Development and optimization of functional nanomaterials for physical modulation of cell aging processes

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Abstract:
Aging is a complex biological process driven by intrinsic and extrinsic factors that ultimately lead to a decline in tissue function. Understanding the interplay between these factors is crucial for developing innovative strategies to slow or counteract age-related cellular deterioration[1]. Recent studies have explored the use of nanomaterials combined with external, physical stimuli (e.g., electric and magnetic fields, visible and infrared light, ultrasounds) to modulate cellular pathways, and they could represent a novel strategy to investigate and potentially mitigate aging-related mechanisms[2].
In this PhD project we aim to study the synergistic effect of nanomaterials and visible light stimulation[3,4] on *in vitro* skin models, as a potential strategy to slow or counteract skin-aging. The study will be organized in the following stages:

i) Optimization of the interface between cells and photoactivated nanomaterials in different forms (nanoparticles, nanostructured thin films, hydrogels conjugated with nanoparticles)
ii) Analysis of the cellular response to nanomaterials exposure and light stimuli, with a focus on molecular pathways known to be involved in skin and cellular aging.
iii) Validation of the approach and assessment of scalability by developing of composite systems that integrate nanomaterials with existing commercial products, in collaboration with Cantabria Labs Difa Cooper, a world-leading healthcare company with a focus on dermatology products.

This highly multidisciplinary project could lead to breakthrough strategies for mitigating or reverting cellular aging, while shedding light on the mechanism of interaction between nanomaterials, light stimuli and molecular pathways. Furthermore, with the support of Cantabria Labs Difa Cooper, the project has the potential for industrial translation, and real-world applications.

Bibliographic references

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