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Action of Essential Oils Obtained from *Baccharis coridifolia* D. C. (Asteraceae-Astereae) on the Activity of Antibiotics*

Sideney Becker Onofre#, Marilde Canton, Paula Andressa Pires
Department of Biological Sciences and Pharmacy, FAED—Faculty of Educational of Dois Vizinhos—União de Ensino do Sudoeste do Paraná—UNISEP—Bairro Nossa Senhora Aparecida, Dois Vizinhos, Paraná, Brazil
Email: #becker@unisep.edu.br

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ABSTRACT

The aim of this study was to investigate the effects of *Baccharis coridifolia* essential oil on the Activity of Antibiotics. Assays were performed with ampicillin (10 µg), cephalothin (30 µg), chloramphenicol (30 µg), gentamicin (10 µg) and tetracycline (30 µg) alone and in combination with the essential oil (4% v/v) through the disk diffusion susceptibility test. The results showed the effects of essential oil on the activity of the antibiotics tested. Zones of inhibition of bacterial growth with different diameters were observed surrounding the antibiotic disks, whether or not they were impregnated with the essential oil. The occurrence of the synergistic or antagonistic effect was observed in both bacterial strains assessed—*Staphylococcus aureus* (ATCC-25923) and *Escherichia coli* (ATCC-25922). These results show that the use of products derived from plants can, in some cases, interfere with the effectiveness of antibiotics during clinical therapy.

Keywords: Medicinal Plants; Essential Oils; Antibiotic; Associated Use; Interference

1. Introduction

The use of natural products as a therapeutic resource is as old as human civilization. Even with the growing economic power of the large pharmaceutical companies, natural products have not lost their place in therapy, being mistakenly regarded by the population as safe medicines and being increasingly used [1].

Plants with therapeutic properties used in traditional health care are an important source of new biologically active compounds. They have appeared as part of the traditional health care in many parts of the world for decades and have attracted the interest of several researchers [2-6].

In folk medicine, plants are used concomitantly with conventional medicaments [7]. In this combined use, medicinal plants and/or their byproducts may act by inhibiting or enhancing the therapeutic effect of conventional drugs, as well as not interacting in the expected way [8]. In dermatology, such associative use often puts the patient at risk, as it can trigger phytodermatitis due to irritation or photosensitivity mechanisms. This practice may also hinder the clinical diagnosis, as often the patients are not aware of the importance of informing health care professionals about the use of medicinal plants during a medical appointment.

Oils and plant extracts have long been used in numerous applications in folk medicine, including the production of topical antiseptics. This was the basis for several scientific investigations aimed at confirming the antimicrobial activity of essential oils [9-13].

Celiktas *et al*. [14] related the increase of antimicrobial activity of *Rosmarinus officinalis* essential oil in samples collected during the spring. Moon *et al*. [15] found significant variation in the size of inhibition zones when testing the antimicrobial activity of essential oils from different samples of *Lavandula angustifolia* against the same microorganisms.

The active ingredients present in plants have been extensively studied in many countries, because new drugs can be developed with this knowledge. Understanding the interactions between drugs and plants can also be useful in therapy (beneficial interaction) and for disease prevention.

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#Corresponding author.

Plants of the family Asteraceae are extensively studied for their chemical composition and biological activity, with some supporting the development of new drugs, insecticides and other products [16-18].

About 120 *Baccharis* species have been studied chemically with 30 of them investigated for biological activity. Generally, the most common compounds are the flavonoids and labdane and clerodane diterpenes, although kaurane diterpenes, triterpenes, germacrene, coumaric acids, trichothecenes, sesquiterpenes and phenylpropanoids are also frequently found. Allelopathic, antimicrobial, anti-inflammatory and cytotoxic effects are highlighted in biological activity studies. The most researched species for chemical composition and/or biological activity include *B. megapotamica*, *B. incarum*, *B. trimera*, *B. trinervis*, *B. salicifolia*, *B. crispa*, *B. coridifolia*, *B. dracunculifolia*, *B. uncinella*, *B. grisebachii and B. tricuneata* [17-20].

Assessing the biological activity of essential oils produced by *B. dracunculifolia*, *B. uncinella* and *B. coridifolia* Ferronato *et al*. [13] observed the antioxidant and anti-inflammatory effect of these oils on *Escherichia coli* ATCC, *Staphylococcus aureus* ATCC, *Pseudomonas aeruginosa* ATCC and *Streptococcus mutans* isolated from saliva, thus showing the importance of these plants. Besides the antimicrobial activity observed in several plant species, natural compounds can also exhibit synergism when used in conjunction with other drugs [21]. Thus, this study evaluated the effect of essential oil and extracts produced by *B. coridifolia* D. C. (Asteraceae) (**Figure 1**) on the activity of some antibiotics used in clinical therapy.

2. Materials and Methods

2.1. Botanical Material

The plant studied was *B. coridifolia* D. C. (Asteraceae) collected in the Southwest region of Paraná, Brazil, from November 2006 to November 2007. The essential oils were obtained followed the method described by Onofre *et al*. [13,17,18,22]. This species was chosen because it is widely used in folk medicine and it contains antimicrobial substances described in previous studies [13,22].

Figure 1. ***Baccharis coridifolia*** **D. C.—Asteraceae-Astereae.**

2.2. Microorganisms

S. aureus (ATCC-25923) and *E. coli* (ATCC-25922) were used as test microorganisms. Suspensions were prepared in a 0.85% (w/v) NaCl solution, with turbidity level compared to the 0.5 McFarland standard, which approximately corresponds to a concentration of 10^8 CFU/mL.

2.3. Antibiotics

Ampicillin (10 µg), cephalothin (10 µg), chloramphenicol (30 µg), gentamicin (10 µg) and tetracycline (30 µg) were selected in the study, because of their availability in primary healthcare. The observational study of bacterial susceptibility to antibiotics was carried out through the disk diffusion susceptibility test (Newprov®) [23].

2.4. Effect of Essential Oil on Antibiotic Activity

The disk diffusion susceptibility test was carried out to analyze the effect of the essential oil on antibiotic activity. The essential oil was studied at a 4% concentration, which corresponds to the MIC determined in previous studies for the microorganisms tested here [2-4,13,24-26]. The disks containing the antibiotics in their respective concentrations were impregnated with 20 µL of 4% essential oil (MIC), and then placed on sterile Petri plates containing Mueller-Hinton agar inoculated with 1 mL of bacterial suspensions. After incubating the plates at 37˚C for 48 h, the effect of the essential oil MIC on the activity of antibiotics was observed. Synergistic effect was considered when inhibition zones ≥2 mm diameter were observed surrounding disks containing the essential oil (EO) and the antibiotic (AB). Antagonistic effect was considered when an inhibition zone of smaller diameter was observed around the disks with AB and EO, compared to that developed by the AB disks. Indifferent effect was considered when there was a zone of inhibition surrounding the disks with AB and EO, with a diameter equal to that resulting from the application of the AB alone [27]. All assays were performed in duplicate and the results were obtained by averaging the results of the parallel tests.

3. Results and Discussion

Table 1 shows the antimicrobial susceptibility of the tested strains. The Gram-positive *S. aureus* was susceptible to all antibiotics tested, showing growth inhibition zones with diameters ranging from 12 to 24 mm. The

Gram-negative *E. coli* was susceptible to cephalothin, gentamicin and tetracycline. These results are in agreement with the CSLI [28].

Table 2 shows the essential oil effects on the activity of antibiotics used in clinical therapy. When comparing the zones of inhibition diameters observed in the assays with antibiotics alone and in combination with the essential oil, the effects of the essential oil on the antibiotic activity can be observed in some cases.

This effect was observed with both strains tested, at different susceptibility levels. The greatest synergistic effect was observed with cephalothin, for the two strains tested. Ampicillin and chloramphenicol showed antagonistic effects for both bacteria. Gentamicin activity was inhibited (antagonistic effect) when evaluated for *S. aureus*, but an indifferent effect was observed when tested for *E. coli*. Tetracycline had indifferent effect on *S. aureus* and synergistic on *E. coli*. Generally, the effect of the essential oil on antibiotic activities varied according to antibiotic type, essential oil combination and bacterial strain tested.

The present results corroborate Canton and Onofre [29], who used the same methodology to assessed the interference of ethanol extracts obtained from *B. dracunculifolia* on 15 antibiotics, reporting activity changes that caused synergistic or antagonistic behaviors, and no alteration in some cases.

In a study on the extracts of *Alternanthera brasiliana* (L.) O. Kunt. (Amaranthaceae) and their effect on the activity of antibiotics used in clinical therapy, Araújo and Onofre [30] found that when such extracts are associated to 18 inhibitors of protein synthesis, altered behavior and, consequently, synergism or antagonism, are observed. Indifferent behavior, though, was also observed.

Table 1. Susceptibility of bacterial strains against the action of different antibiotics expressed in diameters (mm) of inhibition zones of microbial growth.

[M]	Antibiotics				
	AMP	CFL	CLO	GEN	TET
S. aureus	18.00	12.50	19.85	24.34	21.28
E. coli	20.00	16.40	20.22	20.34	16.85

AMP: ampicillin 10 µg; CFL: cephalothin 30 µg; CLO: chloramphenicol 30 µg; GEN: gentamicin 10 µg and TET: tetracycline 30 µg. [M]—Microorganisms.

Table 2. Effect of *B. coridifolia* essential oil on the action of antibiotics used in clinical therapy.

Antibiotics + Oil#	Microorganisms	
	S. aureus	*E. coli*
Oil + Ampicillin	17.22 ± 1.89 (*)	21.23 ± 1.11 (*)
Oil + Cephalothin	19.34 ± 1.68 (↑)	20.45 ± 1.21 (↑)
Oil + Chloramphenicol	19.43 ± 1.45 (*)	19.59 ± 1.25 (*)
Oil + Gentamicin	19.87 ± 0.99 (↓)	21.59 ± 1.89 (*)
Oil + Tetracycline	22.78 ± 1.21 (*)	19.63 ± 1.61 (↑)

(↑): synergistic effect; (↓): antagonistic effect; (*): indifferent effect. AMP: ampicillin 10 µg; CFL: cephalothin 30 µg; CLO: chloramphenicol 30 µg; GEN: gentamicin 10 µg and TET: tetracycline 30 µg. #Oil concentration of 4% (v:v).

It should be noted that the sale of medicinal plant products currently happens in pharmacies and health food stores, where they are marketed according to an industrialized labeling system. In general, these plant preparations have no certificate of quality and are produced from cultivated plants, which mischaracterize traditional medicine that uses almost always plants of the native flora.

The use of medicinal plants from the traditional Chinese and Hindu medicines, completely unknown to westerner civilizations, is increasingly common. These plants are marketed through advertisements that promise safe benefits, because they come from a natural source. However, often the supposed pharmacological properties advertised have no scientific validity, because they have not been investigated, or have not had their pharmacological actions proven through scientific tests in preclinical or clinical trials.

Media calls for the consumption of products made from natural sources increase every day in both developing and developed countries. Herbalists promise health and long life, based on the argument that plants used for millennia are safe for the population.

In Brazil, medicinal plants from the native flora are consumed with little or no evidence of their pharmacological properties, and their consumption is propagated by users or dealers. Frequently, these plants are even used for medicinal purposes different from those originally used by the native people. Compared to the drugs prescribed in conventional treatments, the toxicity of medicinal plants and herbal medicines may seem trivial, but this is not true. The toxicity of medicinal plants is a serious public health problem.

Research to evaluate the safe use of medicinal plants and herbal medicines is still incipient in Brazil, as well as the control of these products' sales by official bodies in public markets or health food stores.

In this sense, this work has contributed to the elucidation of the effects caused by the use of *B. coridifolia*, in relation to the metabolites present in two fractions, showing that such metabolites can interfere positively, causing synergism, or negatively, causing antagonism in the activity of antibiotics commonly employed in clinical therapy.

Multidisciplinary studies involving ethnobotanists, chemists, pharmacologists and agronomists are needed in order to expand the knowledge on medicinal plants. This would bring a better understanding on how their compounds act, what are the toxic and adverse effects, how they interact with new allopathic medicines and what are the most appropriate strategies for production and quality control of herbal medicines, observing the regulatory agencies standards and resolutions.

Raising awareness in the professional team involved in the prescribing, dispensing and administering medications is important. Professionals from different healthcare areas must always question and warn their patients about the non-prescribed use of medicinal herbs.

4. Conclusion

According to the obtained results, it is observed that the essential oil analyzed can have a greater or lesser interfering effect on the activity of the antibiotics tested, either through a synergistic or antagonistic effect. This interference was observed mainly in the assays involving both strains evaluated. Therefore, concomitant use of plant products and conventional medicines deserves careful attention, because of the possibility of interfering with the treatment of diseases of bacterial etiology.

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REFERENCES

[1] T. Eisenberg, S. Sundren and M. Wells, "Larger Board Size and Decreasing Firm Value in Small Firms," *Journal of Financial Economic*, Vol. 48, No. 1, 1998, pp. 35-54. doi:10.1016/S0304-405X(98)00003-8

[2] B. S. O. Ceballos, R. C. S. B. C. Barbosa, E. O. Lima and R. F. Urtiga, "Atividades Antimicrobianas de Produtos Naturais Sobre *Staphylococcus aureus* e *Pseudomonas aeruginosa* Isoladas de águas Recreacionais," *Brazilian Journal of Pharmacognosy*, Vol. 74, No. 1, 1993, pp. 4-6.

[3] E. O. Lima, "Estudo das Dermatofitoses em João Pessoa-Paraíba e da Atividade Antifúngica de Plantas Medicinais da Região Contra Alguns de Seus Agentes Isolados," Universidade de São Paulo, São Paulo, 1996.

[4] E. O. Lima, N. M. P. Farias, E. L. Souza and B. H. C. Santos, "Propriedades Antibacterianas de óleos Essenciais de Plantas Medicinais," *Revista Brasileira de Ciências da Saúde*, Vol. 7, No. 21, 2003, pp. 251-258.

[5] G. M. A. Cunha, "Atividade Antimicrobiana de Plantas Popularmente Usadas no Ceará," *Brazilian Journal of Pharmacognosy*, Vol. 76, No. 3, 1995, pp. 5-6.

[6] M. N. Cowan, "Plant Products as Antimicrobial Agents," *Clinical Microbiology Reviews*, Vol. 12, No. 4, 1999, pp. 564-582.

[7] J. A. Amorim, "Fitoterapia Popular e Saúde da Comunidade: Diagnóstico Para Proposta de Integração Nos Serviços de Saúde em Campina Grande," Universidade de São Paulo, São Paulo, Brazil, 1999.

[8] G. F. Nascimento, J. Locatelli, P. C. Freitas and G. L. Silva, "Antibacterial Activity of Plant Extracts and Phytochemicals on Antibiotic-Resistant Bacteria," *Brazilian Journal of Microbiology*, Vol. 31, No. 4, 2000, pp. 8-53.

[9] D. H. Fine, D. Fergang, M. L. Barnett, C. Drew, L. Steinberg, C. H. Charles and J. W. Vincent, "Effect of an Essential Oil-Containing Antiseptic Mouthrinse on Plaque and Salivary *Streptococcus mutans* Levels," *Journal of Clinical Periodontology*, Vol. 27, No. 3, 2000, pp. 157-161. doi:10.1034/j.1600-051x.2000.027003157.x

[10] P. Pan, M. L. Barnett, J. Coelho, C. Brogdon and M. B. Finnegan, "Determination of the *in Situ* Bactericidal Activity of an Essential Oil Mouthrinse Using a Vital Stain Method," *Journal of Clinical Periodontology*, Vol. 27, No. 4, 2000, pp. 256-261. doi:10.1034/j.1600-051x.2000.027004256.x

[11] R. Seymour, "Additional Properties and Uses of Essential Oils," *Journal of Clinical Periodontology*, Vol. 30, No. s5, 2003, pp. 19-21. doi:10.1034/j.1600-051X.30.s5.7.x

[12] X. P. Nunes, G. L. A. Maia, J. R. G. S. Almeida, F. O. Pereira and E. O. Lima, "Antimicrobial Activity of the Essential Oil of *Sida cordifolia* L.," *Revista Brasileira de Farmacognosia*, Vol. 16, No. 1, 2006, pp. 642-644. doi:10.1590/S0102-695X2006000500010

[13] R. Ferronatto, E. D. Marchesan, F. Bednarski, S. M. Alencar and S. B. Onofre, "Atividade Antioxidante Dos óleos Essenciais, Produzidos por Baccharis dracunculifolia D.C. Baccharis uncinella e B. coridifolia D.C. (Asteraceae)," *Arquivos de Ciências da Saúde da Unipar*, Vol. 10, No. 2, 2007, pp. 67-70.

[14] O. Y. Celiktas, E. E. H. Kocabas, E. Bedir, F. V. Sukan, T. Ozek and K. H. C. Baser, "Antimicrobial Activities of Methanol Extracts and Essential Oils of *Rosmarinus officinalis*, Depending on Location and Seasonal Variations," *Food Chemistry*, Vol. 100, No. 2, 2006, pp. 553-559. doi:10.1016/j.foodchem.2005.10.011

[15] T. Moon, J. M. Wilkinson and H. M. A. Cavanagh, "Antibacterial Activity of Essential Oils, Hidrosols an Plant Extracts from Australian Grown *Lavandula* spp.," *International Journal of Aromatherapy*, Vol. 16, No. 1, 2006, pp. 9-14. doi:10.1016/j.ijat.2006.01.007

[16] C. L. Queiroga, A. E. Fukai and A. Marsaioli, "Composition of the Essential Oil of Vassoura," *Journal of Brazilian Chemical Society*, Vol. 1, No. 4, 1990, pp. 105-109. doi:10.5935/0103-5053.19900023

[17] S. B. Onofre, R. Ferronatto, E. D. Marchesan and F. Bednarski, "Avaliação da Atividade Antimicrobiana de óleos Essenciais Produzidos por *B. dracunculifolia* e *B. uncinella*, Obtidos da Região Sudoeste do Paraná," *Anais*, 2006, pp. 46-52.

[18] S. B. Onofre, R. Ferronatto, E. D. Marchesan and F. Bednarski, "Avaliação da Atividade Antioxidante de óleos Essenciais Produzidos por *B. dracunculifolia* e *B. uncinella*, Obtidos da Região Sudoeste do Paraná," *Anais*, 2006, pp. 72-78.

[19] I. Loayza, G. Collin, M. Gagnon, H. Deslauriers and E. Dellacassa, "Huiles Essentielles de *Baccharis latifolia*, *B. salicifolia* de Bolivia et de *B. dracunculifolia* en Provenance d'Uruguay," *Rivista Italiana*, Vol. 12, 1995, pp. 28-35.

[20] L. G. Verdi, I. M. C. Brighente and M. G. Pizzolatti, "O Gênero Baccharis (Asteraceae): Aspectos Químicos, Econômicos e Biológicos," *Química Nova*, Vol. 28, No. 1, 2005, pp. 85-94. doi:10.1590/S0100-40422005000100017

[21] J. C. Sidrim and J. L. B. Moreira, "Fundamentos Clínicos e Laboratoriais da Micologia Médica," Guanabara Koogan, Rio de Janeiro, 1999.

[22] E. D. Marchesan, R. Ferronatto, F. Bednarski, S. M. Alencar and S. B. Onofre, "Ação dos óleos Essenciais Produzidos por *Baccharis dracunculifolia* D.C. e *Baccharis uncinella* D.C. (Asteraceae) Sobre a Atividade Hialuronidase," *Arquivos de Ciências da Saúde da Unipar*, Vol. 10, No. 2, 2006, pp. 63-66.

[23] A. W. Bauer, M. M. Kirby, J. C. Sherris and M. Truck, "Antibiotic Susceptibility Testing by a Standardized Single Disk Method," *American Journal of Clinical Pathology*, Vol. 45, No. 4, 1966, pp. 493-496.

[24] J. Allegrini, M. S. Bouchberg and H. Maillols, "Emulsions d'huiles Essentielles Fabrication et Applications em Microbiologie," *Societé de Pharmacie de Montpellier*, Vol. 33, No. 1,1973, pp. 73-86.

[25] J. C. L. V. Araújo, E. O. Lima, B. S. Ceballos, K. R. L. Freire, E. L. Souza and L. Santos-Filho, "Ação Antimicrobiana de óleos Essenciais Sobre Microrganismos Potencialmente Causadores de Infecções Oportunistas," *Revista de Patologia Tropical*, Vol. 33, No. 1, 2004, pp. 55-64.

[26] J. C. R. Nogueira, "Atividade Antimicrobiana *in Vitro* de Produtos Vegetais Sobre Microrganismos Isolados de Pacientes Portadores de Otite Externa Aguda," Universidade Federal da Paraíba, Paraíba, 2004.

[27] L. Cleeland and E. Squires, "Evaluation of New Antimicrobials *in Vitro* and Experimental Animal Infections," In: V. M. D. Lorian, Ed., *Antibiotics in Laboratory Medicine*, Williams & Wilkins, Baltimore, 1991, pp. 739-788.

[28] CLSI—National Committee for Clinical Laboratory Standards—Approved standard M7-A5, "Methods for Dilution Antimicrobial Susceptibility Test for Bacteria That Grow Aerobicaly," 5th Edition, CLSI, 2003.

[29] M. Canton and S. B. Onofre, "Interferência de Extratos da *Baccharis dracunculifolia* D.C., Asteraceae, Sobre a Atividade de Antibióticos Usados na Clínica," *Brazilian Journal of Pharmacognosy*, Vol. 20, No. 3, 2009, pp. 348-354.

[30] D. Araújo and S. B. Onofre, "Ação do Extrato Hidroalcoólico de *Alternanthera brasiliana* (L.) O. Kunt., (Amaranthaceae) Sobre a Atividade de Antimicrobianos Utilizados na Terapêutica," *Sabios*, Vol. 6, No. 1, 2011, pp. 23-26.

