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Avaliation anti-*Candida* of essential oils from three medicinal plants species (Astereaceae)

M.V. Linhares Neto [a], R.O. da Silva [b], F.F. de Oliveira [b], L.C.B. Costa [a], A.O. Conceição [a], R.A. de Oliveira [b,*]

[a] Department of Biological Sciences, State University of Santa Cruz, Rodovia Jorge Amado, Km-16, Salobrinho, 45662-900, Ilhéus, Bahia, Brazil
[b] Department of Exact and Technological Sciences, State University of Santa Cruz, Rodovia Jorge Amado, Km-16, Salobrinho, 45662-900, Ilhéus, Bahia, Brazil

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ABSTRACT

The growing resistance to conventional antifungal drugs and concerns about human health has inspired the scientific community to investigate new substances that able to inhibit the growth of the *Candida* genus yeasts; medicinal plants (family Asteraceae) may have antifungal activity. The present study characterized the essential oils of *Artemisia vulgaris*, *Biden pilosa* and *Sphagneticola trilobata*, obtained from the dry and fresh leaves, as well as the evaluation of antifungal activity. The essential oils were extracted by hydrodistillation and analyzed by GC–MS. The antifungal activity upon *C. albicans*, *C. glabrata*, *C. krusei* and *C. parapsilosis* was evaluated by the minimal inhibitory and minimal fungicidal concentration methods. The chemical component's qualitative and quantitative variation was identified between the essential oil's interspecies and intraspecies. Differences were observed in the susceptibility of the yeasts according to the percentage of majority components present in the oils of the species dry and fresh leaves, highlighting the relationship between the presence of 1-phenylhepta-1,3,5-triyne in *B. pilosa* and sclareol in *S. trilobata* and antifungal activity. The three species are able to inhibit the growth of the *Candida* genus yeasts.

1. Introduction

Knowledge about the chemical composition and the bioactivity of plant products, such as essential oils and extracts, have been of great clinical importance in the search for new drugs. With this, there has been an interest in new and efficient substances with lesser collateral effects and better pharmacokinetic properties to control pathogenic microorganisms, in addition to the search to add economic value to the flora.

Ethnobotanical studies in Brazil demonstrate that the species of the Asteraceae family are among the most popular therapeutic plants (Lombardi and Gonçalves, 2000; Pinto et al., 2006). Examples of medicinal plants of this family used in traditional medicine were *Artemisia vulgaris* L., *Bidens pilosa* L., and *Sphagneticola trilobata* L. (Pinto et al., 2006; Feijó et al., 2013; Sanoussi et al., 2015). These species are aromatic and produce essential oils.

In tradicional medicine, *A. vulgaris* is employed as an analgesic, antispamodic, anticonvulsive drug, in the treatment of dyspepsia, asthenia, epilepsy, rheumatic pain, fever, anemias, intestinal worms, dysmenorrhea, diarrhea, and gastritis (Agra et al., 2008; Lorenzi and Matos, 2008). Recommendations for the use of the *B. pilosa* include the treatment of malaria, hepatic problems, diabetes, gonorrhea, stomach gases, dysentery, erysipelas, renal problems, hepatitis, jaundice, hemorrhoids, joint rheumatism, allergy, anemia and skin rashes; to combat asthma, inflammations and skin problems, such as dermatoses and allergies (Agra et al., 2008). *S. trilobata* is used in the cases of diabetes, external and internal wounds, whooping cough and hematomas, as well as antirheumatic, antiinflammatory, febrifuge, antidysuria, antinevralgic and antianemic drugs to treat pain in the urethra, leg pain, menstrual cramps and stomach pains (da Silva et al., 2012), flus, colds and pneumonia (Agra et al., 2008).

Some biological activities of the *A. vulgaris*, *B. pilosa*, and *S. trilobata* essential oils, such as antiinflammatory, antioxidant and antimicrobial have already been proven (Deba et al., 2008; Balekar et al., 2012; Cortés-Rojas et al., 2013). Microbiological tests, important in clinical and environmental areas, were carried out with *A. vulgaris*, *B. pilosa*, and *S. trilobata*. Studies conducted with essential oils showed promising results in the inhibition of various species of bacteria, as well as of filamentous and yeast fungi (Deba et al., 2008), mainly *Candida albicans* (Brodin et al., 2007; Obistioiu et al., 2014).

C. albicans is frequently isolated in cases of surface and invasive infections and is known to cause candidiasis (Peters et al., 2014), an opportunistic mycosis that may be either endogenous or exogenous. Its lesions can occur superficially or deeply, in mild, acute or chronic conditions. This disease can occur in the mouth, throat, tongue, skin, genitalia, fingers, fingernails or internal organs, and can be considered a sexually transmissible disease (Sardi et al., 2013). Epidemiological data also point

* Corresponding author.
E-mail address: rosilene@uesc.br (R.A. de Oliveira).

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to *C. glabrata*, *C. krusei*, and *C. parapsilosis* as the main species of clinical interest, as these are the provokers of health problems in many regions throughout the world (Lima et al., 2006). Other studies have also highlighted the growing resistance of these yeasts to conventional antifungal drugs (Giordani et al., 2015). The growing resistance to conventional antifungal drugs and concerns about human health has inspired the scientific community to investigate new substances that able to inhibit the growth of the *Candida* genus yeasts.

Although *A. vulgaris*, *B. pilosa* and *S. trilobata* are medicinal plants popularly used in the Brazil, to the best of our knowledge, no have been reported chemical characterizations of the *A. vulgaris*, *B. pilosa* and *S. trilobata* essential oils from Ilhéus county, located in the southern region of the state of Bahia (Brazil). This region is inserted in the rest of the Atlantic Rainforest, in a biome comprised of high humidity forests, which can trigger variations in the chemical composition of the essential oils. The present study conducted the chemical characterization of the

Table 1
Content and chemical composition *Artemisia vulgaris*, *Bidens piolosa* and *Sphagneticola trilobata* essential oils obtained from fresh and dried leaves.

Species			*A. vulgaris*		*B. pilosa*		*S. trilobata*	
			FF	FS	FF	FS	FF	FS
	Content (%)		1,17[1]	1.06[2]	0.77[3]	1.57[4]	0.34[5]	1.06[6]
Components	RI (Exp)	RI (Lit)	Relative percentage (%)					
α-pinene	938	939	–	–	–	–	8.9	13.5
sabinene	975	976	–	–	–	–	1.4	0.9
β-pinene	982	980	–	–	–	–	–	1.6
myrcene	988	991	–	–	–	–	1.2	0.9
mesitylene	994	994	–	–	1.6	–	–	–
α-phellandrene	1005	1005	–	–	–	–	2.4	3.2
β-phellandrene	1031	1031	–	–	–	–	6.6	8.0
eucalyptol	1033	1033	3.4	4.2	–	–	–	–
undecane	1093	1098	–	–	1.8	–	–	–
1,3,8-p-menthatriene	1097	1098	0.6	–	–	–	–	–
cis-thujone	1108	1102	27.6	25.9	–	–	–	–
trans-thujone	1119	1114	7.0	6.6	–	–	–	–
iso-3-thujanol	1137	1133	0.7	–	–	–	–	–
trans-sabinol	1140	1140	0.2	–	–	–	–	–
trans-verbenol	1143	1144	0.7	–	–	–	–	–
β-pinene oxide	1156	1156	0.7	–	–	–	–	–
cis-chrysanthenol	1168	1162	–	0.6	–	–	–	–
terpinen-4-ol	1181	1177	0.7	–	–	–	–	–
α-terpineol	1196	1189	–	0.6	–	–	–	–
trans-carveol	1218	1217	2.1	1.7	–	–	–	–
cis-carveol	1228	1229	0.5	–	–	–	–	–
carvotanacetone	1246	1246	0.8	0.7	–	–	–	–
carvacrol	1295	1298	0.7	–	–	–	–	–
δ-elemene	1334	1339	–	–	–	–	1.9	1.9
daucene	1377	1380	–	–	–	–	–	0.2
iso-longifolene	1386	1387	0.7	–	–	–	2.2	2.5
(E)-caryophyllene	1421	1418	19.9	25.3	3.8	12.6	4.4	4.7
α-humullene	1456	1454	3.9	4.5	0.4	2.4	1.0	–
germacrene-D	1481	1480	10.5	9.6	6.1	7.4	–	–
cis-β-guaiene	1492	1490	–	–	–	–	18.7	21.9
bicyclogermacrene	1495	1494	3.4	4.0	–	2.4	–	–
trans-β-guaiene	1499	1500	–	–	–	–	11.5	13.7
γ-cadinene	1515	1513	–	1.7	–	–	–	–
7-*epi*-α-selinene	1517	1517	–	–	–	–	1.5	1.7
calamenene	1521	1521	–	–	–	–	1.4	1.4
germacrene-B	1555	1556	–	–	2.7	3.5	–	–
spathulenol	1576	1576	1.6	0.7	2.3	6.3	–	–
carotol	1579	1580	–	–	–	–	0.6	1.6
globulol	1583	1584	1.8	0.9	–	–	–	–
β-copaen-4-α-ol	1584	1585	–	–	1.7	13.9	0.5	2.1
iso-longifolan-7-α-ol	1621	1619	–	–	–	–	1.1	1.3
1-*epi*-α-cadinol	1622	1627	–	0.7	–	–	–	–
hinesol	1630	1630	–	–	–	–	1.5	1.4
epi-α-cadinol	1640	1640	0.9	1.0	0.4	0.6	–	–
α-muurolol	1641	1645	1.3	1.4	–	–	–	–
cubenol	1645	1645	–	–	2.4	–	–	–
valerianol	1654	1655	2.0	2.2	–	–	–	–
7-epi-α-eudesmol	1659	1658	–	–	–	1.2	0.5	–
cadalene	1671	1672	1.0	0.6	–	–	–	–
khusinol	1670	1674	–	–	–	1.5	0.4	1.0
eudesma-4(15),7 dien-1β-ol	1684	1688	0.6	0.7	–	1.2	–	–
eudesm-7(11)-en-4-ol	1694	1700	2.7	1.9	–	–	–	–
1-phenylhepta-1,3,5-triyne	1736	1726	–	–	69.4	34.2	–	–
14-hydroxy-δ-cadinene	1800	1799	–	–	–	0.3	–	–
sclareol	2182	2198	–	–	–	–	18.2	9.1
Total identified			96.0	95.4	92.5	87.6	85.5	92.8

Deviation of the essential oils content, n = 3: [1]0.01; [2]0.21; [3]0.01; [4]0.14; [5]0.02; [6]0.06; RI (Exp): Retention Indice calculated based on the pattern injections C_8 – C_{26}; RI (Lit.) Literature Retention Indice; Relative percentage based on the normalization of the chromatographic peaks; — not detected; FF: fresh leaves; FS: dry leaves.