ANTIMICROBIAL PROPERTIES OF ZINC OXIDE PARTICLES FOR A USE AS AN ALTERNATIVE TO CONVENTIONAL PRESERVATIVES IN COSMETIC PRODUCTS.

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ABSTRACT
Since few years, the scientific community but also consumers worry about the use of antimicrobial preservatives in cosmetics products, such as parabens or phenoxyethanol for example. According to this context, alternatives to conventional preservatives are searched for. Inorganic antimicrobial agents are such promising alternatives [1] and zinc oxide (ZnO) appears of major importance owing to its antimicrobial activity [2]. The prospect of using ZnO as a preservative in cosmetic products has never been done. To do so, the antimicrobial efficacy as well as the antimicrobial mechanisms of ZnO were studied, and the antimicrobial potential of ZnO in various cosmetic products was evaluated. All these studies were realized on the five germs of the Challenge Tests performed on cosmetic products, but this article is focused only on a single bacterial strain: Staphylococcus aureus CIP 4.83. Four ZnO grades were selected according to their physicochemical characteristics. Microbiological tests were realized and specific studies were carried out in order to investigate the contribution of each antimicrobial mechanism of ZnO particles on their global antibacterial efficiency:
- Direct contact of ZnO to bacterial cells was evaluated by zeta potential measurements on bacterial cell suspensions;
- Zinc content released from the dissolution of ZnO particles was quantified using HPLC coupled to a UV detection and the antimicrobial efficiency of Zn2+ was evaluated;
- Generation of reactive oxygen species (ROS) and more specifically H2O2 was quantified depending on the chemical and physical environment.
Lastly, an assessment of the antimicrobial effectiveness of ZnO in three types of cosmetic formulations (an oil-in-water emulsion, a colored water-in-oil emulsion and a compact powder) was done according to Challenge Tests from the standard ISO 11930.
Microbiological tests revealed that the tested ZnO grades exhibited a bactericidal activity against S. aureus. The sensitivity of S. aureus was mostly attributed to the direct contact of ZnO particles to these bacterial cells governed by an electrostatic attraction phenomenon. Moreover, the irradiation of ZnO suspensions to UV light allowed an enhancement of the antibacterial efficacy of the particles via the production of ROS. Zinc ions also contributed to the global antibacterial efficacy of the particles, and this dissolution phenomenon appeared as really dependent of the environmental conditions. Finally, the influence of ZnO on the microbiological quality of the three cosmetic products is clearly demonstrated since the A criteria was reached on S. aureus in the presence of 1% of ZnO while ZnO-free products do not comply with A or B criteria. To conclude, this study revealed that S. aureus was particularly sensitive to the effect of ZnO particles in complex formulations, which is a promising result for an application of ZnO as an antimicrobial agent to such products.
KEYWORDS
Zinc Oxide | Antimicrobial activity | Antimicrobial mechanisms | Cosmetic formulations

REFERENCES

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