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IMPACT OF A TiO₂ [NANO] COSMETICS GRADE ON THE CUTANEOUS MICROBIOTA: NANOPARTICLES BEHAVIOR IN EMULSION AND BACTERIOTOXICITY

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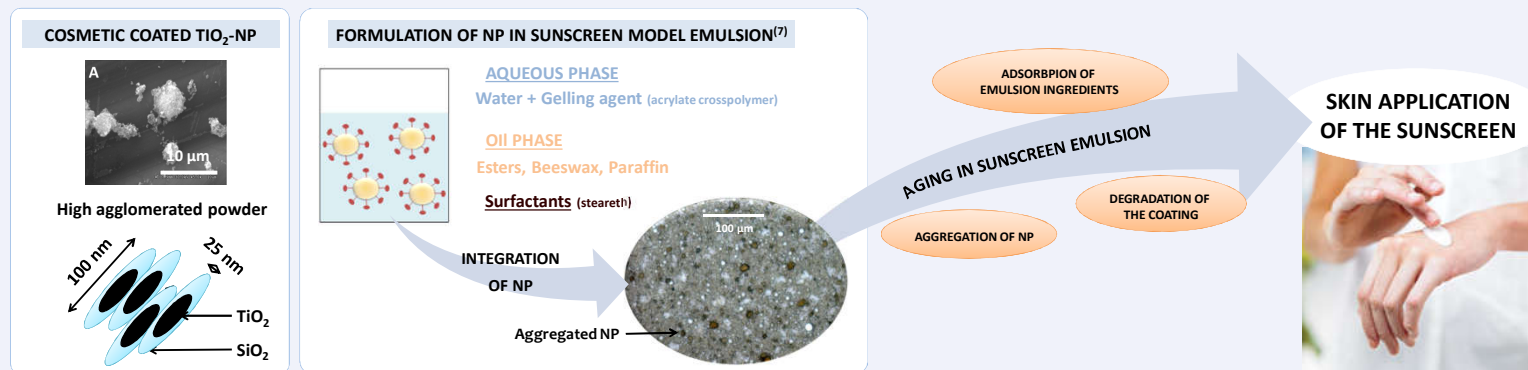


INTRODUCTION

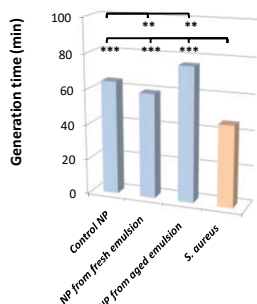
Titanium dioxide (TiO₂) nanoparticles (NP) are commonly used in cosmetics as UV filters^(1,2). For cosmetic grades, coatings (silica or alumina) are applied to prevent TiO₂ from forming radicals. These coatings procure to the NP their surface properties (polarity, charge) and impose their behavior in emulsion.

During formulation and storage, cosmetic emulsions are exposed to aggressions which can accelerate aging. NP in emulsion may aggregate, adsorb formula's compounds or be deteriorated⁽⁵⁾. Hence, the chemical and physicochemical characteristics of these NP could be modified before the skin exposure.

Herein the surface modifications of the NP are studied during aging in emulsion. Then, these modifications are related to the impact of the NP on two cutaneous bacteria. Hence, bacteria are known to compose the first skin barrier.



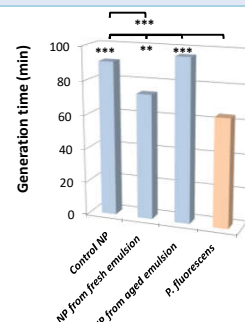
IMPACT OF NP ON BACTERIA GROWTH



Impact of the NP on the growth of *Staphylococcus aureus*.

WHAT IS THE IMPACT OF THE NP AGING ON SKIN BACTERIA ?

- Generation times of both bacteria are significantly longer with NP.
- Impact of the NP dependent on their aging in emulsion:
 - Lower impact: NP from fresh emulsion.
 - Higher impact: NP from aged emulsion.

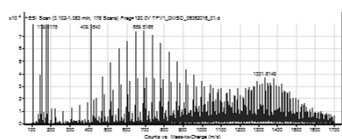


Impact of the NP on the growth of *Pseudomonas fluorescens*.

EVOLUTION OF THE BACTERIAL IMPACT OF THE NP DURING AGING

CHARACTERIZATIONS OF NP & BACTERIA SURFACES

STUDYING THE SURFACE PROPERTIES OF NP AND BACTERIA COULD EXPLAIN THEIR INTERACTIONS.

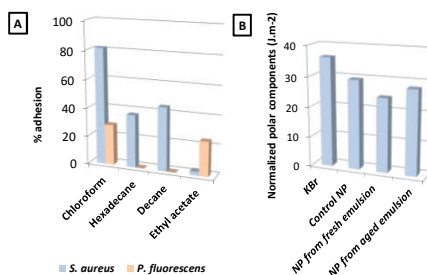


Chemical analysis of the component adsorbed on NP surface by MS-TOF.

CHEMICAL ANALYSIS:

- Adsorption of emulsion components.
- Identified as a compound from paraffin.

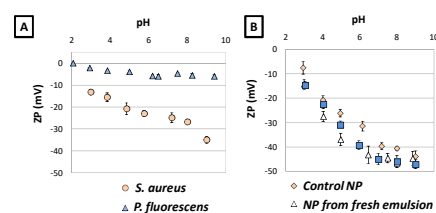
DURING EMULSION AGING, THE SURFACE CHEMISTRY OF THE NP HAS CHANGED.



(A) Results of the microbial adhesion to solvents test (MATS)⁽⁷⁾ and (B) Relative polar component of nanoparticles.

POLARITY:

- *P. fluorescens* is the most hydrophilic bacteria.
- Polarity of the NP dependent on their aging.
- Less polar NP has less impact on bacteria.



Comparison of bacteria (A) and NP (B) surface charges.

SURFACE CHARGES:

- More intense negative surface charges on *P. fluorescens*.
- Intense negative surface charges on all NP.
- Electrostatic repulsions could prevent NP/*S. aureus* interactions.

PHYSICO-CHEMICAL MODIFICATION DURING AGING EXPLAINED THE DIFFERENT IMPACTS OF NP.

CONCLUSION

In this study, the aging of a coated TiO₂-NP was studied in emulsion and gave important information concerning the NP behavior under use conditions.

The surface chemistry of the NP quickly evolved once in emulsion as the particles adsorbed emulsion ingredients. This evolution induced a modification of the physicochemistry of the NP surface (polarity, charges...) and changed the NP impact toward the cutaneous bacteria.

Whereas the surface charges were not shown to have a significant impact, the polarity of the NP is a key parameter that strongly modifies the interaction NP/bacteria.

TAKE-HOME MESSAGE

When measuring the impact of coated-NP on biological models, it is necessary to study their aging under use condition as their surface properties could quickly evolve.

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