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Short Communication

Antimicrobial activities of the essential oils of four *Salvia* species from Turkey

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In the present study, antibacterial and antifungal activities of essential oils of four *Salvia* species against five bacteria and one fungus were evaluated at concentrations of 1/10, 1/20 and 1/30 and incubated for 24 h. Aqueous and hexane extracts of each plant were tested for their antibacterial and antifungal activity by using agar disc diffusion method. The result indicated that all essential oils exhibit antibacterial activity against *Bacillus subtilis, Escherichia coli* and *Staphylococcus aureus.* In addition, essential oils of *Salvia multicaulis* exhibit the antibacterial activity against *Pseudomonas aeruginosa.* Essential oils of *Salvia syriaca* exhibit antibacterial and antifungal activities against all micro-organisms.

Key words: Antimicrobial activity, *Salvia*, essential oils.

INTRODUCTION

Gram positive and gram negative bacteria, as well as fungi, cause different types of human infections. However, effective antimicrobials have been developed over the years; there has been increased development of antimicrobial drug resistance to presently available antimicrobials (Chopra, 2007). This has made the development of new antimicrobial drugs necessary. Since ancient times, the crude herbal extracts of aromatic plants have been in use for different purposes, such as food, perfumery, flavouring foods, beverages and for medication, they have also been considered very valuable for their usage as antimicrobials (Heath, 1981; Ozcan, 1998).

Salvia, the largest genus of the *Lamiaceae* family, includes about 900 species and is common throughout the world. Some of them are economically important since they have been used as spices and flavouring agents in perfumery and cosmetics. The analysis of the essential oil composition of several *Salvia* species indicates that 1,8-cineole (eucalyptol) and borneol are their main constituents (Ahmadi and Mirza, 1999; Baser et al., 1997; Haznedaroglu et al., 2001; Perry et al., 1999; Sivropoulou et al., 1997). Turkey is regarded as an important gene-center regarding the family *Lamiaceae* (Labiatae). The family has 45 genera, 546 species and 730 taxa in Turkey. The rate of endemism in the family is 44.2% (Baser, 1993). The members of the *Lamiaceae* are generally found in the mountainous areas of the Mediterranean region of Turkey and the composition of their essential oils is detailed by Baser (1994).

The gram positive bacteria, such as *Staphylococcus aureus* are primarily responsible for post-operative wound infections, toxic shock syndrome, endocarditis, osteomyelitis and food poisoning (Mylotte et al., 1987). *Escherichia coli*, which is the one of the gram negative bacteria, is present in human intestines and causes urinary tract infection, coleocystitis or septicemia (Singh et al., 2000). *Bacillus subtilis* is a rod-shaped aerobic bacterium and it has been found that they have some pathogenic role (Gorden et al., 1973). In the present study, a wide range of potentially pathogenic micro-organisms were used to evaluate antimicrobial activity of essential oil of *Salvia palaestina, Salvia multicaulis, Salvia syriaca and Salvia ceratophylla.*

MATERIALS AND METHODS

Plant materials and isolation of the essential oils

The aerial parts of four *Salvia* species were collected from South-eastern Anatolia in June 1998 -1999. Voucher specimens have been deposited in the Herbarium of the Department of Biology, Faculty of Science, Dicle University. Dry aerial materials of four plants were pulverized; essential oil of plants was extracted by Clevenger-type apparatus for 4 h. Results were recorded as

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Table 1. Inhibition zones of essential oils at different concentrations (1/10, 1/20 and 1/30).

Micro-organism	Inhibition zone diameter (mm)*													
	S. palaestina			*S. ceratophylla*			*S. multicaulis*			*S. syriaca*			Antibiotics	
	1/30	1/20	1/10	1/30	1/20	1/10	1/30	1/20	1/10	1/30	1/20	1/10	AML	SAM
B. subtilis	10	10	14	14	14	16	10	10	16	12	12	12	20	28
E. coli	12	12	14	14	14	14	12	14	20	10	12	12	22	22
S. aureus	10	12	16	12	12	14	10	12	10	10	10	12	16	16
S. pyogenes	-	-	-	-	-	-	-	-	12	-	-	10	22	22
P. aerugonisa	-	-	-	-	-	-	-	-	14	-	-	14	-	-
C. albicans	-	-	-	-	-	-	-	-	-	-	-	10	D	D

(*):Data are the mean values of two replicates (diameter of inhibition zone mm), (-): Not zone diameter, D : Sensitive.

mL/100 g (%).

Micro-organisms

The micro-organisms used in this study were obtained from the Department of Biology, Faculty of Science, Dicle University. E. coli K12, *Pseudomonas aeruginosa*, *S. aureus*, *Streptococcus pyogenes, B. subtilis* and *Candida albicans* 74 were used in the study. The micro-organisms were grown on nutrient agar slants and maintained deep-freeze at -80°C. The inoculated agar slants were incubated at 37°C.

Antibiotic discs and antimicrobial activity

The antimicrobial activity was based on disc diffusion method (Thitilertdecha et al., 2008) using micro-organisms cell suspension whose concentration was equilibrated to a 0.5 McFarland standard. A 100 µl of each micro-organism suspension was spread on a Mueller-hinton agar plate. Fifty microliters of dilution of essential oils were pipetted on sterile paper discs (6 mm in diameter), which were allowed to dry in an open sterile Petri dish in a biological safety cabinet vertical laminar flow. 1/10, 1/20 and 1/30 solutions of the essential oils in absolute hexane were applied to discs. Discs were placed on surface of the inoculated plates and incubated at 37°C for 24 h. Diameters (mm) of the zones of bacterial and fungal inhibition minus the discs diameter were recorded (Aurelli et al., 1992; Ilçim et al., 1998). Discs with the hexane used for dissolution were used as negative control and 10 µg AML (Amoxicilin) and SAM (Sulbactam/Ampicillin 10/10 = 20 µ) antibiotic discs were used as positive control. The experiment was performed in duplicate and the results were expressed as average values.

RESULTS AND DISCUSSION

The essential oils from the four species of *Salvia* were inhibited the growth of all bacteria and these findings are summarized in Table 1. It has been shown that oils from different plants possessed a wide range of antibacterial spectrum. Because they inhibited the growth, the diameter of inhibition varied from 10 - 20 mm, depending on the susceptibility of the tested organism. In this study, among micro-organisms, most resistant is *C. albicans.* In addition, essential oils of *S. ceratophylla* and *S. palaestina* were ineffective against to *P. aeruginosa*, *S. pyogenes* and *C. albicans.* Some essential oils at 1/30 decreased the inhibition zone against bacteria than those of 1/20 and 1/10. The lower rate of essential oil amount showed lower inhibition zone than the higher one. Essential oil of *S. ceratophylla* showed high inhibition zone against *B. subtilis* and *E. coli* at 1/30 (14 mm). The highest inhibition zones at 1/20 were obtained from *S. multicaulis* essential oil against *E. coli* (14 mm) and *S. ceratophylla* essential oil against *B. Subtilis* (14 mm), *E. coli* (14 mm) and *S. aureus* (12 mm). The highest inhibition zones at 1/10 were obtained from *S. palaestina* essential oil against *E. coli, S. aureus* (16 mm) and *S. ceratophylla* essential oil against *B. subtilis* (16mm) and *S. multicaulis* essential oils against *E. coli* (20 mm).

Essential oil of *S. syriaca* at 1/10 was effective against all micro-organisms. Discs containing of 1/30 essential oils have not had any effects against *S. pyogenes, P. aeruginosa* and *C. albicans*. It is assumed that the rate of essential oils is not enough to affect this bacteria and fungus. As indicated in the table, it was seen that *S. multicaulis* essential oil effected *E. coli* as much as AML and SAM antibiotics. It was seen that *S. palaestina* essential oil effected *S. aureus* as much as AML and SAM antibiotics. Although *P. aeruginosa* is resistant against AML and SAM antibiotics, it is important that it is affected from *S. multicauils* and *S. syriaca* essential oils in 14 mm inhibition zone diameter. It can be said that 1/10 essential oils of *S. multicauils* and *S. syriaca* are sufficient for *P. aeruginosa.*

It was reported that most *Salvia* species have terpens, pinen, lorneol and cineol are recommended for use as a diuretic and an antiseptic (Baytop, 1999). In addition, camphor and 1,8-cineole (eucalyptol) are well-known chemicals with their pronounced antimicrobial potentials (Pattnaik et al., 1997; Tzakou et al., 2001). The chemical composition of essential oils depends on climatic, seasonal, and geographic conditions, harvest period and distillation technique. In addition, their antibacterial activity depends on the type, composition and concentration of the essential oils, the type and concentration of the target micro-organism, the composition of the substrate, the processing and the storage conditions

(Marino et al., 2001; Ozcan and Erkmen, 2001; Pandit and Shelef, 1994; Panizi et al., 1993). So far, previous investigations on the antimicrobial potential of several *Salvia* sp. essential oils have been carried out. The oils of *Salvia officinalis* and *Salvia triloba* showed antibacterial activity (Delamare et al., 2007). Similarly, the oils of *Salvia cryptantha* and *S. multicaulis* showed antimicrobial activity against fourteen micro-organisms (Tepe et al., 2004). The essential oils of *Salvia sivasica* and *Salvia anamurensis* showed antibacterial activity but did not showed antifungal activity against *C. albicans* (Dulger and Gonuz, 2004). The essential oils six Iranian *Salvia* species showed antibacterial and antifungal against six micro-organisms (Javidnia et al., 2008). The antimicrobial activity of essential oils of *Salvia* species used in our study showed similar properties with earlier investigations. As a result the essential oils of *S. multicaulis* and *S. syriaca* showed antimicrobial activity against both bacteria and fungus. So, it can be used as an herbal medicine.

Conclusion

The results of this study suggest the possibility using the four species of *Salvia* essential oils which posses strong antibacterial activity. The result indicated that the oils may be used in the treatment of diseases caused by the micro-organisms tested.

REFERENCES

Ahmadi L, Mirza M (1999). Essential oil of *Salvia multicaulis* Vahl from Iran. J. Essential Oil Res., 11: 289-290.

Aureli P, Constantini A, Zolea S (1992). Antimicrobial activity of some plant essential oils against *Listeria monocytogenes.* J. Food Protection, 55: 344-348.

Baser KHC (1993). Essential oils of Anatolian Labiatae. A profile. Acta Horticulture 333: 217-238.

Baser KHC (1994). Essential oils of Labiatae from Turkey: Recent results. Lamiales Newslett. 3: 6-11.

Baser KHC, Duman H, Vural M, Adiguzel N, Aytac Z (1997). Essential oil of *Salvia aytachii.* J. Essential Oil Res. 9: 489-490.

Baytop T (1999). Therapy with Medicinal Plants in Turkey (Past and Present), 2nd ed. Nobel Tıp Kitapevleri, Istanbul, Turkey. pp. 334-335 (in Turkish).

Chopra I (2007). The increasing use of silver-based products as antimicrobial agents; A useful development or a concern. J. Antimicrob. Chemother., 59: 587-590.

Delamare APL, Moschen-Pistorelo IV, Artico L, Atti-Serafini L, Echeverrigary S (2007). Antibacterial activity of the essential oils of *Salvia officinalis* L. And *Salvia triloba* L. cultivated in South Brazil. Food Chem., 100: 603-608.

Dulger B, Gonuz A (2004). Antimicrobial Activity of Some Endemic *Verbascum*, *Salvia*, and *Stachys* Species Pharmaceutical Biology. 42: 301-304.

Gorden RE, Haynes WC and Paug CHN (1973). The genus *Bacillus*. Agric handbook (No. 427). Washington, DC: US Department of Agriculture.

Haznedaroglu MZ, Karabay NU, Zeybek U (2001). Antibacterial activity of *Salvia tomentosa* essential oil. Fitoterapia 72: 829-831.

Heath HB (1981). Source book of flavours. Westport: Avi pp. 890.

Ilçim A, Dıgrak M, Bagci E (1998). The investigation of antimicrobial effect of some plant extract. Turk. J. Biol., 22: 119-125.

Javidnia K, Miri R, Soltani M, Gholami M and Khosravi AR (2008). Antimicrobial activity and chemical composition of the essential oils of six Iranian *Salvia* species. Chem. Nat. Compounds 44: 654-658.

Marino M, Bersani C, Comi G (2001). Impedance measurements to study the antimicrobial activity of essential oils from Lamiaceae and Compositae. Int. J. Food Microbiol., 67: 187-195.

Mylotte JM, McDermott C, Spooner J (1987). Prospective study of *Staphylococcus aureus* bacteria. Re. Infect. Dis., 5: 891-907.

Ozcan M (1998). Inhibitory effects of spice extracts on the growth of *Aspergillus parasiticus NRRL2999* strain. Zeitschrift fur Lebensmittel-Untersuchung und-Forschung A. 207: 253-255.

Ozcan M, Erkmen O (2001). Antimicrobial activity of the essential oils of Turkish plant spices. Eur. Food Res. Technol. 212: 658-660.

Pandit VA, Shelef LA (1994). Sensitivity of *Listeria monocytogenes* to rosemary (Rosmarinus officinalis L.). Food Microbiol. 11: 57-63.

Panizi L, Flamini G, Cioni PL, Morelli I (1993). Composition and antimicrobial properties of essential oils of four Mediterranean Lamiaceae. J. Ethnopharmacol., 39: 167-170.

Pattnaik S, Subramanyam VR, Bapaji M, and Kole CR(1997). Antibacterial and antifungal activity of aromatic constituents of essential oils. Microbios., 89: 39-46.

Singh R, Chandra R, Bose M, Luthra PM (2000). Antibacterial activity of *Curcuma longa rhizoma* extracton pathogenic bacteria. Curr. Sci., 83(6): 25.

Sivropoulou A, Nikolaou C, Papanikolaou E, Kokkini S, Lanaras T, Arsenakis M (1997). Antimicrobial, cytotoxic, and antiviral activities of *Salvia fruticosa* essential oil. J. Agric. Food Chem. 45: 3197-3201.

Tepe B, Donmez E, Unlu M, Candan F, Daferera D, Vardar-Unlu G, Polissio M, Sokmen A (2004). Antimicrobial and antioxidative activities of the essential oils and methanol extracts of *Salvia cryptantha* (Montbret et Aucher ex Benth.) and *Salvia multicaulis* (Vahl). Food Chem., 84: 519-525.

Thitilertdecha N, Teerawutgulrag A, Rakariyatham N (2008). Antioxidan and antibacterial activities of *Nephelium lappaceum* L. extracts. LWT Food Sci. Technol., 41: 2029-2035.