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SHORT COMMUNICATION

In vitro antimicrobial activity of 20 selected climber species from the Bignoniaceae family

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Hydroalcoholic and aqueous extracts of some climber species from the Bignoniaceae family that grow in the north of Argentina were evaluated for *in vitro* antibacterial activity against Gram-positive and Gram-negative strains. By means of bioautography and disc diffusion methods, it could be determined that all infusions were not active, whereas the hydroalcoholic extracts of seven species were able to inhibit bacterial growth. The minimum inhibitory concentration and minimum bactericidal concentration observed were between 62.5 and 1000 μg gallic acid equivalent (GAE)/mL and between 125 and 1000 μg GAE/mL, respectively. The tested extracts were more active against Gram-positive microorganisms. Time-kill experiments indicated that all extracts have bacteriostatic activity. Phytochemical screening showed the presence of terpenoids, phenols and flavonoids. The amount of phenolic compounds and flavonoids was higher in tinctures when compared with infusions. These results suggest the presence of antibacterial substances in the hydroalcoholic extracts, which could be used for the treatment of infections.

Keywords: antimicrobial activity; Bignoniaceae; phytomedicine; time-kill assay

1. Introduction

Approximately 25% of the medicines prescribed in industrialised countries originate from plants, and about 120 compounds of natural origin, obtained from approximately 90 species of plants, are used in modern therapy (Politi et al. 2011). Furthermore, about 85% of traditional medicines involve the use of plant extracts (Soler 2000). Plants still present a large source of novel active biological compounds with different biological activities.

The abusive and indiscriminate use of antimicrobial compounds for many years is the main factor responsible for the appearance of the phenomenon of bacterial resistance to such compounds (Zampini et al. 2005). The systematic screening of antibacterial plant extracts represents a continuous effort to find new compounds with the potential to act as antimicrobial agents. Plants synthesise substances to defend themselves when attacked by external agents. These compounds are mainly secondary metabolites, those with antimicrobial properties being of particular interest.

The Bignoniaceae is a plant family that contains a worldwide relatively small number of genera (about 110) and species (about 650) (Rahmatullah et al. 2010). A remarkable number of

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Table 1. Phenolic and flavonoid content in tinctures and infusions of 20 selected plant species of Bignoniaceae family.

Species	Tinctures		Infusions	
	Phenolic compounds (mg GAE/g DE)	Flavonoids (mg QE/g DE)	Phenolic compounds (mg GAE/g DE)	Flavonoids (mg QE/g DE)
Adenocalymma marginatum (Cham.) DC.	$145.28 \pm 9.30^{*,a}$	69.01 ± 2.33^{a}	39.65 ± 0.49^{a}	2.93 ± 0.05^{a}
Amphilophium pannosum (DC.) Bureau & K. Schum.	63.46 ± 2.11^{b}	37.50 ± 1.61^{b}	18.42 ± 0.50^{b}	$0.79 \pm 0.06^{b,m}$
A. vauthieri DC.	53.76 ± 3.58^{c}	$33.87 \pm 6.37^{b,g}$	18.92 ± 0.40^{b}	$0.67 \pm 0.002^{b,c}$
Arrabidaea caudigera (S. Moore) A.H. Gentry	131.69 ± 3.09^{d}	259.86 ± 6.80^{c}	27.19 ± 0.38^{c}	8.15 ± 0.13^{d}
A. chica (Humb. & Bonpl.) B. Verl.	148.96 ± 6.87^{a}	172.92 ± 0.80^{d}	12.24 ± 0.11^{d}	0.61 ± 0.01^{c}
A. corallina (Jacq.) Sandwith	146.43 ± 0.78^{a}	46.43 ± 1.98^{e}	75.83 ± 1.18^{e}	5.41 ± 0.04^{e}
A. mutabilis Bureau & K. Schum.	53.64 ± 1.34^{c}	5.55 ± 0.02^{f}	55.14 ± 0.63^{f}	1.85 ± 0.02^{f}
A. selloi (Spreng.) Sandwith	97.87 ± 1.41^{e}	$31.43 \pm 2.99^{b,g}$	31.58 ± 0.57^{g}	3.68 ± 0.07^{g}
Clytostoma binatum (Thunb.) Sandwith	127.50 ± 2.71^{d}	26.25 ± 0.23^{g}	75.00 ± 0.84^{e}	13.85 ± 0.23^{h}
C. sciuripabulum Bureau & K. Schum	112.93 ± 5.65^{f}	75.86 ± 1.14^{h}	51.35 ± 2.53^{h}	4.61 ± 0.04^{i}
Cuspidaria convoluta (Vell.) A.H. Gentry	118.00 ± 8.30^{f}	122.18 ± 2.40^{i}	33.75 ± 0.162^{i}	6.00 ± 0.19^{j}
Dolichandra cynanchoides Cham.	37.63 ± 0.59^{g}	$27.42 \pm 0.54^{j,l}$	36.54 ± 0.85^{j}	2.11 ± 0.16^{k}
Macfadyena dentata K. Schum.	114.70 ± 2.52^{f}	28.82 ± 1.90^{g}	44.44 ± 0.18^{l}	2.92 ± 0.04^{a}
M. hassleri Sprague	96.43 ± 2.60^{e}	41.67 ± 2.029^{j}	71.34 ± 0.09^{m}	5.30 ± 0.04^{e}
Macfadyena unguis-cati (L.) A.H. Gentry	97.80 ± 1.45^{e}	$41.20 \pm 0.87^{j,l}$	80.79 ± 0.57^{k}	8.16 ± 0.02^{d}
Mansoa difficilis (Cham.) Bureau & K. Schum.	36.78 ± 1.27^{g}	40.80 ± 1.99^{j}	25.00 ± 2.14^{n}	0.45 ± 0.002^{l}
Pithecoctenium carolinae (Lindl.) G. Nicholson	122.31 ± 4.22^{d}	62.11 ± 3.20^{a}	$26.17 \pm 0.05^{c,n}$	0.40 ± 0.001^{l}
P. crucigerum (L.) A.H. Gentry	$56.98 \pm 2.59^{b,c}$	20.93 ± 0.49^{k}	12.50 ± 0.32^{d}	$0.94 \pm 0.15^{m,n}$
Pyrostegia venusta (Ker Gawl.) Miers	50.69 ± 1.53^{c}	9.72 ± 0.71^{f}	$34.72 \pm 2.99^{i,j}$	0.97 ± 0.05^{n}
Tynanthus micranthus Correa de Mello ex K. Schum	94.93 ± 7.91^{e}	49.27 ± 2.71^{l}	17.57 ± 0.45^{b}	1.08 ± 0.09^{n}

Note: GAE, gallic acid equivalent; DE, dry extract. Different letters in superscript within a column indicate significant difference at $p < 0.05$.
* Mean values ± standard deviation.

Table 2. Antimicrobial activity, MIC and MBC (μg/mL) values of tinctures against pathogenic bacteria.

Strains	*A. caudigera*	*A. chica*	*A. marginatum*	*A. selloi*	*A. vauthieri*	*C. convoluta*	*M. dentata*
Gram-positive							
Staphylococcus aureus ATCC 29213	125/250	250/1000	125/500	250/500	125/1000	125/500	125/500
S. aureus ATCC 25923	125/250	250/1000	125/R	250/500	125/1000	125/500	250/500
S. aureus (F13)	125/250	250/1000	125/R	250/500	125/500	250/500	250/500
S. aureus (F29)	125/500	250/1000	125/500	250/500	125/1000	250/500	250/1000
Staphylococcus epidermidis ATCC 12228	62.5/125	250/1000	125/1000	62.5/1000	125/1000	125/125	125/1000
Enterococcus faecalis ATCC 29212	1000/R	750/R	R	1000/R	500/R	500/R	1000/R
Gram-negative							
Pseudomonas aeruginosa ATCC 27853	R	R	1000/R	R	R	R	R
Escherichia coli ATCC 35218	R	R	R	R	R	R	R
Proteus mirabilis (F304)	R	R	R	R	R	500/750	1000/1000
Morganella morganii (F339)	R	500/R	500/R	500/R	R	500/750	500/1000

Note: R, Resistant. Not detected within the tested concentrations (62.5–1000 μg GAE/mL).

bioactive compounds have been reported from some species of the Bignoniaceae family plants (Barboza et al. 2009; Castillo & Rossini 2010; Rahmatullah et al. 2010). These reported compounds demonstrated a wide range of important activities, which are beneficial to human. However, till date there are no reports about the biological activities of several species of the Bignoniaceae family from the Northeast Argentine region (Barboza et al. 2009). This study was conducted to determine the polyphenol contents of aqueous and hydroalcoholic extracts from the Bignoniaceae family and to evaluate the effect of these extracts against human pathogenic bacteria.

2. Results and discussion

In this study, 20 different plant species of Bignoniaceae family that grow in the north of Argentina were studied. Alkaloids and saponins were not detected, but all the plants showed the presence of terpenoids, phenols and flavonoids. The results of the total phenolics and flavonoids content are presented in Table 1. Extensive survey of literature regarding phytochemicals in the family Bignoniaceae revealed that extracts from some species of this family contain secondary metabolites, such as tannins, flavonoids, alkaloids, terpenes and coumarins (Chen et al. 2003; Warashine et al. 2004; Usman & Osuji 2007).

Although some researchers have found that the extracts of the flowers of *Pyrostegia venusta* had antimicrobial activity (Roy et al. 2012), no further reports were found regarding antimicrobial activity in leaves extracts. The qualitative screening of antimicrobial activity showed that 30 μg of phenolic compounds from infusions were not active, whereas the ethanolic extracts of many plants were able to inhibit bacterial growth. In the disc diffusion method, seven tinctures were selected for the determination of minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) values. These results are presented in Table 2. In the time-kill assay, the extracts significantly inhibited bacterial growth when compared with the growth control. The reduction in growth was $<3\ \log_{10}$ colony forming unit (CFU)/mL for all isolates, indicating a bacteriostatic effect.

In this study, antibacterial activity of some of the selected species is reported for the first time. No previous reports on the antimicrobial activity of the leaves of these plant species could be found in the literature. Among all plants tested in this study, *Adenocalymma marginatum* (voucher specimen AGonzalez 408), *Amphilophium vauthieri* (AGonzalez 422), *Arrabidaea caudigera* (AGonzalez 418) and *Cuspidaria convoluta* (AGonzalez 104) showed the most promising antimicrobial properties indicating the potential for the discovery of antibacterial principles. This result would support their use for the treatment of skin infections, mainly caused by *Staphylococcus* strains.

3. Conclusions

The results of this study suggest that the extracts of the studied Bignoniaceae species possess compounds with antimicrobial properties, which could be used as the antimicrobial agents in new drugs for the treatment of infectious diseases in human. Chemical studies are required to determine the compounds responsible for the antibacterial effects of these species, and investigation to identify the structures of active principles has been in progress in our laboratory.

Supplementary material

Supplementary material relating to this article is available online, alongside Tables S1 and Figure S1.

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