A comparative evaluation of preparation protocols, physicochemical properties, and delivery efficiency of albumin nanoparticles as biocompatible nanocarriers

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Protein-based nanoparticles (NPs) represent a versatile platform for delivery applications in various fields, from pharmaceuticals to dermocosmetics, thanks to their ability to enhance penetration through biological barriers, modulate release profiles, and optimise the bioavailability and precision targeting of active ingredients [1,2]. Moreover, they are characterised by high biocompatibility and biodegradability, as well as high encapsulation efficiency.
Among proteins, serum albumins are particularly promising for these purposes, as they are non-toxic, scarcely immunogenic, highly available and inexpensive. Their multiple functional groups enable interactions with a diverse array of molecules through both hydrophobic and hydrophilic domains [3]. Among the numerous experimental approaches to produce albumin NPs, the desolvation method is likely the best known and most widely used. It is based on reducing protein solubility by adding a desolvating agent, which induces controlled precipitation and particle formation. NP stabilisation is then achieved by adding a suitable cross-linker, such as glutaraldehyde. This approach enables high drug loading and tunable particle size; however, the use of organic solvents and potentially toxic cross-linking agents may raise concerns regarding biocompatibility and residual toxicity. To address these limitations, non-toxic cross-linking agents such as glucose have recently been proposed [4]. Moreover, alternative strategies based on albumin self-assembly can be exploited.
We will present the optimisation and thorough characterisation of highly biocompatible albumin-NPs, which are prepared by either desolvation or metal-induced self-assembly methods and cross-linked by glucose, as carriers of *Populus nigra* (L.) root metabolites with antimicrobial and prebiotic potential for skin microbiota [5].
The properties of the NPs are investigated using light scattering techniques, while the structure and conformation of the albumin are assessed using spectroscopic techniques. Finally, the loading capacity and release profiles are monitored using UV spectroscopy.

Keywords:
Albumin nanoparticles, drug delivery, desolvation, metal-induced protein self-assembly, physico-chemical characterization, structural proprierties

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