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PAGES: 129-134

ORIGINAL PDF URL: <https://dergipark.org.tr/tr/download/article-file/840313>

Antimicrobial Activity of Some Bidens Species

Received : 25.06.2016

Revised : 27.07.2016

Accepted : 03.08.2016

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Abstract

The aim of this study was to determine the antimicrobial activities of aerial parts extracts of some *Bidens* species against some bacteria and yeast. Aqueous and ethanolic aerial parts extracts of *Bidens cernua* L. var. *radiata* DC., *B. frondosa* L. and *B. tripartita* L. were screened for their antimicrobial activities against *Staphylococcus aureus* ATCC 25923, *S. aureus* ATCC 43300 (methicillin-resistant *S. aureus*), *Bacillus subtilis* ATCC 6633, *Escherichia coli* ATCC 25922, *Pseudomonas aeruginosa* ATCC 27853 and *Candida albicans* ATCC 10231. Broth macrodilution method was used to determine the antimicrobial activities of plant extracts. Ethanolic extracts of tested species exhibited better antimicrobial activity than aqueous extracts. Ethanolic extracts of tested species possessed activity having MIC values of 0.125-0.250 mg/ml against the tested microorganisms. No antibacterial activity was observed for all the aqueous extracts. Only aqueous extracts of *B. frondosa* and *B. tripartita* showed antifungal activity having MIC values of 0.500-1.000 mg/ml against *C. albicans*, respectively. It is conceivable that use of *Bidens* species for treatment of various skin diseases and injuries, and also cold in folk medicine is because of its antimicrobial activity. This is the first research on antimicrobial activity of Turkish *Bidens* species.

Keywords: Antimicrobial activity, *Bidens* sp., *B. cernua* var. *radiata*, *B. frondosa*, *B. tripartita*

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Özet

Bazı *Bidens* Türlerinin Antimikrobiyal Aktivitesi

Bu çalışmanın amacı, bazı *Bidens* türlerinin topraküstü kısımlarının, sulu ve etanollü ekstrelerinin antimikrobiyal aktivitelerinin araştırılmasıdır. *Bidens cernua* L. var. *radiata* DC., *B. frondosa* L. ve *B. tripartita* L. türlerinin *Staphylococcus aureus* ATCC 25923, *S. aureus* ATCC 43300 (metisilin dirençli *S. aureus*), *Bacillus subtilis* ATCC 6633, *Escherichia coli* ATCC 25922, *Pseudomonas aeruginosa* ATCC 27853 ve *Candida albicans* ATCC 10231'a karşı antimikrobiyal aktiviteleri makrodilüsyon yöntemi ile belirlenmiştir. Çalışmada kullanılan türlerin etanollü ekstrelerinin, sulu ekstrelerle kıyasla daha iyi antimikrobiyal aktivite gösterdiği belirlenmiştir. Etanollü ekstrelerin test mikroorganizmalarına karşı MIC değerleri 0.125-0.250 mg/ml olarak saptanırken, sulu ekstrelerin antibakteriyel etki göstermediği görülmüştür. *B. frondosa* ve *B. tripartita*'nın *C. albicans*'a karşı MİK değerleri sırasıyla, 0.500-1.000 mg/ml olarak saptanmıştır. Geleneksel tıpta *Bidens* türlerinin çeşitli cilt hastalıklarının ve yaralanmalarının tedavisinde ve ayrıca soğuk algınlığında kullanılması, antimikrobiyal etkisinin varlığı ile ilişkilendirilebilir. Bu çalışma Türkiye'de yetişen *Bidens* türleri ile yapılan ilk antimikrobiyal aktivite çalışmasıdır.

Anahtar kelimeler: Antimikrobiyal aktivite, *Bidens* sp., *B. cernua* var. *radiata*, *B. frondosa*, *B. tripartita*

1. Introduction

The genus *Bidens* L., belongs to the Asteraceae family, distributes in many regions of the world with 280 species [1,2]. Most of the species of the genus grow in America while only 4–5 species of this genus were described in Europe [3]. The genus *Bidens* is mainly represented by four species, five taxons in Turkey [2]. Phytochemical studies on *Bidens* species have shown the presence of polyacetylenes [4-7], flavonoids [8,9], essential oils, coumarins, polysaccharides, carotenoids, amines, mineral elements [10,11] and chalcones [6]. Several *Bidens* species are used in traditional medicine for the treatment of inflammation, rheumatism (arthritis), diabetes, enteritis, angina (pharyngitis), malaria, metabolic disorders, dermal diseases, seborrhea, psoriasis, wound and tumors [12-14].

The purpose of this study was to evaluate the *in vitro* antimicrobial activities of aerial parts extracts of *B. cernua* L. var. *radiata* DC., *B. frondosa* L. and *B. tripartita* L. against some bacteria and yeast. This is the first research on antimicrobial activity of Turkish *Bidens* species.

2. Material and Methods

Plant materials

The plant materials used in this study, their localities, collection dates and voucher specimen numbers are presented in Table 1. All voucher specimens were deposited in the Herbarium of the Faculty of Pharmacy, Ankara University, Ankara, Turkey. *Bidens* species were identified by Assoc. Prof. Dr. Ayşe Mine Gençler Özkan (*B. tripartita* was identified by Prof. Dr. Mehmet Koyuncu and Assoc. Prof. Dr. Ayşe Mine Gençler Özkan).

Table 1. Scientific names, studied plant parts, locations, harvest dates and voucher specimen numbers of the studied plants

<i>Species</i>	<i>Plant parts</i>	<i>Location</i>	<i>Harvest Date</i>	<i>Voucher Specimen (AEF) No</i>
<i>B. cernua</i> L. var. <i>radiata</i> DC.	aerial parts	Gölyaka Etfeni lakeside, Düzce	Aug-2011	25995
<i>B. tripartita</i> L.	aerial parts	Düzce to Yeniçağa	Aug-2011	25996
<i>B. frondosa</i> L.	aerial parts	Dereboyu-Trabzon	Sep-2011	25993

Preparation of the Extracts

5 g of each powdered dried plant material was extracted with water and 75% of ethanol in an ultrasonic bath for 1 h. The water extracts were filtered and then lyophilized. The ethanol extracts were filtered and then evaporated to dryness.

In Vitro Antibacterial and Antifungal Activities of Bidens Species

Aqueous and ethanolic aerial parts extracts of *B. cernua* var. *radiata*, *B. frondosa* and *B. tripartita* were screened for their potential *in vitro* antibacterial activities against *Staphylococcus aureus* ATCC 25923, *S. aureus* ATCC 43300 (methicillin-resistant *S. aureus*), *Bacillus subtilis* ATCC 6633, *Escherichia coli* ATCC 25922, *Pseudomonas aeruginosa* ATCC 27853 and antifungal activities against *Candida albicans* ATCC 10231. Prior to testing all extracts were filter-sterilized through 0.45 µm membrane filters. Broth macrodilution assay was used for determination of the minimum inhibitory concentrations (MIC). Cultures were obtained in Mueller Hinton Broth (Difco, Difco Laboratories, Detroit, MI, USA). Serial two-fold dilutions ranging from 1.000 to 0.0625 mg/ml were prepared in medium. A set of tubes containing only inoculated broth was used as controls. After incubation for 18-24 h at 37±1 °C for bacteria and 48 h for fungi, the last tube with no microbial growth was recorded to represent MIC value (mg/ml). Ampicillin, ofloxacin and fluconazole were used as the control agents [15,16].

3. Results and Discussion

MIC results of the tested extracts are shown in Table 2. Ethanolic extracts of tested species exhibited better antimicrobial activity than aqueous extracts. Ethanolic extracts of tested species possessed activity having MIC values of 0.125-0.250 mg/ml against the tested microorganisms. No antibacterial activity was observed for all the aqueous extracts. Only aqueous extract of *B. frondosa* and *B. tripartita* showed antifungal activity having MIC values of 0.500-1.000 mg/ml against *C. albicans*, respectively.

Table 2. MIC values (mg/ml) of Bidens species against tested microorganisms

<i>Extracts</i>		<i>Microorganisms</i>					
		<i>S. aureus</i> ATCC 25923	<i>S. aureus</i> ATCC 43300	<i>B. subtilis</i> ATCC 6633	<i>E. coli</i> ATCC 25922	<i>P. aeruginosa</i> ATCC 27853	<i>C. albicans</i> ATCC 10231
<i>B. tripartita</i> L.	E	0.250	0.250	0.250	0.250	0.250	0.125
	W	-	-	-	-	-	1.0
<i>B. cernua</i> L. var. <i>radiata</i> DC.	E	0.250	0.250	0.250	0.250	0.250	0.125
	W	-	-	-	-	-	-
<i>B. frondosa</i> L.	E	0.250	0.250	0.250	0.250	0.250	0.125
	W	-	-	-	-	-	0.500
Ampicillin		0.00078	0.05	0.006			
Ofloxacin					0.001	0.008	
Fluconazole							0.001

E: ethanol, W: water, '-'=represents no activity

B. cernua L. is an annual herb that grows by the sides of rivers, lakes and bogs in many regions of Asia and Europe. It is used in folk medicine for the treatment of metabolic disturbances, diathesis, skin diseases, scrofulous, seborrhea, psoriasis, neurodermatitis, wounds, neoplasms, and also as a diuretic and sudorific agent [17].

B. frondosa L. is an annual species growing on wet, nutrient-rich mudsoils or muddy sandsoils at the shores of rivers and lakes. *B. frondosa*, which is commonly known as devils beggarticks, is used as human food. It is also beneficial to in cold, acute bronchial and laryngeal attack induced by from exposure to cold. The infusions of the plant are used for herbal therapies against for irritation, inflammation, bleeding of the respiratory organs, and uterine haemorrhage [18].

B. tripartita L. , which is commonly known as bur-marigold, is used in folk medicine as a diuretic, sudorific and an anti-inflammatory agent [10]. Antimalarial, cholaretic, anti-ulcer and photoprotective effects of *B. tripartita* L. (Herba Bidentis) are reported in the monograph of Word Health Organisation [19].

In the previous studies, Silva et al [20] demonstrated that the extracts from the leaves of *B. pilosa* has good anti-MRSA activity. They indicated that the extracts from the stem of *B. pilosa* possessed high MIC values (50 mg/ml) against MRSA. On the other hand, for the extracts from the leaf and flower, MIC values are 6.25 and 12.5 mg/ml respectively. In another study, Tomczykowa et al [10] were investigated the antimicrobial activities of the extracts (methanol-water, acetone-water and methanol), subextracts (ethyl acetate, diethylether and n- butanol) and essential oils of *B. tripartita* flowers and herbs. All extracts and subextracts possessed antibacterial activity against Gram positive strains (*B. subtilis*, *Micrococcus luteus*, *S. aureus*) except butanolic extracts. None of the extracts was found active against fungi (*C. albicans*, *C. parapsilosis*, *Aspergillus fumigatus*, *A. terreus*). Ethyl ether extract of herba showed the highest antibacterial activity against Gram positive strains. Bacteriostatic effects of both essential oils obtained from herbs and flowers were insignificant, but they were found to have strong antifungal activity.

The antimicrobial activities of the methanol, acetone and water extracts from root part of *B. pilosa* were investigated against Gram positive (*S. aureus*, *S. epidermidis*, *B. cereus*, *Micrococcus kristinae*, *Streptococcus faecalis*) and Gram negative (*E. coli*, *P. aeruginosa*, *Shigella flexneri*, *Klebsiella pneumoniae* and *Serratia marcescens*) bacteria. It was determined that the methanol extract inhibited all Gram-positive and Gram-negative strains. Although the water extract did not inhibit any of the bacteria, the acetone extract was able to suppress the growth of *S. aureus*, *S. epidermidis*, *E. coli* and *K. pneumoniae*. All the extracts exhibited 100% inhibition against *Penicilium notatum* at the concentration of 0.1 mg/ml, likewise all the extracts showed good activity against *Aspergillus niger* but none of them none could inhibit of *Aspergillus flavus* [21].

The study of Adedapo et al [22], in which the antibacterial activities of acetone, methanol and water extracts obtained from *B. pilosa* leaves against Gram positive bacteria (*B. cereus*, *S. aureus*, *Micrococcus kristinae*, *Streptococcus pyogenes* and Gram negative bacteria (*E. coli*, *Salmonella poona*, *Serratia marcescens*, *P. aeruginosa* and *Klebsiella pneumoniae*) revealed that the acetone extract of *B. pilosa* exhibited activity against all the organisms tested, except *P. aeruginosa* and *K. pneumoniae*. Methanol extract of *B. pilosa* showed activity against five organisms, while the water extract showed activity against all Gram positive strains except *S. pyogenes*. It has also been shown that the plant extracts were active against most of the Gram-positive strains and less of the Gram-negative strains.

In this study ethanolic extracts of *Bidens* species exhibited better antimicrobial activity than aqueous extracts. No antibacterial activity was observed for all the aqueous extracts. Only aqueous extract of *B. frondosa* and *B. tripartita* showed antifungal activity against *C. albicans*. As a result, the antimicrobial substances were dissolved better in ethanol than water.

4. Conclusions

In conclusion, this study provides significant information about antimicrobial activities of aqueous and ethanolic aerial parts extracts *B. cernua* var. *radiata*, *B. frondosa* and *B. tripartita*. It is conceivable that use of *Bidens* species for treatment of various skin diseases and injuries, and also cold in folk medicine is because of its antimicrobial activity. This is the first research on antimicrobial activity of Turkish *Bidens* species.

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