

## The use of bionanotechnology in the recovery of wine by-products for delivery systems of bioactive compounds

Universidade de Vigo



Rafael Nogueira-Marques<sup>1</sup>, Franklin Chamorro<sup>1</sup>, A.O.S. Jorge<sup>1,2</sup>, Javier Echave<sup>1,3</sup>, Ana Perez-Vazquez<sup>1</sup>, Paula Barciela<sup>1</sup>, Maria Carpena<sup>1</sup>, Rui Oliveira<sup>4</sup>, M. Beatriz P. P. Oliveira<sup>2</sup> and Miguel A. Prieto<sup>1,\*</sup>



<sup>1</sup> Universidade de Vigo, Nutrition and Food Group (NuFoG), Department of Analytical Chemistry and Food Science, Instituto de Agroecología e Alimentación (IAA) – CITEXVI, 36310 Vigo, Spain; <sup>2</sup> REQUIMTE/LAQV, Department of Chemical Sciences, Faculty of Pharmacy, University of Porto, R. Jorge Viterbo Ferreira 228, 4050-313 Porto, Portugal; <sup>3</sup> CIMO, LA SusTEC, Instituto Politécnico de Bragança, Campus de Santa Apolónia, 5300- 253 Bragança, Portugal; <sup>4</sup> Centre of Molecular and Environmental Biology (CBMA), Department of Biology, Campus of Gualtar, University of Minho, 4710-057 Braga, Portugal.

\* Corresponding author: Miguel A. Prieto ([mprieto@uvigo.es](mailto:mprieto@uvigo.es))

### INTRODUCTION & AIM

In recent years, there has been an **increasing production of agro-industrial waste**, resulting from the transformation of raw materials in the food industry, raising environmental, economic and nutritional concerns, but also becoming a strategic opportunity in the context of the **circular bioeconomy** (1,2). An example of these by-products is the wine industry, which produces high quantities of organic residues considered **promising sources of valuable nutritional components**, triggering various **bioactive activities** (3,4). This literature review aims to investigate the emerging role of bionanotechnology in altering these residues in the development of nanosystems.

### METHOD

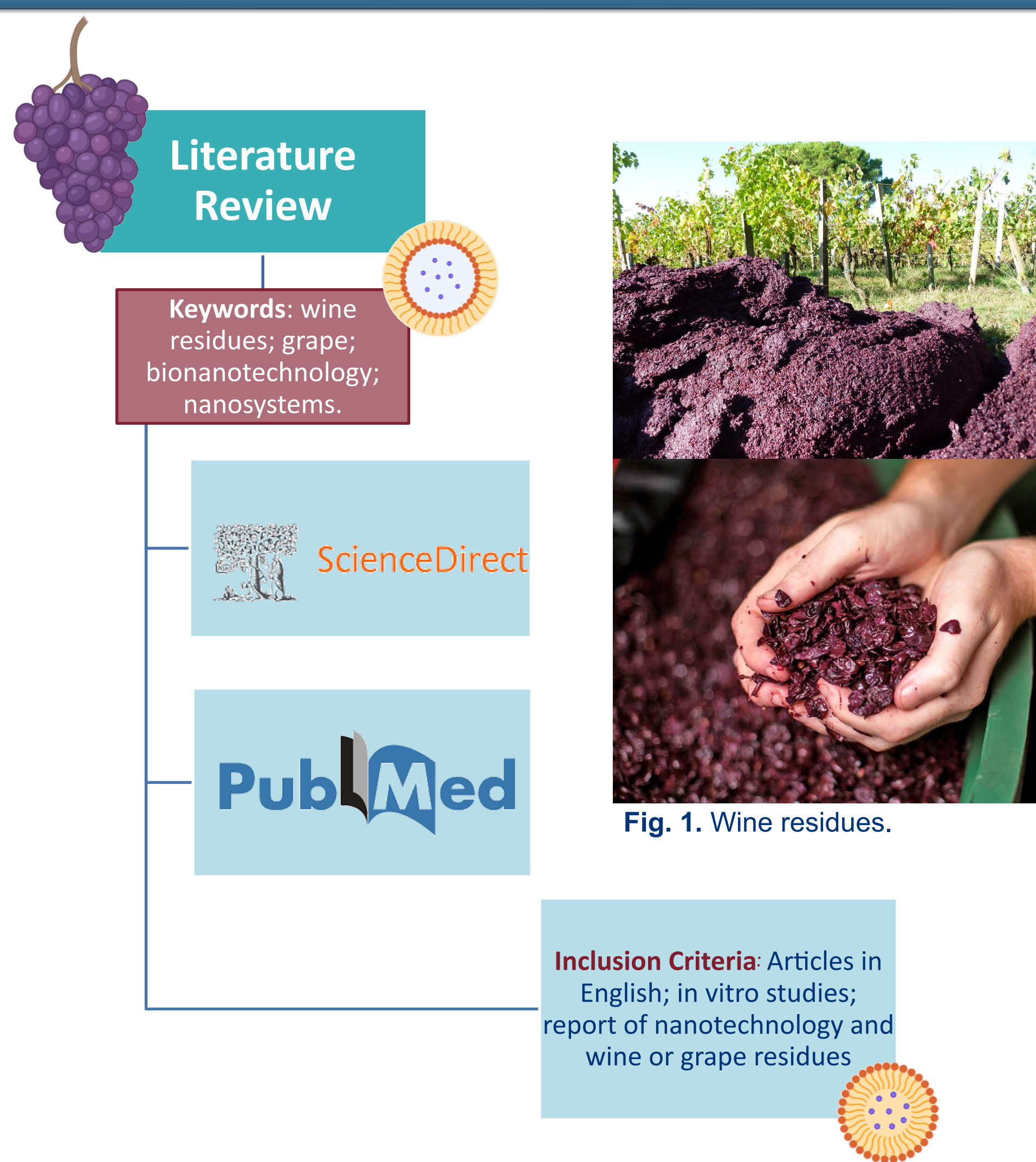


Fig. 1. Wine residues.

### RESULTS & DISCUSSION

- Several studies refer to the **richness of grape** extracts in polyphenols and flavonoids; however, these groups are characterized by their **chemical instability and solubility**, which leads to obstacles such as low permeability and bioavailability (5).

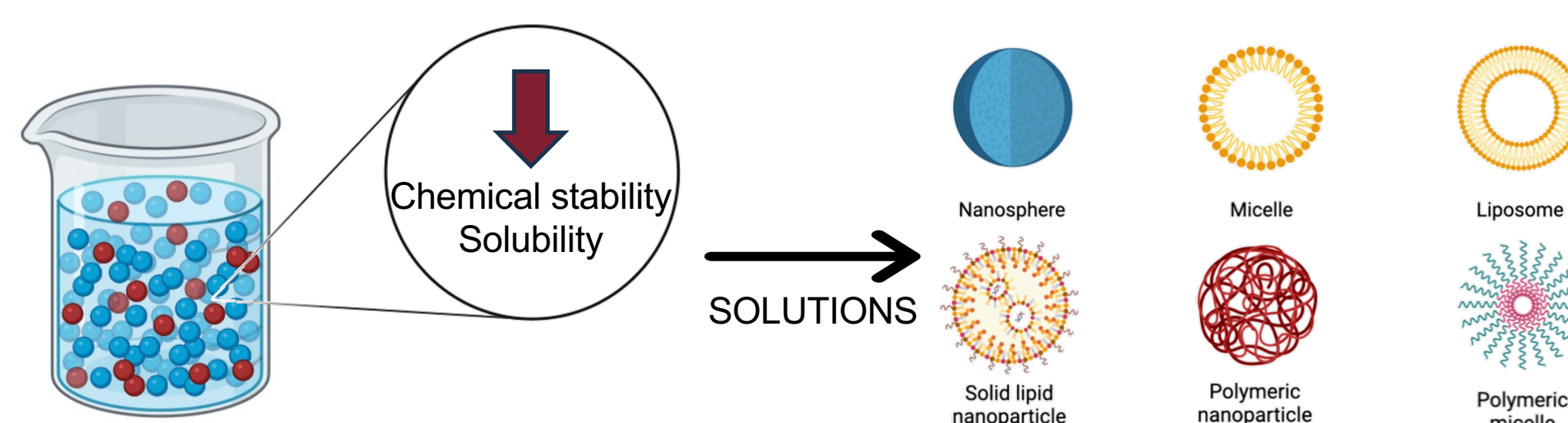


Fig. 2. Nanoparticles as a solution to chemical instability and solubility of extracts.

- For example, **nanofibers** loaded with grape seed extracts **did not affect their morphology and still promoted a sustained release**, favoring the antioxidant and regenerative activity of the extract (6,7).
- Another study nanoincorporated extracts into **liposomal vesicles**, demonstrating the ability to **neutralize the basal production of reactive oxygen species (ROS) and not cytotoxic to cells** (8).
- Castangia et al. (2017) involved **silver nanoparticles** and an extract of grape pomace designed for skin protection, capable of **inhibiting the proliferation of *Staphylococcus aureus* and *Pseudomonas aeruginosa*** (9).

### CONCLUSION

Thus, the creation of **nanosystems is a promising, natural and innovative technological solution** for obtaining **new sustainable food, pharmaceutical and cosmetic products**, reducing the impacts caused by the wine industry and contributing to the improvement of the **circular economy**.

### REFERENCES

- Yildiz F, Wiley RC, editors. Minimally Processed Refrigerated Fruits and Vegetables. 2nd ed. 2017. Boston, MA: Springer; 2017. 774 p. (Food Engineering Series);
- Teigiserova DA, Hamelin L, Thomsen M. Towards transparent valorization of food surplus, waste and loss: Clarifying definitions, food waste hierarchy, and role in the circular economy. Science of The Total Environment. 2020 Mar;706:136033;
- Maicas S, Mateo JJ. Sustainability of Wine Production. Sustainability. 2020 Jan 11;12(2):559;
- Chamorro F, Otero P, Rodríguez MC, García-Oliveira P, Pereira AG, Perez-Gregorio R, et al. Chemical and Nutritional Characterization of By-Products from the Wine Industry—Source of Healthy Ingredients for the Formulation of Nutraceuticals and Functional Foods. In: The 3rd International Electronic Conference on Foods: Food, Microbiome, and Health—A Celebration of the 10th Anniversary of Foods—Impact on Our Wellbeing [Internet]. MDPI; 2022 [cited 2025 Apr 20]. p. 65. Available from: <https://www.mdpi.com/2673-9976/18/1/65>;
- Gibis M, Ruedt C, Weiss J. In vitro release of grape-seed polyphenols encapsulated from uncoated and chitosan-coated liposomes. Food Research International. 2016 Oct;88:105–13.
- Lociento DA, Mercante LA, Andre RS, Mattoso LHC, Luna GLF, Brassolatti P, et al. Biocompatible and Biodegradable Electrospun Nanofibrous Membranes Loaded with Grape Seed Extract for Wound Dressing Application. Journal of Nanomaterials. 2019 Mar 6;2019:1–11.
- Lin S, Chen M, Jiang H, Fan L, Sun B, Yu F, et al. Green electrospun grape seed extract-loaded silk fibroin nanofibrous mats with excellent cytocompatibility and antioxidant effect. Colloids and Surfaces B: Biointerfaces. 2016 Mar;139:156–63.
- Montagner GE, Ribeiro MF, Cadoná FC, Franco C, Gomes P. Liposomes loading grape seed extract: A nanotechnological solution to reduce wine-making waste and obtain health-promoting products. Future Foods. 2022 Jun;5:100144.
- Castangia I, Marongiu F, Manca ML, Pompei R, Angius F, Ardu A, et al. Combination of grape extract-silver nanoparticles and liposomes: A totally green approach. European Journal of Pharmaceutical Sciences. 2017 Jan;97:62–9.