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Chemical characterization and antimicrobial activity of the essential oil from *Leptohyptis macrostachys* (Benth.)

Harley & J.F.B. Pastore

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Abstract: The Lamiaceae family has approximately 300 genera and 7,500 species and it is estimated that at least 22 genera and 402 species. *Leptohyptis macrostachys* (Benth.) Harley & J.F.B. Pastore is a shrub species belonging to the family Lamiaceae, found in the semi-arid region of northeastern Brazil and popularly known as "alfavaca-brava" and "hortelã-do-mato". In this study, a chemical characterization of *L. macrostachys* essential oil was carried out. The plant material was collected in the city of Serra Branca, Paraíba, in northeastern Brazil. The essential oil from *L. macrostachys* was obtained by the hydrodistillation process. The chemical characterization of the essential oil was performed by a gas chromatograph coupled to a mass spectrometer (GC-MS). An analysis of the antimicrobial activity of the essential oil was carried out using the broth microdilution method to determine the Minimum Inhibitory Concentration (MIC), using *Escherichia coli*, *Salmonella enteritidis*, *Staphylococcus aureus*, *S. epidermidis*, *Candida albicans*, *C. tropicalis* and *Cryptococcus neoformans* strains. The investigation of the essential oil from *L. macrostachys* by GC-MS allowed the identification of 43 components, corresponding to 99% of the total oil. The major constituents were Fenchone (20.14%), 1,8-cineole (19.74%), β -pinene (12.31%), Germacrene D (7.14%), Limonene (6,74 %), α -pinene (4.74%) and Thymol (4.52%). In relation to the antimicrobial activity, the essential oil from *L. macrostachys* presented a strong activity, being able to inhibit bacterial and yeast growth in concentrations below 600 $\mu\text{g/mL}$. Among the bacterial strains, the essential oil showed a greater activity against the gram-positive strains and among the microorganisms used in this study, the essential oil presented higher potency against yeasts than against bacteria strains.

Keywords: *Leptohyptis macrostachys*; alfavaca-brava; GC-MS; essential oil; Minimum Inhibitory Concentration

1. Introduction

The Lamiaceae family has approximately 300 genera and 7,500 species and it is estimated that at least 22 genera and 402 species. *Leptohyptis macrostachys* (Benth.) Harley & J.F.B Pastore is a shrub species belonging to the

family Lamiaceae, found in the semi-arid region of northeastern Brazil and popularly known as "alfavaca-brava" and "hortelã-do-mato"^{1,2,3}. In this study, a chemical characterization of *L. macrostachys* essential oil was carried out.

2. Results and Discussion

By analyzing the essential oil from the aerial parts of *Leptohyptis macrostachys* by GC-MS it was possible to identify 43 components corresponding to 99% of the total oil in a complex mixture. The results showed that Fenchone (20.14%), 1,8-cineole (19.74%), β -pinene (12.31%), Germacrene D (7.14%), Limonene (6,74 %), α -pinene (4.74%) and Thymol (4.52%) were the major constituents. This chemical composition is compatible with literature data for volatile constituents from *Leptohyptis* species⁴, as well as other species of Lamiaceae. The Table 1 shows the results of the evaluation of the antifungal activity of *L.*

macrostachys essential oil in the concentration of 1024 to 16 $\mu\text{g} / \text{mL}$. The tested substance was able to inhibit the growth of gram-negative strains *E. coli* and *S. enteritidis* from the concentration of 512 $\mu\text{g} / \text{ml}$. In addition to the bacteria, the essential oil showed the highest activity against two gram positive species: *S. aureus* and *S. epidermidis*, presenting MIC of 128 $\mu\text{g}/\text{mL}$ and 32 $\mu\text{g}/\text{mL}$, respectively. In contrast to the yeast used in the assay, the essential oil had MIC of: 16 $\mu\text{g}/\text{mL}$ for *C. albicans* and *C. tropicalis*, and 32 $\mu\text{g}/\text{mL}$ for *C. neoformans*.

Table 1. Results of Minimum Inhibitory Concentration (MIC) ($\mu\text{g}/\text{mL}$) of *Leptohyptis macrostachys* essential oil against bacterial and fungal strains.

Samples ($\mu\text{g}/\text{mL}$)	Bacteria				Yeasts		
	<i>E. coli</i> ATCC-18739	<i>S. enteritidis</i> ATCC-6017	<i>S. aureus</i> ATCC-13150	<i>S. epidermidis</i> ATCC-12228	<i>C. albicans</i> ATCC-76645	<i>C. tropicalis</i> ATCC-13803	<i>C. neoformans</i> FCF-119
Essential oil	512	512	128	32	16	16	32
Growth medium	-	-	-	-	-	-	-
Microorganism	+	+	+	+	+	+	+
Gentamicin	-	-	-	-	x	x	x
Anfotericin B	x	x	x	x	-	-	-

3. Materials and Methods

The aerial parts of *Leptohyptis macrostachys* were collected in June of 2018, in Serra Branca – PB and were identified by Prof. Dr. Maria de Fátima Agra and the exsicata was deposited in Herbarium Prof. Lauro Pires Xavier – Federal University of Paraíba under identification AGRA et al. 6947. The essential oil from *L. macrostachys* was obtained by the hydrodistillation process. The chemical characterization of the essential oil was

performed using a Shimadzu GC17-A chromatograph using a DB-5 fused silica capillary column. An analysis of the antimicrobial activity of the essential oil was carried out using the broth microdilution method to determine the Minimum Inhibitory Concentration (MIC), using *Escherichia coli*, *Salmonella enteritidis*, *Staphylococcus aureus*, *S. epidermidis*, *Candida albicans*, *C. tropicalis* and *Cryptococcus neoformans* strains.

4. Conclusions

The chemical composition of the essential oil from *L. macrostachys* was mainly monoterpenes and sesquiterpenes. Fenchone is the majority constituent, result compatible with the chemical composition of essential oils from other species of Lamiaceae.

The essential oil of *Leptohiptys macrostachys* presented strong antimicrobial

activity⁵, being able to inhibit bacterial and yeast growth in concentrations below 600 µg/mL. Among the bacterial strains, the compound showed greater activity against the gram-positive strains. It is also noteworthy that, among the microorganisms used in this study, the essential oil presented higher potency against yeasts than against bacteria^{5,6,7}.

Acknowledgments

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Conflicts of Interest

The authors declare no conflict of interest.

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