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ANTIBACTERIAL ACTIVITY OF MEDICINAL PLANT EXTRACTS

Priscila Ikeda Ushimaru[1]; Mariama Tomaz Nogueira da Silva[1]; Luiz Claudio Di Stasi[2]; Luciano Barbosa[3]; Ary Fernandes Junior[1]*

[1]Departamento de Microbiologia e Imunologia, Instituto de Biociências de Botucatu, Universidade Estadual Paulista, Botucatu, SP, Brasil; [2]Departamento de Farmacologia, Instituto de Biociências de Botucatu, Universidade Estadual Paulista, Botucatu, SP, Brasil; [3]Departamento de Bioestatística, Instituto de Biociências de Botucatu, Universidade Estadual Paulista, Botucatu, SP, Brasil

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SHORT COMMUNICATION

ABSTRACT

The present study aimed at evaluating the *in vitro* antimicrobial activity of methanolic extracts of some medicinal plants against *Escherichia coli*, *Salmonella* Typhimurium, *Staphylococcus aureus* and *Enterococcus* sp. The methanolic extract of *Caryophyllus aromaticus* presented the highest anti-*S. aureus* activity and was effective against all bacterial strains tested.

Key words: medicinal plants, antibacterial activity, Minimal Inhibitory Concentration

Further acquaintance with different ethnic groups has contributed to the development of research on natural products, to the increase in knowledge about the close relationship between the chemical structure of a certain compound and its biological properties, and to the understanding of the animal/insect-plant interrelation (8). For these reasons, medicinal plants are important substances for the study of their traditional uses through the verification of pharmacological effects and can be natural composite sources that act as new anti-infectious agents.

The present study aimed at evaluating the *in vitro* antimicrobial activity of plant (*Allium sativum*, *Zingiber officinale*, *Caryophyllus aromaticus*, *Cymbopogon citratus*, *Mikania glomerata* and *Psidium guajava*) extracts against Gram-positive and Gram-negative bacterial strains isolated from human infections.

For the preparation of plant extracts, samples of *A. sativum* (bulbs), *Z. officinale* (rhizomes) and *C. aromaticus* (flower buds) were obtained at the local commerce in April 2006 and used *in natura*. *Cymbopogon citratus* (leaves) and *Psidium guajava* (leaves) were collected in May 2006 from an experimental field of the School of Agronomical Sciences, Unesp, Botucatu, São Paulo, Brazil. *Mikania glomerata* (leaves) was collected around Demétria farm, Botucatu, São Paulo, during the same period. The leaves were dried at approximately 50ºC and triturated in a mechanical mill. The voucher specimens were deposited in the Herbarium of the Department of Botany, Institute of Biosciences, Unesp, Botucatu-SP.

The determined plant parts (200g) were ground, extracted with 70% methanol and filtered after 48hs. The plant residue was re-extracted by adding 70% methanol and filtered again after 48hs. Such procedure was repeated every 72hs, completing three filtration processes. The filtrate was concentrated on a rotary evaporator at 45ºC for methanol elimination, and the extracts were kept in sterile bottles under refrigerated conditions until use. The dry weight of the extracts was obtained by allowing the solvent to evaporate and was used to determine concentration in mg/mL. (Methodology based on Betoni *et al*. (3); Table 1).

Microbial susceptibility assays using the agar dilution (Mueller-Hinton Agar) method (%v/v and corresponding mg/mL values) and the Minimal Inhibitory Concentration (MIC) were carried out for fifteen *Salmonella* Typhimurium, *S. aureus*, *Enterococcus* sp and *E. coli* strains plus one ATCC strain of each bacterium. Overnight cultures (37ºC) in Brain Heart

*Corresponding Author. Mailing address: Departamento de Microbiologia e Imunologia, IBB/UNESP, Botucatu, SP, Brasil. Tel.: (14) 3811-6058 FAX (14) 3815-3744. E-mail: ary@ibb.unesp.br

Table 1. Characteristics of the plants extracts.

Scientific name	Common name	Part of the plant used	Extract dry weight (mg/mL)
Allium sativum	Garlic	Bulbs	133.0
Caryophyllus aromaticus	Clove	Flower buds	95.0
Zingiber officinale	Ginger	Rhizomes	17.0
Psidium guajava	Guava	Leaves	122.0
Cymbopogon citratus	Lemongrass	Leaves	75.0
Mikania glomerata	"Guaco"	Leaves	70.0

Infusion (BHI) were adjusted to 0.5 Mac Farland standard and inoculated on Petri plates by using a Steer's replicator. After 37ºC/24 hours, MIC values (4,6) were read and MIC 50% and 90% values calculated. Kruskal-Wallis test for significant analysis ($p<0.05$) and Dunn's Test for multiple comparisons were carried out. Then, the results mean values, which represent the inhibitory capacity of each plant extract against the bacteria tested, were obtained and expressed as %v/v and mg/mL (Table 2).

MIC 90% values were different among extracts. Garlic and ginger extracts showed high antimicrobial action against Gram-negative strains. Gram-positive bacteria were more susceptible to the other plant extracts. Clove extracts were highly effective against bacterial strains, especially *S. aureus* strain (Table 2).

The antimicrobial properties of medicinal plants has been explained by the chemical association of active substances; however, the activity of their extracts is not related to their respective dry weights, which can be proven when more

Table 2. Minimal inhibitory concentrations (MIC 50% and 90%) and mean values (%v/v and mg/mL) according to the plant extracts against *Escherichia coli, Salmonella, Staphylococcus aureus* and *Enterococcus* sp.

Plant Extracts	**Bacteria spp.**	***Escherichia coli***		***Salmonella***		***Staphylococcus aureus***		***Enterococcus* sp**	
		%v/v	mg/mL	%v/v	mg/mL	%v/v	mg/mL	%v/v	mg/mL
Garlic	**MIC50%**	1.00	1.33	1.06	1.41	2.00	2.66	3.25	4.32
	MIC90%	1.04	1.38	1.21	1.61	2.00	2.66	3.67	4.88
	Median	1.000 a	1.330 a	1.100 a	1.460 a	2.000 b	2.660 b	3.375 a	4.485 b
Clove	**MIC50%**	1.22	1.16	1.60	1.52	0.41	0.39	1.15	1.09
	MIC90%	1.68	1.60	1.76	1.67	0.49	0.46	1.31	1.24
	Median	1.800 a	1.710 a	1.800 a	1.710 a	0.500 a	0.470 a	1.350 a	1.280 a
Guava	**MIC50%**	3.,70	4.51	1.90	2.32	0.55	0.67	1.25	1.52
	MIC90%	7.40	9.03	2.18	2.66	0.63	0.77	1.43	1.74
	Median	4.000 a	4.880 b	2.250 a	2.740 a	0.650 a	0.790 a	1.250 a	1.520 a
Guaco	**MIC50%**	30.00	21.00	30.00	21.00	4.67	3.27	12.86	9.00
	MIC90%	32.33	22.63	30.00	21.00	6.20	4.34	15.14	10.60
	Median	30.000 b	21.000 c	30.000 b	21.000 c	5.000 b	3.500 b, c	15.000 b	10.500 c, d
Lemongrass	**MIC50%**	40.00	30.00	40.37	30.28	19.00	14.25	17.50	13.12
	MIC90%	40.80	30.60	40.87	30.65	21.80	16.35	21.20	15.90
	Median	40.500 b	30.375 c	41.000 b	30.750 c	19.500 c	14.625 d	18.250 b	13.685 d
Ginger	**MIC50%**	41.00	6.97	41.00	6.97	45.11	7.67	46.00	7.82
	MIC90%	41.00	6.97	41.00	6.97	45.82	7.79	46.00	7.82
	Median	41.000 b	6.970 b	41.000 b	6.970 b	46.000 d	7.820 c	46.000 c	7.820 b, c

Letters a, b, c and d: Means in the same column not followed by the same letter are significantly different ($p<0.001$).

effective extracts are considered, e.g. clove extract (95 mg/mL) which had relatively lower activity than guava (122 mg/mL) and garlic (133 mg/mL) extracts, and all these extracts showed similar antimicrobial activity patterns. Such results were different from data reported in literature. Samy (7) used methanolic extracts of ginger which did not present antimicrobial effect against *S. aureus* and *E. coli*. However, Indu *et al*. (5), using a different method of ginger extract preparation, verified an inhibitory action against *E. coli* as well as high antimicrobial activity of garlic extracts against *E. coli* and *Salmonella*.

Ahmad and Aqil (2) concluded that ethanolic extracts of garlic did not have anti-*E. coli* or anti-*Shigella* action. Using another methodology, Vuddhakul *et al*. (9) observed that garlic extracts inhibited the growth of *V. parahaemolyticus*, *E. coli* and *S. aureus*; however, lemongrass and ginger extracts did not show any antimicrobial activity. Such behavior of the antibacterial action was also verified by Adonizio *et al*. (1), who used lemongrass extracts and did not observe antibacterial effects.

Comparisons with pertinent data from literature indicate that, according to the methodology adopted in studies on antimicrobial activity, the most diverse results can be obtained. Plant extracts have shown inhibitory effect on the growth of the bacteria studied, although of distinct forms. It is therefore recommended that the nature and the number of the active antibacterial principles involved in each plant extract be studied in detail.

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RESUMO

Atividade antibacteriana de extratos de plantas medicinais

Avaliou-se a atividade antimicrobiana *in vitro* de extratos metanólicos de algumas plantas medicinais frente a *Escherichia coli*, *Salmonella* Typhimurium, *Staphylococcus aureus* e *Enterococcus* sp. O extrato metanólico de *Caryophyllus aromaticus* foi o mais eficaz para todas as bactérias testadas e apresentou a melhor atividade anti-*S. aureus*.

Palavras-chave: plantas medicinais, atividade antibacteriana, concentração inibitória mínima

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