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Research Paper Healthcare

Antibacterial Activity of Turkish Endemic Sideritis Akmanii (Lamiaceae)

*** Mehmet Temel**	Department of Biology, Faculty of Arts and Science, Afyon Kocatepe University, Afyonkarahisar, Turkey * Corresponding author
Recep Kara	Department of Food Hygiene and Technology, Faculty of Veterinary Medicine, Afyon Kocatepe University, Afyonkarahisar, Turkey.
Raziye Müdüroğlu	Public Health Laboratory (No. 1), Zeytinburnu / İstanbul, Turkey.
Levent Akkaya	Department of Food Hygiene and Technology, Faculty of Veterinary Medicine, Balıkesir University, Balıkesir, Turkey.

ABSTRACT

Antibacterial activity of Sideritis akmanii Z. Aytac, M. Ekici and A. Donmez extracts was investigated by disc diffusion methods against Aeromonas hydrophila, Salmonella typhimurium, Escherichia coli O157:H, Bacillus subtilis, Staphylococcus aureus, Listeria monocytogenes, Pseudomonas aeruginosa, Bacillus cereus, Klebsiella pneumoniae, Yersinia enterocolitica, Saccharomyces cerevisiae, and Candida albicans. Different concentrations of Sideritis akmanii oil posses a significant antibacterial acitivity against Bacillus subtilis, Bacillus cereus, Aeromonas hydrophila, and Pseudomonas aeruginosa, but have no effect on yeasts. This plant can be used as a food additive and traditional medicine.

KEYWORDS : Antibacterial activity, antifungal activity, Lamiaceae, Sideritis akmanii

Introduction:

The genus *Sideritis* L. (Lamiaceae) distributed mainly in the Mediterranean basin is represented by more than 150 species [1]. 25 species of thirty-one *Sideritis* taxa are endemic to Turkey and some species have been collected for exportation [2]. The members of genus *Sideritis* are called as "Dağ Çayı, Yayla Çayı, Ada Çayı, Alanya Adaçayı or Balbaşı" and consumed as herbal tea and in folk medicine in Turkey. They are widely used in the treatment of gastrointestinal disorders and for treatment of cough, common cold, and as diuretic [3-5].

Although the chemical composition, antiinflammatory, antioxidant, antibacterial, antifungal, analgesic, morphological and anatomical studies have been done on some *Sideritis* L. species [6-13], no data exists concerning about *Sideritis akmanii*'s antibacterial and antifungal activity. Only one literature related with our species is that eight known diterpenoids were isolated from the aerial parts of *Sideritis akmanii*, *S. niveotomentosa, S. brevidens, S. rubriflora* and *S. gulendamii* were used to evaluate the activity against the final-instar larvae of *Spodoptera littoralis* and *Spodoptera frugiperda*. Sideroxol was the only diterpenoid out of the 7 tested with significant antifeedant activity against *Spodoptera frugiperda*. Foliol was a potent phagostimulant for *Spodoptera littoralis*. The presence of the epoxide in sideroxol might contribute to the activity of this compound against *Spodoptera frugiperda*. The aim of this research is to investigate the antibacterial and antifungal activity of Turkish endemic *Sideritis akmanii* extract against some pathogenic bacteria and yeasts.

Material and method:

Plant material

Samples of *Sideritis akmanii* was collected during the flowering stage from Şuhut districts of Afyonkarahisar province of Turkey (Kumalar Mointain, Çakmaktepe) in June 2008 at altitudes of 1850 m. Voucher specimens were deposited at the herbarium of Afyon Kocatepe University Biology Department (Herb. No: AKU 2104)

Preparation of the *Sideritis akmanii* extract

Aerial parts of plant dried at shadow were first powdered. Then the powdered plant material was extracted by the Clevenger hydrodistillation method [14]. The amount of 50 g plant material was placed in an flask with 500 mL of double distilled water and hydrodistilled at 150 °C for 2 hours.

Bacterial cultures

The microorganism strains used in this study were *Aeromonas hydrophila* ATCC 7965, *Salmonella typhimurium* ATCC 14028, *Escherichia coli O157:H7* ATCC 43894, *Bacillus subtilis* ATCC 6633, *Bacillus cereus* ATCC 11778, *Staphylococcus aureus* ATCC 25923, *Listeria monocytogenes* ATCC 25923, *Pseudomonas aeruginosa* ATCC 27853, *Klebsiella pneumoniae* ATCC 27736, *Yersinia enterocolitica* ATCC 1501, *Saccharomyces cerevisiae* ATCC 9763, and *Candida albicans* ATCC 1223.

Determination of Antimicrobial Activity

All test bacteria in nutrient broth were enumerated by using the serial dilution method. Final cell concentrations were 10^6-10^7 cfu/ml. 250 µl of each bacteria was added into a flask containing 25 ml sterile nutrient agar at 45 °C and poured into petri dishes (8 cm diameter). Then the agar was allowed to solidify at 4 °C for 1 h. The agar diffusion method was used to detect the antibacterial activity of the extracts. Four equidistant holes were made in the agar using sterile cork borers (Oxoid Discs, CT0998B). 50 µl of 2.5% (A), 5% (B), 10% (C) and 20% (D) volume of extract solutions was added to the holes using a pipettor [11]. The inoculated plates were incubated at 37C at 18-24 h for bacterial strains, 27C at 24-48 h for yeast. At the end of the period, inhibition zones which formed on the medium were measured in millimetres (mm). All the tests were performed in triplicate.

Result and discussion:

The antibacterial activities of *Sideritis akmanii* extracts at 2.5, 5, 10 and 20 % concentrations on the test microorganisms are given in Table 1. Different concentrations of *Sideritis akmanii* extract have an activity on *Aeromonas hydrophila, Salmonella typhimurium, E. coli O157:H7, Bacillus subtilis, Bacillus cereus, Listeria monocytogenes* and *Pseudomonas aeruginosa,* but have no effect on *Staphylococcus aureus, Klebsiella pneumoniae, Yersinia enterocolitica, Saccharomyces cerevisiae* and *Candida albicans*. *Aeromonas hydrophila*, *Bacillus subtilis, Bacillus cereus* and *Pseudomonas aeruginosa* were inhibited at lower concentration (2.5%) and inhibition zones have increased at 5%, 10% and 20%, respectively (Table 1).

Antibacterial activity of *Sideritis akmanii* extract shows a variation according to the test organisms. While the most effective concentration (20%) inhibits all bacteria except *Staphylococcus aureus,* it has no activity against test yeasts (*Klebsiella pneumoniae, Yersinia enterocolitica, Saccharomyces cerevisiae*, and *Candida albicans*). *Listeria monocytogenes* was inhibited only 20% concentration. *Escherichia coli* O157:H7 had no growth at 2.5% concentration. Different studies have been undertaken to investigate the antimicrobial and antifungal activity of *Sideritis* species. *Sideritis albiflora, Sideritis brevibractata* and *Sideritis pisidica* extracts have no effective on *Staphylococcus aureus*, *Micrococcus flavus, Micrococcus luteus* and *Proteus vulgar-*

is, but *Bacillus subtilis, Escherichia coli* and especially *Pseudomonas aeruginosa* were inhibited strongly [15]. Özkan *et al.* [11] informed that *Pseudomonas aeruginosa* was to be sensitive to *Sideritis condensata* and *Sideritis eryhrantha* var. *eryhrantha* extracts, whereas *Enterococcus faecalis* and *Staphylococcus aureus* had resistant to them. Uğur *et al.* [16] indicated that essential oils of *Sideritis curvidens*. Stapf. and *Sideritis lanata* L. showed stronger antimicrobial activity against Gram-positive bacteria than reference antibiotics. Basile *et al.* [12] found that essential oils of *Sideritis italica* demonstrated strong inhibitory effect against *Enterococcus fecalis,* low sensitivity against *Staphylococcus aureus,* and high sensitive against *Pseudomonas aeruginosa, Salmonella typhi* and *Proteus mirabilis.* Sagdic *et al.* [17] determined that antimicrobial activities of the extracts of *Sideritis. ozturkii* and *S. caesarea* extracts at 10, 5, 2.5 and 1% concentrations on the test microorganisms and presented that *S. ozturkii* and *S. caesarea* extracts had the least effective at 1 and 2.5% concentrations while 10% concentration inhibiting completely the growth of all the microorganisms. Yeast strains were more resistant than bacterial strains. It is noticable that the results of antibacterial and antifungal activity studies on *Sideritis* species are similar to our results. In general, *Sideritis* extracts have better antibacterial effect than antifungal effect.

Conclusion:

The antimicrobial and antifungal activities of endemic *Sideritis akmanii* used as folk medicine in Turkey were determined in this study. While antibacterial activity of *Sideritis akmanii* extract shows a variation according to the test organisms, no effect on yeast strains was observed. Natural antibacterial agents which don't effect sensorial and characteristical properties of some foods can be prefered as food protective and should be evalueted with further studies.

Tablo 1: Antibacterial activity of *Sideritis akmani* extracts

Microorganisms	Zone of inhibition (mm)			
	A	B	C	D
Aeromonas hydrophila	8,63±0.48	11,75±0.50	16,00±0.82	20,50±1.73
Salmonella typhimurium	NI	NI	10,25±0.96	15,25±0.50
Escherichia coli O157:H7	NI	8,50±0.58	13,25±0.96	17,00±1.15
Bacillus subtilis	9,50±0.58	12,25±0.96	20,25±2.06	31,50±4.36
Bacillus cereus	8,75±0.96	11,00±2.16	17,00±2.45	38,00±2.16
Staphylococcus aureus	NI	NI	NI	NI
Listeria monocytogenes	NI	NI	NI	13,00±3.16
Pseudomonas aeruginosa	7,75±1.50	10,75±3.40	12,63±1.70	14,50±2.38
Klebsiella pneumoniae	NI	NI	NI	NI
Yersinia enterocolitica	NI	NI	NI	NI
Saccharomyces cerevisiae	NI	NI	NI	NI
Candida albicans	NI	NI	NI	NI

A:2.5%, B: 5%, C: 10%, D: 20%, NI: no zone of inhibition Values expressed are mean standard deviation of three experiments (p)

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