

Type of the Paper (Article)

# Incorporation of *Lippia Citriodora* Microwave Extract into Total-green Biogelatin-phospholipid Vesicles to Improve Its Antioxidant Activity

Francisco Javier Leyva-Jiménez <sup>1</sup>, María Letizia Manca <sup>2</sup>, María Manconi <sup>2</sup>, Carla Caddeo <sup>2</sup>, José Antonio Vázquez <sup>3</sup>, Jesús Lozano-Sánchez <sup>1,4,\*</sup>, Elvira Escribano-Ferrer <sup>5,6</sup>, David Arráez-Román <sup>1,7</sup> and Antonio Segura-Carretero <sup>1,7</sup>

<sup>1</sup> Functional Food Research and Development Center, Health Science Technological Park, Avenida del Conocimiento s/n, E-18016 Granada, Spain; [jleyva@cidaf.es](mailto:jleyva@cidaf.es) (F.J.L.-J.); [jesusls@ugr.es](mailto:jesusls@ugr.es) (J. L.-S.); [darraez@ugr.es](mailto:darraez@ugr.es) (D.A.-R.); [ansegura@ugr.es](mailto:ansegura@ugr.es) (A.S.-C.).

<sup>2</sup> Department of Scienze della Vita e dell'Ambiente, University of Cagliari, via Ospedale 72, 09124 Cagliari, Italy; [mlmanca@unica.it](mailto:mlmanca@unica.it) (M.L.M.); [manconi@unica.it](mailto:manconi@unica.it) (M.M.); [caddeoc@unica.it](mailto:caddeoc@unica.it) (C.C.).

<sup>3</sup> Group of Recycling and Valorization of Waste Materials (REVAL), Marine Research Institute (IIM-CSIC), C/Eduardo Cabello, 6, CP36208, Vigo, Spain; [jvazquez@iim.csic.es](mailto:jvazquez@iim.csic.es) (J.A.V.)

<sup>4</sup> Department of Food Science and Nutrition, University of Granada, Campus of Cartuja, 18011 Granada, Spain; [jesusls@ugr.es](mailto:jesusls@ugr.es) (J. L.-S.).

<sup>5</sup> Biopharmaceutics and Pharmacokinetics Unit, Institute for Nanoscience and Nanotechnology, University of Barcelona, 08193 Barcelona, Spain; [eescrivano@ub.edu](mailto:eescrivano@ub.edu) (E.E.-F.)

<sup>6</sup> CIBER Physiopathology of Obesity and Nutrition (CIBEROBN), Institute of Health Carlos III, 28029 Madrid, Spain; [eescrivano@ub.edu](mailto:eescrivano@ub.edu) (E.E.-F.)

<sup>7</sup> Department of Analytical Chemistry, Faculty of Sciences, University of Granada, Fuentenueva s/n, E-18071 Granada, Spain; [darraez@ugr.es](mailto:darraez@ugr.es) (D.A.-R.); [ansegura@ugr.es](mailto:ansegura@ugr.es) (A.S.-C.).

\* Correspondence: [jesusls@ugr.es](mailto:jesusls@ugr.es); Tel.: +34-958-637083

**Supplementary material Table S1:** ANOVA of results obtained in biocompatibility assays.

Dependent variable	Formulation	Formulation	Significance
50 µg/mL	Solution	Liposomes	0
		Glycerosomes	0
		PG-PEVS	1
		Glycerosomes+biogelatin	0
		PG-PEVS+biogelatin	0
	Liposomes	Solution	0
		Glycerosomes	0
		PG-PEVS	0
		Glycerosomes+biogelatin	0
		PG-PEVS+biogelatin	0
5 µg/mL	Glycerosomes	Solution	0
		Liposomes	0
		PG-PEVS	0
		Glycerosomes+biogelatin	0
		PG-PEVS+biogelatin	0
	PG-PEVS	Solution	1
		Liposomes	0
		Glycerosomes	0
		Glycerosomes+biogelatin	0
		PG-PEVS+biogelatin	0
	Glycerosomes+biogelatin	Solution	0
		Liposomes	0
		Glycerosomes	0
		PG-PEVS	0
		PG-PEVS+biogelatin	0
	PG-PEVS+biogelatin	Solution	0
		Liposomes	0
		Glycerosomes	0
		PG-PEVS	0
		Glycerosomes+biogelatin	0
5 µg/mL	Solution	Liposomes	0
		Glycerosomes	0
		PG-PEVS	0
		Glycerosomes+biogelatin	0

<b>0.5 µg/mL</b>		PG-PEVS+biogelatin	0
		Solution	0
		Glycerosomes	0
		PG-PEVS	0
		Glycerosomes+biogelatin	0
		PG-PEVS+biogelatin	0
		Solution	0
		Liposomes	0
		Glycerosomes	0
		Glycerosomes+biogelatin	0
		PG-PEVS	0
		Solution	0
		Liposomes	0
		Glycerosomes	0
		Glycerosomes+biogelatin	0
		PG-PEVS+biogelatin	0
		Solution	0
		Liposomes	0
		Glycerosomes	0
		PG-PEVS	0
		Glycerosomes+biogelatin	0
		Solution	0
		Liposomes	0
		Glycerosomes	0
		PG-PEVS	0
		Glycerosomes+biogelatin	0
		PG-PEVS+biogelatin	0
		Solution	0
		Liposomes	0
		Glycerosomes	0
		PG-PEVS+biogelatin	0
		Solution	0
		Liposomes	0
		Glycerosomes	0
		PG-PEVS	0
		Glycerosomes+biogelatin	0
		PG-PEVS+biogelatin	0
		Solution	0
		Liposomes	0
		Glycerosomes	0
		Solution	0
		Liposomes	0
		Glycerosomes	0
		PG-PEVS	0
		Glycerosomes+biogelatin	0
		PG-PEVS+biogelatin	0
		Solution	0
		Liposomes	0
		Glycerosomes	0
		PG-PEVS	0
		Glycerosomes+biogelatin	0
		Solution	0
		Liposomes	0
		Glycerosomes	0
		PG-PEVS	0
		Glycerosomes+biogelatin	0
		PG-PEVS+biogelatin	0
		Solution	0
		Liposomes	0
		Glycerosomes	0
		PG-PEVS	0
		Solution	0
		Liposomes	0
		Glycerosomes	0
		PG-PEVS	0
		Glycerosomes+biogelatin	0
		PG-PEVS+biogelatin	0
		Solution	0
		Liposomes	0
		Glycerosomes	0
		Glycerosomes	0
		Solution	0
		Liposomes	0
		Glycerosomes	0
		PG-PEVS	0
		Glycerosomes+biogelatin	0
		PG-PEVS+biogelatin	0
		Solution	0
		Liposomes	0
		Glycerosomes	0

		Liposomes	0
		PG-PEVS	0
		Glycerosomes+biogelatin	0
		PG-PEVS+biogelatin	0
	PG-PEVS	Solution	0
		Liposomes	0
		Glycerosomes	0
		Glycerosomes+biogelatin	0
		PG-PEVS+biogelatin	0
0.05 µg/mL	Glycerosomes+biogelatin	Solution	0
		Liposomes	0
		Glycerosomes	0
		PG-PEVS	0
		PG-PEVS+biogelatin	0
	PG-PEVS+biogelatin	Solution	0
		Liposomes	0
		Glycerosomes	0
		PG-PEVS	0
		Glycerosomes+biogelatin	0
	Solution	Liposomes	1
		Glycerosomes	0
		PG-PEVS	0
		Glycerosomes+biogelatin	0
		PG-PEVS+biogelatin	0
	Liposomes	Solution	1
		Glycerosomes	0
		PG-PEVS	1
		Glycerosomes+biogelatin	0
		PG-PEVS+biogelatin	1
	Glycerosomes	Solution	0
		Liposomes	0
		PG-PEVS	1
		Glycerosomes+biogelatin	0
		PG-PEVS+biogelatin	1
	PG-PEVS	Solution	0
		Liposomes	1
		Glycerosomes	1

	Glycerosomes+biogelatin	1
	PG-PEVS+biogelatin	0
Glycerosomes+biogelatin	Solution	0
	Liposomes	0
	Glycerosomes	0
	PG-PEVS	1
	PG-PEVS+biogelatin	1
PG-PEVS+biogelatin	Solution	0
	Liposomes	1
	Glycerosomes	1
	PG-PEVS	0
	Glycerosomes+biogelatin	1

1 indicates a significative difference ( $p<0.05$ ); 0 indicates a non-significative difference ( $p>0.05$ ).