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Chemical Composition and Biological Activity of the Essential Oil of *Senecio neaei* DC

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Abstract The objective of this investigation was the determination of the antimicrobial activity of a native plant from Patagonia Argentina *Senecio neaei* DC var. *neaei* (Asteraceae). Until the present day, no previous studies have been reported on the composition of the essential oil for this species of *Senecio.* The essential oil was obtained by hydrodistillation with a yield of 0.09 %, expressed as mL of essential oil per 100 g of fresh vegetable matter. The essential oil had antibacterial activity with a concentration of 3 µL/ 0.5 mL of culture medium against *Pseudomonas aeruginosa*, *Escherichia coli* and *Sthaphyloccus aureus*. The biological activity against yeast was tested and presented activity against all of them with a concentration of 3 µL/ 0.5 mL.

Keywords *Senecio neaei*; essential oil; antifungal activity; antibacterial activity

Introduction

The genus *Senecio* (Asteraceae) is one of the richest in angiosperm species. There are around 3000 species scattered throughout the world (with the exception of Antarctica and the Amazon region). In Argentina there are more than 270 species distributed in the Andes and in Patagonia. It presents a varied morphological and chemical diversity, *Senecio neaei* DC var. *neaei* is an endemic species of Patagonia and neighboring Chilean regions [1-2]. From the taxonomic point of view it belongs to the section section Xerosenecio subseries Filaginoidei [3-4].
There are numerous works in the bibliography that study the antimicrobial activity of essential oils [5]. Many of them report the importance that bioactivity studies using natural products have acquired, against relevant microorganisms in different human pathologies and their possible application in the pharmaceutical industry.

Materials and Methods

Collection of plants materials

Plant material, including stems and leaves of *Senecio neaei*, was collected in the area in the southwest of Río Senguer -Department (45° 36’ 10,3” S, 70° 12’ 22,2”W) in the province of Chubut, Argentina, in May 2020. Voucher specimen was authenticated and deposited in the Patagonia Regional Herbarium (HRP 7205-7214) of Universidad Nacional de la Patagonia San Juan Bosco (UNPSJB), Comodoro Rivadavia, Argentina.

Essential oil Extraction

The essential oil was obtained by steam distillation of from adult leaves and tender branches. The distillates were saturated with NaCl and the oil was the extracted with hexane. The hexane extracts were dried over anhydrous Na_2SO_4 and the solvent was removed using reduced pressure. The yield was 0.09 mL/100 g of plant material.

Gas Chromatography-Mass Spectrometry

The analysis of the essential oils was carried out by gas chromatography with a Hewlett Packard 5890 Series II chromatograph coupled to an HP 5972 spectrometer (EI 70 eV). Capillary column HP 5 MS 25 m × 0 25 mm i d 0 25 µm film thickness. T° Injector: 250 ºC. T° FID detector :300 ºC Initial temperature program 50 º(2 min), ramp 5 ºC/min, final 200 ºC (10 min). Carrier He: 1ml/min. The constituents of the essential oil were identified on the basis of their GC retention indices (RI) with reference to a homologous series of n-alkanes (C8-C20) and by comparison of their mass spectrum with reported data (Adams, Wiley, and Nist/EPA/NIH Mass Spectral Library).

Microbiological Activity

The antibacterial and antifungal properties were tested against Gram Positive(+) and Gram Negative(-) bacteria and yeast, including the following organisms: *Staphylococcus aureus* (ATCC 29213), *Pseudomonas aeruginosa* (ATCC 27853), *Escherechia coli* (ATCC 252993), *Candida albicans* (NIM MC 9982891), *Candida krusei* (ATCC 6258) y *Candida parapsilopsis* (ATCC 22019) [4-5]. Biological activity tests were carried out using Mueller Hinton for bacteria and Mueller Hinton glucose for yeast as culture medium. The methods were carried out by diluting in 500 µL of agar [6-7]. An inoculum of 10^6 cells per mL was mixed with the medium, bacteria and yeast culture were incubated for 24 hours at 37ºC and 48 hours at 28ºC respectively. The MIC endpoint was determined visually by recording the lowest concentration of the essential oil that prevented the appearance of visible growth [8-9]. Choramphenicol and Nystatin were used as the positive control in bacteria and yeast respectively [10-11].

Results and Discussion

Table 1: Chemical composition of essential oil (EO) of *Senecio neaei* (expressed as percentages)[a].

Compounds	Percentages	RT cal. [b]	RT lit. [c]
α-thujene	1.6	928.0	927.8
α- pinene	15	937.1	936.1
β - pinene	12.5	978.7	977.7
β - terpinene	1	989.0	988
δ-2-carene	0.6	1004.3	1003.3
p-cymene	17.2	1025.2	1024.3
limonene	4.6	1029.6	1029.5
β - phellandrene	1.2	1030.2	1030.0
1,8 cineole	1	1032.0	1031.8
Phenylacetaldehyde	1.9	1046.1	1045,9
Isopentyl isovalerate	0.6	1104.6	1103.6
Pinocarvone	1.3	1161.6	1160.6
Linalool oxide, trans-	0.7	1172.1	1171,0
p-methylacetophenone	1.2	1183.0	1182.7
Myrtenal	1.2	1193.1	1192.0
Thymol	1.5	1291.1	1290.1
(E)-3,7-dimethyl-6-oxo-2-octenal	1,1	1357.0	1356.2
β-cedrene	1.1	1423.1	1422.4
Diethyl phthalate	0.8	1547.1	1546.0
β-Eudesmol	3.4	1651.2	1650.3
Tremetone	28.3	1747.3	1746.7
Benzofuran, 2-5 diacetyl	1.2	1835.0	1834,1
TOTAL	99		

[a]Compound percentage by CG/FID analysis.
[b]RI calc. = retention index calculated on a HP 5 column (comparison with n-alkanes C8–C24).
[c]RI lit. = retention index from Adams (2007).

Table 2: Microbiological activity of the essential oil of *Senecio neaei.*

Strains			**Concentration**	**(µg/500µL)**		
Yeast	20	10	5	3	1	1:10
C. albicans	+	+	+	+	-	-
C. krusei	+	+	+	+	-	-
C. parapsilopsis	+	+	+	+	-	-
Bacteria						
S. aureus	+	+	+	+	+	+
E. coli	+	+	+	+	+	+
P. aeruginosa	+	+	+	+	-	-

Ref. (+) Antimicrobial bioactivity

(-) No Antimicrobial bioactivity

Conclusions

The essential oil had antifungal activity with a concentration of 3 µL/ 0.5 mL. The antibacterial activity against *Pseudomonas aeruginosa* was with a concentration of 3 µL/ 0.5 mL. It also presented antimicrobial activity against *Escherichia coli* and *Sthaphyloccus aureus* with dilution of the oil in dimethyl sulfoxide (1:10) in 0.5 mL of culture medium.

The main compound of the essential oil was tremetone in a percentage of 28.3%. This component together with the pinenes could infer the importance of their role, as a defense mechanism and adaptation to arid areas of central Patagonia of these species vegetables.

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List of Abbreviations:

HRP (Herbario Regional Patagónico)

ATCC (American Type Culture Collection)

NIM (Número Instituto Malbrán)

MIC (Minimal Inhibition Concentration)

ANLIS (Administración Nacional de Laboratorios e Institutos de Salud).

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