EUCALYPTUS GLOBULUS L. ESSENTIAL OIL: CHEMICAL CHARACTERIZATION AND BIOACTIVITIES ASSESSMENT

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INTRODUCTION

Eucalyptus is a large genus of tall evergreen plants belonging to the Myrtaceae family, being also **one of the most important trees** due to its several uses, specially of timber, pulp and essential oil. **The demand of *Eucalyptus* sp. essential oil** has significantly increased as it has been approved as **a natural additive**. It is widely used in **food, flavor, pharmaceutical, and perfumery industries**, thanks to **its many biological properties**, including antibacterial, antifungal, analgesic and anti-inflammatory ones.

Essential oils have been under intensive research, mainly regarding their **bioactive properties** (antioxidant, fungitoxic, anti-viral, anti-inflammatory, antimicrobial, among others). Owing to these properties they are potentially **interesting** for diverse industries including the **food industry** since one of its **main problems** concerns pathogenic **microorganisms** and **associated toxins** that are responsible for **food spoilage**.

Although the application of **essential oils in the food industry may have some limitations**, such as impact on the organoleptic properties and low solubility, **different delivery strategies such as nanoencapsulation, active packaging and coatings** are **promising technologies** that may overcome these issues without compromising nutritional properties in food systems.

OBJECTIVE

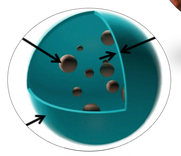
Characterize the **essential oil obtained from *E. globulus* L. fresh and dry leaves** and assess its antioxidant and antimicrobial properties for further application as a food spoilage **preventing agent**.

LIMITATIONS OF ESSENTIAL OILS IN FOOD INDUSTRY

- Impact on the organoleptic properties
- Low solubility

SOLUTIONS

- Nanoencapsulation
- Acitve packaging and coating



MATERIALS & METHODS

dry leaves

fresh leaves

Hydrodistillation: Clevenger Apparatus

essential oil

Extraction conditions:
S/L=1/20
t=3h

GC-MS

Characterization of the *E. globulus* essential oils obtained

Chemical composition	GC-MS
Antioxidant activity	DPPH, Reducing Power, celular antioxidante assay (CAA)
Antimicrobial activity	Microdilution method with INT against food microorganisms

RESULTS

CHEMICAL CHARACTERIZATION

Quantitative result

- The **essential oil yield** was **2.2 ± 0.3 %** for **dry leaves** and **2.5 ± 0.1% for fresh leaves (dry basis).**

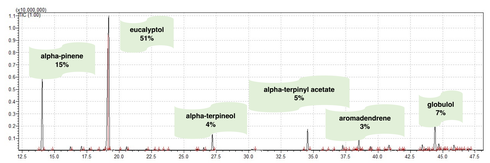


Figure 1. Chromatogram from *E. globulus* fresh leaves essential oil.

Qualitative result

- **94% of total compounds** were identified by GC-MS analysis in eucalyptus essential oil for both fresh and dry leaves.

ANTIOXIDANT ACTIVITY

- For **DPPH assay** an EC_{50} value of **145.5 ± 0.7 mg/mL** for **dry leaves** and **146.15 ± 0.6 mg/mL** for **fresh leaves** was obtained,
- For the **reducing power assay** an EC_{50} value of **3.0 ± 0.2 mg/mL** for **dry leaves** and **0.9 ± 0.10 mg/mL** for **fresh leaves** was presented.
- Essential oil from **fresh leaves inhibited in 55%** the cell oxidation, while the essential oil from **dry leaves** showed **40%** of inhibition.

Table 1. Antioxidant activity of eucalyptus essential oil from fresh and dry leaves.

	Essential Oil		
	Fresh leaves	**Dry leaves**	**Positive Control**
			Trolox (mg/mL)
DPPH assay EC_{50} **(mg/mL)**	146.14 ± 0.64	145.47 ± 0.67	0.04 ± 0.01
Reducing power EC_{50} **(mg/mL)**	2.94 ± 0.10	3.05 ± 0.18	0.04 ± 0.01
Cellular antioxidant activity [ ] max tested (*μM*)	2000		**Quercetin**
% inhibition	55	40	95.30 ± 4.60

ANTIMICROBIAL ACTIVITY

Table 2. Antimicrobial activity of eucalyptus essential oil from fresh and dry leaves against foodborne bacteria

	Essencial Oil (%, v/v)[a]				Positive control					
	Fresh leaves		Dry leaves		Streptomicin 1mg/mL		Methicilin 1mg/mL		Ampicillin 20mg/mL	
	MIC	MBC	MIC	MBC	MIC	MBC	MIC	MBC	MIC	MBC
Gram-negative bacteria										
Enterobacter Cloacae	2.5	_c	1.25	_c	0.007	0.007	n.t.	n.t	0.15	0.15
Escherichia coli	2.5	_c	2.5	_c	0.01	0.01	n.t.	n.t.	0.15	0.15
Pseudomonas aeruginosa	_b	_c	_b	_c	0.06	0.06	n.t.	n.t.	0.63	0.63
Salmonella enterocolitica	2.5	_c	2.5	_c	0.007	0.007	n.t.	n.t.	0.15	0.15
Yersinia enterocolitica	0.6	1.25	0.6	2.5	0.007	0.007	n.t.	n.t.	0.15	0.15
Gram-positive bacteria										
Bacillus cereus	2.5	_c	1.25	_c	0.007	0.007	n.t.	n.t.	n.t.	n.t.
Listeria monocytogenes	0.6	_c	0.6	_c	0.007	0.007	n.t.	n.t.	0.15	0.15
Staphylococcus aureus	1.25	2.5	1.25	2.5	0.007	0.007	0.007	0.007	0.15	0.15

[a]Essential oils were tested in the concentration range of 2.5% to 0.039% (v/v).

[b]No inhibition was visually observed for the maximum tested concentration (2.5%).

[c]Growth was obtained for the maximum tested concentration (2.5%).

- **Minimal Inhibitory Concentrations (MIC)** and **Minimal Bactericidal Concentrations (MBC)** were **determined** against the food borne bacteria selected, **evidencing a wide spectrum of antibacterial activity. Essentially**, the essential oils were effective against ***Y. enterocolítica*, *L. monocytogenes*** and ***S. aureus.***
- Concentration range between **0.6 and 2.5 mg/mL** was reported against **food bacteria.**

CONCLUSION

The results showed that essential oils from eucalyptus fresh and dry leaves could be a potential and natural source of bioactive substances for the food industry.

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