

# Emulsions containing essential oils: eco-friendly aqueous formulations of potential biopesticides for insect pest control

Eduardo Guzmán<sup>1\*</sup>, Natalia Sánchez-Arribas<sup>1</sup>, Alejandro Lucia<sup>2</sup>, Ramón G. Rubio<sup>1,3</sup>,  
Francisco Ortega<sup>1</sup>

<sup>1</sup>*Departamento de Química Física I, Universidad Complutense de Madrid, Madrid, Spain*

<sup>2</sup>*UNIDEF/CITEDEF, CONICET, Buenos Aires, Argentina*

<sup>3</sup>*Instituto Pluridisciplinar, Universidad Complutense de Madrid, Madrid, Spain*

*\*eduardogs@quim.ucm.es*

Essential oils present a well recognized bioactivity for insect pest control. However, their application is rather limited due to the difficulties associated with their distribution in the environment. Thus, the development of commercial formulations containing this type of components has been scarce in the last years. A promising alternative for their application is the development of new oil in water emulsion in which the essential oil can remain distributed as small droplets in a continuous phase formed by water. The main advantage of these formulations is that they are aqueous based formulations, thus making easy their application, and reducing their environmental impact.

We have studied three different types of formulations, containing mainly eugenol as essential oil, in which the stabilization of the emulsions is obtained by different phenomena. The first system is formed by free surfactant emulsion stabilized by the so called “pre-ouzo” (water/eugenol/ethanol system). A second type of system is formed by conventional emulsion stabilized by Pluronic F127, being the third system Pickering emulsions in which silica nanoparticles are added to the formulations containing Pluronic F127. One of the main characteristics of these emulsions is that they can be prepared by shaking mildly the samples, leading to stable emulsions in a wide range of compositions.

As a proof of concepts, different insecticides (imidacloprid and azametiphos) were encapsulated inside the droplets, demonstrating the applicability of the aforementioned formulations for pest control. Preliminary efficiency test of different formulations have shown better performance of these new formulations against different insects than conventional one. Thus, the results of this work open new perspective for designing new formulations with interest due to their enhanced bioactivity and biosustainability.

**Acknowledgements** We are grateful for the financial support of COST MP1106, of CoWet ITN (E.U.), and of MINECO through grant FIS2014-62005-EXP.