea mainly because of their content of essential oils. *Origanum acutidens* (Hand. -Mazz.) Ietsw. is endemic in Turkey and belongs to the sect. *Brevifilamentum* Ietsw. In the present study, chemical composition, antimicrobial activity and anticholinesterase activity of the essential oil of *O. acutidens* were investigated.

Materials and Methods

O. acutidens was collected from Malatya between Kozluk and Gündüzbey, in eastern Anatolia. The dried aerial parts were subjected to hydro distillation for 4 h, using a Clevenger-type apparatus to produce essential oil. Chemical composition of the oil was investigated using with Thermo Scientific TSQ GC-MS/MS. The antimicrobial activity tested against *Escherichia coli*, *Staphylococcus aureus Mycobacterium smegmatis*, and the fungus *Candida albicans*. DMSO and methanol wereused as negative control and ketoconazole, streptomycin, oxacillin, gentamicin were used as positive control. To determine the anticholinesterase activity of the oil, inhibitory activities of acetyl- and butyryl-cholinesterase (AChE and BChE) were measured. Galanthamine was used as a reference compound.

Results and Discussion

GC/GC-MS analyses of the oil resulted in the characterization of 25 compounds, representing 99.2%of the total oil. An aromatic monoterpene p-cymene (39.2%) was determined as the main component of the oil followed by allo-aromadendrene (24.8%) and aromadendrene (11.8%). The oil showed very good antimicrobial activity to all the studied species especially against *M. smegmatis* and possessed moderate inhibition against BChE (45.69%) while weak AChE (25.61%) activity was observed.

Acknowledgments and References

The authors thank to The Scientific and Technological Research Council of Turkey (TUBITAK) for supporting thisstudy as a part of project 113Z225.

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PP-38. Phenolic composition and antioxidant activity of *Origanum husnucanbaseri* endemic in Turkey

Turgut Kılıç, Sema Çarıkçı[1], Tuncay Dirmenci[2], Hasibe Yılmaz[3], Ahmet C. Gören[3], Turan Arabacı[4]*

[*] Science Education Department/ Faculty of Necatibey Education, Balıkesir University, Turkey

[1] Chemistry Department/Faculty of Art&Science, Balıkesir University, Turkey

[2] Biology Education Department/Faculty of Necatibey Education, Balıkesir University, Turkey

[3] TUBITAK National Metrology Institute (UME), Department of Chemistry, Gebze-Kocaeli, Turkey

[4] Department of Pharmaceutical Botany, Faculty of Pharmacy, İnonu University, Malatya, Turkey

tkilic@balikesir.edu.tr

Introduction

Phenolic compounds play vital role in neutralizing and inhibiting free radicals. Therefore, there has been increasing interest in phenolic compounds with a view to their antioxidant and health properties (Taamali et al., 2015). Most plants of the family Lamiaceae are of special interest in phenolic compounds antioxidant potential. Lamiaceae (Labiatae) is a widespread and diversified herb family consisting of about 233 genera and 6900 species (Heywood et al., 2007). The genus *Origanum* L. is a member of the family Lamiaceae and is represented by 23 species (26 taxa) and 8 hybrids in Turkey, 20 of which are endemic (Dirmenci et al., 2016). *Origanum husnucanbaseri* H.Duman, Aytaç & A.Duran is endemic in Turkey and belongs to the sect. *Brevifilamentum* Ietsw.. In the present study, phenolic composition and antioxidant activity of the extracts of the species were investigated.

Materials and Methods

O. husnucanbaseri was collected from Alanya, Turkey. The dried aerial parts of the plants macerated with chloroform (C), acetone (Ac) and methanol (M1) respectively and directly extracted with methanol (M2). The extracts were analyzed LC-MS/MS and determined quantitative amounts of the phenolic compounds. The inhibition of lipid peroxidation, Cu^{2+} and DPPH scavenging activity of the extracts were analyzed.

Results and Discussion

Ac extract of *O. husnucanbaseri* was found as rich in phenolic compounds. The main compounds and amounts as follow: salvigenin (18.16 mg/kg dried herba) for C, rosmarinic acid (1002.22 mg/kg dried herba) for Ac, t-ferulic acid (96.42 mg/kg dried herba) for M1, and luteolin (430.84 mg/kg dried herba) for M2. All the studied antioxidant capacity assay, Ac and M2 extracts were found to be the most active.

Acknowledgments

The authors thank to The Scientific and Technological Research Council of Turkey (TUBITAK) for supporting this study as a part of project 113Z225.

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PP-39. Biochemical changes of mint (*Mentha piperita* L.) during postharvest storage at different temperatures

Tuba Seçmen[1], Cemile Ebru Onursal[2], Atakan Güneyli[2], Derya Erbaş[3]

[1] West Mediterranean Agricultural Research Institute, Antalya, Turkey

[2] Fruit Research Institute, Isparta, Turkey

[3] Süleyman Demirel University, Faculty of Agriculture, Department of Horticulture, Isparta, Turkey

ebru.onursal@gmail.com

Abstract

In this study, biochemical changes of the Mint (*Mentha piperita*) were investigated during 7 days storage at 4°C and 8°C temperature and 85-90% relative humidity conditions. Samples stored in locked refrigerator bags. During the storage period, weight loss (g), color (L*, a*, b*, C*, h°), titratable acidity (TA-%), soluble solid content (SSC-%), respiration rate (CO_2/Kg.h), total phenolic content (mg GAE / 100 gYA), total carotenoids (mg/g), total chlorophyll content (mg/g) and antioxidant activity (mg/100 ml) were determined at daily intervals. In addition, L-ascorbic acid (mg/100ml) and sugar (fructose, glucose) quantities (mg/100ml) were determined using high pressure liquid chromatography (HPLC). Weight loss (%) of mints increased with increasing storage temperature. Thus, these increases reached the higher values when mints stored at 8°C. The respiratory rate showed a gradual decline at both temperatures at the beginning, which showed a suddenly increase in the last days of the storage and a tendency to decrease again in the 8 °C storage. The highest antioxidant activity was found as 8,87 µmol TE/gYA at the beginning of storage and it began to reduce during the storage period. The total phenol content of mints significantly tended to decrease throughout the storage. The ascorbic acid values of the mint decreased during storage. Total chlorophyll and carotenoid of mints was remittent during storage periods and there was no stable increase or decrease. But these values displayed a slightly increasing at the end of storage.

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PP-40. Anatomical and micromorphological properties of *Origanum husnucan-baseri* H. Duman, Aytac & A. Duran

Çağla Kızılarslan-Hançer, Gülay Ecevit-Genç[2], Türker Yazıcı[3], Tuncay Dirmenci[3]*

[1] Department of Pharmaceutical Botany, Faculty of Pharmacy, Bezmialem Vakif University, Istanbul-Turkey

[2] Department of Pharmaceutical Botany, Faculty of Pharmacy, Istanbul University, Istanbul-Turkey

[3] Department of Biology, Faculty of Necatibey Education, Balıkesir University, Balıkesir

c.kizilarslan@gmail.com

Introduction

The genus *Origanum* L. is represented by 23 species (26 taxa), 14 of which are endemic in the Flora of Turkey (Ietswaart 1982, Duman 2000). Mediterranean area is the main origin of the species. Endemic species are concentrated to Mediterranean area in Turkey. In this study, the anatomical and micromorphological properties of *O. husnucan-baseri* H. Duman, Aytac & A. Duran were investigated. It is an endemic species and one of the members of sect. *Brevifilamentum* Ietsw.. This species is named after Prof. Dr. K. Hüsnü Can Başer, a scientist interested in aromatic features of the family Lamiaceae.

Materials and Methods

O. husnucan-baseri was collected from natural habitats and different localities in Turkey by the authors. The aerial parts of plant (nutlets, leaves, bracts, petals and stems) were preliminarily observed using a light microscope to make sure that they were of normal size and maturity. For scanning electron microscopy (SEM) analysis, at least 5 samples were prepared. The samples of aerial parts were mounted on stubs and coated with gold before they were studied with FEI Quanta 450 FEG-EDS scanning electron microscope. The dried parts of stem and leaf were kept in warm water for anatomical studies and then all transverse sections were cut by hand with blade. Samples were investigated in Sartur reagent. Photographs were taken with Nikon 80i trinocular light microscope and Kameram 21 Digital micro structure analysis system.

Results and Discussion

Micromorphological results: The shape of studied nutlets is oblong, elliptic. The surface pattern is discoid with some radiating ridges; the circles show broken wrinkles. Leaves, bracts and stems of *O. husnucan-baseri* show very similar patterns, with peltate glandular trichomes. Petals have peltate glandular trichomes and long multi cellular trichomes.

Anatomical results: Leaf: Epidermis one-layered, consisting of ovoid-rectangular cells. Leaves are dorsiventral with cylindrical and single-layered palisade parenchyma cells and circular, ovoid or irregular shaped and 5-6 layered spongy parenchyma cells. Midrib vascular bundle is collateral type. The 2-4 layered collenchymatic tissue is located above and below the bundle, near epidermis.

Stem: Circular shaped. The epidermis consists of single-layered rectangular cells, surrounded by a cuticle layer. Adjacent to the epidermis there is 2-4 layers of collenchyma. A thin cortex is present between collenchyma and endodermis. The endodermis is conspicuous, consists of single-layered, flattened-ovoid cells. Phloem and xylem elements can be easily distinguished in the vascular cylinder.

In this study, *O. husnucan-baseri* was anatomically and micromorphologically examined. It shows general anatomical features of the family Lamiaceae. These results are seen as supportive for future studies on the genus.

Acknowledgments

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NVEO
Natural Volatiles & Essential Oils

PP-41. Antituberculosis activity of *Salvia euphratica* from Turkey

Seçil Yazıcı-Tütüniş, Nur Tan[1], Yeter Yeşil[2], Meltem Uzun[3]*

[1] Department of Pharmacognosy, Faculty of Pharmacy, Istanbul University, 34116 Istanbul, Turkey

[2] Department of Pharmaceutical Botany, Faculty of Pharmacy, Istanbul University, 34116 Istanbul, Turkey

[3] Department of Microbiology and Clinical Microbiology, Faculty of Medicine, Istanbul University, 34093 Istanbul, Turkey

secilyaz@istanbul.edu.tr

Introduction

Tuberculosis is a deadly infectious disease caused by the bacteria *Mycobacterium tuberculosis*. For centuries, medicinal plants have been the subject of many studies to treat this disease. In addition, bioactivity researches have shown the antimicobacterial properties of *Salvia* species that are traditionally used as antimicrobial, antidiabetic and antispasmodic. Hence, the present study designed to investigate *in vitro* antituberculosis activity of the essential oil and extracts of *S. euphratica* (Ulubelen, 1997).

Materials and Methods

The air dried aerial parts of the plant were extracted with petroleum ether, chloroform and ethanol in a Soxhlet apparatus. Solvents were removed on a rotary evaporator *in vacuo*. Infusion and decoction of the aerial parts were prepared. The essential oil from plant material was obtained by hydrodistillation using a Clevenger-type apparatus. The antituberculosis activity was tested by using microdilution method which was used according to a standard protocol by Clinical and Laboratory Standard Institute (CLSI, 2011). Five strains were tested including each of the following species: *M. tuberculosis* H37Rv ATCC 27294 (Susceptible all antimycobacterial drugs), *M. tuberculosis* H37Rv ATCC 35838 (resistant to Rifampin), *M. tuberculosis* H37Rv ATCC 35822 (resistant to Isoniazid) and multi-drug resistant (resistant to Rifampin+Isoniazid+Streptomycin+Ethambutol). *M. tuberculosis* that was isolated from patient by Istanbul Faculty of Medicine, Department of Microbiology Laboratory.

Results and Discussion

The essential oil of *S. euphratica* showed strong inhibitory effects against tested strains having MIC values from 0.8 µl/ml to 3.12 µl/ml. Chloroform extract has better activity (having MIC values of 25-50 µg/ml) especially against *M. tuberculosis* H37Rv ATCC 27294. Petroleum ether extract showed good effect (having values of 50-100 µg/ml) especially against *M. tuberculosis* H37Rv ATCC 27294. This study shows that essential oils of *Salvia euphratica* may be explored for development of new antimicobacterial agent.

Acknowledgment

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PP-42. Comparison of the antifungal activities on the some *Salvia* species from Turkey

Nur Tan[1], Dilek Satana[2], Seçil Yazıcı-Tütüniş[1], Emir Tan[3]*

[1] Department of Pharmacognosy, Faculty of Pharmacy, Istanbul University, 34116 Istanbul, Turkey

[2] Department of Microbiology and Clinical Microbiology, Faculty of Medicine, Istanbul University, Fatih/Çapa Istanbul

[3] Department of Pharmaceutical Microbiology, Faculty of Pharmacy, Istanbul Yeni Yüzyıl University, 34010 Istanbul

nurtan@istanbul.edu.tr

Introduction

Turkey is an important gene centre for the Lamiaceae family which is represented in Turkey by 45 genera, 546 species and a total of 731 taxa. The rate of endemism in the family is 44.2% and *Salvia* genus is the larges genus in the family which are represented in Turkey by 94 taxa belonging to 89 species. *Salvia* species are used in the traditional medicine for the treatment of a variety of diseases, including infections (Walker and Sytsma, 2007; Baytop 1999; Demirci et al., 2003). This study aimed to compare the antifungal activities to various solvent and aqueous extracts with that of the essential oils from the aerial parts of different *Salvia* species.

Materials and Methods

The solvent extracts from the aerial parts of *S. nydeggeri, S. wiedemannii, S. aramiensis, S. euphratica* and *S. candidissima* were extracted in a Soxhlet with petroleum ether (PE), chloroform ($CHCl_3$), ethanol (EtOH) and the essential oils (EO) were obtained by hydrodistillation. Infusions and decoctions were also prepared. The antifungal activity of 30 different samples was established against *Candida parapsilosis* (ATCC 22019), *Candida krusei* (ATCC 6258), *Candida albicans* (ATCC 90028), *Trichophyton mentagrophytes* var. *erinacei* (NCPF 275), *Microsporum gypseum* (NCPF 580). The standard antifungal agents, Amphotericin B, Itraconazole were used as positive controls. Amphotericin B, itraconazol and the extracts of *S. nydeggeri, S. wiedemannii, S. aramiensis, S. euphratica* and *S. candissima* were dissolved in 100 % dimethyl sulfoxide and EOs were dissolved in RPMI 1640 with 5 % Tween80 recommended as CLSI Microdilution method guidelines (M38-A2, M27-A32, M27-S3;2008). The final extract concentrations were 400 to 3.13µg/mL, amphotericin B and itraconazol were 64 to 0.03µL/mL, for aqueous EO's were 50 to 0.01µL/mL

Results and Discussion

S. nydeggeri PE extract and infusion, and *S.wiedemanni* PE extract against *T. mentagrophytes* var. *erinacei* NCPF 275 showed the highest activity with MIC 12,5 µl/ml. Following these with MIC 25 µl/ml value; *S. nydeggeri* decoction against *C. albicans* ATCC 90028, *S. nydeggeri*, *S. wiedemannii* and *S. candissima* $CHCl_3$ extracts against *C. parapsilosis* ATCC 22019, *C. albicans* ATCC 90028 and *S.wiedemanni* $CHCl_3$ extract against *T. mentagrophytes* var. *erinacei* NCPF 275, *S. aramiensis* EtOH extracts against *C. parapsilosis* ATCC 22019 and *C. albicans* ATCC 90028 showed good antifungal activity. The volatile oils showed the highest activity as expected; especially EOs of *S. candissima* and *S. euphratica* showed the best antifungal activity with the lowest MIC value ($\leq$0.05 µl/ml) against *T.mentagrophytes* var. *erinacei* NCPF 275 and *M gypseum* NCPF 580 and *S.wiedemanni* against *T. mentagrophytes* var. *erinacei* NCPF 275 and also better than the standard controls. As a result, the investigated *Salvia* species may be developed as a new antifungal agent.

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PP-43. Essential oil composition of *Origanum majorana* from three different locations in Northern Cyprus

Azmi Hanoğlu[*1], Duygu Yiğit Hanoğlu[1], Betül Demirci[2], Dudu Özkum Yavuz[1], İhsan Çalış[3], K. Hüsnü Can Başer[3]*

[1] Department of Pharmaceutical Botany, Faculty of Pharmacy, Near East University, Nicosia/ T.R.N.C.

[2] Department of Pharmacognosy, Faculty of Pharmacy, Anadolu University, Eskişehir, Turkey;

[3] Department of Pharmacognosy, Faculty of Pharmacy, Near East University, Nicosia/ T.R.N.C

azmi.hanoglu@neu.edu.tr

Herbal parts of *Origanum* species are used as condiment or herbal tea. Dried aerial parts of these plants are used for obtaining essential oil and aromatic water (Baser, 2002). The genus *Origanum* is represented by six species in Cyprus (Meikle, 1985). Ethnobotanical studies in Cyprus showed that aerial parts of *Origanum majorana* are used in folk medicine to treat mostly respiratory, gastrointestinal and urinary tract diseases (Lardos, 2006; Gonz´alez-Tejero et al., 2008; Dokos et al., 2009). The aim of this work is to determine locational variations in essential oil compositions of *Origanum majorana* collected from three different regions in Northern Cyprus.

The aerial parts of the plant materials were collected during the flowering stage from three different localitions: Kozanköy- Om1, Alevkayası- Om2 and Avtepe- Om3, respectively. Voucher specimens are kept at the Herbarium of the Near East University.

In the present study, essential oils were obtained by hydrodistillation method and chemical composition analysis were performed by GC-FID and GC-MS systems, simultaneously. The yields were calculated as v/w which were Om-1 (8.14%), Om-2 (8.10%) and Om-3 (8.13%). The number of identified compounds were 37 (Om-1), 37 (Om-2) and 39 (Om-3). Major compounds of the essential oils of Om-1 and Om-3 were *cis*-sabinene hydrate (45.0% and 33.3%) and terpinen-4-ol (11.1% and 12.3%), respectively. However, main component of the essential oil of Om-2 was α-terpineol (76.9%).

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PP-44. An overview of antimicrobial effect of essential oils obtained from some *Origanum* (Lamiaceae) taxa*: in-vitro* studies and food applications

Esra Karakaş[1], Esra Martin[1], Tuncay Dirmenci[2]*

[1]Biotechnology Department, Faculty of Science, Necmettin Erbakan University, Turkey

[2]Biology Education Department, Necatibey Education Faculty, Balıkesir University, Balıkesir

ekarakas@konya.edu.tr

Introduction

Preventing spoilage microorganisms and pathogens from foods has always been an important issue of the food industry to date. Public awareness towards food processing and its effects on human health and environment is also an important concern especially nonthermal food processing is acceptable by consumers. In recent years, application of "green technologies" is the main focus by producers in order to apply innovative, safe and alternative preservation methods. Therefore, antimicrobial substances taken from other natural sources have been started to use for the reduction of microbiological risks without changing the nutrients and organoleptic characteristics of food products (Lopez-Gomez et al., 2009; Drosinos et al., 2005; Forsythe, 2010; Ersus Bilek and Turantaş, 2013, Gálvez et al., 2014, Gálvez et al., 2014; Turantaş et al., 2015; Parker and Pace, 2016).

This study presents an overview about antimicrobial use of essential oils from *Origanum* taxa in foods, as flavoring agent and summarize the results of the studies related to *in vitro* treatments.

Materials and Methods

A syststematic review of multiple studies has been introduced in terms of *in vitro* and in food model implications centred on the use of *Origanum* as a natural antimicrobial source by comprehensive search.

Results and Discussion

Results summarized from studies clearly demonstrated that some essential oils obtained from *Origanum* taxa may be used practically as an alternative method with the provision of optimum conditions and appropriate amount in order to inhibit undesired microorganisms. It is also noted that assessment related to MIC (Minimum Inhibitory Concentration) of essential oils for concerning microorganisms is properly carried out in food industry. Addition of relevant amount of essential oil can be used for good preservation method as well as being a flavoring agent.

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PP-45. Phenolic composition and in vitro cytotoxicity assessment of *Origanum haussknechtii* Boiss.

Esra Köngül[*1], *Gökçe Şeker Karatoprak*[1], *Fatma Ayaz*[2], *Nurgün Küçükboyacı*[2]

[1] Erciyes University, Faculty of Pharmacy, Department of Pharmacognosy, 38039 Kayseri, Turkey

[2] Gazi University, Faculty of Pharmacy, Department of Pharmacognosy, 06330 Ankara, Turkey

eczesr@gmail.com

Introduction

Origanum haussknechtii Boiss. (Lamiaceae) is an endemic species in Turkey which can grow up to 50 cm long (Ietswaart, 1982). It has been used as a tea in the district of Kemaliye-Erzincan. *Origanum* species showed a high phenolic content, principally rosmarinic acid as major constituent (Ozkan and Ozan, 2014). In our previous studies, methanol and water extracts of the plant were evaluated for their antioxidant capacities as well as cholinesterase and tyrosinase inhibitory activities (Küçükboyacı et al., 2014; Erdogan Orhan et al. 2016). On the other hand, the only phytochemical study carried out was on the essential oil composition of *O. haussknechtii* (Baser et al. 1998). In the present study, we aimed to investigate phenolic composition and cytotoxic activities of methanol and water extracts from aerial parts of *O. haussknechtii.*

Materials and Methods

Phenolic compositions of methanol and water extracts from aerial parts of *O. haussknechtii* were analyzed by HPLC-DAD analysis. The chromatographic separation was performed using a gradient system with a mobile phase of A) methanol / water / acetic acid (10: 88: 2, v / v / v), B) methanol / water / acetic acid (90: 8: 2, v / v / v), and C) methanol with on the reversed phase column, Teknokroma C18 (250 x 4.6 mm i.d., 5 µm). Cytotoxic activity of the extracts was investigated against A549 cancer cell line (human lung epithelial carcinoma) using MTT assay during 48 h of incubation at a concentration range of 3.9 µg/mL-2000 µg/mL.

Results and Discussion

HPLC analysis showed that the extracts of *O. haussknechtii* include various phenolic compounds such as rosmarinic acid, caffeic acid, chlorogenic acid, catechin and 3,4-dihydroxybenzoic acid. Rosmarinic acid was determined to be the major phenolic compound in both methanol and water extracts. The cytotoxic studies indicated that the methanol extract inhibited A549 cells in a dose dependent manner. While there was no significant decrease in cell viability between 3.9-1000 µg/mL concentration of methanol extract, 47.7% cell viability inhibition was found at 2000 µg/mL. Water extract showed no cytotoxicity at any concentration.

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PP-46. Diterpenoids from *Sideritis germanicopolitana* Bornm. subsp. *germanicopolitana*

*Nurgün Küçükboyacı[1], Fatma Ayaz[1], Mustafa Buğra Ersoy[1], İhsan Çalış[*2], Hayri Duman[3], M.Iqbal Choudhary[4]*

[1] Gazi University, Faculty of Pharmacy, Department of Pharmacognosy, 06330 Ankara, Turkey

[2] Near East University, Faculty of Pharmacy, Department of Pharmacognosy, Nicosia, Turkish Republic of Northern Cyprus

[3] Department of Biology, Faculty of Science, Gazi University, 06500 Ankara, Turkey

[4] HEJ, Research Institute of Chemistry, International Center for Chemical Sciences, University of Karachi, Karachi, Pakistan

icalis@neu.edu.tr

Introduction

The genus *Sideritis* L. (Lamiaceae), known as "mountain tea", is one of the most common and diverse plants in the world and consists of more than 150 species widely distributed in the Mediterranean area. The genus has high endemism ratio with almost 80 % and is also represented by 46 species (54 taxa) in Turkey (Güvenç and Duman, 2010). *Sideritis* species have been widely reported to be used for the treatment of some gastrointestinal ailments, common colds and cough in Turkish folk medicine (Baytop 1999). *S. germanicopolitana* Bornm. subsp. *germanicopolitana,* an endemic perennial plant, has been used as a herbal tea in Anatolia (Huber-Morath, 1982). The only phytochemical study carried out was on the chemical composition of the essential oil from the plant (Kirimer et al. 1992). In this presentation, we aimed to isolate and characterize the structures of diterpenoids from *S. germanicopolitana* subsp. *germanicopolitana*.

Materials and Methods

The aerial parts of *S. germanicopolitana* subsp. *germanicopolitana* was collected from Söğüt, Bilecik, Turkey at flowering stage. The methanol extract of of the plant was subsequently fractionated by *n*-hexane, chloroform and *n*-butanol. The *n*-hexane and chloroform fractions were subjected to column chromatographic separation on silica gel to isolate diterpenoids. The structures of the metabolites were elucidated by spectroscopic (1D- and 2D-NMR, and EI-MS) evidence.

Results and Discussion

We have identified a mixture of diterpenoid (major: 7-epicandicandiol; minor:sideridiol) from *n*-hexane fraction of the plant. In addition, from chlorofom fraction of the aerial parts of the plant , we isolated a mixture of diterpenoid, foliol as a major and isofoliol as a minor compounds. This is the first report on the non-volatile chemical constituents from *S. germanicopolitana* subsp. *germanicopolitana.*

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PP-47. Composition of the essential oils of five subspecies of *Scutellaria orientalis* from Turkey

Mehmet Çiçek[1], Gülderen Yılmaz[2], Betül Demirci[3]*

[1] Pamukkale University, Faculty of Arts and Science, Department of Biology, 20070 Denizli, Turkey

[2] Ankara University, Faculty of Pharmacy, Department of Pharmaceutical Biology, 06100 Ankara, Turkey

[3] Anadolu University, Faculty of Pharmacy, Department of Pharmacognosy, 26470 Eskisehir, Turkey

mcicek@pau.edu.tr

Introduction

The family Lamiaceae is one of the largest families with more than 233 genera and about 6870 species throughout the word. The genus *Scutellaria* L., comprising nearly 400 species, is one of the largest genera of the family Lamiaceae. The genus is represented by 39 taxa consisting of 17 species, 1 hybrid, 23 subspecies and 2 varieties in Turkey. The genus *Scutellaria* is known as "kaside" in Turkey. *Scutellaria orientalis* has 16 subspecies and 2 varieties in Turkey. *S. orientalis* is used in traditional and folk medicine for constipation, hemostatic, tonic and wound healing.

Materials and Methods

The chemical compositions of the essential oils were obtained by hydrodistillation from the dried aerial parts of 5 subspecies of *Scutellaria orientalis*. The essential oil of the subspecies, *S. orientalis* L. subsp. *haussknechtii* (Boiss.) J.R.Edm. *S. orientalis* L. subsp. *carica* J.R.Edm., S. *orientalis* L. subsp. *macrostegia* (Hausskn. ex Bornm.) J.R.Edm., *S. orientalis* L. subsp. *orientalis* and S*. orientalis* L. subsp. *santolinoides* (Hausskn. ex Bornm.) J.R.Edm., were separately identified simultaneously by gas chromatography (GC) and gas chromatography/mass spectrometry (GC/MS).

Results and Discussion

The main components were determined as germacrene D (24%) and β-caryophyllene (14%) in the oil of *S. orientalis* L. subsp. *haussknechtii*; germacrene D (57%), bicyclogermacrene (7.5%) in the oil of *S. orientalis* L. subsp. *carica*; germacrene D (48%) and β-caryophyllene (16%) were found as major components in the oil of *S. orientalis* L. subsp. *macrostegia*; caryophylene oxide (24%) and germacrene D (20%) in the oil of *S. orientalis* L. subsp. *orientalis*. The main components in the oil of *S. orientalis* L. subsp. *santolinoides* were germacrene D (42%) and β-caryophyllene (14%). 51, 63, 58, 63 and 57 constituents were identified in the aerial parts of subsp. *haussknechtii*, subsp. *carica*, subsp. *macrostegia*, subsp. *orientalis* and subsp. *santolinoides* essential oils representing 90.4%, 93.9%, 98.7%, 88.5% and 94.5% of the essential oils, respectively.

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PP-48. A checklist of species of the Lamiaceae of Denizli (Turkey)

Mehmet Çiçek
Pamukkale University, Faculty of Arts and Science, Department of Biology, 20070 Denizli, Turkey
mcicek@pau.edu.tr

Introduction

Lamiaceae known as "the mint family" is one of the largest families of flowering plants. Lamiaceae showing cosmopolitan distribution contains 236 genera and 7534 species (WCSP, 2017). Because of its aromatic odour and medicinal properties, its many species are used in traditional folk medicine, alternative medicine or complementary medicine, pharmacy and perfumery. Most of Lamiaceae species known as thyme, peppermint, and sage are usually used as tea and spice in everyday life. Therefore, it has become the focus of pharmacognostic studies. In Flora of Turkey, the Lamiaceae, with 46 genera and 609 species, 184 subspecies, 42 varieties, 24 hybrids, in total 748 taxa, is one of the families containing the most species. Of these taxa, 322 (43.05%) are endemic to Turkey (Güner et al., 2012).

Materials and Methods

The checklist is based on the field study conducting between 2010-2016 years in Denizli and literature surveys. In preparation of checklist, Türkiye Bitkileri Listesi (Güner et al., 2012), Flora of Turkey (Davis, 1965-1985; Davis et al., 1988; Güner et al., 2000), IPNI and The Plant List taxonomic databases and the regional floristic studies carried out in Denizli (Tuzlacı, 1976; Tuzlacı, 1977; Tuzlacı, 1983; Gemici ,1986; Bekat, 1992; Oluk, 1999; Çelik et al., 2004; Çiçek and Çelik, 2004; Semiz and Çelik, 2005; Çiçek et al., 2007; Gürcan and Düşen, 2015) were used. Threat categories of the endemic species were evaluated according to Red Data Book of Turkish Plants: (Pteridophyta and Spermatophyta) (Ekim et al., 2000).

Results and Discussion

The family Lamiaceae is represented by 137 taxa belonging to 27 genera, 37 of which are endemic (27%), in Denizli. The biggest five genera containing the most species in Lamiaceae of Denizli are *Salvia* 19 (13.87%), *Stachys* 11 (8.03%), *Phlomis* 10 (7.30%), *Clinopodium* 8 (5.84%) and *Marrubium* 8 (5.84%).The numbers of endemic taxa of Lamiaceae of Denizli in threat categories are as follows: CR (Critically Endangered) 2, EN (Endangered) 3, VU (Vulnerable) 4, NT (Near Threatened) 5, CD (Conservation Dependent) 8 and LC (Least Concern) 14. Distribution to phytogeographical regions of the taxa is as follows: Mediterranean 69 (50.36%), Irano-Turanian 16 (11.68%), Euro-Siberian 10 (7.30%), and Blacksea region 1 (0.73%).

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NVEO
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PP-49. The leaf and the gall volatiles of *Salvia fruticosa* Miller from Turkey: Chemical and biological diversity

*Sevda Süzgeç-Selçuk[1], Gülmira Özek[3], Süleyman Yur[3], Fatih Göger[3], Ertan Tuzlacı[2], M. Bahar Gürdal[4], Gizem Gülsoy Toplan[*5], Ali H. Meriçli[6], K. Hüsnü Can Başer[6], Temel Özek[3]*

[1] Marmara University, Faculty of Pharmacy, Department of Pharmacognosy, 34668 Istanbul, Turkey

[2] Marmara University, Faculty of Pharmacy, Department of Pharmaceutical Botany, 34668 Istanbul, Turkey

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

[4] Istanbul University, Faculty of Pharmacy, Department of Pharmaceutical Botany, 34452, Istanbul, Turkey

[5] Istanbul University, Faculty of Pharmacy, Department of Pharmacognosy, 34452, Istanbul, Turkey

[6] Near East University, Faculty of Pharmacy, Department of Pharmacognosy, Lefkoşa (Nicosia)/TRNC, Mersin 10, Turkey

sevdasuzgec@hotmail.com

The genus *Salvia* (sage) is one of the largest genera of Lamiaceae and represented by nearly 900-1000 species in the world. In the Flora of Turkey, 100 *Salvia* taxa and 93 species are recorded, 53 of which are endemic (Özhatay et al., 2011; Hedge, 1982). *S. fruticosa* oil is produced from wild plants as well as from cultivated ones (Dinçer et al., 2012). The actual situation of sage oil production and export (mainly in Mediterranean countries) was reported by Başer (Başer, 2005). In Turkey, approximately 500 kg of the leaf oil from *S. fruticosa* is annually produced and 600 tons of sage leaves worth more than 1.5 million US$ is exported. The sage oil is produced from *S. fruticosa* (wild) in Manisa and Alanya provinces of Turkey. The local people call the sage oil "elma yağı" (apple oil) due to resemblance of galls (apples) growing on its leaves and stems to small apples.

In this study, two different isolation techniques, conventional hydrodistillation (HD) and micro-steam distillation-solid-phase microextraction (MSD-SPME), have been used to analyze volatile constituents from the leaves and the galls of *S. fruticosa* Miller, collected from three different locations from Turkey, by gas chromatography (GC-FID) and gas chromatography coupled to mass spectrometry (GC-MS). The oxygenated monoterpenes (69.3-62.4) were found to be the predominating compound group with 1,8-cineole and camphor as main constituents in all the tested samples with exception of the gall oil in which oxygenated sesquiterpenes (25.6%) and diterpenes (17.3%) were detected in high percentages. Qualitative differences of the volatiles obtained by HD and MSD-SPME techniques from the leaf and the galls are discussed. The leaf oils were subjected to investigation for memory enhancing property *via* the inhibition of acetylcholinesterase (AChE). Also, free radical scavenging (DPPH) and cupric reducing antioxidant potential (CUPRAC) of the leaf oils was evaluated. Biological activity tests resulted in moderate anti-AChE and antioxidant potential of the leaf oils.

Chemical composition of EOs obtained by hydrodistillation of the galls of *S. fruticosa* from three collection sites (I), (II) and (III) was found to be significantly different from those of leaf oils. The big difference was detected in amount of the main compound 1,8-cineole, with percentages 1.7% in G(I)-HD, and to 13.1% and 12.9% in G(II)-HD and G(III)-HD oils, respectively. Similarly, the percentages of camphor were 3.2% in G(I)-HD oil, 21.3% and 21.0% in the G(II)-HD and G(III)-HD gall oils, resp. Sesquiterpenes were found in higher amount (up to 11.9%) in G(I)-HD oil while in other galls β-caryophyllene (7.9%) and viridiflorol (8.6%) were major representatives. The gall oils were characterized with significant amount of diterpenes (5.2-17.2%) while in the leaf oils they were detected in scarce amount (0.8%).

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PP-50. Antimicrobial evaluation and chemical characterisation of the essential oil of the endemic *Salvia cryptantha* Montbert & Aucher ex Bentham from Eskişehir

Gözde Öztürk, Betul Demirci[1], Fatih Demirci[2], K. Husnu Can Başer[3]*

[1] Anadolu University, Faculty of Pharmacy, Department of Pharmacognosy, 26470, Eskişehir, Turkey.

[2] Anadolu University, Faculty of Health Sciences, 26470, Eskişehir, Turkey

[3]Near East University, Graduate School of Health Sciences, Nicosia, Northern Cyprus.

g.ozturkau@gmail.com

Introduction

The genus *Salvia* (Lamiaceae) is presented in Flora of Turkey by 89 species with 94 taxa, of which 45 are endemic in Turkey. *Salvia cryptantha* Montbert & Aucher ex Bentham is a Central Anatolian endemic. The plant is used in the food flavorings and medicinal purposes as antimicrobial, antifungal and antioxidant.

Materials and Methods

Aerial parts of *S. cryptantha* were collected from Eskisehir in May 2015, and was air dried prior to distillation. The essential oil was isolated by hydrodistillation for 3 h using a Clevenger-type apparatus and the composition of the essential oil was simultaneously analyzed by GC-FID and GC-MS. In addition, antimicrobial activity of the essential oil and main constituents were tested against *Bacillus cereus* NRRL B-3711, *Escherichia coli* NRRL B-3008, *Streptococcus sanguinis* ATCC 10556 by broth microdilution method. Ciprofloxacin was used as control and Minimal Inhibitory Concentrations (MIC) were determined.

Results and Discussion

The oil yield for *S. cryptantha* was 0.9% (v/w). Chromatospectral analyses have resulted in the characterization of 1,8-cineole (30.7%), α-pinene (12.9%), camphor (12.8%), camphene (7.4%) and β-pinene (4.0%) as main constituents. The oil was found relatively to be more effective against the human pathogens *Bacillus cereus* (2.5 mg/mL) than *Escherichia coli* (10 mg/mL) and *Streptococcus sanguinis* (5 mg/mL).

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PP-51. The influence of harvesting period and cutting hour on yield and quality in thyme (*Thymus vulgaris* L.) in Çukurova condition

Ceren D. Yıldırım[1], M. Enes, Akdoğan[1], Tuncay Çalışkan[1], Hasan Maral[*],Ebru Kafkas[3], Saliha Kırıcı[1]

[1] Department of FieldCrops, Faculty of Agriculture, University of Cukurova, Adana, Turkey

[2] KaramanoğluMehmetbey University, Ermenek Vocational School, Karaman, Turkey

[3] Department of Horticulture, Faculty of Agriculture, University of Cukurova, Adana, Turkey

kirici@cu.edu.tr

Abstract

This research was conducted in 2016 at the Research Area of Department of Field Crops, Faculty of Agriculture, Çukurova University, Adana for the influence of harvesting period and cutting hour on yield and quality in *Thymus vulgaris* L. Field trial was arranged in randomized complete block design, with three replications. Thyme seeds were sown on December 17, 2015 in the green house. Seedlings were transferred to field at March 31, 2016. The plants were harvested three times at one month interval (first: August 22, second: September, 23 and third: October 21, 2016). Cutting hours were 9:00 am, 12:30 am and 16:00 pm. In the study, plant height (22.7 – 32,8 cm), drug herbage yield (39 - 156 kg da^{-1}) and essential oil content (1.54- 1.88%) were determined. The highest essential oil content was obtained as a mean 1.88 % from the first harvest at 16:00 pm cutting. The lowest value was obtained from second harvest at 9:00 am cutting time.

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PP-52. Antimicrobial activity of various extracts from *Salvia chionantha*

Gizem Gulsoy Toplan[1], Nur Tan[1], Emir Tan[2], Emine Akalin Urusak[3], Meltem Uzun[4]*

[1] Deparment of Pharmacognosy, Faculty of Pharmacy, Istanbul University, Istanbul

[2] Department of Pharmaceutical Microbiology, Faculty of Pharmacy, Yeni Yuzyıl University, Istanbul

[3] Department of Pharmaceutical Botany, Faculty of Pharmacy, Istanbul University, 34116, Istanbul

[4] Department of Microbiology and Clinical Microbiology, Faculty of Medicine, Istanbul University, Istanbul

eczgizemgulsoy@gmail.com

Introduction

Salvia species are used in Anatolian folk medicine to treat severeal diseases, including infectious disorders (Baytop, 1999). The extracts (petroleum ether, chloroform, ethanol), infusion and decoction of plant were tested against *Staphylococcus aureus, Bacillus subtilis, Enterococcus faecalis, methicillin resistant S. aureus (MRSA), Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, Proteus mirabilis* using microbroth dilution method. The antimycobacterial activity was also investigated against five *Mycobacterium tuberculosis* (sensitive-resistant-standard strains and multidrug resistance clinical isolate) strains.

Materials and Methods

Powdered aerial parts of *S.chionanta* was extracted with petroleum ether, chloroform, ethanol using Soxhlet apparatus. Infusion and decoction of plant were also prepared. Microdilution method was used according to a standard protocol by Clinical and Laboratory Standard Institute (CLSI, 2011, Amsterdam et al , 2005) for Mycobacteria and the CLSI standard method modified with rezasurin for bacteria (CLSI, 2006, Sarker et al., 2007). The antimicrobial activity of the extracts were evaluated against reference standard microorganisms; *S. aureus*, Meticillin Resistant *S. aureus* (MRSA), *E. faecalis*, *P. aeruginosa*, *E. coli*, *K. pneumoniae*, *B. subtilis*, *P. mirabilis*. Five strains were tested to determine antituberculosis activity including each of the following species: three Standards *M. Tuberculosis* (isoniazide (INH) resistant), *M. tuberculosis* (Susceptible all antimycobacterial drugs), *M. tuberculosis* (rifampicin (R) resistant) and two multi-drug resistant clinical isolate(INH+R resistant and streptomycin+INH+R+ethambutol resistant) *M. Tuberculosis*.

Results and Discussion

As to the antibacterial activity results, the MIC values ranged from 50 µg/mL to 5000 mg/mL for all tested bacteria. The strongest inhibitory effect was detected in ethanol extract against *S. aureus* with a MIC value of 625 mg/ml, followed by *methicillin MRSA, B.subtilis, E. faecalis.* As the antimycobacterial activity , infusion of *S.chionantha* showed better activity compared to the other extracts, against sensitive *M. tuberculosis* and multi-drug resistant *M. tuberculosis* (INH+R) with a MIC value of 50 mg/ml; following Chloroform extract had a good activity with a MIC value 100 mg/ml against *M. tuberculosis* (INH-resistant) and *M. tuberculosis* (R-resistant).

Acknowledgment and References

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PP-53. Antimicrobial and cytotoxic activity of various extracts from *Scutellaria sibthorpii*

Selin Tufan[1], Gizem Gulsoy Toplan[1] , Ezgi Oztas[2], Mayram Tuysuz[3], Afife Mat[1], Gunay Sariyar[4]*

[1] Department of Pharmacognosy, Faculty of Pharmacy, Istanbul University, Istanbul, Turkey

[2] Department of Toxicology, Faculty of Pharmacy, Istanbul University, Istanbul, Turkey

[3] Department of Microbiology, Faculty of Pharmacy, Istanbul University, Istanbul, Turkey

[4] Faculty of Pharmacy, Cyprus International University, Lefkosa, Turkish Republic of Northern Cyprus

Introduction

The genus *Scutelleria* (Lamiaceae) have long been used in folk medicine for centuries to treat several disorders. There are many studies on biological activity of *Scutelleria* species (Awad et al., 2003). The aerial parts of *Scutellaria sibthorpii* were extracted with different solvents such as hexane, ethyl acetate, methanol. Infusion of plant was also prepared. All extracts were studied against *Staphylococcus aureus, Staphylococcus epidermidis, Enterococcus faecalis, Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, Proteus mirabilis* and *Candida albicans* using microbroth dilution method. Cytotoxicity of extracts against human prostate cancer cell line (PC-3) and mouse embryo fibroblast cell line (NIH/3T3) were also examined *in vitro* by MTT assay.

Materials and Methods

Aerial parts of *S. sibthorpii* were extracted with hexane, ethyl acetate, methanol using Soxhlet apparatus. Antimicrobial activities of extracts against *S. aureus* (ATCC 29213), *S.epidermidis* (ATCC 12228), *E.faecalis* (ATCC 29212), *E.coli* (ATCC 25922), *K. pneumonia* (ATCC 4352), *P.aeruginosa* (ATCC 27853), *P.mirabilis* (ATCC 14153) and *C.albicans* (ATCC 10231) were determined by the microbroth dilutions technique using the Clinical Laboratory Standards Institute (CLSI) recommendations (CLSI, 2006,2008). The cytotoxicity of each extracts was evaluated using the MTT asay (Van Meerloo et al., 2011). IC_{50} values were calculated by MTT assay based on colorimetric changes. Two different cell line PC-3 and NIH/3T3 were used to evaluate anticancer potencies based on IC_{50} values.

Results and Discussion

All studied extracts were found more effective against Gram positive bacteria (MIC=625-1250 µg/mL) rather than Gram negative bacteria and yeast. Among tested extracts, hexane extract showed better activity both against Gram positive and negative bacteria (MIC=625-1250 µg/mL). Nevertheless none of the studied extracts showed antibacterial activity against *E. coli*, *P. aeruginosa* and *C. albicans*. According to MTT assay, all extracts showed moderate cytotoxic activity.

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PP-54. Diterpenoids from *Sideritis hispida* P. H. Davis endemic in Turkey

Sema Çarıkçı[1], Demet Acar[1], Turgut Kılıç[2], Tuncay Dirmenci[3]*

[1] Chemistry Department/Faculty of Art&Science, Balıkesir University, Turkey

[2] Science Education Department/ Faculty of Necatibey Education, Balıkesir University, Turkey

[3] Biology Education Department/Faculty of Necatibey Education, Balıkesir University, Turkey

carikci@balikesir.edu.tr

Introduction

Sideritis, belongs to the family of Lamiaceae (Labiatae), mainly found in the Mediterranean area and mostly in Spain and Turkey[1]. It is one of the species with the highest endemism rate (78%) among the species that are grown in Turkey[2]. *Sideritis* species are used for their analgesic, antirheumatic, digestive facilitator, antiulcerogenic, anti-inflammatory and antimicrobial properties as well as to heal common cold, flu and allergies in rural areas in both Turkey and Europe[2, 3]. This study was aimed to investigate diterpenoids components of *S. hispida* P. H. Davis endemic in Turkey.

Materials and Methods

The aerial parts of *S. hispida* were collected from Karaman – 16 km from the Mut, in July 2014. The plants were allowed to dry in the shade. To determine diterpenic components of the plant, hexane, acetone and methanol extract were prepared. For the isolation and purification of diterpenoids, chromatographic techniques (column, thin layer etc.) were used. Spectral methods (^{1}H-NMR, ^{13}C-NMR, COSY, HMQC, HMBC) were used to identify for the isolated compounds.

Results and Discussion

Six known diterpenoids and one steroid were isolated from the extracts and their structures were elucidated using spectral methods as follow: Siderol (*ent*-7α-acetyl-18-hydroxykaur-15-ene) (1), Sidol (*ent*-3β-acetyl-7α,18-dihydroxykaur-16-ene) (2), Eubotriol (*ent*-7α,15β,18-trihydroxykaur-16-ene) (3), 7-acetyl sideroxol (*ent*-7α-acetoxy-18-hydroxy-15β,16β-epoxykaurane) (4), Linearol (*ent*-3,7-dihydroxy,18-acetoxy-kaur-16-ene) (5), Sideroxol (*ent*-7α-18-dihydroxy-15β,16β-epoxykaurane) (6).

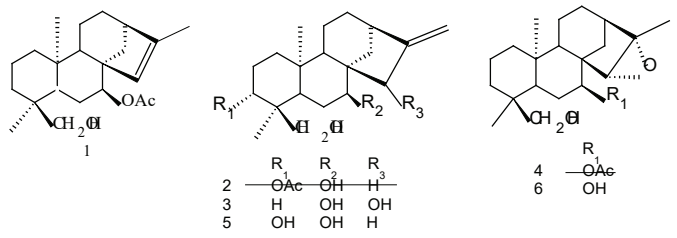

Figure 1. Structure of the isolated diterpenoids

Acknowledgments

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PP-55. Sustainability, production and quality of medical plants of the family Lamiaceae in Turkey

Yüksel Kan
Selçuk University, Agriculture Faculty, Department of Medicinal Plants, Konya, Turkey
kanyuksel@gmail.com

Abstract

Turkey is one of the world's richest countries in terms of plant genetic diversity. The main reasons for the richness of the endemic plant species in Turkey are due to different types of soil and topography which are the results of the diverse climate and other environmental conditions. Flora of Turkey comprises a total of 12,000 plant species, including about 4,000 endemic plants. About 500 medicinal plants are used for traditional medicine and food in Turkey. In recent years, about 50 species of medicinal plants belonging to Lamiaceae family have been cultivated for the purpose of commercial production in Turkey. Among these cultivated medicinal plant species are *Lavandula, Melissa, Mentha, Nepeta, Ocimum, Origanum, Rosmarinus, Salvia, Satureja, Sideritis* and *Thymus* sp. Some of the cultivated medicinal plant species are endemic. Phytochemical investigations of these medicinal plants cultivated in Turkey have revealed many interesting bioactive compounds. In this presentation, investigation of medicinal plants with high economic value of both natural and cultivated origin will be discussed in the context of conservation of biodiversity in the natural flora of Turkey.

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PP-56. The uses of some of medical plant belonging to Lamiaceae family as functional beverages in Turkey

Asuman Kan[*]
Selcuk University, Technical Sciences Vocational School of Higher Education, Department of Food Processing, Konya/ Turkey
asumankan42@gmail.com

Abstract

Lamiaceae is a family of flowering plants, mostly fragrant, with annual or perennial, herbaceous, rarely woody. Because family members contain essential oils and some important bioactive compounds, these plants are usually used as functional beverages. Turkey, where many plants are used in traditional beverages, is one of the world's richest countries in terms of medicinal and aromatic plants. These medicinal and aromatic plant species are used variously by the Turkish population, such as beverages like hot and cold tea as well as pharmaceuticals. Several endemic medicinal and aromatic plant species belonging to the family Lamiaceae such as mountain tea, sage and oregano both cultivated and collected from their natural habitats in Turkey, have been assessed for external and internal trades for beverage industry. In recent years, some medicinal and aromatic plants have been cultivated for the purpose of commercial production for beverages industry in Turkey. In this presentation, the uses as functional beverages of medicinal and aromatic plants both natural and cultivated in Turkey with high economic value will be discussed.

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PP-57. The important uses of thyme (*Thymbra spicata* L.) as a preservative in food industry

Asuman Kan

Selcuk University, Technical Sciences Vocational School of Higher Education, Department of Food Processing, 42049 Konya/ Turkey

asumankan42@gmail.com

Abstract

Many medicinal and aromatic plants are used in traditional as food preservative in Turkey. *T. spicata* is one of them used in Turkey. Thyme (*Thymbra spicata* L.) plant belongs to the family Lamiaceae grows naturally is a native plant of Turkey. In Turkey, *Thymbra spicata* is known with local names as "Zahter", "Sater" or "Karabaş Kekiği". Leaves of this plant are consumed as spice and tea, while young shoots are consumed as salad. One of the biggest problems that arise during the preservation and storage of food is lipid oxidation. Oxidation also causes degradation of color, taste, aroma, texture and consistency of the food and decrease of nutritional quality. *T. spicata* does not only prevent pestilence thanks to carvacrol and thymol contained in essential oil, but also prevents the growth of certain yeast and bacteria. With the functional properties of leaves and flowers of *T. spicata*, it is an alternative raw material that can be used as a natural preservative in extending the shelf life of foods in the food industry. In recent years, some medicinal and aromatic plants have been widely used for the purpose of commercial production by the food industry in the World. In this presentation, the uses of *T .spicata* (Thyme) as a natural preservative with high economic potential will be discussed

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PP-58. Ethnobotanical uses of Lamiaceae taxa at Çat (Rize) and environs

Hüseyin Baykal[1], Vagif Atamov[2], Fatma Abak[2], Abdulkadir Süzen[2]*

[1] Plant and Animal Breeding Department, Pazar Vocational School, Recep Tayyip Erdoğan University, Turkey

[2] Biology Department, Art and Science Faculty, Recep Tayyip Erdogan University, Turkey

huseyin.baykal@erdogan.edu.tr

Introduction

Lamiaceae is one of the most important family whose members are used as folk medicine or spice. The main goal of this study is to determine the ethnobotanical uses of the *Lamiaceae* taxa which are naturally grown in Çat (Rize).

Materials and Method

The *Lamiaceae* taxa samples were collected between 2012-2014, during the vegetation seasons with field surveys (Baykal, 2015). The collected taxa were identified by using the Flora of Turkey. The taxa were dried and their herbarium specimens were prepared. All taxa have been housed at the herbarium of Biology Department, Art and Science Faculty, Recep Tayyip Erdoğan University. The taxa shown to the local people of Çat and environs and the questions about their uses were asked and the answers were noted. Local name, used parts and ethnobotanical uses of taxa were determined.

Result and Discussion

It is found that *Origanum vulgare* (Boiss.)Hayek, *Thymus praecox* Opiz, *Thymus longicaulis* C. Presl., *Thymus nummularius* M. Bieb., *Mentha longifolia* (L.) Hudson, *Mentha spicata* L., *Stachys cretica* L., *Salvia verticillata* L. have an ethnobotanical importance in the study area. The taxa were used as folk medicine, tea and as ornamental. The villagers use medicinal plants for the treatment of abdominal and stomach ache, cold, cough, sniffles, flu.

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PP-59. Biodiversity of Lamiaceae family in Handuzu and Ceymakçur plateau (Rize)

Vagif Atamov[1], Fatma Abak[1], Huseyin Baykal[2], Abdulkadir Süzen[1]*

[1] Biology Department, Art and Science Faculty, Recep Tayyip Erdogan University, Turkey

[2] Plant and Animal Breeding Department, Pazar Vocational School, Recep Tayyip Erdoğan University, Turkey

vhatemov@yahoo.com

Introduction

The *Lamiaceae* family comprising a high number of taxa is an important family in the flora of Rize. The aim of this study was to evaluate the biodiversity of *Lamiaceae* family according to the the floristical studies which were carried out between the years 2012-2016 in Handüzü and Ceymakçur, Başhemşin Plateau, Rize(Çobanoglu, 2012; Demir, 2013; Baykal, 2015).

Material and methods

The plant samples were collected during the years 2012-2016 by field surveys from the study area. The collected plant materials were identified using the Flora of Turkey and were dried and herbarium specimes were prepared. The herbarium materials are deposited at the Faculty of Science and Art.

Result and Discussion

The families which are rich in useful taxa in the study area are *Asteraceae* (52 taxa), *Poaceae* (35 taxa), *Rosaceae* (31 taxa), *Fabaceae* (25 taxa) and with 24 taxa, Lamiaceae is also one of those families. The distribution of *Lamiaceae* genera (with the number of taxa) used is as follows: *Lamium* (3), *Stachys* (3*), Mentha* (2), *Salvia* (2), and *Mentha* (2), *Ajuga* (2). In terms of habitat diversity, the taxa belonging to this family are distributed in mesophyte and xeromezophite habitats. They are usually distributed on hard rocky slopes or aquatic areas. On the other hand, most of the *Lamiaceae* taxa are more abundant in alpine and subalpine meadows. The taxa which are naturally distributed in both Handüzü and Ceymakçur plateau are *Ajuga reptans, Origanum vulgare* subsp. *vulgare, Prunella vulgaris, Salvia verticillata* subsp. *verticillata, Scutellaria pontica, Stachys macrantha, Thymus pseudopulegionides, Thymus praecox* subsp. *caucasicus* var. *grossheimii*. The family is represented by 15 genera and 23 taxa in Handüzü and 9 genera and 11 taxa in Ceymakçur (Çobanoğlu, 2012, Demir 2013). The taxa such as *Mentha spicata* subsp. *spicata*, *Mentha pulegium*, *Nepeta nuda* subsp. *albiflora*, *Ocimum basilicum, Salvia glutinosa, Stachys sylvatica, , Stachys annua* subsp. *annua*, *Teucrium chamaedrys* subsp. *trapezunticum*, *Ziziphora clinopodioides Clinopodium umbrosum, Lamium amplexicaule, Salvia forskahlei* and *Scutellaria galericulata* taxa are only distributed in one of these plateaus.

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PP-60. Chemical composition and antioxidant activity of essential oils of six Lamiaceae plants growing in southern Turkey

Hasan Maral[1], Ebru Kafkas[2], Tuncay Çalışkan[3], Saliha Kırıcı[3]*

[1] Karamanoğlu Mehmetbey University, Ermenek Vocational School, Karaman, Turkey.

[2] Çukurova University, Agricultural Faculty, Department of Horticulture, Adana, Turkey.

[3] Çukurova University, Agricultural Faculty, Department of Field Crops, Adana, Turkey.

hasmaral@kmu.edu.tr

Abstract

The family Lamiaceaeincludes about 220 genera and 3300 species which are widely used for various purposes worldwide. Plants belonging to the family Lamiaceae are rich in polyphenolic compounds and a large number of them are well known for their antioxidant properties. In our work, the essential oils of six species were evaluated for their chemical composition and antioxidant activity. The plants analyzed and their essential oil yields were *Thymbra spicata:* 1.28%,*Saturejacilicica:* 1.64%, *Thymus sipyleus:* 0.18%, *Salvia albimaculata:* 0.02%, *Salvia caespitosa:* 0.03%, *Ziziphora clinopodioides:* 0.35%.

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PP-61. Essential oil composition of *Marrubium lutescens* Boiss.

Yavuz Bülent Köse[*,1], Elif Dündar[1], Gökalp İşcan[2], Betül Demirci[2]*

[1] Anadolu University, Faculty of Pharmacy, Department of Pharmaceutical Botany, 26470, Eskişehir, Turkey

[2] Anadolu University, Faculty of Pharmacy, Department of Pharmacognosy, 26470, Eskişehir, Turkey

ybkose@anadolu.edu.tr

Introduction

The genus *Marrubium* L. of Lamiaceae is an annual and perennial plant. The species of this genus are mainly distributed in the Irano-Turanian and Mediterranean phytogeographic regions. The genus comprises about 40 taxa (Akgül, 2012), and is represented by 21 taxa, of which 12 are endemic in Turkey (Aytaç et al., 2012). This endemism rate (57%) shows that Turkey is an important gene centre for this genus.

Materials and Methods

M. lutescens was collected from Niğde, Meydan Plato Road at flowering stage in July 2015. A voucher specimen is kept in the Faculty of Pharmacy Herbarium, Anadolu University, Eskişehir, Turkey. The essential oil was obtained from the dried plant material by hydrodistillation, subsequently analysed by GC-FID and GC/MS for the determination of the phytochemical profile.

Results and Discussion

The essential oil was obtained using a Clevenger apparatus by hydrodistillation from the aerial parts of *M. lutescens* yielding 0.02%. Main constituents were found as germacrene D (43.1%), bicyclogermacrene (7.6%), β-caryophyllene (6.2%), limonene (4.1%), and bicycloelemene (3.1%), respectively. To the best of our knowledge, this is the first report on the chemistry of this plant.

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PP-62. Biological activities of the essential oils of *Ajuga postii* briq. and *Ajuga relicta* P.H.Davis (Lamiaceae) from Turkey

Emel Sönmez[*1], Yavuz Bülent Köse[1], Betül Demirci[2], Nursenem Karaca[3], Fatih Demirci[2]*

[1] Anadolu University, Faculty of Pharmacy, Department of Pharmaceutical Botany, Eskişehir, Turkey

[2] Anadolu University, Faculty of Pharmacy, Department of Pharmacognosy, Eskişehir, Turkey

[3] Anadolu University, Institute of Health Sciences, Eskişehir, Turkey

emels@anadolu.edu.tr

Introduction

Members of the genus *Ajuga* L. grow naturally in Europe, Asia, Africa, Australia and North America, or are grown in the gardens. According to previous reports Ajuga species are used in traditional medicine as antiinflammatory and antimycobacterial agents, against fever, toothache, dysentery, malaria, hypertension, diabetes, intestinal disorders and also to prevent insect growth (Israili and Lyoussi, 2009). *Ajuga* is represented by 13 species and 10 subspecies in Turkey (Güner et al., 2012), while *Ajuga postii* Briq. and *Ajuga relicta* P.H.Davis are local endemic species, which are the subject of this study.

Material and Methods

The aerial parts of *A. postii* were collected from İçel: Çamlıyayla, Namrun Castle, 1350 m (10.07.2015) and aerial parts of *A. relicta* were collected from Kahramanmaraş: Çimen Mountain, Yavşan Hill, Pekmezpınarı, 1500 m (03.06.2015), respectively.

Hydrodistillation of the airdried herbal parts of *A. postii* and *A. relicta* yielded essential oils. In vitro antibacterial, anti-helicobacter and anticandidal activities werestudied by microdilution against human pathogenic standard strains.

Results and Discussion

The essential oil of *A. postii* was effective against *Helicobacter pylorii* at 4 mg/mL concentration. Both tested essential oils were effective against *C. albicans* strains also at 4 mg/mL, while the only essential oil of *A. relicta* was effective against *C. krusei*, when compared with standard antimicrobial agents.

Acknowledgement

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PP-63. Study of the yield and the chemical composition of *Origanum vulgare* subsp. *hirtum*

Selda Oflaz[1], K. Hüsnü Can Başer[2]

[1] Department of Medical Oncology, Akdeniz University Faculty of Medicine, Antalya, Turkey

[2] Near East University, Faculty of Pharmacy, Department of Pharmacognosy, Lefkoşa (Nicosia), TRNC, Mersin 10, Turkey

The study material *Origanum vulgare* subsp. *hirtum* was collected before and during flowering and during seeding stages from Çanakkale province, Turkey. Essential oils were obtained by water distillation from before-flowering, flowering and seeding herbal materials with 3.3%, 3.6% and 4.4% yields, respectively. Main components in the oils were carvacrol, thymol, α-pinene, γ-terpinene and p-cymene. Quantitative variations were observed in the oils obtained during different vegetative stages. Carvacrol (75 %), p-cymene (7%), γ-terpinene (5.7%) were higher in oils obtained from flowering plants while carvacrol (43%), thymol (27%) and γ-terpinene (10%) contents were relatively higher in oils obtained from fruiting plant materials.

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PP-64. Essential oil composition of *Lamium purpureum* L. from İstanbul

Kaan Polatoğlu[1], Hüseyin Servi[2], Mesut Tandoğan[3], Nilüfer Şahin[3], Mehmet Özdemir[3]*

[1] İstanbul Kemerburgaz University, Faculty of Pharmacy, Department of Analytical Chemistry

[2] Yıldız Technical University, Graduate School of Science, Department of Organic Chemistry

[3] Republic of Turkey, General Directorate of Forestry, Institute of Marmara Forestry Research

kaan.polatoglu@kemerburgaz.edu.tr

Introduction

There are very few reports on the essential oil composition of *Lamium purpureum* L. Until now there are only handful of reports investigating the essential oil composition of this invasive weed. According to a study from USA, essential oil of *L. purpureum* was reported to contain varying amounts of germacrene D 46.3-15.0%, β-pinene 16.3-5.8%, β-elemene 16.0-3.7%, α-pinene 15.3-4.1%, 1-octen-3-ol 15.3-4.2% and β-ylangene 5.7-0.3% compounds as major components (Jones et. al., 2012). Another study from Italy reports main components of the essential composition of aerial parts as germacrene D 35.4%, β-pinene 26.8% and α-pinene 13.4%.

Materials and Methods

Lamium purpureum was collected during the flowering period from İstanbul. Essential oil was obtained by 3h hydrodistillation (yield: 0.01%). The GC-MS analysis was performed with an Agilent 5977 MSD system operating in EI mode.

Results and Discussion

According to GC-MS analysis, the essential oil contained β-elemene 28.9%, germacrene D 11.7%, undecane 7.3%, phytol 7.2%, nonacosane 4.5% and heptacosane 2.9% as major components. The essential oil obtained from *L. purpureum* collected from İstanbul have considerable differences than the oils reported from USA and Italy which contained α-pinene, β-pinene and germacrene D as the major components.

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PP-65. Comparative analysis of aromatherapy grade *Mentha piperita* L. commercial essential oils

Ufuk Müftüoğlu[1], Kaan Polatoğlu[2]*

[1] İstanbul Kemerburgaz University, School of Pharmacy, Istanbul, Turkey

[2] İstanbul Kemerburgaz University, Faculty of Pharmacy, Department of Analytical Chemistry, Istanbul, Turkey

kaan.polatoglu@kemerburgaz.edu.tr

Introduction

Mentha piperita L. essential oil finds its use in confectionaries, food products, herbal teas and in aromatherapy. Previously essential oil composition of *Mentha piperita* was reported to contain menthol 42.3-27.5%, menthone 27.9-18.4%, pulegone 14.4-1.0%, menthofuran 5.5-1.3% and 1,8-cineole 5.3-3.4% main components (Iscan et al., 2002).

Materials and Methods

Commercial aromatherapy grade essential oil samples of different brands (S1, S2) were obtained from a local community pharmacy. The authentic *Mentha piperita* dried aerial parts were obtained from a local herb store and its essential oil was obtained through 3h hydrodistillation (yield: 1.3%). The GC-MS analysis was performed with an Agilent 5977 MSD system operating in EI mode. dentification of essential oil components were carried out by comparison of their relative retention indices (RRI) obtained by series of *n*-alkanes (C5 to C30) to the literature and with mass spectra comparison.

Results and Discussion

Authentic hydrodistilled (HD) *M. piperita* essential oil and commercial oil samples (S1, S2) showed considerable differences. HD essential contained menthone 32.6%, menthol 17.2%, 1,8-cineole 5.8%, isomenthone 5.6%, neo-menthol 5.2%, piperitone 3.9%, menthyl acetate 3.7% and germacrene D 2.1%. The commercial oil samples (S1, S2) contained menthol 25.9-27.2%, menthone 21.8-22.5%, isomenthone 10.7-10.5%, neo-menthol 10.2-11.9%, pulegone 5.4-5.5% and menthyl acetate 4.9-3.7% respectively for S1 and S2. Both commercial oils lack components 1,8-cineole, piperitone and germacrene D. Pulegone was present in the HD oil in minor amounts (0.6%) and isomenthone, neo-menthol were lesser in amounts when compared with the S1-S2 oils. Unfortunately the S1-S2 were richer in pulegone content which is reported to be a hepatoxic compound (Sulivan et. al., 2002).

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PP-66. Essential oil composition of *Stachys obliqua* Waldst et Kit

Betül Demirci[1], Gülsüm Yıldız[1], Neşe Kırımer[1], Atila Ocak[2], K. Hüsnü Can Başer[3]*

[1] Department of Pharmacognosy, Faculty of Pharmacy, Anadolu University, 26470, Eskişehir, Turkey

[2] Department of Biology, Faculty of Science and Literature, Osmangazi University, 26480, Eskişehir, Turkey

[3] Department of Pharmacognosy, Faculty of Pharmacy, Near East University, Nicosia (Lefkoşa), N. Cyprus, Mersin 10, Turkey

gulsumyildiz@anadolu.edu.tr

Introduction

The genus *Stachys* L. (Lamiaceae) is represented in Turkey by 83 species and altogether 109 taxa (Akçiçek, 2010). The rate of endemism in Turkey is 43.4 with 33 species (Davis et al., 1988, Duman, 2000). Stachys is known in Anatolia as 'Adaçayı', `Dağ çayı' and `Balbaşı' and used like sage (Sezik & Basaran, 1985).

Materials and Methods

S. obliqua Waldst et Kit was collected in July, 2015 in Yarımca to Eskişehir 2nd km by the road side. The essential oil from air-dried aerial parts was isolated by hydrodistillation using a Clevenger apparatus. Chemical composition of the oil was investigated using GC-FID and GC/MS techniques.

Results and Discussion

Hexadecanoic acid (10.1%), germacrene D (8.2%), hexahydro farnesyl acetone (4.4%), β-bourbonene (2.1%) were found as main constituents in the oil. In a previous study, the major components were reported as germacrene D (25.4%), thymol (16.4%), borneol (4.9%), α-pinene (4.7%) and isomenthol (3.4%) (Harmandar et al., 1997). According to Gören et al. germacrene D (45%) and β-caryophyllene (17%) were main components (Gören et al., 2011).

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PP-67. Journey to the past: Tracing ancient distribution and migration of *Salvia s.l.* on the globe

Maria Will[1,2], *Regine Claßen-Bockhoff*[1 *]

[1] Institut für Organismische and Molekulare Evolutionsbioloie, Johannes Gutenberg-Universität Mainz, Germany

[2] Institut für Biologie und Umweltwissenschaften, Carl von Ossietzky-Universität Oldenburg, Germany

classenb@uni-mainz.de

Introduction

Salvia L. is one of the most famous plant genera including many useful and ornamental species. Traditionally, it was accepted as the largest genus within the mint-family, morphologically well supported by the staminal lever mechanism. However, molecular studies clearly indicate that *Salvia* is polyphyletic splitting into four distinct evolutionary lineages (Clade I-IV) (Walker et al. 2004; Will and Claßen-Bockhoff 2014). Based on a comprehensive molecular dataset and fossil data, we here reconstruct the distribution and putative migration routes of *Salvia* s.l. during the past.

Materials and Methods

We included ITS data from 220 *Salvia* species, 86 of which were sequenced for the first time. Additionally, the highly variable plastid marker *rpl*32-*trn*L was sequenced, providing new data for 100 *Salvia* species. These sequences were combined with the GenBank accessions. Old World *Salvia* is, thus, represented with 57% of its species. The two datasets were analyzed separately using BI and ML.

Results and Discussion

Based on molecular data, geographical distribution, morphology, and karyology we propose to split *Salvia* s.l. into six genera (Will and Claßen-Bockhoff 2017), i.e. *Salvia* s.s. (clade I), *Lasemia* Raf. and *Ramona* Greene (clade II), *Pleudia* Raf. (Will et al. 2015) and *Polakia* Stapf (clade III) and *Glutinaria* Raf. (clade IV). These groups show a remarkable geographic pattern. Clade I (*Salvia* s.s.) is the only lineage distributed over two continents (Africa-Eurasia, N-America), while the other clades are restricted to the new world (clade II), to an area ranging from SW-Asia to N-Africa (clade III) and to E-Asia (clade IV). We conclude that *Salvia* s.s. originated in SW Asia from where America was colonized once and South Africa and the Canary Islands each twice. Regarding *Salvia* s.l., the American clade II most likely evolved in the new world after the migration of an Asian ancestor via the Bering Land Bridge. The E-Asian species form a molecularly and geographically clearly separated clade with the European *Salvia glutinosa* being the only outlier. Though knowledge about *Salvia* has considerably increased during the last 15 years, many molecular, morphological and biological data are still lacking. Understanding the evolution of *Salvia* remains a challenge.

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PP-68. Composition of the essential oil and antioxidant capacity of *Moluccella species* from Turkey

Ayşegül Köroğlu (Güvenç)[1], Gülmira Özek[2], M. Mesud Hürkul[1], Temel Özek[2,3], K. Hüsnü Can Başer[4]*

Anadolu University, Department of Pharmacognosy, Faculty of Pharmacy, 26470 Eskisehir, Turkey

[1] Ankara University, Department of Pharmaceutical Botany, Faculty of Pharmacy, 06100, Tandoğan, Ankara, Turkey

[2] Anadolu University, Department of Pharmacognosy, Faculty of Pharmacy, Eskişehir, 26470, Turkey

[3] Medicinal Plants, Drugs and Scientific Research Center, Anadolu University, 26470, Eskisehir, Turkey

[4] Near East University, Faculty of Pharmacy, Department of Pharmacognosy, Lefkoşa (Nicosia), N. Cyprus, Mersin 10, Turkey

aguvenc@ankara.edu.tr

Introduction

The genus *Moluccella* L. belongs to Lamiaceae family (subfamily: Lamioideae). Representatives of the genus are annual plants. The genus grows mainly in the Mediterranean region and two species *Moluccella laevis* L. and *M. spinosa* L. are native to Turkey. *M. laevis* is Ir.-Tur. element and *M. spinosa* is a rare plant. Both species are distributed in Southern Anatolia. In scope of the present work, chemical composition of the essential oils of *Moluccella laevis* and *M. spinosa* were investigated. The oils as well as the extracts obtained with solvents of different polarities were evaluated for their antioxidant properties. To the best of our knowledge, the chemical composition of volatile constituents and antioxidant capacities of *Moluccella* species from Turkey have not previously been reported.

Materials and Methods

The aerial parts of *M. laevis and M. spinosa* were subjected to hydrodistillation in Clevenger-type apparatus to yield essential oils (EO's) as well as to solvent extraction (with MeOH) to yield extracts (ME's). The oils were analyzed with GC-FID and GC/MS techniques. The total phenol content in ME's was determined with spectrophotometric method. The EO's and ME's were investigated for free radical scavenging effect with DPPH assay. The thiobarbituric acid (TBA) test was used to assess the efficacy of the extract and essential oil in protecting liposomes from lipid peroxidation. The total polyphenol content of *Moluccella* extracts was determined by Folin-Ciocalteu method, referring to calibration curve of gallic acid, phenol compound used as a standard.

Results and Discussion

The main components of the oils were found as *cis*-chrysanthenyl acetate (6.6 %) in *M. laevis* and hexahydrofarnesyl acetone (4.0 %) in *M. spinosa*. Among the tested extracts the highest phenolic contents were determined in *n*-BuOH extract (150.0 ± 4.83 mg/g) of *M. laevis* and in dichloromethane extract (95.0 ± 9.09 mg/g) of *M. spinosa*. The ability to scavenge free radicals was found to be as highest in *n*-BuOH extract of *M. laevis*. The inhibition of lipid peroxidation was demonstrated by the water extract of *M. laevis*. The rest of the extracts showed a moderate antioxidant capacity. The essential oils did not demonstrate noteworthy antioxidant capacity in both assays.

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PP-69. Antioxidant and antimicrobial activities of *Phlomoides laciniata* essential oil, methanolic extract and infusion

Damla Kırcı, Betül Demirci[1], Fatih Göger[1], M. Armağan[2], K.H.C. Başer[3]*

[1] Department of Pharmacognosy, Faculty of Pharmacy, Anadolu University, Eskişehir, Turkey

[2] Faculty of Education, Yüzüncü Yıl University, Van, Turkey

[3] Department of Pharmacognosy, Faculty of Pharmacy, Near East University, Lefkoşa, N. Cyprus, Mersin 10, Turkey

damlakirci@anadolu.edu.tr

Introduction

The one of the largest families of flowering plants is Lamiaceae comprising about 250 genera. The family is divided into seven subfamilies containing almost 7200 species. *Phlomoides laciniata* (L.) Kamelin & Makhm. which thrives in Iran, Turkey and Azerbaijan, is utilized in Persian traditional medicine as a local antiinflammatory and analgesic and also for the treatment of musculoskeletal problems (Eftekharsadat, B. *et al.* 2010; Delazar et al., 2004). In the present work, chemical composition of the essential oil (EO), methanolic extract (ME) and infusion (INF) of *Phlomoides* laciniata were investigated. In addition, antioxidant and antimicrobial activities were also examined.

Material and Methods

The aerial parts of *Phlomoides laciniata* was collected in June 2016 from Doğubayazıt, Ağrı (Turkey). The EO was obtained by hydrodistillation using a Clevenger type apparatus for 3h. A small amount of essential oil trapped in *n*-hexane was analyzed by GC-FID and GC/MS, simultaneously. The methanolic extract and 5% infusion of *E. laniciata* were prepared. HPLC analysis was performed to determine their chemical composition. 2,2-Diphenyl-1-picrylhydrazyl (DDPH) autographic evaluation was used for the detection of the antioxidant capacity of the ME and INF. ME and INF were examined for antimicrobial activity by the microdilution broth susceptibility assay against *Staphyloccoccus aureus, S. epidermidis, Bacillus cereus, Salmonella typhimurium, Listeria monocytogenes, Enterobacter aerogenes*.

Results and Discussion

Phytol (32.2%), hexahydrofarnesyl acetone (12.6%), tricosane (10.7%), methyl pentadecane (6%), pentacosane (4.8%), heptacosane (4.4%), hexadecanoic acid (3.8%) and nonacosane (1.2%) were determined as major components by GC/MS and GC-FID. Verbascoside, forsythoside B, luteolin glucoside were determined in the ME and INF by using HPLC. Antioxidant activity was measured against the positive controls ascorbic acid and gallic acid. The IC_{50} value was calculated as the ME 0.125 mg/mL and the INF 0.25mg/mL. The ME and INF showed weak antimicrobial effects against all tested microorganisms.

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PP-70. Mineral contents of *Cyclotrichium origanifolium* (Labill.) Manden & Scheng

Züleyha Özer[1], Turgut Kılıç[2], Sema Çarıkçı[3]*

[1] Medicinal and Aromatical Plants Programme, Altinoluk Vocational School, Balikesir University, Altinoluk, Edremit-Balikesir, Turkey

[2] Department of Science Educations, Necatibey Education Faculty, Balikesir University, Altieylül-Balikesir, Turkey

[3] Department of Chemistry, Faculty of Sciences and Arts, Balikesir University, Balikesir, Turkey

zuleyhaozer@balikesir.edu.tr

Introduction

The family Labiatae has an important role as a source of medicinal and aromatic plants of commercial importance (Kaya et al., 2000). The *Cyclotrichium* genus is represented in Turkish flora by 15 species of which two are endemic. *Cyclotrichium origanifolium* (Labill.) Manden & Scheng (known as nane ruhu in Turkish) has been used as flavoring agent in soups, salads and herbal tea in Turkey (Göktürk et al., 2013). Mineral elements are plant nutrients and are therefore essential for growth and field production of medicinal plants.

Materials and Methods

The aerial parts of *Cyclotrichium origanifolium* were collected from Mersin, Toroslar, Isiktepe village road, in July 2015. The species was identified by Assoc. Prof. Dr. Selami Selvi of Balikesir University. Voucher specimens were deposited at the Herbarium of Altinoluk Vocational School, Balikesir University, Balikesir, Turkey (SS1406). Infusion; dried aerial parts of the plant (2 g) were added to 98 mL distilled boiled water and it was allowed to stay for a known interval (15 min). The tea was filtered with an ashless filter paper. Decoction; dried aerial parts of the plant (2 g) were added in 98 mL distilled water and heated together in a steel kettle, and were allowed to stay for a known interval (15 min) after boiling. This was filtered with an ashless filter paper. Wet digestion; dried aerial parts of the plant (0.5 g) were added in a 100 mL beaker. 10 mL concentrated nitric acid (HNO_3, 65 %) was added to beaker. Beaker was closed with watch-glass and left to stand for 16 h. Then, the beaker was boiled 2 h in hood. It was filtered with an ashless filter paper when it was cold. Then, it was completed to 25 mL with distilled water. The determination were performed using inductively coupled plasma optical emission spectra (ICP-OES) (Pelmer optime 3100XL mod.).

Results and Discussion

In this study, mineral contents of *Cyclotrichium origanifolium* were investigated. Three methods were used: infusion, decoction and wet digestion. The following elements were determined: Al, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Ni, Pb, Sn, Be, Ba, Mo, B, V and Zn. The Highest levels were observed in Ca, Mg and Mn. Ca and Mg are referred as mineral macronutrients in higher plants because of the high requirements of these elements for plant growth.

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PP-71. Comparative volatile analysis of *Melissa officinalis* L. herbal tea preparations

Melis İleri[1], Kaan Polatoğlu[2]*

[1] İstanbul Kemerburgaz University, School of Pharmacy, İstanbul, Turkey

[2] İstanbul Kemerburgaz University, Faculty of Pharmacy, Department of Analytical Chemistry, İstanbul, Turkey

kaan.polatoglu@kemerburgaz.edu.tr

Introduction

Previously *Melissa officinalis* volatile analysis was performed with HS-SPME method and the major components were identified as citronellal 31.1%, citronellol 18.3%, β-caryophyllene 12.0%, (*E*)-citral 11.9%, (*Z*)-citral 9.6%, geraniol 3.6%, (*Z*)-β-ocimene 3.1% and 1-octen-3-ol 2.0% (Rehman et al. 2013).

Materials and Methods

Dried leaves of *Melissa officinalis* L., *Hibiscus sabdariffa* L.*, Piper longum* L., *Myristica fragrans* Houtt. were obtained from the local herb market. *Melissa officinalis* tea and its mixed tea was prepared by infusing 10 g of herb in 200 mL boiling water for 5 minutes. Mixed teas contained either 2g of crushed *P. longum* (HPM) or *M. fragrans* (HMM) and 2g of *H. sabdariffa* flowers and 6g of *M. officinalis* or only 10 g *M.officinalis* (M). The volatiles of the herbal teas were extracted with 10 mL *n*-hexane with 50 mL of hot tea in a separating funnel. The organic layer was then separated and dried over anhydrous Na_2SO_4. The GC-MS analysis was performed with an Agilent 5977 MSD system operating in EI mode.

Results and Discussion

M. officinalis (M) herbal tea volatiles have geranial (*E*-citral) 16.3%, 1,8-cineole 15.3%, neral (*Z*-citral) 8.8% and eugenol 7.9% compounds as major components. The volatiles of herbal tea prepared from *M. fragrans, H. sabdariffa* and *M. officinalis* (HMM) have terpinen-4-ol 23.1%, 2-dodecanoic acid 17.8%, myrsticine 10.7%, 3-hexanol 8.9% and 2-hexanol 6.9% compounds. MPM tea volatiles contained geranial, 1,8-cineole and neral in minor quantities. The volatiles of herbal tea prepared from *P. longum*, *H. sabdariffa* and *M. officinalis* (HPM) contained geranial 20.3%, 1,8-cineole 15.2% and neral 10.2% compounds. Currently our research is directed to evaluate AChE & BChE inhibition properties of these herbal teas.

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PP-72. Biological activity of *Cyclotrichium origanifolium* (Labill.) Manden. & Scheng.

Yavuz Bülent Köse[1] , Gökalp İşcan[2,3], Betül Demirci[2,]*

[1] Anadolu University, Faculty of Pharmacy, Department of Pharmaceutical Botany, Eskisehir, Turkey.

[2] Anadolu University, Faculty of Pharmacy, Department of Pharmacognosy, Eskisehir, Turkey.

[3] Anadolu University, Yunus Emre Vocational School of Health Services, Eskisehir, Turkey.

ybkose@anadolu.edu.tr

Introduction

Cycotrichium Manden. & Scheng. (Lamiaceae) is one of the medicinal plants used in traditional medicine in Turkey. Six species belonging to Cyclotrichium are growing in Turkey (Güner et al., 2012). Cyclotrichium origanifolium is endemic from Turkey and widely used as flavouring agents in soup and salads in Turkey (Baytop,1997).

Materials and Methods

The plant material was collected from Turkey, İçel, Namrun in June 2015. Hydrodistilled plant yielded an essential oil, which was analysed by both Gas Chromatography-Mass Spectrometry (GC-MS) and Gas Chromatography-Flame Ionization Detection (GC-FID) systems. In addition, the essential oil was tested for its antimicrobial activity against ten bacteria and eight different pathogenic Candida strains, by using CLSI M7-A7 and M27-A2 protocols, respectively.

Results and Discussion

According to GC-MS results, pulegone (49.9 %), isomenthone (19.4 %) and piperitenone (10.0 %) were found as major constituents of the essential oil. All tested pathogens were inhibited between 500 - 2000 µg/mL (MIC).

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PP-73. Characterization of *Calamintha nepeta* subsp. *glandulosa* essential oil and investigation of its basic apoptosis studies on mm U266 cell line

Sinem Aslan Erdem[1], Selin Gerekci[2], Burak Bıyık[3], Tuğba Somay Doğan[4], Maksut Coşkun[3], Can Özen[4,5,6],*

[1] Department of Pharmacognosy, Faculty of Pharmacy, Ankara University, Ankara

[2] Graduate Program of Biochemistry, METU, Ankara

[3] Department of Pharmaceutical Botany, Faculty of Pharmacy, Ankara University, Ankara

[4] Central Laboratory, Molecular Biology and Biotechnology R&D Center, METU, Ankara

[5] Graduate Program of Biotechnology, METU, Ankara

[6] Center of Excellence in Biomaterials and Tissue Engineering, METU, Ankara

sinemaslanerdem@yahoo.com

Introduction

Calamintha nepeta (L.) Savi, a well-known Mediterranean plant, has been used in folk medicine as antispasmodic, stimulant, antiseptic as well as spice. It has been revealed that the essential oil has antimicrobial, antifungal and antispasmodic activities (Baldovini et al., 2000; Demirci et al., 2011). Multiple Myeloma (MM) is a hematological malignancy which is characterized by the uncontrolled growth of plasma cells in the bone marrow (Naymagon and AbdulHay, 2016). In this study apoptic effect of the essential oil from *C. nepeta* subsp. *glandulosa* was examined on the MM U266 cell line.

Materials and Methods

The plant material was collected from Ankara, Güdül region in Turkey. Essential oil was obtained from the dried aerial parts of the plant by hydrodistillation and analyzed by GC and GC/MS in order to identify the components of the oil. Drug treatment was done at 105 cells/mL cell density in all experiments. Caspase-3 (PE Active Caspase-3 Apoptosis Kit, BD USA) and Annexin V (PE Annexin-V Apoptosis Kit, BD USA) levels were detected with on BD Accuri C6 flow cytometer. Flow rate was set to medium (35 uL/min) and 104 events were recorded for each measurement.

Results and Discussion

trans-Piperitone oxide (65.3%) was determined to be the major component of the oil, followed by limonene (11.0%) and piperitenone oxide (7.9%). To evaluate the loss of cell membrane phospholipid asymmetry, MM U266 cells were treated with 50 µg/mL volatile oil for 48 h. There was a significant increase in treated cell population % for early apoptosis and late apoptosis state while live cell population % was decreasing. Active caspase-3 is used as a marker for cells undergoing apoptosis. To evaluate the apoptotic effect of volatile oil, cells were treated with 50 µg/mL extraction for 48 h. There was a significant increase in Caspase-3 activity of volatile oil treated cells. Our results show that volatile oil of *C. nepeta* subsp. *glandulosa* has a potent apoptotic effect on U266 cell line.

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PP-74. Essential oil and fatty acid compositions of *Stachys hissarica* Regel from Uzbekistan

Daniya T. Asilbekova[1], Gulmira Özek[2], Temel Özek[2,3], K. Hüsnü Can Başer[4], Shamansur Sh. Sagdullaev[1]*

[1] Acad. S.Yu. Yunusov Institute of the Chemistry of Plant Substances, Academy of Sciences of the Republic of Uzbekistan, 100170 Tashkent, Uzbekistan

[2] Anadolu University, Department of Pharmacognosy, Faculty of Pharmacy, 26470 Eskisehir, Turkey

[3] Anadolu University, Medicinal Plant, Drug and Scientific Research Center (AUBIBAM) 26470 Eskisehir, Turkey

[4] Near East University, Faculty of Pharmacy, Department of Pharmacognosy, Lefkosa (Nicosia), TRNC, Mersin 10, Turkey

dasil@rambler.ru

Introduction

In the Flora of Uzbekistan, the genus *Stachys* is represented by four species. Among them *Stachys hissarica* Regel is endemic in Central Asia (1). The present work is the first detailed contribution into the essential oil and fatty acid compositions of the aerial parts of *S. hissarica*.

Materials and Methods

The flowering and fruiting aerial parts of *S. hissarica* were collected in 2015 (Tashkent region, Uzbekistan). The species was identified by Dr. Alim M. Nigmatullaev (The Laboratory of Medical and Technical Plants of ICPS AS of RUz). The essential oil was obtained by hydrodistillation in a Clevenger-type apparatus. The oil analysis was performed by GC (FID) and GC/MS on Innowax column. The total lipids (TL) from the plant material were isolated with chloroform - methanol (2:1, v/v) by Folch method (2). TL were separated into neutral (NL) and polar lipids (PL) by column chromatography on silica gel. The fatty acids obtained from NL and PL were converted to methyl esters and analyzed by capillary GC on HP-5 column.

Results and Discussion

The yield of essential oil from aerial part of *S. hissarica* was 0.12% on dry weight. In total, 64 compounds were identified, amounting 91.2% of the oil. The major constituents of the essential oil were germacrene D (43.2%), geranyl-α-terpinene (12.6%), 9-geranyl-*p*-cymene (4.9%), α-cadinol (2.9%), δ-cadinene (2.7%), β-bourbonene (2.2%), α-muurolene (2.2%) and α-eudesmol (2.1%). The TL yield was 3.8% based on dry weight. The lipids consist of 27.9% PL and 72.1% NL with 15.5% of unsaponifiable substances. The fatty acid compositions of NL and PL were 14:0 – 7.0% and 0.7%, 16:0 – 33.4% and 9.1%, 18:0 – 5.0% and 1.2%, 20:0 – trace and 0.3%, 22:0 – 2.1% and 0.5%, 24:0 – 2.0% and 0.8%, 18:2 – 13.0% and 15.3%, 18:3 (main)+18:1 – 37.5% and 71.7%. In addition, the fatty acid composition of PL was 15:0 – 0.2%, 17:0 – 0.2%. These results show that NL contain equal amounts of saturated (49.5%) and unsaturated fatty acids (50.5), while in PL unsaturated fatty acids (87.0%) predominated.

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PP-75. The volatile components of *Marrubium cuneatum* Banks & Sol. from Turkey

Mehmet Sina İçen[1], Betül Demirci[2]*, Fatih Demirci[2], İlhan Gürbüz[3]*

[1] Department of Pharmacognosy, Faculty of Pharmacy, İnönü University, 44280, Malatya, Turkey

[2] Department of Pharmacognosy, Faculty of Pharmacy, Anadolu University, 26470, Eskişehir, Turkey

[3] Department of Pharmacognosy, Faculty of Pharmacy, Gazi University, 06330, Ankara, Turkey

sina.icen@gmail.com and betuldemirci@gmail.com

Introduction

Marrubium L. is a nonarboreal genus of Lamiaceae, comprising about 40 species in the Irano-Turanian and Mediterranean phytogeographic regions. The genus is represented by 20 species with 24 taxa in Turkey. In this present study, the volatile components of *Marrubium cuneatum* collected from Turkey were analyzed.

Materials and Methods

Aerial parts of *M. cuneatum* were collected at flowering stage from Gündüzbey, Malatya (Turkey). The volatile components were obtained by hydrodistillation for 4 h using a Clevenger-type apparatus. The essential oil yield of *M. cuneatum* was low, therefore, the essential components were trapped in *n*-hexane. The volatile components were analyzed by gas chromatography flame ionization detector (GC-FID) and gas chromatography/ mass spectrometry (GC/MS), simultaneously.

Results and Discussion

The major volatile components of the aerial parts were characterized as linalool (29.7%), caryopyllene oxide (9.8%), β-caryophyllene (9.0%), linalyl acetate (8.2%), germacrene D (3.9%) and hexadecanoic acid (3.3%). Two previous reports (1, 2) on *M. cuneatum* volatiles were compared, where the major components of our material were different from the Iranian [bicyclogermacrene (37.9%) and germacrene D (15.6%)] and the Lebanese [hexadecanoic acid (6.5%) and spathulenol (6.5%)] plant material, respectively. To the best of our knowledge, this is the first report on *M. cuneatum* from Turkey.

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PP-76. Chemical constituent and anti-mycobacterial activity of eight *Nepeta* species against *Mycobacterium tuberculosis*

Tulin Askun[*]*, Gulendam Tumen, Pinar Celikboyun*
Department of Biology, Faculty of Sciences and Arts, University of Balikesir, Cagis Campus, 10145, Balikesir, Turkey
taskun@balikesir.edu.tr

Introduction

Tuberculosis (TB) is caused by bacterium (Mycobacterium tuberculosis) that most often affects the lungs. Tuberculosis (TB) is one of the top 10 causes of death worldwide. In 2015, 10.4 million people fell ill with TB and 1.8 million died from the disease. In 2015, an estimated 1 million children became ill with TB and 170 000 children died of TB.

Nepeta is a genus of flowering plants belonging to the family Lamiaceae also known as catmints. Nepeta genus has 35 species, including 40 taxa, 19 are endemic.

Materials and Methods

Eight species of *Nepeta* (*Nepeta nuda* ssp *nuda, N. viscida, N. phyllochlamys, N. stricta var. stricta, N. lamiifolia, N.cadmea, N. cilicica, N. nuda ssp. lydiae)* were collected from different localities during 2000 and 2014.

Extracts were prepared according to the method of Seshadri. Phenolic constituents were detected by high-performance liquid chromatography (HPLC) using 33 standards. The activity of Nepeta methanol and ethanol extracts against *M. tuberculosis* Ra, Rv and two isolates from patients were tested using the Microplate Presto Blue Assay (MPBA).

Results and Discussion

Ethyl acetate (EA) and methanol (ME) extracts were investigated for their antimycobacterial activity. The effective constituents of ethyl acetate and methanol extracts of these plants were determined. Myricetin was major phenolic for *N. phyllochlamys* EA; Naringenin was found in the high amount of *N. stricta* var. *stricta* ME; Luteolin were in the high amount of *N.* lamiifolia ME and *N.* cilicica EA extracts. While six of the plant EA extracts were effective and killed all *Mycobacterium* strains, 4 of the plant ME extracts were effective all *Mycobacterium* strains.

To the best of our knowledge, this is the first report of mycobactericidal activity of Nepeta spp. against four *M. tuberculosis* strains.

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PP-77. Biological activity and fatty acid compositions of *Salvia hispanica* L. seeds

Hale Gamze Ağalar, Fatih Demirci, Nursenem Karaca, Betül Demirci*
Anadolu University, Faculty of Pharmacy, Pharmacognosy Department, 26470, Eskişehir, Turkey.
ecz.halegamze@gmail.com

Introduction

Salvia hispanica L. is an ancient crop commonly known as 'chia' of the Lamiaceae. Chia is native to the region that stretches from North Mexico to Guatemala. Its seeds were widely used by Aztec tribes as food, medicine and paints (Coelho et al., 2014). Chia is a rich source of plant omega-3- fatty acids and a valuable nutraceutical without gluten.The biological and functional activities of chia products withdraw more and more attention.

Materials and methods

Black chia seeds and oil were obtained from commercial sources (ChiaPinta®, Acanchia UG & Co. KG, Germany). Seed oil was extracted by *n*-hexane (A) for 6 h using a Soxhlet apparatus. The solvent was then evaporated under reduced pressure at 40°C. Sample A and sample B (Chia Oil) fatty acids (FA) in both samples were methylated.The FA compositions were determined by GC-FID and GC/MS systems, simultaneously. In addition, both Chia oil samples were evaluated for their potential *in vitro* antioxidant, antimicrobial and 5-LOX inhibitory activities. To extend the bioactivity the oil samples were subjected to microbial biotransformation studies.

Results and Discussion

The oil yield of the A sample was calculated as 33.7%. Thirteen fatty acids representing 99.2% of the total fatty acids were identified. The B sample was characterized by eleven fatty acids representing 97.2% of the total oil. The main fatty acids were linolenic acid (69.7%, 61.8%) and linoleic acid (19.7%, 19.5%) in A and B samples, respectively. Linolenic acid was found to be as the major fatty acid in both samples. Both samples had relatively a low n-6 PUFA / n-3 PUFA ratio, with a health benefit impact. Our results support previous reports (Ayerza, 1995; Nitrayova et al., 2014; Silva et al., 2016). The combination of biological activity results will be reported for the first time.

Acknowledgement

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PP-78. Chemical characterization of *Phlomis kurdica* Rech. fil. essential oil from Turkey

Ayşe Esra Karadağ[1,2,], Betül Demirci[2,3], Fatih Demirci[3,*], K. Hüsnü Can Başer[4]*

[1] İstanbul Medipol University, Faculty of Pharmacy, Pharmacognosy Department, İstanbul, Turkey

[2] Anadolu University, Graduate School of Health Sciences, Pharmacognosy Department, Eskişehir, Turkey.

[3] Anadolu University, Faculty of Pharmacy, Pharmacognosy Department, Eskişehir, Turkey.

[4] Near East University, Faculty of Pharmacy, Department of Pharmacognosy, Nicosia (Lefkoşa), N. Cyprus, Mersin 10, Turkey.

*ayseesraguler@gmail.com, demircif@gmail.com

Introduction

The genus *Phlomis* L. is represented by more than 100 species in the world, and 46 species are in Turkey. Different *Phlomis* species are used as herbal tea in Turkey for various purposes (Baytop, 1999). The aim of this study was to elucidate the phytochemistry of volatiles of this endemic species.

Materials and Methods

The aerial parts of *P. kurdica* Rech. fil. were collected during flowering time from Malatya, Turkey. The air dried plant material was hydro-distilled in a Clevenger-type apparatus for 5 h to give a dark yellow oil. The yield of the essential oil obtained from the *P. kurdica* was 0.8% (v/w). The essential oil was analyzed both by gas chromatography-flame ionization detector (GC-FID) and gas chromatography/mass spectrometry (GC/MS).

Results and Discussion

In this study, we report a detailed characterization of the chemical constituents of essential oil isolated from *P. kurdica*. The phytochemical constituents of this oil was analyzed using GC-FID and GC/MS which led to the identification of a total of 44 different compounds. The main components characterized were germacrene D in 55.4 %, (*Z*)-*β-Farnesene 11.2%, and hexadecanoic acid 8.4%, respectively. To the best of our knowledge, this is the first report on the volatiles of P. kurdica*.

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PP-79. Inotropic, antihypertensive and spasmolytic effects of flavonoids from *Dracocephalum komaravii*

Zokir O. Toshmatov[1,2], Komila A. Eshbakova[3], Shunkor S. Khushmatov[4]. Haji A. Aisa[1*]*

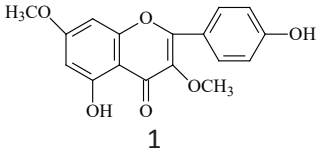
[1] The Key Laboratory of Plant Resources and Chemistry of Arid Zone and State Key Laboratory Basis of Xinjiang Indigenous Medicinal Plants Resource Utilization, Xinjiang Technical Institute of Physics and Chemistry, CAS, Urumqi 830011, China, E-mail: haji@ms.xjb.ac.cn

[2] University of Chinese Academy of Sciences, Beijing 100190 China

[3] S.Yu.Yunusov Institute of the Chemistry of Plant Substances, Academy of Sciences, 100170, Tashkent, Republic of Uzbekistan. E-mail: e_komila@yahoo.com

[4] Institute of the Bioorganic Chemistry, Academy of Sciences, 100125, Tashkent, Republic of Uzbekistan

Dracocephalum komarovii Lipsky (Labiatae) is an endemic plant, growing in Uzbekistan. We have studied chemical composition of the flowering aerial parts and isolated ten flavonoids. Isolated flavonoids were identified as pachypodol (1), genkwanin (2), kumatekin (3), penduletin (4), xanthomicrol (5), calycopterin (6), Apigenin (7), luteolin (8), quercetin 3,4'-dimethyl ether (9) and cirsimaritin (10). Compounds 1-10 were isolated from *Dracocephalum komarovii* for the first time. The molecule structures of the isolated compounds (1-10) are determined on basis of 1H-NMR, 13C- NMR, 2D-NMR and Mass spectrum. In in vitro conditions, inotropic, antihypertensive and spasmolytic effects of the isolated flavonoids and their mechanisms were investigated. All isolated flavonoids showed highly inotropic, antihypertensive and spasmolytic effects and positive inotropic effects of flavonoids increased with number of OH group; however, increase in the number of OCH3 groups resulted in negative inotropic effects.



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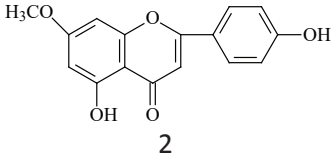

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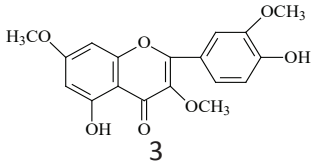

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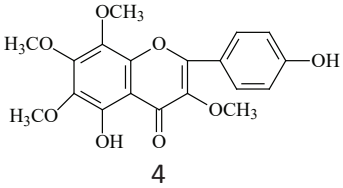

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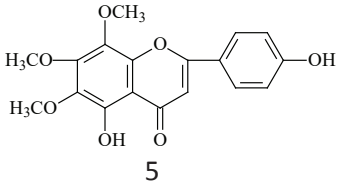

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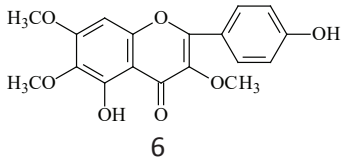

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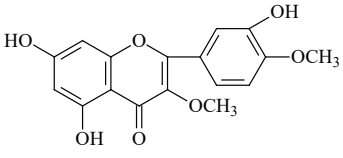

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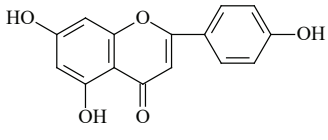

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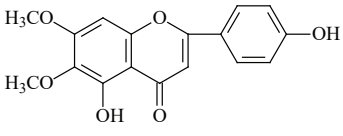

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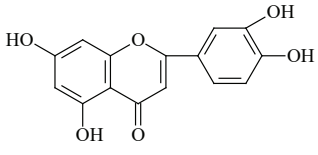

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Supporting Organizations

ANADOLU ÜNİVERSİTESİ

NEAR EAST UNIVERSITY

AKDENİZ UNIVERSITY 1982 ANTALYA

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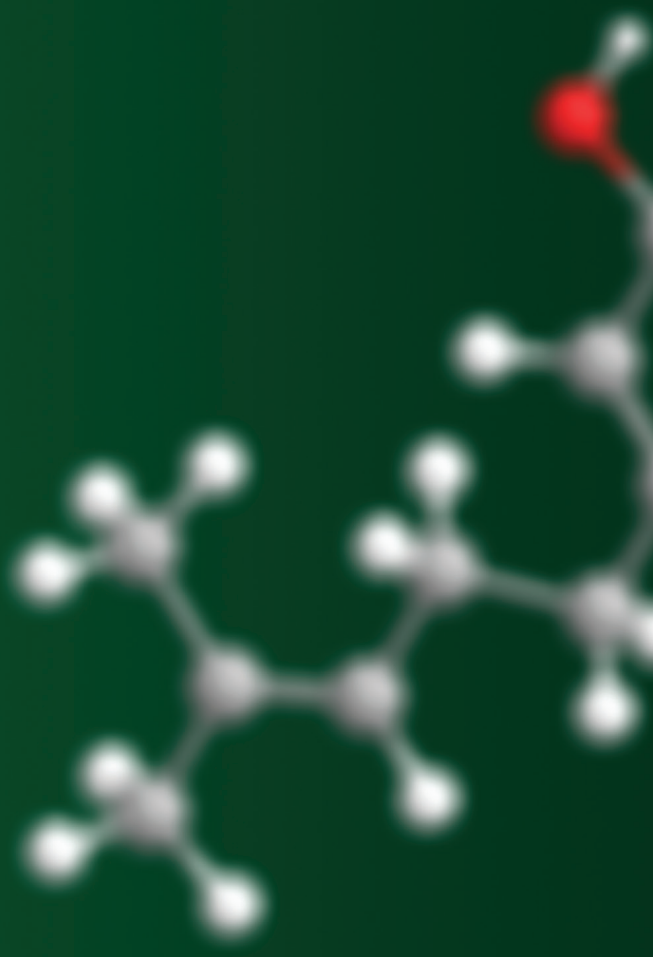
Sponsors



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