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Tümü

Detaylı Arama

ANA SAYFA › SON EKLENEN YAYINLAR › SCREENING OF TURKISH ENDEMIC TEUCRIUM MO...

Screening of Turkish endemic Teucrium montbretii subsp pamphylicum extracts for antioxidant and antibacterial activities

Özkan G., Kuleaşan H., Çelik S., Gokturk R. S. , Unal O.

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Özet

The antioxidant and antimicrobial activities of Teucrium montbretii Bentham subsp. pamphylicum P.H. Davis (Lamiaceae) methanolic extracts were investigated. Total contents of phenolic compounds, flavonols and flavanols were determined by Folin-Ciocalteu colorimetric, Neu's reagent solution and vanillin colorimetric methods, respectively. Total phenolics were 99.4 mg gallic acid equivalents (GAE)/g. Total flavanols. and flavonols were 43.8 mg catechin equivalents (CE)/g and 0.5 mg rutin equivalents (RE)/g, respectively. At 100 ppm, the free radical scavenging activity was 58.6%. Antioxidant activity measured by the phosphomolybdenum method was 191.5 mg/g. Antibacterial activity was assessed (1%, 2.5%, 5%, 7.5% and 10% w/v) by the agar diffusion method against 10 species. Concentrations of 1% and 2.5% were not effective against any of the bacteria. The most resistant bacterium was Salmonella typhi while Listeria monocytogenes showed the highest sensitivity. (c) 2006 Elsevier Ltd. All rights reserved.

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The antioxidant and antimicrobial activities of Teucrium montbretii Bentham subsp. pamphylicum P.H. Davis (Lamiaceae) methanolic extracts were investigated. Total contents of phenolic compounds, flavonols and flavanols were determined by Folin–Ciocalteu colorimetric, Neu's reagent solution and vanillin colorimetric methods, respectively. Total phenolics were 99.4 mg gallic acid equivalents (GAE)/g. Total flavanols and flavonols were 43.8 mg cate...

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... flavum were very rare and probably decimated. Many species of Teucrium are used in traditional folk medicine and it is claimed they have hypoglycemic, antipyretic, antiulcer, anti-inflammatory, antitumor and antibacterial properties (Couladis, Tzakou, Verykokidou, & Harvala, 2003;Fernandez, Iglesias, & Villar del Fresno, 1997;Menichini et al., 2009; Ozkan, Kuleasan, Celik, Gokturk, & Unal, 2007) . Maccioni, Baldini, Tebano, and Cioni (2007) noted the importance of Teucrium species as alimentary plants; some of them are currently used in the preparation of flavored wines and beer, herbal teas, bitters and liqueurs (Bosisio, Giavarini, Dell'Agli, Galli, & Galli, 2004). ...

... Maccioni, Baldini, Tebano, and Cioni (2007) noted the importance of Teucrium species as alimentary plants; some of them are currently used in the preparation of flavored wines and beer, herbal teas, bitters and liqueurs (Bosisio, Giavarini, Dell'Agli, Galli, & Galli, 2004). The importance of this genus in food industries lies also in the fact that many species show antimicrobial, antioxidant and antifungal activities, rendering them useful as natural perspective ingredients (Bosisio et al., 2004; Ozkan et al., 2007; Saracoglu, Arfan, Shabir, Hadjipavlou-Litina, & Skaltsa, 2007;Ulubelen, Topu, & Sönmez, 2000). ...

Antibacterial activities and phytochemical composition of Teucrium essential oils from Corsica.

Article Nov 2012

Vannina Lorenzi · Elodie Guinoiseau · Djabou Nassim · Alain Muselli

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... We can mention: Their traditional uses in the symptomatic treatment of digestive disorders and in that of States neurotoniques of adults and children in particular in the case of minor disorder of sleep [1]. The species of Teucrium are bitter and astringent [7, 8], used as antirheumatic diuretic, diaphoretic, tonic, antipyretic, and antispasmodic. Many of them are used in popular medicine as anti-inflammatory, antihypertensive, and anorexia [2], as well as antidiabetic medicine, antiseptic, anthelmintic, and carminative [9]. ...

... The species Teucrium montbretii is traditionally used as healing, anti-inflammatory and in the treatment of cancer. The antioxidant activity has also been demonstrated [7]. Several studies on the antimicrobial activity, smooth muscle relaxants, antipyretics, and anti-inflammatory drugs were conducted on Teucrium marum [1,10]. ...

The chemical composition and the antimicrobial properties of the essential oil extracted from the leaves of Teucrium capitatum L

Article Feb 2017

Jalila El Amri · Khalid El Badaoui · Zoubida Haloui

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... Plants of this genus have been used medicinally since ancient Greek times, when they were used for coughs and asthma; most of these are bitter, astringent, anti-rheumatic herbs that were used as an antispasmodic for gastric ulcer and intestinal inflammation, to stimulate the digestion, lower fever, and as diuretic, antiseptic, antipyretic and antihelmintic agents. Many species show interesting biological properties, e.g., analgesic, hypoglycaemic, hypolipidemic, antipyretic, anti-inflammatory, antiulcer, antioxidant and antibacterial (Abdollahi, Karimpour, & Monsef-Esfehani, 2003;Barrachina, Bello, Martinez-Cuesta, Esplugues, & Primo-Yufera, 1995;Bellomaria, Arnold, & Valentini, 1998;Panovska, Kulevanova, Gjorgoski, Bogdanova, & Petrushevska, 2007;Saracoglu, Calis, Inoue, & Ogihara, 1997;Tariq, Ageel, al-Yahya, Mossa, & al-Said, 1989;Ulubelen, Topcu, & Sonmez, 2000; Özkan, Kuleas ßan, Çelik, Göktürk, & Ünal, 2007) . Maccioni, Baldini, Tebano, Cioni, and Flamini (2007) noted the importance of Teucrium species as alimentary plants, as some of them are currently used in the preparation of flavoured wines, herbal teas, bitters and liqueurs and infusions of leaves and flowers are used for flavouring beer in some areas. ...

... Maccioni, Baldini, Tebano, Cioni, and Flamini (2007) noted the importance of Teucrium species as alimentary plants, as some of them are currently used in the preparation of flavoured wines, herbal teas, bitters and liqueurs and infusions of leaves and flowers are used for flavouring beer in some areas. The importance of this genus in food industries lies also in the fact that many species show antimicrobial, antioxidant and antifungal activities, rendering them useful as natural preservative ingredients (Saroglou, Arfan, Shabir, Hadjipavlou-Litina, & Skaltsa, 2007;Ulubelen et al., 2000; Özkan et al., 2007) . ...

Phytochemical composition, anti-inflammatory and antitumour activities of four Teucrium essential oils from Greece

Article Jul 2009 · FOOD CHEM

Federica Menichini · Filomena Conforti · Daniela Rigano · Felice Senatore

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... Plants of this genus are well known in traditional medicine for their use against coughs and asthma, as antispasmodic in gastric ulcer, in intestinal inflammation, to stimulate the digestion, lower fever, as diuretic, antiseptic, antipyretic and antihelmintic agents [2]. Many species show analgesic, hypoglycaemic, hypolipidemic, antipyretic, antiinflammatory, antiulcer, antioxidant and antibacterial activities [3] [4] [5]. Teucrium ssp. are in addition used in the preparation of flavoured wines, herbal teas, bitters and liqueurs, and infusions of leaves and flowers for flavouring beer in some areas with the aim of providing a bitter aromatic taste [6]. ...

Analysis of Essential Oil from Teucrium maghrebinum Greuter et Burdet Growing Wild in Algeria

Article Full-text available Apr 2009

Carmen Formisano · Daniela Rigano · Felice Senatore · Sergio Rosselli

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... The Lamiaceae family includes a large number of plants that are well-known for their strong antioxidant and antimicrobial properties. Plants belonging to the Lamiaceae family are rich in polyphenolic compounds with over 160 polyphenols having been identified, some of which P E E R R E V I E W A B S T R A C T are unique to the genus [8, 9] . Although, as antimicrobial and antioxidant compounds, many plants belonging to Lamiaceae and their derivatives have been studied in detail [8,101112 , there are only two study concerning the chemical constituents of W. orientalis [7,13] . ...

Biological activities of Wiedemannia multifida (Linnaeus) Bentham and Wiedemannnia orientalis Fisch. & Mey

Article Mar 2013

Ahmet Aksoy · Rumiza Abd Rashid · Sevil Albayrak

... These findings were consistent with previous studies that flower extracts from Mentha pulegium [38], Teucrium montbretii subsp. pamphylicum [39], and Plantago major [40] showed greater inhibition activity against L. monocytogenes compared to S. aureus. ...

Effects of Flower and Fruit Extracts of Melastoma malabathricum Linn. on Growth of Pathogenic Bacteria: Listeria monocytogenes, Staphylococcus aureus, Escherichia coli, and Salmonella typhimurium

Article · Full-text available · Jan 2013 · EVID-BASED COMPL ALT

Siti Nurhadis Che Omar · Janna Ong Abdullah · Khairul Anuar · Muhajir Hamid

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... Research has shown that medicinal plants exhibit antioxidant (Nam and Kang, 2004; Katalinic et al., 2006; Kiselova et al., 2006), as well as antimicrobial (Chan et al., 2008) activity. Because of their antibacterial and antioxidant properties, herbs are used as natural food and cosmetics preservatives (Chan et al., 2007; Özkan et al., 2007) and are considered in formulation of new functional food products (Kiselova et al., 2006). Croatia has approximately 10% of endemic and subendemic species from the total number of registered plants (about 5000) varieties of endemic herbs, which are commonly used in traditional medicine. ...

Antioxidant and antimicrobial properties of Teucrium arduini L. (Lamiaceae) flower and leaf infusions (Teucrium arduini L. antioxidant capacity)

Article · Sep 2009

Dunja Samec · Miroslav Strnad · Jasenka Piljac Zegarac · Jiri Gruz

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... They exhibited some interesting biological activities like diuretic, diaphoretic, antiseptic, antipyretic, antispasmodic, antiulcer, antirheumatic, antibacterial, antioxidant, hypoglycemic, antifeedant. Besides, some Teucrium extracts are used in folk medicine to treat various ailments such as stomach and intestinal troubles, rheumatism, hemorrhoids and renal inflammatory, asthma, an infusion of the leaves and flowers is used as a hop substitute for flavouring beer [12][13][14][15] [16] . ...

Investigation of the volatile oils, lipid constituents and biological activity of Ballota andreuzziana, Teucrium zanonii and Verbena tenuisecta in Libya

Article · Full-text available · Aug 2010

Khaled Abdelshafeek · Adnan Elgattar · Aziza H Zarkoon · Abdelaaty A Shahat

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... The obtained endophytic bacterial and fungal extracts were tested for growth inhibition against Escherichia coli (ATCC 8739), Salmonella typhimurium (ATCC 23564), Klebsiella pneumoniae (ATCC 9621), Proteus vulgaris (ATCC 13315) as performed by well diffusion method (21, 22). ...

Study of antibacterial, anti-proliferative, and pro-apoptotic potential of the cell extracts of endophytic fungi and bacteria isolated from Pajanelia longifolia (Willd.) K. Schuman

Article · Full-text available · Jul 2021

Gowthami G a · Subhankar Das · Yalpi Karthik · Ik Manjula

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... Herbs possess a wide range of biological activities, including antibacterial, antiviral and antioxidant effects. Because of that it is used as food and cosmetics preservatives [10, 11]. The purpose of antioxidants in a physiological setting is to prevent reactive oxygen species (ROS) from reaching intracellular concentrations which could lead to cell damage. ...

Antioxidant and Antimicrobial Properties of Veronica spicata L. (Plantaginaceae)

Article · Full-text available · May 2015

Dunkić Valerija · Ivan Kosalec · Iztok Joze Kosir · Dario Kremer

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... The concentration of total phenolic compounds in the extracts was determined comparing the absorbance between the extract samples and the gallic acid standard solutions. All samples were preservative ingredients (Özkan et al. 2007; Saroglou et al. 2007;Bezić et al. 2011). Previous phytochemical and pharmacological studies showed that the leaf, flower, and fruit essential oils are characterized by a predominance of sesquiterpenes, such as β-caryophyllene, germacrene D, and β-bisabolene (Lo Presti et al. 2010). ...

Biological activities of Teucrium flavum L., Teucrium fruticans L., and Teucrium siculum Rafin crude extracts ---- http://www.tandfonline.com/eprint/TY5cbsKUS5jPtb6pDW4X/fu

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Rosaria Acquaviva · Carlo Genovese · Andrea Amodeo · Claudia Di Giacomo

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... Research has shown that medicinal plants exhibit antimicrobial activity [9] . Because of their antibacterial properties, herbs are used as new source for antibiotics discovery [10, 11] . The medicinal value of plants lies in some chemical substances that produce a definite physiological action on the human body. ...

Preliminary study on the antimicrobial activity of Enicostemma littorale using different solvents

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Ponmoni Abirami · Muthiah Gomathinayagam · Rajaram Panneerselvam

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... 2000; Couladis et al., 2003; Bruno et al., 2003). The importance of this genus and family patterrns in food industries lies also on the fact that many species show antimicrobial, antioxidant and antifungal activities, rendering them useful as natural preservative ingredients (Ulubelen et al., 2000; Bagci and Baser, 2005; Saroglou, et al., 2007; Ozkan et al., 2007). The Mediterranean flowering plant known as T. chamaedrys L. (Germander) is useful in herbal medicine for its anti-inflammatory, anti-rheumatic, digestive and diuretic effects. ...

Composition of the essential Oil of Teucrium chamaedrys L. (Lamiaceae) from Turkey

Article · Full-text available · Dec 2010 · J MED PLANTS RES

Eyup Bagci · Sukru Hayta · Ayse Yazgin · Uğur Çakılcıoğlu

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... Species of Mentha, Thymus, Salvia, Origanum, Coleus and Ocimum are used as food flavorings, vegetables and in industry [8].Lamiaceae family, are of interest to food manufacturers as consumers move towards functional foods with specific health effects. The anti-oxidative and antimicrobial effects are mainly due to phenolic components, such as Flavonoids, phenolic acids, and phenolic diterpenes [9]. ...

THE THIRD INTERNATIONAL CONFERENCE ON BASIC SCIENCES & THEIR APPLICATIONS Essential oil composition of Teucrium L. (Lamiaceae) collected from different locations in

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Abdelbaset Askar

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... Finding antioxidant active extract as effective as a standard compounds is unfortunately very rare. When comparing other Teucrium species from Anatolia: T. cavarnarum the total phenol content was found to be much higher for T. montbret and T polium [11, 12]. We determined antioxidant activity levels that are more active than the previously reported data noted in the above reporting. ...

PHENOLIC COMPOUNDS DETERMINATION AND ANTIOXIDANT ACTIVITY OF TEUCRIUM CAVERNARUM

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... When investigating the chemical composition, many authors have shown that the Teucrium genus is one of the richest sources of polyphenolic compounds (Henchiri et al. 2009, Rahim et al. 2013. Numerous studies revealed the presence of saponins, phenolic acids, flavonoids, sterols, tannins, essential oils, iridoids and diterpenoids (€ Okzkan et al. 2007 , . Some polyphenolic compounds such as ferulic, gallic, caffeic, vanillic, sinapic, rosmarinic, p-coumaric, syringic, chlorogenic acids, quercetin and rutin, in previous studies were identified from plants of Teucrium genus (Kremer et al. 2013, Belarbi et al. 2018, Kaska and Mammadov 2019. ...

Methanol extracts of Teucrium arduini L. and Teucrium flavum L. induce protective effect against mitomycin C in human lymphocytes in vitro

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Aleksandra Markovic · Jovana Tubić Vukajlović · Darko Grujicic · Olivera Milosevic-Djordjevic

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... From the nonpharmacologic perspective, Maccioni et al. (2007) has noted the importance of Teucrium species as edible plants, as some of them are currently used in the preparation of flavored wines, herbal teas, bitters, and liqueurs; infusions of the leaves and flowers are used for flavoring beers in some areas. The importance of this genus in the food industries lies also in the fact that many species display anti-microbial, anti-oxidant, and anti-fungal activities, rendering them useful as natural preservative ingredients (Ulubelen et al., 2000; Özkan et al., 2007; Saroglou et al., 2007). ...

In vitro and in vivo immunomodulatory and anti-ulcerogenic activities of Teucrium ramosissimum extracts

Article | Full-text available | Jul 2011 · J IMMUNOTOXICOL

Mounira Krifa · Rim Mensi · Mohamed ben sghaier · Leila Chekir-Ghedira

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... (2) It is a cosmopolitan genus that differs from other related genera in that its corolla is formed of one lip. Many studies have shown that extract from Teucrium species may act as antinociceptive, (3) anti-inflammatory, (4,5) immunomodulatory, free-radical scavenging, (6) antimicrobial, (7) antimutagenic, and antiulcerogenic factors. (8) These activities are attributed to the drug compositions. ...

Anti-inflammatory and antiulcerogenic activities of leaf extracts and sesquiterpene from Teucrium ramosissimum (Lamiaceae)

Article | Full-text available | Mar 2011 · IMMUNOPHARM IMMUNOT

Mohamed ben sghaier · Hedi Harizi · Teheni Louhichi · Leila Chekir-Ghedira

... belonging to Labiatae family was studied for the antioxidant and antimicrobial activity. It was reported that the extract has a natural compound which prevents the auto-oxidation of lipids, and it was also suggested that the plant could be used as a natural food protectant due to its antibacterial and antioxidant activities 20 Presence of radical scavenging activity of Nepeta determined in the present study supports the previous reports with respect to the antioxidant activity of Nepeta. It was reported that flavonoids, phenolic acids, essential oils and terpens found in plants of Labiatae family are the compounds leading to antioxidant effects 23 . ...

In vitro antioxidant and antimicrobial assays of acetone extracts from Nepeta meyeri Bentham

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Yilmaz Cigremis · Zeynep Ulukanli · Ahmet ilçim · Muslum Akgoz

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... Because of a range of biological activities, including antioxidant, antibacterial and antiviral effects, herbs are used as food and cosmetics preservatives (Chan et al., 2007; Özkan et al., 2007) and are valuable ingredients in formulation of new functional foods (Kiselova et al., 2006). The role of reactive oxygen species (ROS) in many pathological conditions such as cardiovascular diseases (Kaliora et al., 2006) or diabetes (Robertson and Harmon, 2006) has been in the focus of research interests in the past decade. ...

Antioxidant and antimicrobial properties of Moltkia petraea (Tratt.) Griseb. flower, leaf and stem infusions

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... Maccioni, Baldini, Tebano, and Cioni (2007) noted the importance of Teucrium species as alimentary plants; some of them are currently used in the preparation of flavored wines and beer, herbal teas, bitters and liqueurs (Bosisio, Giavarini, Dell'Agli, Galli, & Galli, 2004). The importance of this genus in food industries lies also in the fact that many species show antimicrobial, antioxidant and antifungal activities, rendering them useful as natural perspective ingredients (Bosisio et al., 2004; Ozkan et al., 2007; Saracoglu, Arfan, Shabir, Hadjipavlou-Litina, & Skaltsa, 2007; Ulubelen, Topu, & Sönmez, 2000). The genus Teucrium is one of the richest sources of neoclerodane diterpenes: more than 220 diterpenes have been described, many of them are of interest due to their insect-repellent and medicinal properties (Bruno et al., 2004; Coll & Tandrón, 2005; Piozzi, Bruno, Rosselli, & Maggio, 2005). ...

Phytochemical composition of Corsican Teucrium essential oils and antibacterial activity against foodborne or toxi-infectious pathogens

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Comparative study of genotoxicity and antimutagenicity of methanolic extracts from Teucrium chamaedrys and Teucrium montanum in human lymphocytes using micronucleus assay

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Essential oil composition, antioxidant activity and phenolic content of endemic Teucrium alyssifolium Staph. (Lamiaceae)

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Screening of Turkish endemic Teucrium montbretii subsp. pamphylicum extracts for antioxidant and antibacterial activities

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Screening of Turkish endemic *Teucrium montbretii* subsp. *pamphylicum* extracts for antioxidant and antibacterial activities

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Abstract

The antioxidant and antimicrobial activities of *Teucrium montbretii* Bentham subsp. *pamphylicum* P.H. Davis (Lamiaceae) methanolic extracts were investigated. Total contents of phenolic compounds, flavonols and flavanols were determined by Folin–Ciocalteu colorimetric, Neu's reagent solution and vanillin colorimetric methods, respectively. Total phenolics were 99.4 mg gallic acid equivalents (GAE)/g. Total flavanols and flavonols were 43.8 mg catechin equivalents (CE)/g and 0.5 mg rutin equivalents (RE)/g, respectively. At 100 ppm, the free radical scavenging activity was 58.6%. Antioxidant activity measured by the phosphomolybdenum method was 191.5 mg/g. Antibacterial activity was assessed (1%, 2.5%, 5%, 7.5% and 10% w/v) by the agar diffusion method against 10 species. Concentrations of 1% and 2.5% were not effective against any of the bacteria. The most resistant bacterium was *Salmonella typhi* while *Listeria monocytogenes* showed the highest sensitivity.
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Keywords: *Teucrium montbretii*; Phenolics; Flavanols; Flavonols; Antioxidant activity; Antibacterial effect

1. Introduction

Throughout recorded history, spices and herbs have been used for flavoring foods and beverages and for medicinal purposes (Draughon, 2004). They have been screened for their potential uses as alternative remedies for the treatment of many infections and preservation of foods from the toxic effects of oxidants (Barlow, 1990). The preservative effect of many plant species and herbs suggests the presence of antioxidative and antimicrobial constituents (Hirasa & Takemasa, 1998). A number of phenolic compounds with strong antioxidant and antimicrobial activities have been identified in these plants, especially those belonging to the *Lamiaceae* family, and are of interest to food manufacturers as consumers move towards functional foods with specific health effects (Loliger, 1991; Özkan, Sağdıç, & Özcan, 2003; Pietta, 1998). The antioxidative and antimicrobial effects are mainly due to phenolic components, such as flavonoids, phenolic acids, and phenolic diterpenes (Shahidi, Janitha, & Wanasundara, 1992; Hammer, Carson, & Riley, 1999; Sağdıç, Kuşçu, Özcan, & Özçelik, 2002).

Teucrium (family Lamiaceae) is a cosmopolitan genus of about 340 species and *Teucrium montbretii* subsp. *pamphylicum* is a 5–40 cm perennial procumbent plant with lilac to purplish flowers. It is endemic to Anatolia, where it grows in Antalya province only (Ekim, 1982). *Teucrium* species are bitter, astringent, antirheumatic herbs that reduce inflammation, stimulate the digestion and have been used as herbal medicines for coughs and asthma since ancient times. Several studies about bacteriostatic, spasmolytic, antioxidant

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and antiinflammatory effects of *Teucrium* species have been reported in the literature (Coban, Citoglu, Sever, & Iscan, 2003; Couladis, Tzakou, Verykokidou, & Harvala, 2003; Ricci et al., 2005; Yıldırım et al., 2004). Nevertheless, no data exist concerning the antioxidant capacities and antioxidant activities of *T. montbretii* subsp. *pamphylicum* extracts.

The purpose of this study was to evaluate methanolic extract of *T. montbretii* subsp. *pamphylicum* as new potential sources of natural antioxidants and antimicrobials. Antibacterial effects, phenolics, flavanols, flavonols, antiradical activity and antioxidant capacity of extracts were determined by in vitro assays.

2. Material and methods

2.1. Plant materials

The flowering aerial parts of *T. montbretii* subsp. *pamphylicum* were collected in Turkey, C3 Antalya, Konyaaltı, Varyant (36 53 078 N, 30 40 697 E), on limestone and tufa rocks near the coast, about 10 m above sea level at the end of June 2004. A voucher specimen is deposited at AKDU (Herbarium of the Biology Department of Akdeniz University) as Gokturk 5927 and COMU (Herbarium of the Biology Department of Canakkale Onsekiz Mart University) as Celik 2165.

2.2. Preparation of the herb extracts

Ground herb (10 g) was extracted in a Soxhlet extractor with 100 ml methanol (50 °C for 6 h). The extract was concentrated by using rotary evaporator (Rotavator, $T < 40$ °C) under vacuum to get crude extracts and dried extracts were stored in a desiccator until use (Göktürk Baydar, Özkan, & Sağdıç, 2003). Yield (%) was 10.7 ± 1.2.

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

The concentration of phenolic compounds in the extracts was determined by the Folin–Ciocalteu colorimetric method (Singleton & Rossi, 1965). Estimations were carried out in triplicate and calculated from a calibration curve obtained with gallic acid. Total phenolics were expressed as gallic acid equivalent (mg GAE/g extract).

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

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

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

2.4. Evaluation of antioxidant activity and antiradical activity

The antioxidant activities of samples were evaluated by the phosphomolybdenum method according to the procedure of Prieto, Pineda, and Aguilar (1999) and expressed relative to that of ascorbic acid.

Antiradical activity was determined according to Lee et al. (1998) and calculated by the following equation: antiradical activity $= 100 \times$ (absorbance of blank $-$ absorbance of sample/absorbance of blank)

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

2.5. Bacterial cultures

Strains were obtained from type culture collections of the Food Engineering department. The pathogenic organisms were *Escherichia coli*, *Salmonella typhi*, *Yersinia enterocolitica*, *Staphylococcus aureus, Streptococcus pneumoniae*, *Enterobacter aerogenes and Listeria monocytogenes*. Three non-pathogenic organisms were *Lactobacillus reuteri*, *Lactobacillus acidophilus* and *Micrococcus luteus*. Pathogens and *M. luteus* were incubated in Tryptic Soy Broth and *Lactobacillus* species in MRS broth at 37 °C for 18 h. In antibacterial activity tests agar plates of the same media were used.

2.6. Determination of antibacterial effect

The well diffusion method (Schillinger, Kaya, & Lücke, 1991) was applied to detect antibacterial activity. Herb extracts (30 μl) prepared at 10%, 7.5%, 5%, 2.5% and 1% concentrations in absolute ethanol and applied to wells on agar plates. Absolute ethanol without herb extract was used as a control. Inhibition zones were measured in millimetres (mm). Tests were done in triplicates and the results were presented as averages.

3. Results and discussion

Total phenolics, total flavanol and antioxidant total flavonol contents of the herb extract were determined. The mean amounts of total phenolics were 99.4 ± 10.1 mg GAE/g extract. Total flavanols and flavonols were between 43.8 ± 7.9 mg CE/g and 0.5 mg RE/g, respectively. The vanillin–HCl assay is quite specific to a narrow range of flavanols (monomers and polymers) including catechin monomers, and is the most commonly used method for rapid quantification of condensed tannins in plant materials (Hagerman, Rice, & Richard, 1998; Tempel, 1982). Condensed tannins are known to belong to the oldest of plant secondary metabolites, and polymers responsible for the astringency, monomers such as catechin and epicathechin contribute to their bitterness (Ojeda, Andary, Kraeva, Carbonneou, & Deloire, 2002). The reactivity of condensed tannins with molecules of biological significance such as proteins, metal ions and polysaccharides

Table 1
Antibacterial activity of *T. montbretii* subsp. *pamphylicum* extract at different % concentrations (inhibition zones, mm)

Bacteria	Extract concentrations (%)				
	10	7.5	5	2.5	1
Escherichia coli	13.5 ± 0.7[a]	11.5 ± 0.7	–	–	–
Salmonella typhi	–	–	–	–	–
Lactobacillus reuteri	11.0 ± 1.4	10.0 ± 0.0	–	–	–
Lactobacillus acidophilus	14.5 ± 2.1	12.0 ± 1.4	–	–	–
Yersinia enterocolitica	16.0 ± 1.4	12.0 ± 0.0	–	–	–
Staphylococcus aureus	17.0 ± 1.4	13.5 ± 0.7	–	–	–
Enterobacter aerogenes	21.5 ± 0.7	14.5 ± 2.1	9 ± 1.4	–	–
Streptococcus pneumoniae	20.0 ± 0.6	12.0 ± 1.4	12 ± 0.7	9 ± 0.0	–
Micrococcus luteus	12.5 ± 0.7	–	–	–	–
Listeria monocytogenes	22.5 ± 0.7	18.0 ± 1.4	16 ± 1.4	11.5 ± 0.4	–

– : not detected (diameter of wells were 8 mm).
[a] Values expressed are mean ± SD of three experiments.

has important nutritional and physiological consequences, and hence the determination of the content of condensed tannins in plant material is important (Schofield, Mbugua, & Pell, 2001). Flavonols such as quercetin and rutin are also known to support human health by serving as antiinflammatory, antihistaminic and antiviral agents (Soleas, Diamandis, & Goldberg, 1997).

Antiradical activities were tested by the DPPH model system and were the highest (58.6 ± 0.3%) at 100 ppm concentration of the extract. BHT, used as a synthetic antioxidant in food industry, showed lower antiradical activity (38.9 ± 1.0%) when compared to the extract. Free radicals cause auto oxidation of unsaturated lipids in food (Kaur & Perkins, 1991) and the antiradical activity of the extracts could be attributed to their hydrogen donating ability. Antioxidant capacity of the extract (equivalent to ascorbic acid) was 191.5 ± 5.2 mg/g. Jayaprakasha, Selvi, and Sakariah (2003) reported that the antioxidant activity of extracts depends on the presence of polyphenols which may act as reductons. According to our knowledge, there was little previous literature on antioxidant properties of *T. montbretii* subsp. *pamphylicum* extracts. Coban et al. (2003) and Couladis et al. (2003) found that the ethanol extracts from *T. polium* had high antioxidant and antiradical activities.

Total phenolics, flavanols, flavonols, antiradical and antioxidant activities were measured spectrophotometrically. For routine quality control, spectrophotometric methods such as the Folin–Ciocalteu and the vanillin assays, which are well understood in terms of their mechanisms, are considered to be very valuable because they are low cost, quick and reproducible (Vrhovsek, Mattıvı, & Waterhouse, 2001).

The antibacterial activities of the herb extracts are presented in Table 1. As expected, the control treatment (absolute ethanol) had no inhibitory effect on any of the test bacteria. The strength of antibacterial effect of herb extract concentrations followed the sequence: 10 > 7.5 > 5 > 2.5 > 1%. *S. typhi* was the most resistant bacterium, while *L. monocytogenes* was the most sensitive. Extracts at high concentrations affected the growth of all of the organisms tested except *S. typhi*. While the effect can not be regarded as very significant, the lowest three concentrations (5%, 2.5% and 1%) also affected the growth of microorganisms at some level. Mansouri (1999) reported that extract of *T. polium* L had very little antibacterial activity against *S. aureus*. Studies on the antibacterial effect of *T. montbretii* are lacking in literature.

4. Conclusion

These herb extracts were natural products preventing the auto-oxidation in oils and in oil-bearing foods. The growth of food-borne pathogens or spoilage organisms can be inhibited when high concentrations were applied in food products. The results of this study suggest the possibility of using the herb extracts as natural food preservatives, because the extracts possess antibacterial and antioxidant activities.

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