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Detaylı Arama

ANA SAYFA › SON EKLENEN YAYINLAR › STUDY ON CHEMİCAL COMPOSİTİON AND BİOLOG...

Study on chemical composition and biological activities of essential oil and extract from Salvia pisidica

ÖZKAN G., Sagdic O., GÖKTÜRK R. S. , ÜNAL O. , ALBAYRAK S.

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Özet

In this study, total contents of phenolic, flavanol and flavonol, antioxidant activities and antimicrobial activities of the Turkish endemic Salvia pisidica Boiss. & Heldr. ex Bentham (Lamiaceae) extract and essential oil were assessed in vitro. Total phenolic, flavanol and flavonol contents in the extract were 54.57 mg gallic acid equivalents (GAE)/g, 16.70 mg catechine equivalents (CE)/g and 18.19 mg rutin equivalents (RE)/g, respectively. Antioxidant activities (IC(50) value) of the extract and essential oil were determined as 4.88 and 6.41 mg/mL by DPPH assay, respectively. 31 compounds were determined in the essential oil using GC-MS and the major compounds (%) were camphor (23.76), sabinol (19.2), alpha-thujone (14.2) and eucalyptol (1.8-cineole) (5.8).

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Study on chemical composition and biological activities of essential oil from Salvia pisidica

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Citations (75) References (48)

Abstract

In this study, total contents of phenolic, flavanol and flavonol, antioxidant activities and antimicrobial activities of the Turkish endemic Salvia pisidica Boiss. & Heldr. ex Bentham (Lamiaceae) extract and essential oil were assessed in vitro. Total phenolic, flavanol and flavonol contents in the extract were 54.57 mg gallic acid equivalents (GAE)/g, 16.70 mg catechine equivalents (CE)/g and 18.19 mg rutin equivalents (RE)/g, respectively. Antioxidant activities (IC50 value) of the extract and essential oil were determined as 4.88 and 6.41 mg/mL by DPPH assay, respectively. 31 compounds were determined in the essential oil using GC–MS and the major compounds (%) were camphor (23.76), sabinol (19.2), α-thujone (14.2) and eucalyptol (1.8-cineole) (5.8).The antimicrobial activity of the methanolic extract and the essential oil against 13 bacterial and two yeast strains was determined. The extract (concentration 5 g/100 ml or 10 g/100 ml) was effective against most of the strains tested, yet not against Bacillus cereus, Staphylococcus aureus, Aeromonas hydrophila and the two yeast strains tested. The essential oil (2 g/100 ml) showed an antimicrobial effect against all the gram (+) bacteria tested, against Saccharomyces cerevisiae, but was not effective against all gram (−) bacteria and Candida albicans. These results show that S.piscidica essential oil and extract could be considered as a natural alternative to traditional food preservatives and be used to enhance food safety and shelf life.

Citations (75) References (48)

... In order to confirm the initial spore counts, the pour plate method was used and negative (methanol) and positive (essential oils) controls were prepared. The test organism was enumerated on growing broth media by serial dilution method (Ozkan et al., 2010). The viability and inoculums size of the strain were checked using quantitative colony counts. ...

... Regarding the sage EO, the composition and a broad antifungal spectrum of the EOs of the Salvia species (Perry et al., 1999;Salgueiro et al., 2003;Pina-Vaz et al., 2004;Pinto et al., 2007; Ozkan et al., 2010) has also been studied. Ozkan et al. (2010) determined total phenolics, total flavonols, total flavanols, antioxidant and antimicrobial activities and chemical composition of Turkish endemic Salvia pisidica extract and essential oil. ...

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Antifungal activity of lemon balm and sage essential oils on the growth of ochratoxigenic Penicillium verrucosum

Article Full-text available Mar 2012 · AFR J MICROBIOL RES

Sibel Özçakmak · Muhammet Dervisoglu · Azime Yilmaz

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Sibel Özçakmak · Dervisoglu Muhammet · Yilmaz Azime

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... En Colombia no se ha desarrollado la industria de recubrimientos a partir de fuentes naturales que mantengan, como por ejemplo el almidón tropical que es un polímero biodegradable, comestible y abundante, que actúa como barrera contra gases y lípidos, mejora la textura, se adhiere fácilmente a la superficie del producto y permite estabilidad durante el embarque y almacenamiento (Acosta et al., 2007). Otros componentes usados son los aceites esenciales que son mezclas de compuestos aromáticos solubles en alcohol y poco solubles en agua que se caracterizan por su actividad antimicrobiana, por ejemplo, extractos de romero al 0.03% más oxígeno puro y quitosano en peras cortadas (Xiao et al., 2010), de tomillo al 0.1% y de limón mexicano al 0.5% en papayas almacenadas , aceite y extracto de Salvia pisidica como antioxidantes y antimicrobianos (Ozkan et al., 2010) , aceites de los géneros Origanum (orégano), Thymus vulgaris (tomillo) y Cinnamomum verum (canela) (Acevedo et al., 2010). ...

... filling polymer, which acts as a barrier against gases and lipids, improves texture, attaches easily to the surface of the product and allows stability during shipment and storage (Acosta et al., 2007). Others used components are essential oils which are mixtures of aromatic compounds soluble in alcohol and slightly soluble in water are characterized by their antimicrobial activity, for instance extracts of rosemary at 0.03% pure oxygen and sliced pears chitosan (Xiao et al., 2010), 0.1% of thyme Mexican lime and 0.5% in stock papayas , oil and extract of Salvia pisidica as antioxidants and antimicrobials (Ozkan et al., 2010) , oils of the genera Origanum (Oregano), Thymus vulgaris (thyme) and Cinnamomum verum (cinnamon) (Acevedo et al., 2010). ...

Effect of coating of starch from cassava modified and thyme oil applied to the pepper (Capsicum annuum)

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Diana Yamile Ordoñez Bolaños · Danyely Zuñiga Camacho · José Luis Hoyos Concha · Lyda Patricia Mosquera Sánchez

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... The diameters of inhibition zones observed for the essential oil as well as the various Salvia tested extracts ranged from 11 to 16 mm. Generally, this activity is attributed to the presence of 8-cineole and trans-caryophyllene [53, 54]. ...

... The activity of the essential oils of plants of this genus is linked to their composition, in particular compounds such as d-limonene, δ-cadinene, and β-caryophyllene [54]. ...

Comparison of Essential Oil Composition, Phenolic Compound and Biological Activities of Salvia microphylla and Teucrium polium (Lamiaceae)

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... It has been shown that antimicrobial properties of the many plants and their extracts are frequently found in the EO fraction (Burt 2004;Bakkali et al. 2008;Hayouni et al. 2008;Ebrahimabadi et al. 2010; Ozkan et al. 2010; Ulukanli et al. 2012a). EOs from different plant species possess ovicidal, larvicidal, repellent and deterrent properties against various insect species (Shaaya et al. 1991;Isman 2000). ...

... The single colonies selected from the freshly grown colonies on nutrient agar were inoculated into Mueller Hinton Broth and then incubated for 24 h at 37C. Y. enterocolitica was incubated for 24 h at 25C (Ozkan et al. 2010; Ulukanli et al. 2011). Adjustment of bacterial cells to 0.5 McFarland standards was carried out using 0.85% saline solution. ...

CHEMICAL COMPOSITION, ANTIBACTERIAL AND INSECTICIDAL ACTIVITIES OF THE ESSENTIAL OIL FROM THE PISTACIA TEREBINTHUS L. SPP. PALAESTINA (BOISS.) (ANACARDIACEAE)

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Zeynep Ulukanli · Salih Karaborklu · Bintug Ozturk · Mehmet Balcilar

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... En Colombia no se ha desarrollado la industria de recubrimientos a partir de fuentes naturales que mantengan, como por ejemplo el almidón tropical que es un polímero biodegradable, comestible y abundante, que actúa como barrera contra gases y lípidos, mejora la textura, se adhiere fácilmente a la superficie del producto y permite estabilidad durante el embarque y almacenamiento (Acosta et al., 2007). Otros componentes usados son los aceites esenciales que son mezclas de compuestos aromáticos solubles en alcohol y poco solubles en agua que se caracterizan por su actividad antimicrobiana, por ejemplo, extractos de romero al 0.03% más oxígeno puro y quitosano en peras cortadas (Xiao et al., 2010), de tomillo al 0.1% y de limón mexicano al 0.5% en papayas almacenadas , aceite y extracto de Salvia pisidica como antioxidantes y antimicrobianos (Ozkan et al., 2010), aceites de los géneros Origanum (orégano), Thymus vulgaris (tomillo) y Cinnamomum verum (canela) (Acevedo et al., 2010). ...

... filling polymer, which acts as a barrier against gases and lipids, improves texture, attaches easily to the surface of the product and allows stability during shipment and storage (Acosta et al., 2007). Others used components are essential oils which are mixtures of aromatic compounds soluble in alcohol and slightly soluble in water are characterized by their antimicrobial activity, for instance extracts of rosemary at 0.03% pure oxygen and sliced pears chitosan (Xiao et al., 2010), 0.1% of thyme Mexican lime and 0.5% in stock papayas , oil and extract of Salvia pisidica as antioxidants and antimicrobials (Ozkan et al., 2010), oils of the genera Origanum (Oregano), Thymus vulgaris (thyme) and Cinnamomum verum (cinnamon) (Acevedo et al., 2010). ...

Efecto de recubrimiento de almidón de yuca modificado y aceite de tomillo aplicado al pimiento (Capsicum annuum)

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Diana Yamile Ordoñez Bolaños · Danyely Zuñiga Camacho · José Luis Hoyos Concha · Lyda Patricia Mosquera Sánchez

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... Recently, essential oils and various plants extracts especially phenolic compounds have gained special interest as a source of natural antimicrobial and antioxidant compounds to contrast antibiotics resistant, and microorganism growth, and the possible toxic effects of synthetic antioxidant additives such as butylated hydro-xytoluene (BHT), butylated hydroxyanisole (BHA) 1 . Phenolic components present in essential oils or solvent extracts were found to play a major role on these properties 2,3 . ...

Composition, Antioxidant and Antimicrobial Activities of Algerian Rosmarinus officinalis L. Extracts

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Tydia Outaleb · Mohamed Hazzit · Zoulikha Ferhat · Nasserdine Sabaou

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... EOs and their constituents have been broadly tested in vitro as well as biopreservation of a diversity of foods such as minced beef, cheese, vegetables, salads, fish products, and chicken Mendoza-Yepes et al., 1997;Menon et al., 2001;Skandamis et al., 2001;Mejlholm and Dalgaard, 2002;Sagdic et al., 2002;Singh et al., 2002;Baydar et al., 2004;Ozkan et al., 2004;Arici et al., 2005;Ozcan et al., 2006;Sagdic et al., 2009; Ozkan et al., 2010). In general, it has been found that a higher level of EO is required to achieve comparable effect in foods (Shelef, 1984;Burt, 2004). ...

Biological Preservation of Foods

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... Furthermore, the essential oil was found more active than those of the reference discs. Some other members of the Salvia genus have been subjected to antimicrobial activity evaluation (Akin et al., 2010;Cardile et al., 2009;Kelen and Tepe, 2008;Kotan et al., 2008;Miguel et al., 2011; Ozkan et al., 2010) . If compared with our results, S. officinalis from Tunusia (Bouaziz et al., 2009), S. officinalis and S. triloba from South Brazil (Delamare et al., 2007), S. officinalis from Syria (Khalil and Li, 2011), S. lanigera from Cyprus (Tenore et al., 2010) showed higher antimicrobial activity against tested bacteria. ...

Chemical composition and antimicrobial activity of essential oil of Salvia potentillifolia Boiss. Heldr. ex Benth. from Turkey

Article Apr 2013 · AFR J MICROBIOL RES

Odabaş Kouml se Elif · Ouml nguuml t Gouml zde · Yanıkoğlu Atila

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... Antifungal activity on dermatophytes Trichophyton rubrum, Trichophyton mentagrophytes, Epidermophyton floccosum and Microsporum canis was also found in the essential oil from Moringa oleifera leaves [42]. Salvia pisidica and Achillea ligustica oils showed antibacterial activity against Gram (+) bacteria and were suggested as food preservatives and anti-cariogenic agent [43, 44] . The essential oil from Salvia tomentosa, composed of β-pinene (39.7%), α-pinene (10.9%) and camphor (9.7%), was highly active and showed minimal inhibitory concentration ranging from 0.54 mg/mL (Clostridium perfringens) to 72.00 mg/mL (Moraxella catarrhalis, Enterobacter aerogenes and Klebsiella pneumoniae). ...

Antimicrobial activity of secondary metabolites and lectins from plants

Chapter Full-text available Jan 2010

Luana Cassandra Breitenbach Barroso Coelho

... Some researched proved that this genus has a potential to use as an antimicrobial substance source. For instance, Ozkan et al. (2010) studied the essential oil antimicrobial activity of Salvia pisidica against 13 bacterial and two yeast strainsand the results implied that The extract was effective against most of the strains tested, yet not against Bacillus cereus, Staphylococcus aureus, Aeromonas hydrophila and the two yeast strains tested. The essential oil showed an antimicrobial effect against all the gram (+) bacteria tested, against Saccharomyces cerevisiae, but was not effective against all gram (-) bacteria and Candida albicans. ...

Chemical composition, antimicrobial activity and biological properties of essential oils

Article Feb 2015

Amir Hossein Saeidnejad · Peyman Rajaei

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... In recent years, great notation has been focused on herbal medicines and natural products (Albuquerque , 2007) as are therapeutically used for traditional communities in the world (Moshafi , 2009). It is because of the side effects of chemical drugs (Reynolds, 1996) and many people therefore are turning to herbal remedies, especially for minor ailments, and modem scientific medicine still depends on plants, and the knowledge gained from plants, for some essential drugs (Ndawonde, 2006; Ozkan , 2010) . Therefore, the use of herbal remedies requires sufficient knowledge about the efficacy, safety and proper use of such products (Barbosa , 2010;Nori-Sharagh , 1999). ...

Study of chemical composition and antibacterial effects of essential oils of Stachys lavandulifolia Vahl., Salvia verticillata L., and Tanacetum polycephalum Schultz-Bip. on some microbial lineages

Article Full-text available Apr 2015

Mohammad Mahdavi · Mohammad H. Jouri · Samanehsadat Mahzooni-kachapi · Solyman Halimi 'jelodar

... Moreover, the discovery of natural antimicrobials, especially those of plant origin, has become a worldwide trend. This is not only due to development of microbial resistance against conventional food preservatives but also increasing awareness of their residual toxicity or possible side effects [8]. ...

Comparison of Chemical Compounds and Antioxidant and Antibacterial Properties of Various Satureja Species Growing Wild in Iran

Article · Full-text available · Oct 2016

Javad Hadian · Atousa Aliahmadi · Mansour Ghorbanpour · Mehrnaz Hatami

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... This species produces an essential oil rich in phenolic compounds: Thymol and carvacrol, the most active antimicrobial molecules described to date (Kempf et al., 2011). The development of these herbs has affected several areas of the food industry (Ozkan et al., 2010). Where they can be applied as an effective alternative to chemical preservatives controlling pathogens in food products such as Bacillus cereus and Listeria monocytogenes. ...

Chemical composition and antibacterial activity of the essential oil of Thymus ciliatus growing wild in North Eastern Algeria

Article · Full-text available · Jan 2015

Sonia Heni · Salima Bennadja · Djahoudi Abdelghani

... This species produces an essential oil rich in phenolic compounds: Thymol and carvacrol, the most active antimicrobial molecules described to date 11,12 . The development of these herbs has affected several areas of the food industry 13 . Where they can be applied as an effective alternative to chemical preservatives controlling pathogens in food products such as methicillin-resistant Staphylococcus aureus. ...

Sensibility of Methicillin Resistant Staphylococcus aureus to Essential Oil of Thymus ciliatus

Article · Full-text available · Dec 2015 · J PHARM PHARM SCI

Heni Sonia · Abdesselam Amira · Kermiche Fella · Djahoudi Abdelghani

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... The spore suspension was adjusted to approximately 10 6 spores mL -1 using haemocytometer (ELIAS et al., 2006). Test organism was enumerated in growing broth media by serial dilution method (ÖZKAN et al., 2010). The viability and inoculums size of the strains were checked using quantitive colony counts. ...

The effects of Heracleum platytaenium Boiss essential oil on the growth of ochratoxigenic Penicillium verrucosum (D-99756) isolated from Kashar Cheese

Article · Full-text available · Sep 2012 · J APPL BOT FOOD QUAL

Sibel Özçakmak

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... The in vitro antiproliferative activity of the methanol crude extracts of six Salvia species was examined and the extracts were found to be potential antitumor agents (Tepe, 2008;Askun et al., 2009 Universităţii St.,no.16,700115,Iaşi,România Some of the phenolic compounds of plants belonging to this genus have also shown excellent antimicrobial activity, as well as scavenging activity of active oxygen, inhibiting lipid peroxidation (Ozkan et al., 2010). ...

Phytochemical evaluation of some Salvia species from Romanian flora

Article | Full-text available | Jun 2012

M. Coisin · Radu Necula · V. Grigora · Maria Magdalena Zamfirache

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... This plant contains different secondary metabolites such as terpenoids, phenolics and flavonoids, which have been shown to possess a significant array of pharmaceuticals and biological characteristics (Loizzo et al. 2007). Generally, the herbal products as well as essential oils and their constituents are considered as the best alternative remedies for food preservatives and medicinal properties, since many synthetic antioxidants have been shown to be carcinogenic having deleterious side effects in living organisms (Ozkan et al. 2010). ...

Major essential oil constituents, total phenolics and flavonoids content and antioxidant activity of Salvia officinalis plant in response to nano-titanium dioxide

Article | Full-text available | Oct 2015

Mansour Ghorbanpour

... Generally, the plant extract as well as purified essential oils (EOs) and their constituents are considered as the best alternative remedies and natural products for pharmaceuticals, food preservation from toxicity caused by oxidative agents and human health, because many synthetic antioxidants and antibiotics have shown to be carcinogenic having detrimental side effects in living organisms [3]. ...

Phytochemical Variations and Enhanced Efficiency of Antioxidant and Antimicrobial Ingredients in Salvia officinalis as Inoculated with Different Rhizobacteria

Article | Full-text available | Feb 2016

Mansour Ghorbanpour · Mehrnaz Hatami · Khalil Kariman · Payman Abbaszadeh Dahaji

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... In this study, DPPH radical scavenging activity of the essential oil was found to be 38.950%. Ozkan et al 25 reported that IC 50 value of S. pisidica extract for DPPH radical was 4.88 mg/ml. As a summary, it is possible to say that O. hypericifolium essential oil contained considerable amounts of phenolic compounds and can be useful to enrich antioxidant bioavailability of food products. ...

Essential Oil Composition, Antimicrobial and Bioactive Properties of Origanum hypericifolium, An Endemic Plant Species grown in Turkey

Article | Full-text available | Dec 2015

Hüseyin Fakir · Ahmet Abdullah Us · Mustafa Sağdıç · Fatih Tornuk

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... Antifungal activity on dermatophytes Trichophyton rubrum, Trichophyton mentagrophytes, Epidermophyton floccosum and Microsporum canis was also found in the essential oil from Moringa oleifera leaves [42]. Salvia pisidica and Achillea ligustica oils showed antibacterial activity against Gram (+) bacteria and were suggested as food preservatives and anti-cariogenic agent [43, 44]. The essential oil from Salvia tomentosa, composed of β-pinene (39.7%), α-pinene (10.9%) and camphor (9.7%), was highly active and showed minimal inhibitory concentration ranging from 0.54 mg/mL (Clostridium perfringens) to 72.00 mg/mL (Moraxella catarrhalis, Enterobacter aerogenes and Klebsiella pneumoniae). ...

Antimicrobial Activity of Secondary Metabolites and Lectins from Plants

Article Nov 2009

P.M.G. Paiva · Fabiana Oliveira Dos Santos Gomes · Thiago Henrique Napoleão · Luana Cassandra Breitenbach Barroso Coelho

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... Sage modulated antioxidant pathways to minimize stress by scavenging free radicals (Luvone et al., 2006;Elida et al., 2010), inhibiting lipid peroxidation (Ozkan et al., 2010). The active constitutes of sage polyphenols, especially, phenolic and rosmarinic acid have antioxidant effects, thus protecting membrane lipids of fatty acids and phospholipids from oxidative stress (Lima et al., 2005;Nour et al., 2010;Kianbakht et al., 2011). ...

Evaluate the effect of oral administration of Salvia officinalis extract on albino rats' fetuses during gestation period

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Eman Youssri · Amel Ramadan Omar

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Evaluate the effect of oral administration of Salvia officinalis extract on albino rats' fetuses during gestation period

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Amal Ramadan Omar

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... Moreover, the ethanolic extract of S. officinalis potentiated memory retention, as previously described by Eidi et al. (2006). These plants and their essential oils are also used in food flavoring, pharmaceuticals, and in perfumery (Ozkan et al., 2010). Despite extensive studies about the uses of Salvia species extracts, there is no study clarifying the possible neurological effects. ...

Evaluation of antiamnesic activity of Salvia multicaulis essential oil on scopolamine-induced amnesia in rats: in vivo and in silico approaches

Article Full-text available Aug 2019

Eyup Bagci · Emel Akbaba · Calin Maniu · Lucian Hritcu

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... Rosmarinus officinalis L., belong to the family Lamiaceae, is a flowering plant that grows widly in Mediterranean countries, Southern Europe and Asia. Volatile compounds obtained from plants are known as antimicrobial 5,6 , antifungal 7 , antioxidant 8 and insecticidal activities 9,10 . Essential oils are composed of complex mixtures of monoterpenes, biogenetically related phenols and sesquiterpenes obtained from plants 11 . ...

Effect of Essential Oil from the Leaves of Rosemary Used in the Control of Callosobruchus maculatus (F.) on the Hydration Coefficient, Cookability, Taste and Color of the Edible Chickpea

Article | Full-text available | Apr 2020 · J ESSENT OIL BEAR PL

Hüseyin Çetin · Melek Güdek

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... Chemical compositions of oleoresin thyme and rosemary extracts were carried out by gas chromatography mass spectrum technique (GC/MS) according to the method described by Ozkan et al. (2010) . Qualitative analysis was based on the comparison of retention times and the computer mass spectra libraries using Wiley GC/MS Library and Nist, Tutore Libraries. ...

Effect of natural extracts on the stability of sunflower oil and acrylamide formation at different thermal treatments

Article | Dec 2018

E. El-Naggar

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... Previous reports showed that approximately 900 species have been known as Salvia all across the world. Eighty-six species of Salvia (Lamiaceae) have been known in Turkey [1] and many species are medicinal and aromatic plants. Salvia species (Lamiaceae) could be defined to be quite endemic with a high endemism percentage of 45% in the flora of Turkey [2]. ...

Chemical Fingerprinting of Seeds of Some Salvia Species in Turkey by Using GC-MS and FTIR

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Eray Tulukcu · Nur Cebi · Osman Sagdic

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... In recent years the EOs and extracts of many plant species have become popular, and attempts to characterize their bioactive principles have gained momentum in many food-processing applications. The chemical composition and antimicrobial properties of Eos extracted from diverse plant species have been demonstrated using a variety of experimental methods (Özkan, et al., 2010 and Djenane et al., 2011). Several recent studies described in detail the antimicrobial properties of EOs against a number of relevant food-borne microorganisms. ...

Antibacterial activity of some spices and herbs essential oils

Article | Full-text available | Jan 2012

Elsayed Ali

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... In comparison with other Salvia species EO, S. officinalis was a more efficient radical scavenger (IC 50 = 8.31 ± 0.55 mg/L) than S. tomentosa Miller (IC 50 = 150 mg/L) (Tepe et al., 2005), S. aucheri var. aucheri (IC 50 = 18.8 ± 1.2 mg/L), S. aramiensis (IC 50 = 12.2 ± 1.0 mg/L), S. pilifera (IC 50 = 24.1 ± 0.7 mg/L) (Kelen and Tepe, 2008) and S. pisidica (IC 50 = 6.41 ± 1.28 mg/mL) (Ozkan et al., 2010). ...

Salvia officinalis essential oil: Chemical analysis and evaluation of anti-enzymatic and antioxidant bioactivities

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Salma Kammoun El Euch · Dorsaf Ben Hassine · Sylvie Cazaux · Jalloul Bouajila

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... The analysis of the essential oils of S. sclarea inflorescence and leaves has been reported by a number of researchers [3]. The major ingredients of its essential oil appeared to be: camphor, sabinol, α-thujone and 1,8-cineole, which exhibit mainly antimicrobial and antibiotic properties [13]. The study also covered the extraction from the seeds of sage. ...

Antioxidant Phenolic Compounds in Salvia officinalis L. and Salvia sclarea L.

Article | Full-text available | Mar 2018 · ECOL CHEM ENG S

Anna Poliwoda · Magdalena Petecka · Piotr P Wieczorek · Izabela Jasicka-Misiak

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... Performance Standards for AntimicrobialDisc Suspectibility Tests. Approved Standard NCCLS Publication M2-A5, Villanova, PA, USA.Özkan, G.; Sagdic, O.; Göktürk, R. S.; Unal, O. and Albayrak, S. (2010). Study onchemical composition and biological activities of essential oil and extract fromSalvia pisidica.LWT Food Science and Technology, 43, 186 -190. ...

Effect of some Herbs Essential Oils on Labneh

Article | Full-text available | Apr 2019

Y A Abd El-Tawab · Mohamed Ebrahim · Mansour Abdou Ali

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... The analysis of the essential oils of S. sclarea inflorescence and leaves has been reported by a number of researchers [3]. The major ingredients of its essential oil appeared to be: camphor, sabinol, α-thujone and 1,8-cineole, which exhibit mainly antimicrobial and antibiotic properties [13]. The study also covered the extraction from the seeds of sage. ...

Chromatographic fingerprint, antioxidant activity, and colour characteristic of polish goldenrod (Solidago virgaurea L.) honey and flower

Article | Full-text available | Jul 2018 · EUR FOOD RES TECHNOL

Izabela Jasicka-Misiak · Ewa Makowicz · Natalia Stanek

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... In the case of sage SCFE, there was no antimicrobial activity against most of the tested bacteria strains, except for S. putrefaciens and S. epidermidis, which were inhibited. On contrary, some previous studies have reported strong antibacterial activity for sage EO [9, 25]. As it was mentioned before P. fluorescens was one of the most resistant bacteria against all extracts except garlic SCFE. ...

Development of Whey Protein Isolate Films Incorporated with Rosemary Extracts to Improve the Microbiological Quality of Fresh Tuna

Article | Full-text available | Nov 2017

Ximena Carrión Granda · Idoya Fernández Pan · Bruno Iñarra · Juan I. Maté

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... In recent years the EOs and extracts of many plant species have become popular, and attempts to characterize their bioactive principles have gained momentum in many food-processing applications. The chemical composition and antimicrobial properties of EOs extracted from diverse plant species have been demonstrated using a variety of experimental methods (Djenane et al., 2011; Özkan, Sagdic, Göktürk, Unal, & Albayrak, 2010). ...

Djenane Food Control 2011

Data | Full-text available | Nov 2017

Djamel Djenane

View

... The β-carotene/linoleic acid bleaching assay was determined by measuring the inhibition of selenium complexes and conjugated diene hydroperoxides arising from linoleic acid oxidation by described method [29]. The reductive potential based on the ferric reducing antioxidant power of the studied complexes and the standards positive controls (BHT and trolox) was determined [30]. Each of the measurements described was carried out in three replicate experiments and the results are recorded as mean±standard deviation. ...

Synthesis, Spectroscopic Interpretations, and Antioxidant Efficiency of Two Vital Selenium Complexes

Article | Oct 2017

Fatima A. I. Al-Khodir

View | Show abstract

... The mixture was agitated and diluted with water to a final volume of 5 mL. After incubation for 30 min at room temperature, the absorbance was read at 765 nm with a UV-VIS spectrophotometer (UV-2550, Shimadzu, Japan) and total phenols in the essential oils were expressed as gallic acid equivalents (GAE), using a calibration curve (5, 10,15,20,25,30,35,40,45, 50 µg·mL -1) of a freshly prepared gallic acid solution. ...

How properties of edible oils are improved by essential oils

Article Full-text available Jan 2016

Sonia Amariei · G. Gutt · Cristina-Elena Hreţcanu · Alice Roşu

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... EOs of the Salvia species have also been studied[18, 28]. Antifungal activity of Salvia genus oils could be attributed to the presence and synergistic effect of 1,8-cineole, camphor and borneol as major constituents[29].M. piperita oil at 250 µL/mL resulted in approximately 50% inhibition at the end of the incubation time. The antifungal effect of this plant extract may possibly be due to the presence of menthol, menthone and neomenthol that are oxygenated monoterpenes[30].Antimicrobial activities of M. piperita oil have also been previously investigated by Iscan et al.[31] who reported that menthol as a major compound of the EO showed weak antifungal activity at a concentration of 5 mg/mL.Average 60-80% lethal effects were observed after 96 h of the EO mix treatment and it was permanent up to the incubation period. ...

Inhibition Kinetics of Penicillium verrucosum Using Different Essential Oils and Application of Predictive Inactivation Models

Article Full-text available Mar 2017

Osman Gul · Sibel Özçakmak

View Show abstract

... [23] Recently, various extracts of plants have gained a particular concern as sources of natural antimicrobial because of the resistance to antibiotics that some microorganisms have acquired. [24] The antimicrobial activity in terms of zone of inhibition was presented in Table 2. ...

TOPICAL HERBAL ANTIMICROBIAL FORMULATION CONTAINING PROSOPIS JULIFLORA METHANOL EXTRACT

Article Full-text available Oct 2016 · WJPR

Nasser Ali

View Show abstract

... Recently, food preservation via natural products, especially with plant-base origins, has become a worldwide trend. This is for two reasons: 1) concerns regarding the safety of synthetic compounds and 2) the increase in microbial resistance against conventional food preservatives (Ozkan et al., 2010; Shetty and Labbe, 1998). This particular attention on plants essential oil and extract is mainly a result of a wide customer satisfaction, presence of structurally different active components, and a relatively higher safety for human consumption (Bajpai et al., 2007;Cavar et al., 2008). ...

Ferulago angulata and Tetrataenium lasiopetalum: Essential oils composition and antibacterial activity of the oils and extracts

Article Full-text available Oct 2019

Hasan Mumivand · Avin Aghemiri · Asrin Aghemiri · Kianoush Nikoumanesh

Microcalorimetry coupled with principal component analysis for investigating the anti-Staphylococcus aureus effects of different extracted fractions from Dracontomelon dao

Article Apr 2014 · J THERM ANAL CALORIM

Yanling Zhao · Shuxian Liu · Fen Qu · Xiaohe Xiao

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Anti-biofilm Activities and Chemical Composition of Essential Oil from Burdock Leaf

Article Sep 2013

Zaixiang Lou · Yijun Liu · Ying Hong · Lianzhong Ai

View Show abstract

Essential oil composition and antibacterial activity of Zanthoxylum bungeanum

Article Nov 2011 · AFR J MICROBIOL RES

Rui-Xue Zhu

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A review on using essential oil of Labiatae species in food products

Article Full-text available Jan 2017

Masoud Kazeminia · Razzagh Mahmoudi · Peyman Ghajarbeygi

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Dietary Phytochemicals and Microbes

Chapter Feb 2012

Mehrdad Tajkarimi · Salam Ibrahim

View Show abstract

Phytochemical Study and Evaluation of the Antimicrobial and Antioxidant Activity of Essential Oils and Phenolic Compounds of Pistacia Lentiscus L

Article Full-text available Aug 2015

Kobra Arab · Bouchenak Ouahiba · Yahiaoui Karima

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Essential Oil Composition of Aerial Parts of Salvia mirzayanii Rech. f. & Esfand. from Southern Fars, Iran

Article Sep 2015

Efat Jafari · Gholamabbas Ghanbarian

View Show abstract

Effect of Flavanol-Rich Cocoa Powder on the Growth of Bacillus cereus Spores in Reference Media

Article Sep 2010 · ARCH LEBENSMITTELHYG

C. Ferrer · Aurora Marco · Dolores Rodrigo · Antonio Martínez

View Show abstract

Determination of Volatile Organic Compounds in Fourty Five Salvia Species by Thermal Desorption-GC-MS Technique

Article Full-text available May 2016 · REC NAT PROD

Seda Damla Hatipoğlu · Nihal Zorlu · T. Dirmenci · Gulacti Topcu

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Headspace Solid Phase Microextraction Analysis of Volatile Compounds of the Aerial Parts and Flowers of Plectranthus neochilus Schltr. and Salvia farinacea Benth.

Article May 2018 · J ESSENT OIL BEAR PL

Fatma El sakhawy · Hanaa A. Kassem · Sabah H. El-Gayed · Mayy M. Mostafa

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A class of sulfonamides as carbonic anhydrase I and II inhibitors

Article Jun 2016

Taner Gokcen · Ilhami Gülçin · Turan Ozturk · Ahmet C Gören

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... It has been shown that antimicrobial properties of the many plants and their extracts are frequently found in the EO fraction (Burt 2004;Bakkali et al. 2008;Hayouni et al. 2008;Ebrahimabadi et al. 2010; Ozkan et al. 2010; Ulukanli et al. 2012a). EOs from different plant species possess ovicidal, larvicidal, repellent and deterrent properties against various insect species (Shaaya et al. 1991;Isman 2000). ...

... The single colonies selected from the freshly grown colonies on nutrient agar were inoculated into Mueller Hinton Broth and then incubated for 24 h at 37C. Y. enterocolitica was incubated for 24 h at 25C (Ozkan et al. 2010; Ulukanli et al. 2011). Adjustment of bacterial cells to 0.5 McFarland standards was carried out using 0.85% saline solution. ...

Chemical Composition, Antibacterial and Insecticidal Activities of the Essential Oil from the Pistacia terebinthusL. Spp. Palaestina (Boiss.) (Anacardiaceae)

Article Full-text available Jun 2014

Zeynep Ulukanli · Salih Karabörklü · Bintug Ozturk · Mehmet Balcilar

View Show abstract

... The effect of antioxidant on DPPH radical is a result of antioxidant hydrogen donating ability or radical-scavenging activity. Mixing the DPPH• solution with a substrate used for donating hydrogen atom leads to the reduced form (non radical DPPH) of this reagent with simultaneous change of the violet color to pale yellow (Ozkan et al., 2010; Ayoughi et al., 2011). DPPH• scavenging activity is shown by IC 50 value, defined as the concentration of the antioxidant required for the 50% loss of the DPPH• activity. ...

Antioxidant Activity of Essential Oil from Black Zira (Bunium persicum Boiss.) Obtained by Microwave-assisted Hydrodistillation

Article Sep 2012

Sara Mazidi · Karamatollah Rezaei · Mohammad-Taghi Golmakani · Shamsali Rezazadeh

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... Moreover, these preservatives always cause the development of drug-resistant bacteria after long-term usage. Therefore, much effort has been made to search for natural preservatives, including the extracts or essential oils isolated from various species of edible and medicinal plants, herbs and spices (Longaray Delamare et al., 2007; Ozkan et al., 2010; Singh et al., 2005). ...

Essential oil composition and antibacterial activity of Zanthoxylum bungeanum

Article Full-text available

Rui-Xue Zhu · Kai Zhong · Wei-Cai Zeng · Hong Gao

Chemical Composition and Insecticidal Activity of Essential Oil of Salvia officinalis L. Cultivated in Tunisia

Article Aug 2014 · J ESSENT OIL BEAR PL

Ali Laamari · Hassen Teyeb · Hassen Ben Cheikh · Mohamed Neffati

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Bioherbicidal Effects of Essential Oils Isolated from Thymus fallax F., Mentha dumetorum Schult. and Origanum vulgare L.

Article Full-text available Mar 2013 · ASIAN J CHEM

M. Yilar · Yusuf Bayar · Huseyin Aksit · Yusuf Yanar

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Chemical Composition of the Essential Oil from Cupressus sempervirens L. horizontalis Resin in Conjunction with its Biological Assessment

Article Full-text available May 2014 · J ESSENT OIL BEAR PL

Zeynep Ulukanli · Salih Karaborklu · Burhan Ates · Merve Goksin Karaaslan

View Show abstract

... Their application in controlling pathogens could reduce the risk of foodborne outbreak and assure consumers safe meat products. The chemical composition and antimicrobial properties of EOs extracted from diverse plant species have been demonstrated using a variety of experimental methods [21, 22]. ...

Chemical Composition, Antioxidant and Antimicrobial Activities of Thymus capitata Essential Oil with Its Preservative Effect against Listeria monocytogenes Inoculated in Minced Beef Meat

Article Full-text available Feb 2014 · EVID-BASED COMPL ALT

Nariman El Abed · Belhassen Kaabi · Issam Smaali · Ben Hadj Ahmed Sami

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... Plant-derived essential oils have long been used as flavoring agents or preservatives in foods, beverages and confectionary products. The chemical composition and antimicrobial properties of plant-based essential oils have been demonstrated using a variety of experimental models (Bajpai, Al-Reza, Choi, Lee, & Kang, 2009;Bajpai et al., 2012;Bajpai, Rahman, & Kang, 2008;Djenane et al., 2011; Ozkan, Sagdic, Gokturk, Unal, & Albayrak, 2010; Yoon et al., 2011). Although antimicrobial mode of action of synthetic antimicrobial agents has been reviewed to some extent, there is still lack on determining the mode of action of plant-based natural compounds including essential oils against pathogenic microorganisms. ...

Antibacterial mde of action of Cudrania tricuspidata fruit essential oil, affecting membrane permeability and surface characteristics of food-borne pathogens

Article | Full-text available | Aug 2013 · FOOD CONTROL

Vivek K. Bajpai · Ajay Sharma · Kwang-Hyun Baek

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ANTIMICROBIAL EFFECT OF ESSENTIAL OIL FROM Salvia officinalis L. ON FOOD RELATED MICROORGANISMS

Article | Full-text available | Jun 2013

lina maria lopez de avila · Hader Castaño · Carlos Eduardo Mejía Gómez

View Show abstract

... In vitro and epidemiological studies strongly suggest that consumption of a variety of phenolic compounds could significantly lower the risk of serious health disorders for the antibacterial, antimutagenic and anti-inflammatory activity of phenolics (Albayrak, Aksoy, Sagdic, & Hamzaoglu, 2010;Lou, Wang, Li et al., 2010;Senevirathne et al., 2006;Surh, 2002;Surh et al., 1999;Tu, Sun, Tian, Xie, & Chen, 2009), therefore, more and more attention is being paid on phenolic compounds (Liu, Qiu, Ding, & Yao, 2008; Ozkan, Sagdic, Gokturk, Unal, & Albayrak, 2010; Sagdic, Aksoy, Ozkan, Ekici, & Albayrak, 2008). ...

P-Coumaric acid kills bacteria through dual damage mechanisms

Article | Jun 2012 · FOOD CONTROL

Zaixiang Lou · Hongxin Wang · Shengqi Rao · Jing Li

View Show abstract

... Antimicrobial activities as well as the chemical constituents of the essential oils of many Salvia species have been well-documented (Ozkan et al., 2003;Tepe et al., 2004;Delamare et al., 2007;Arslan and Celik, 2008;Hayouni et al., 2008;Kelen and Tepe, 2008;Kotan et al., 2008;Cardile et al., 2009;Kıvrak et al., 2009;Ebrahimabadi et al., 2010; Ozkan et al., 2010; Tenore et al., 2011;Hussain et al., 2011). In addition, reports are also available for the essential oil of S. tomentosa Miller (Lamiaceae), including with different chemical compounds as well as antibacterial activities (Haznedaroglu et al., 2001;Tepe et al., 2005). ...

Essential oil composition, insecticidal and antibacterial activities of Salvia tomentosa Miller

Article | Full-text available | Feb 2013

Zeynep Ulukanli · Salih Karaborklu · Menderes Çenet · Mehmet Balcilar

... [11] However, it should be noticed that not all the protective effects of S. sahendica is attributed to rosmarinic acid. Other bioactive compounds in S. sahendica extract, including catechin, rutin and luteolin, have also provided a wide range of pharmacological activities, including anti-inflammatory, [45] antioxidant [46] and prevention of cancer. [47] So the observed effects in this investigation can be attributed to the additional bioactive components in this plant as a whole, which could be much more interesting with regard to human diets and lifestyle. ...

Dietary supplementation with Salvia sahendica attenuates acetylcholinesterase activity and increases mitochondrial transcription factor A and antioxidant proteins in the hippocampus of amyloid beta-injected rats

Article Oct 2013 · J PHARM PHARMACOL

Forough Foolad · Fariba Khodagholi

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Antimicrobial activity of Pistacia lentiscus and Satureja montana essential oils against Listeria monocytogenes CECT 935 using laboratory media: Efficacy and synergistic potential in minced beef

Article Jul 2011 · FOOD CONTROL

Djamel Djenane · Javier Yangüela · Luis Montañés · Pedro Roncalés

View Show abstract

Study on chemical composition and biological activities of essential oil and extracts from Stevia rebaudiana Bertoni leaves

Article Nov 2011 · LWT-FOOD SCI TECHNOL

Francois Muanda · Rachid Soulimani · Babakar Diop · Amadou Dicko

View Show abstract

... Several studies have investigated the antioxidant activities of Salvia species [5,[10][11][12][13], including screening of the antioxidant potential of some Salvia extracts and essential oils. Moreover, the anti-inflammatory [13,14], analgesic and antipyretic [15], antiepileptic, anti-ulcerogenic and tranquillizing activities [16] and antimicrobial effects [5,[17][18][19] [20] [21] of different Salvia species have also been studied. ...

... It was found that the dichloromethane fractions from acetone extracts of S. sclarea roots as well as four pure diterpenes isolated from hairy root cultures presented antimicrobial activity against G +ve bacteria. Additionally, a methanolic extract from S. pisidica [20] showed high antimicrobial activity against G +ve bacteria and a moderate effect against G -ve species, and an ether extract from S. lanigera growing in Egypt, which contained several flavonoid compounds, exhibited marked antimicrobial activity against G +ve bacteria, but a weaker effect on G -ve microorganisms [21]. The results showed that methanol extract of S. bicolor is more active than petroleum ether extract as antioxidant, anti-inflammatory and analgesic and antimicrobial. ...

Chemical Composition and Biological Activity of Extracts from Salvia bicolor Desf. Growing in Egypt

Article Full-text available Dec 2012 · MOLECULES

Taghreed A. Ibrahim

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... Several studies have investigated the antioxidant activities of Salvia species [5,[10][11][12][13], including screening of the antioxidant potential of some Salvia extracts and essential oils. Moreover, the anti-inflammatory [13,14], analgesic and antipyretic [15], antiepileptic, anti-ulcerogenic and tranquillizing activities [16] and antimicrobial effects [5,[17][18][19] [20] [21] of different Salvia species have also been studied. ...

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Chemical Composition and Biological Activity of Extracts from Salvia bicolor Desf. Growing in Egypt

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... The common indications include GIT symptoms/disorders (colic, diarrhea, indigestion, and abdominal pain), respiratory tract symptoms/disorders (colds, sore throat, and cough), infections (tuberculosis, bacterial infections, influenza, and parasitic infections), pain (headache and arthralgia), and miscellaneous disorders (diabetes mellitus, liver diseases, barrenness, urticaria, and hemorrhage). Studies have demonstrated that Salvia species have important biological activities including antimicrobial (e.g., against Helicobacter pylori) [14] [15], antioxidant [14] [16] [17] [18], antiinflammatory [17] [19] [20], analgesic and antipyretic [21], and antiangiogenic [22]. Although a few chemical studies have been done on S. wiedemannii [23] [24] [25] there is no activity studies on its extracts [25]. ...

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Analgesic Activity of Salvia wiedemannii Boiss. Used in Turkish Folk Medicine

Article | Full-text available | Aug 2011

Osman Ustun · Ekrem Sezik

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... In nature, these oils play an important role in the protection of the plants by acting as anti-bacterial, anti-viral, and anti-fungal agents, as well as functioning as insecticides and deterrents to the plant's consumption by herbivores. Some oils have also been shown to elicit anti-oxidative, anti-genotoxic, and free radical scavenging effects, as well as to exert overt cytotoxicity and induce apoptosis in cancer cells (Ahmad et al., 2012; Alpsoy et al., 2012; Goncalves et al., 2012; Mihajilov- Krstev et al., 2010; Ozkan et al., 2010 ; Tepe et al., 2005). The applications of essential oils in anti-cancer therapy may appear unconventional; however, their availability, pleasant aroma, and low or insignificant toxicity make them more attractive candidates for treatment of various chronic ailments (Sharma et al., 2010). ...

Toxicity of essential oil of Satureja khuzistanica : In vitro cytotoxicity and anti-microbial activity

Article | Full-text available | May 2013 · J IMMUNOTOXICOL

Morteza Yousefzadi · Ali Riahi-Madvar · Javad Hadian · Mehdi Biniaz

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... Moreover, several products present on the market have little or no effect due to incorrect preparation and storage. In the enriched metabolic extracts, the presence of undesirable compounds is often a reality, such as the case of pesticides and heavy metals, or other toxic natural chemicals; for instance, α-thujone, a natural monoterpene, is present as an active component in various herbal products such as the extracts of Salvia officinalis (Ozkan et al., 2009) and of Artemisia absinthium (Teixeira da Silva et al., 2005; Lopes-Lutza et al., 2008). In the scientific literature, beneficial effects are reported for these plant extracts which possess antioxidant, bactericidal, and antimicrobial activities but α-thujone is also known for its psychoactive effects and its toxicity has become an important issue in recent years (Deiml et al., 2004; Haji Mahdipour et al., 2008; Kharoubi et al., 2009). ...

Healthy and Adverse Effects of Plant-Derived Functional Metabolites: The Need of Revealing their Content and Bioactivity in a Complex Food Matrix

Article | Full-text available | Oct 2012 · CRIT REV FOOD SCI

Teresa Lavecchia · Giuseppina Rea · Amina Antonacci · Maria Teresa Giardi

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... showed strong antimicrobial activity and was considered to be potential anti-infective agents (Ibrahim et al., 2009; Oladosu et al., 2009; Ozkan et al., 2010 ; Runyoro et al., 2010). Activities of free radical scavenging and antioxidation were confirmed in plant extracts containing -pinene, -sesquiphellandrene, (Ricci et al., 2005; Sultan et al., 2009). ...

Analysis of chemical composition of Chrysanthemum indicum flowers by GC/MS and HPLC

Article | Full-text available | Apr 2010 · J MED PLANTS RES

Liang-Yu Wu · Hong-Zhou Gao · Xun-Lei Wang · Yue-Rong Liang

... Although this is the first report on the antimicrobial activity of S. lanigera, other members of the Salvia genus have been subjected to antimicrobial activity evaluation (Haznedaroglu et al., 2001;Tepe et al., 2003;Tepe et al., 2004;Senatore et al., 2005;Tepe et al., 2005;Delamare et al., 2007;Esmaeili et al., 2008;Kelen and Tepe, 2008;Cardile et al., 2009;Kivrak et al., 2009;Li and Wang, 2009;Ebrahimabadi et al., 2010; Özkan et al., 2009) . Generally such activity is attributed to the presence of 1,8-cineole, thujone and camphor; in reality, even if antimicrobial activity of an essential oil is often attributed mainly to its major components, today it is known that the synergistic or antagonistic effect of one compound in minor percentage of mixture has to be considered (Burt, 2004). ...

Antimicrobial and antioxidant properties of the essential oil of Salvia lanigera from Cyprus

Article | Oct 2010

Gian Carlo Tenore · Roberto Ciampaglia · Nelly Arnold Apostolides · Felice Senatore

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... Recently, the discovery of natural antimicrobials, especially those of plant origin, has become a worldwide trend. This is not only due to development of microbial resistance against conventional food preservatives but also increasing awareness of their residual toxicity or possible side effects (Ozkan, Sagdic, Gokturk, Unal, & Albayrak, 2010; Shetty & Labbe, 1998). Essential oils and their constituents, whose inhibitory effects against a wide range of microorganisms are documented, have received particular attention mainly due to their relatively safe status, wide acceptance by consumers and enrichment by a variety of structurally different active components (Bajpai, Rahman, Choi, Youn, & Kang, 2007; Cavar, Maksimovic, Solic, Jerkovic-Mujkic, & Besta, 2008). ...

Composition and in vitro antibacterial activity of essential oils from four Satureja species growing in Iran

Article | Full-text available | Aug 2011

Javad Hadian · Morteza Akramian · Hajar Heydari · Behvar Asghari

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... There are *500 Salvia species in the nature (Gali-Muhtasib, 2006). Salvia species contain essential oils and phenolic compounds with antioxidative, antiinflammatory, anticancer, and antimicrobial activities (Sagdic et al., 2002(Sagdic et al., , 2003Gali-Muhtasib, 2006; Ozkan et al., 2010). ...

Evaluation of Listeria monocytogenes Survival in Ice Cream Mixes Flavored with Herbal Tea Using Taguchi Method

Article Oct 2010 · FOODBORNE PATHOG DIS

Ismet Ozturk · Adem Golec · Safa Karaman · Ahmed Kayacier

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Synergistic activity and mode of action of flavonoids isolated from smaller galangal and amoxicillin combinations against amoxicillin-resistant Escherichia coli

Article Nov 2011 · J APPL MICROBIOL

Griangsak Eumkeb · Supatcharee Siriwong · Sineewan Phitaktim · Santi Sakdarat

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Gas chromatographic-mass spectrometric analysis of volatiles obtained by four different techniques from Salvia rosifolia Sm., and evaluation for biological activity

Article Dec 2009

Gulmira Ozek · Fatih Demirci · Temel Ozek · Ergin Hamzaoğlu

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LWT - Food Science and Technology 43 (2010) 186–190

Contents lists available at ScienceDirect

LWT - Food Science and Technology

journal homepage: www.elsevier.com/locate/lwt

Study on chemical composition and biological activities of essential oil and extract from *Salvia pisidica*

Gulcan Ozkan [a,*], Osman Sagdic [b], R. Suleyman Gokturk [c], Orhan Unal [c], Sevil Albayrak [d]

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ABSTRACT

In this study, total contents of phenolic, flavanol and flavonol, antioxidant activities and antimicrobial activities of the Turkish endemic *Salvia pisidica* Boiss. & Heldr. ex Bentham (Lamiaceae) extract and essential oil were assessed *in vitro*. Total phenolic, flavanol and flavonol contents in the extract were 54.57 mg gallic acid equivalents (GAE)/g, 16.70 mg catechine equivalents (CE)/g and 18.19 mg rutin equivalents (RE)/g, respectively. Antioxidant activities (IC_{50} value) of the extract and essential oil were determined as 4.88 and 6.41 mg/mL by DPPH assay, respectively. 31 compounds were determined in the essential oil using GC–MS and the major compounds (%) were camphor (23.76), sabinol (19.2), α-thujone (14.2) and eucalyptol (1.8-cineole) (5.8).

The antimicrobial activity of the methanolic extract and the essential oil against 13 bacterial and two yeast strains was determined. The extract (concentration 5 g/100 ml or 10 g/100 ml) was effective against most of the strains tested, yet not against *Bacillus cereus*, *Staphylococcus aureus*, *Aeromonas hydrophila* and the two yeast strains tested. The essential oil (2 g/100 ml) showed an antimicrobial effect against all the gram (+) bacteria tested, against *Saccharomyces cerevisiae*, but was not effective against all gram (−) bacteria and *Candida albicans*. These results show that S.piscidica essential oil and extract could be considered as a natural alternative to traditional food preservatives and be used to enhance food safety and shelf life.

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1. Introduction

The genus *Salvia* L. (Lamiaceae) had 86 species in Turkey (Hedge, 1982). Since the last revision of the genus, four new species have been described from Turkey: *Salvia nydeggeri* Hub.-Mor. (Davis, Mill, & Kit, 1988), *Salvia aytachii* Vural & Adiguzel (Vural & Adiguzel, 1996), *Salvia hedgeana* Donmez (Donmez, 2001), and *Salvia anatolica* Hamzaoglu & A. Duran (Hamzaoglu, Duran, & Pinar, 2005). *Salvia pisidica* Boiss.& Heldr. ex Bentham is a 14–35 cm perennial suffruticose herb with violet-blue flowers. This plant prefers *Quercus coccifera* macchie, dry limestone slopes and field sides, from 950 to 1750 m above sea level. It is endemic to Anatolia, where it grows in Burdur, Usak, Antalya and Afyon province only (Hedge, 1982)

Salvia species have been used in folk medicine for wound healing and in alleviating stomach, liver, and rheumatism pains and for treating the common cold in the form of infusion and decoction in various parts of the world (Bayrak & Akgul, 1987; Sezik & Yesilada, 1999). They and their essential oils are used in food flavoring, pharmaceuticals, and in perfumery. *Salvia* species mainly contain essential oil and phenolics (Baser, Kurkcuoglu, & Kirimer, 1998). Some of the phenolic compounds of plants belonging to this genus have also shown excellent antimicrobial activity, as well as scavenging activity of active oxygen, inhibiting lipid peroxidation and antioxidant activity (Hohmann et al., 1999; Masaki, Sakaki, Atsumi, & Sakurai, 1995; Pizzale, Bortolomeazzi, Vichi, Uberegga, & Conte, 2002).

Recently, the essential oils and various extracts of plants have gained special interest as sources of natural antimicrobial and antioxidant agents because of the resistance to antibiotics that some microorganisms have acquired and the possible toxicities of the synthetic antioxidants (Essawi & Srour, 2000; Madhavi & Salunkhe, 1996). Spices consumed daily in different types of food to improve flavours, since ancient times, are well known for their antioxidant and antimicrobial properties (Madsen & Bertelsen, 1995; Sagdic, Karahan, Ozcan, & Ozkan, 2003). As far as our

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literature survey could ascertain, antimicrobial and antioxidant activity of essential oil and extract of *S. pisidica* have not been previously published.

Therefore the aim of this study was to determine total phenolics, total flavonols, total flavanols, antioxidant and antimicrobial activities, and chemical composition of *S. pisidica* extract and essential oil, in an attempt to contribute to the use of these as alternative ingredients in oxidative and microbial control for food preservation.

2. Material and methods

2.1. Plant material

The flowering aerial parts of *S. pisidica* were collected in Turkey, C3 Antalya, Korkuteli district, dry limestone slopes about 970 m above sea level at the end of May 2005. A voucher specimen is deposited at AKDU (Herbarium of the Biology Department of Akdeniz University) as Unal 1563. Leaves from *S. pisidica* were air dried at room temperature.

2.2. Isolation of essential oil

Two hundred grams of dried leaves were cut in small pieces, and the essential oil was obtained by steam distillation in 3000 mL H_2O for 3 h by Clevenger apparatus. The oil was dried over anhydrous sodium sulphate and, after filtration (Whatman No. 2, 4.25 cm diameter), stored at −20 °C until tested and analyzed. Extraction was carried out in duplicate and the results were averaged.

2.3. Preparation of the extract

Powdered herb material (7.5 g) was extracted in a Soxhlet extractor with 100 mL mixture of methanol:acetone:water:acetic acid (45:45:9:1) at 60 °C for 6 h. The extract was concentrated using rotary evaporator (Rotavator, T < 40 °C) under vacuum and then lyophilized (Virtis 2 K, T = −60). The dried extract was stored in a desiccator until use (Gokturk Baydar, Ozkan, & Sagdic, 2004). Extraction was carried out in duplicate and the results were averaged.

2.4. Analysis of volatile compounds

The composition of the volatile constituents was established by GC–MS/Quadrupole detector analyses, using a Shimadzu QP 5050 system, fitted with an FFAP polar capillary column (50 m × 0.32 mm (i.d.), film thickness: 0.25 μm). Detector and injector temperature were set at 230 °C. The temperature program for FFAP column was 120 °C (1 min) to 230 °C at a rate of 6 °C/min and then holding at 230 °C for 35 min. Helium was used as a carrier gas at a flow rate of 14 psi (split 1:10 mL/min) and injection volume of each sample was 1 μl. The ionization energy was set at 70 eV. Qualitative analysis was based on the comparison of retention times and the computer mass spectra libraries using Wiley GC/MS Library and Nist, Tutore Libraries. The percentage composition was computed from the GC peak areas.

2.5. Determination of total phenolics, total flavonols and total flavanols

The concentration of phenolic compounds in the extract was determined by the Folin-Ciocalteu method (Singleton & Rossi, 1965). The absorbance of the sample and standard were measured at 765 nm and estimations were calculated from a calibration curve obtained with gallic acid. Total phenolics were expressed as mg gallic acid equivalent (GAE)/g extract.

Total flavonol was determined with Neu's reagent solution by the method of Dai, Andary, Mondolot-Cosson, and Boubals (1995). The absorbance of the sample and standard were measured at 410 nm and the flavonols were expressed as mg rutin equivalent (RE)/g extract.

Total flavanols were assayed by the vanillin method using catechine as a standard (Butler, Price, & Brotherton, 1982). The absorbance of the sample was measured at 500 nm and the content of total flavanol in the extract was expressed as catechine equivalents (CE)/g extract.

All determinations were carried out in triplicate and the results were averaged.

2.6. Evaluation of antioxidant (antiradical) activity

Antioxidant activity was determined according to Lee et al. (1998). Briefly, the essential oil and extracts (0, 10, 25, 50, 100, 250, 500, 750 and 1000 μg) in methanol (1 mL) was mixed with 2 mL of methanolic solution containing 1,1-diphenyl-2- picrylhydrazyl (DPPH, Sigma) in a concentration of 10 mg/l. The mixture was shaken vigorously and left to stand for 30 min in the dark, and the absorbance was measured at 517 nm against a blank. The percent of DPPH discoloration of the samples was calculated according to the formula:

$$\text{Antioxidant activity} = 100\times (\text{absorbance of blank} - \text{absorbance of sample})/\text{absorbance of blank}$$

Extract concentration providing 50% inhibition (IC_{50}) was calculated from the plot of inhibition percentage against extract concentration. All determinations were carried out in triplicate and the results were averaged.

2.7. Determination of antimicrobial activity

Thirteen bacteria and two yeasts were used as test organisms: *Aeromonas hydrophila* ATCC 7965, *Bacillus brevis* FMC3, *Bacillus cereus* FMC 19, *B. subtilis* ATCC 6630, *B. subtilis* var. *niger* ATCC 10, *Escherichia coli* ATCC 25922, *Klebsiella pneumoniae* FMC 5, *Morganella morganii*, *Mycobacterium smegmatis* RUT, *Proteus mirabilis* BC 3624, *Pseudomonas aeruginosa* ATCC 27853, *Staphylococcus aureus* ATCC 28213, *Yersinia enterocolitica* ATCC 1501, *Candida albicans* ATCC 1223, *Saccharomyces cerevisiae* BC 5461.

These microorganisms were supplied by the department of Food Engineering, Erciyes University, Kayseri, Turkey.

Bacterial strains and yeast species from stock cultures were grown in 10 ml nutrient broth (Merck 5443, CDarmstadt, Germany) or malt extract broth (Merck 5397, Darmstadt, Germany) cultures for 24 h. Ten milliliters of broth cultures were prepared overnight in nutrient or malt extract broths for 24 h. Test yeasts *C. albicans* and *S. cerevisiae*, and *Y. enterocolitica* were grown in malt extract and nutrient broths at 25 °C for 18 h, respectively. The other microorganisms were grown in nutrient broth at 35 °C for 18 h. All test microorganisms were enumerated in nutrient broth or malt extract broth by serial dilution method. Their final cell concentrations were 10^6–10^7 cfu/mL. The agar diffusion method (Sagdic, 2003; Sagdic, Aksoy, & Ozkan, 2006) was used to detect antimicrobial activity. Each microorganism (250 μL) was added into a flask containing 25 mL sterile nutrient agar or malt extract agar at 45 °C and poured into Petri dishes (9 cm diameter). Then the agar plates were allowed to solidify at 4 °C for 1 h. Five equidistant holes were made

in the agar using sterile cork borers (Ø = 4 mm). The extracts (50 μL) were prepared at 1, 2.5, 5 and 10 g/100 mL concentrations in absolute methanol and were applied to the holes using a pipettor and absolute methanol without herb extract was used as a control. Again, 50 μL of the essential oil at 0.2, 0.5, 1 and 2 g/100 mL concentrations in dimethylsulfoxide (DMSO, Merck, Germany) were filled to the holes using a pipettor and DMSO without the essential oil was used as a control. *Y. enterocolitica*, *C. albicans* and *S. cerevisiae* was incubated at 25 °C for 14–24 h. The other microorganisms were incubated at 35 °C for 18–24 h. Inhibition zones which formed on the medium were measured in millimeters (mm). All determinations were carried out in duplicate and the results were averaged.

3. Results and discussion

3.1. Chemical composition of the essential oil

Yield of essential oil was found as 1.00 ± 0.04 mL/100 g dried herb. About 31 compounds of the oil were determined. GC/MS analyses revealed that the major compounds of the oil (%) were camphor (23.8), sabinol (19.2), α-thujone (14.2) and eucalyptol (1.8-cineole) (5.8) as listed in Table 1. Camphor as the main constituent (21.7%) of *S. pisidica* essential oil was reported by Demirci et al. (2005). It was also reported that camphor, sabinol, sabinyl acetate, α and β thujone and 1,8-cineole were main constituents of
S. pisidica essential oil (Sarer, 1989) and camphor, sabinol, α-thujone and 1,8-cineole have also been found to be the major components of several other *Salvia* species (Santos-Gomes & Fernandes-Ferreira, 2003; Sarer, 1989). Sabinyl acetate could not be found in our sample.

Table 1
Chemical composition of the essential oil of *S. pisidica*.

Essential oil compounds		RT[b]	%
1	α-Pinene[a]	8.9370	1.2[c]
2	Camphene	10.739	0.5
3	β-Pinene	12.595	1.3
4	Limonen	17.273	0.2
5	Eucalyptol (1,8-cineole)	17.825	5.8
6	p-Cymene	21.607	1.2
7	3-Octyl acetate	25.177	0.4
8	3-Octanol	28.639	0.5
9	Linalyl oxide	32.380	1.5
10	α- Thujene	32.893	14.2
11	Camphor	38.038	23.8
12	Linalool	38.785	0.5
13	Pinacarvone	41.371	0.6
14	Bornyl acetate	41.755	1.1
15	Norinone	42.125	1.4
16	Terpineol	42.938	0.5
17	Sabinene ketone	45.391	0.6
18	Sabinol	45.957	19.2
19	Pinocarveol	46.370	1.5
20	Verbenol	47.598	1.0
21	Cryptone	47.856	4.4
22	Linalyl propionate	48.967	0.4
23	Borneol	49.118	1.5
24	Verbenone	50.062	0.3
25	Cuminol	54.448	3.4
26	p-Cymene-8-ol	57.625	0.3
27	Caryophyllene oxide	66.162	0.5
28	2,3-Dehydro-4-oxo-beta-ionol	71.177	2.3
29	Thymol	75.453	3.9
30	Carvacrol	77.014	2.4
31	β-Eudesmol	78.439	0.3

[a] Compounds listed in order of elution from a FFAP MS column.
[b] Retention time (as minutes).
[c] The percentage composition was computed from the GC peak areas.

This may be attributable that the amounts of the essential oil differ by geographic region, collect time, altitude and climate.

3.2. Amount of total phenolics, total flavanols, total flavonols and antioxidant activity

Yield, contents of total phenolic, flavanol and flavonol of extract of *S. pisidica* are given in Table 2. Yield of extract was found as 13.97 ± 0.12 g/100 g dried herb. The mean amount of total phenolic was 54.57 ± 2.02 mg GAE/g extract. Similar values have been reported for other *Salvia* samples (Dorman, Hiltunen, & Tikkanen, 2003; Miliauskas, Venskutonis, & van Beek, 2004; Tepe, Daferera, Sokmen, Sokmen, & Polissiou, 2005). Total flavanol and flavonol of extract were 16.70 ± 1.64 mg CE/g and 18.19 ± 0.36 mg RE/g, respectively. Total flavonol were found as 0.6, 0.7, 0.9 and 0.5 mg RE/g extract for *Salvia officinalis*, *Salvia sclarea*, *Salvia glutinosa* and *Salvia pratensis* by Miliauskas et al. (2004). Ozkan, Kuleasan, Celik, Gokturk, and Unal (2007) also reported that total flavanols and flavonols of *Teucrium montbretii* subsp. *pamphylicum* were tested as 43.78 mg catechine equivalents (CE)/g and 0.48 mg rutin equivalents (RE)/g extract, respectively.

Antioxidant activities tested by the DPPH model system. The values for IC_{50} of the extract (Table 2) and essential oil were calculated as 4.88 ± 1.56 and 6.41 ± 1.28 mg/mL. Free radicals cause auto-oxidation of unsaturated lipids in food (Kaur & Perkins, 1991) and the antioxidant activity of the extracts could be attributed to their hydrogen donating ability. There was no previous literature on antioxidant activities of *S. pisidica* extract and essential oil. However, similar antioxidant activity values of sage essential oil were reported by Baratta, Dorman, Deans, Biondi, and Ruberto (1998), Erdemoglu, Turan, Cakici, Sener, and Aydin (2006), and Kamatou et al. (2007).

3.3. Antimicrobial activity

The antimicrobial activities of *S. pisidica* extract at a concentration of 1, 2.5, 5 and 10 g/100 mL methanol are shown in Table 3. Absolute methanol (control) had no inhibitory effects on the fifteen microorganisms tested. Antimicrobial activity of extract and essential oil of *S. pisidica* varied related to the test organisms. The extract of the *S. pisidica* at 5 and 10 g/100 mL concentrations in methanol showed antibacterial activities against Gram (+) bacteria tested but not against *B. cereus* and *S. aureus*. Additionally, the extract had antibacterial activities against Gram (−) bacteria tested but not against *A. hydrophila* and *P. mirabilis*. Also, the extract was inactive against *C. albicans* and *S. cerevisiae* at all concentrations. *M. smegmatis*, *P. aeruginosa* and *B. subtilis* var. *niger* was the most sensitive microorganism to the extract concentrations examined.

Antimicrobial activity of the essential oil of *S. pisidica* at 0.2, 0.5, 1.0 and 2.0 g/100 mL in DMSO concentrations was examined against fifteen microorganisms containing thirteen bacteria and two yeasts (Table 3). 2.0 g/100 mL concentration of the essential oil had antimicrobial effects against Gram (+) bacteria tested and

Table 2
Yield, contents of total phenolic, flavanol, flavonol and antioxidant activity of extract from dried leaves of *S. pisidica*.

Bioactive profile of the extract	Amounts
Yield	13.97 ± 0.12 g/100 g herb
Total phenolic	54.57 ± 2.02 mg GAE/g extract
Total flavanol	16.70 ± 1.64 mg CE/g extract
Total flavonol	18.19 ± 0.36 mg RE/g extract
Antioxidant activity	4.88 ± 1.56 IC_{50} = mg/ml

GAE: Gallic acid equivalent, CE: Catechine, RE: Rutin equivalent.

Table 3
Antimicrobial activities of *S. pisidica* essential oil and extract at different concentrations (inhibition zones, mm[a]).

Microorganisms	Essential oil concentrations (g/100 ml)				Extract concentrations (g/100 ml)			
	0.2	0.5	1	2	1	2.5	5	10
Gram (+)								
B. brevis	–	–	–	10.0 ± 1.0	–	–	10.0 ± 2.0	13.0 ± 1.0
B. cereus	–	–	–	8.0 ± 1.0	–	–	–	–
B. subtilis	–	–	–	10.0 ± 0.0	–	–	10.0 ± 1.0	16.0 ± 2.0
B. subtilis var. *niger*	–	–	9.0 ± 0.0	13.0 ± 0.0	–	10.0 ± 2.0	11.0 ± 1.0	19.0 ± 2.0
M. smegmatis	–	–	–	8.0 ± 1.0	8.0 ± 1.0	9.0 ± 1.0	12.0 ± 0.0	15.0 ± 0.0
S. aureus	–	–	–	8.0 ± 0.0	–	–	–	–
Gram (−)								
A. hydrophila	–	–	–	–	–	–	–	–
E. coli	–	–	–	–	–	–	9.0 ± 0.0	13.0 ± 1.0
K. pneumonia	–	–	–	–	–	–	8.0 ± 0.0	9.0 ± 0.0
M. morganii	–	–	–	–	–	–	9.0 ± 0.0	11.0 ± 0.0
P. mirabilis	–	–	–	–	–	–	–	–
P. aeruginosa	–	–	–	–	8.0 ± 0.0	8.0 ± 0.0	10.0 ± 0.0	17.0 ± 0.0
Y. enterocolitica	–	–	–	–			10.0 ± 0.0	10.0 ± 0.0
Yeasts								
C. albicans	–	–	–	–	–	–	–	–
S. cerevisiae	–	–	–	10.0 ± 2.0	–	–	–	–

–: not detected.
[a] Includes diameter of hole (4 mm).

S. cerevisiae but not against all Gram (−) bacteria tested as well as *C. albicans*. Essential oils at a concentration of 0.2 or 0.5 g/100 mL were inactive. The essential oil concentration of 1 g/100 mL was only active against *B. subtilis* var. *niger*. *B. subtilis* var. *niger* was the most sensitive microorganism to the 2.0 g/100 mL essential oil concentration. Grams (+) bacteria are more sensitive to *S. pisidica* essential oil than Gram (−) bacteria tested.

Several studies have been conducted for antimicrobial activities of essential oils and extracts from different *Salvia* species (Delamare, Moschen-Pistorello, Artico, Atti-Serafini, & Echeverrigaray, 2007; Haznedaroglu, Karabay, & Zeybek, 2001; Tepe et al. 2005). The result of this study concerning the antimicrobial activities of *S. pisidica* extract and essential oil was first. Our study supports the observations of some other researchers. The essential oil of *S. officinalis* and *S. triloba* exhibited remarkable bacteriostatic and bactericidal activities against *B. cereus*, *B. megaterium*, *B. subtilis*, *A. hydrophila*, *A. sobria*, and *Klebsiella oxytoca*. Also the essential oil of both species at a concentration 0.05 mg/100 mL methanol inhibited the growth of *S. aureus*. The growth of *S. aureus* and *A. hydrophila* drastically reduced (Delamare et al., 2007). On the contrary to our findings, Haznedaroglu et al. (2001) reported that the essential oil of *S. tomentosa* remarkably inhibited the growth of tested Gram (−) bacteria except for *P. aeruginosa*. This may be due to chemical composition of different species. Tepe et al. (2005) showed that the essential oil of *S. tomentosa* possessed strong antimicrobial activity while other non-polar extracts and subfractions showed moderate activities against *S. aureus*, *Streptococcus pneumoniae*, *Moraxella catarrhalis*, *B. cereus*, *Acinetobacter lwoffii*, *Clostridium perfringens*, *M. smegmatis* and *C. albicans* while polar extracts remained almost inactive against microorganisms tested. Methanolic extracts of *S. cryptantha* and *S. multicaulis* had also antimicrobial potential (Tepe et al., 2004). The acetone extract of *S. jaminiana*, containing the sterols campestanol, stigmasterol and sitosterol, and five known diterpenoids, ferruginol, cryptanol, 6,7-dehydroroyleanon, 6-hydroxysalvinolone and microstegiol, remarkably inhibited the growth of *B. subtilis*, *S. aureus* ATCC 25923 and *Streptococcus* α-hemolitic (Kabouche et al., 2005). Kamatou, Viljoen, van Vuuren, and van Zyl (2006) reported that the extract of *S. chamelaeagnea* showed good antibacterial activity against the four pathogens containing *B. cereus*, *S. aureus*, *E. coli* and *K. pneumoniae*. Also Kamatou et al. (2007) reported that *S. albicaulis* and *S. dolomitica* essential oil showed poor activity against *E. coli* while moderate activity was shown against the other pathogens. It was shown that the essential oil of *S. officinalis* had antifungal activities (Santos-Gomes & Fernandes-Ferreira, 2003). Kuzma, Rozalski, Walencka, Rozalska, and Wysokinska (2007) determined that the crude dichloromethane fractions from acetone extracts of *S. sclarea* roots as well as four pure abietane diterpenoids isolated from the hairy root cultures had antimicrobial activity against tested Gram (+) bacteria.

4. Conclusions

In conclusion, various high concentration of the extract and essential oil of *S. pisidica* had antioxidant activities and antimicrobial effects. Therefore, it is suggested that further work be performed on the isolation and identification of the antioxidative and antimicrobial components of the extract and essential oil of *S. pisidica*. These results showed that *S. pisidica* essential oil and extract could be considered as a natural alternative to traditional food preservatives and be used to enhance food safety and shelf life.

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