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ANTIMICROBIAL COMPOSITION BASED ON CELLULOSE AND ZnO LOADED WITH CITRONELLOL FOR RESTORING PAPER FROM DOCUMENTS AFFECTED BY THE MICROORGANISMS

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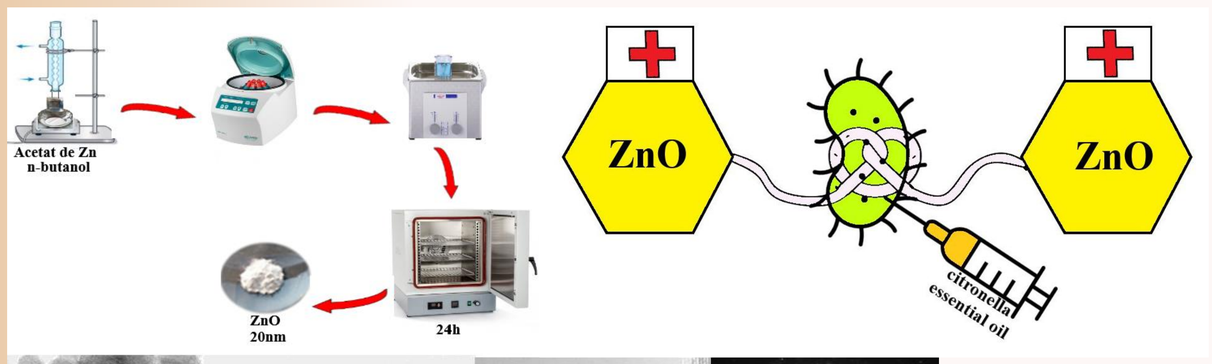
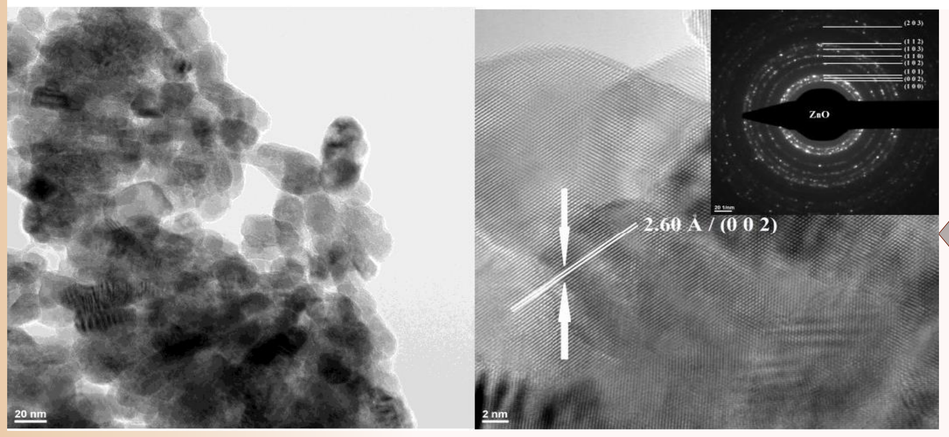
Introduction

The present invention relates to the production of cellulose-based gel compositions with citronellol-loaded ZnO nanoparticles for the restoration of paper documents, which will provide long-lasting antimicrobial protection. against specific pathogens (fungi, molds or bacteria). Due to the activity of microorganisms, the cellulosic support can be damaged, from the appearance of spots to the complete destruction. The cellulose derivative gel, with ZnO nanoparticles loaded with citronellol, by rapid drying, forms a cellulose film that will repair the damaged areas (cracks, holes with missing material, etc.). The gel can also be inserted under the letters that came off the original support due to the degradation of the cellulosic material. By fast drying it will act like a real glue, but having the same composition, based on cellulose. Because the composition contains ZnO nanoparticles, the cellulose film remaining after drying has antimicrobial activity and no longer allows the development of microorganisms on the treated area. The loaded citronellol will potentiate antimicrobial activity through synergism. If desired, the gel can be applied evenly over the entire page, after drying forming a protective film over the inscription, with antimicrobial activity, which will seal and protect virtually the entire document. Thus, immediately after application, by evaporation of the solvent, a cellulose film with a thickness of microns can be obtained, which is much thinner than the thinnest Japanese paper. The nanoparticles will remain trapped into the cellulosic net and will confer a long-lasting antimicrobial activity. This will ensure an increased resistance of the support to subsequent attacks.

Obtaining method

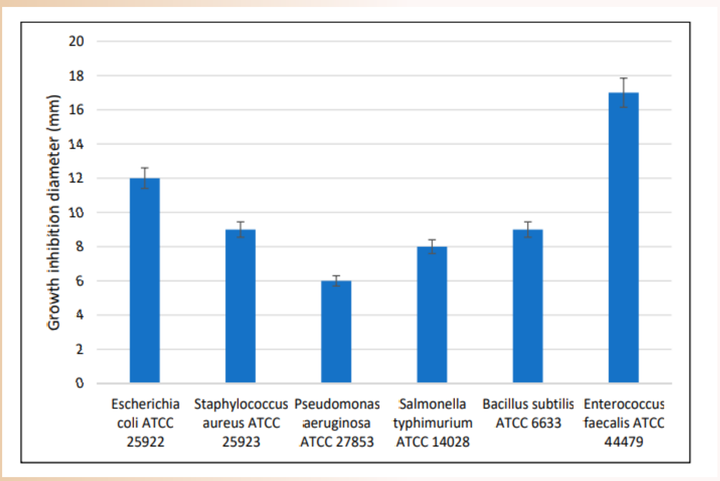
The antibacterial and antifungal activity of ZnO nanoparticles is well known, which is why these nanoparticles have been tested and exploited in many applications. Nanoparticles do not need stabilization to maintain their antimicrobial activity, and contact with human skin is not harmful, ZnO being biocompatible and considered non-toxic. This will prevent any allergic reactions if the documents come in prolonged contact with human skin and also ensure an additional interaction with the cellulose support on which they are to be applied.





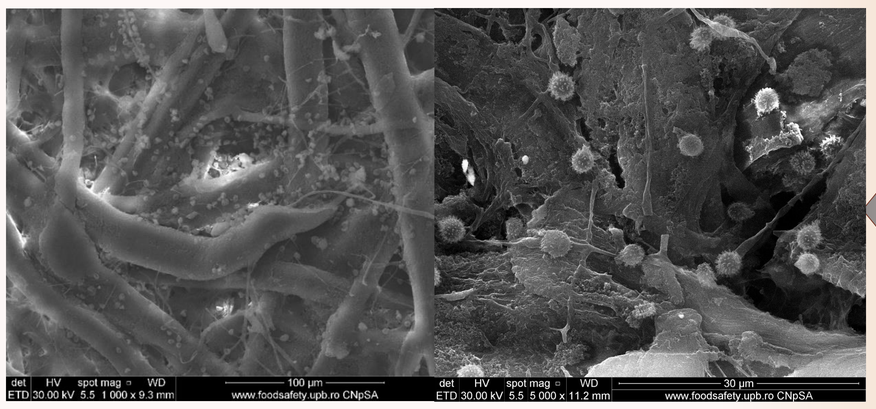
TEM and HRTEM for ZnO NPs

Quantitative assay of the ZnO antimicrobial activity



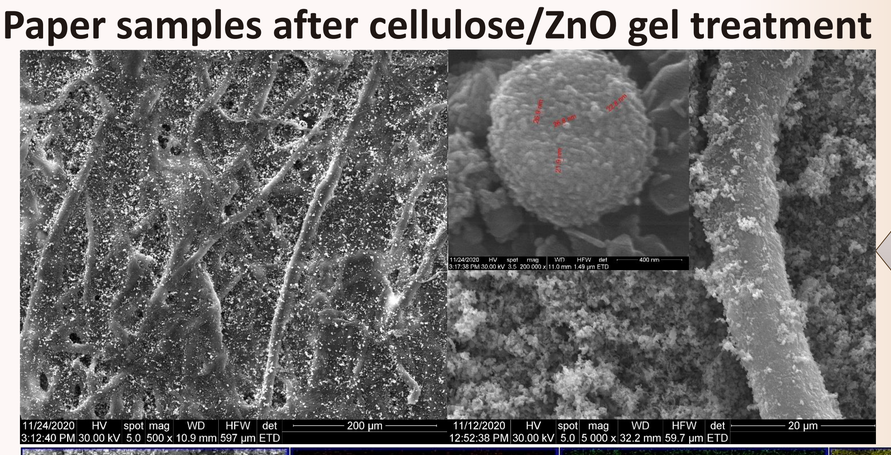
The gel with cellulose derivatives, with ZnO nanoparticles, by rapid drying, forms a cellulose film that will repair the damaged areas (ruptures, holes with missing material, etc.). The gel can also be inserted under the letters that came off the initial support following the degradation of the cellulosic material. By rapid drying it will act as a real glue, but having the same composition, based on cellulose. Because the composition contains ZnO nanoparticles, the cellulose film remaining after drying has antimicrobial activity and no longer allows the development of microorganisms on the treated area.

Paper samples before treatment

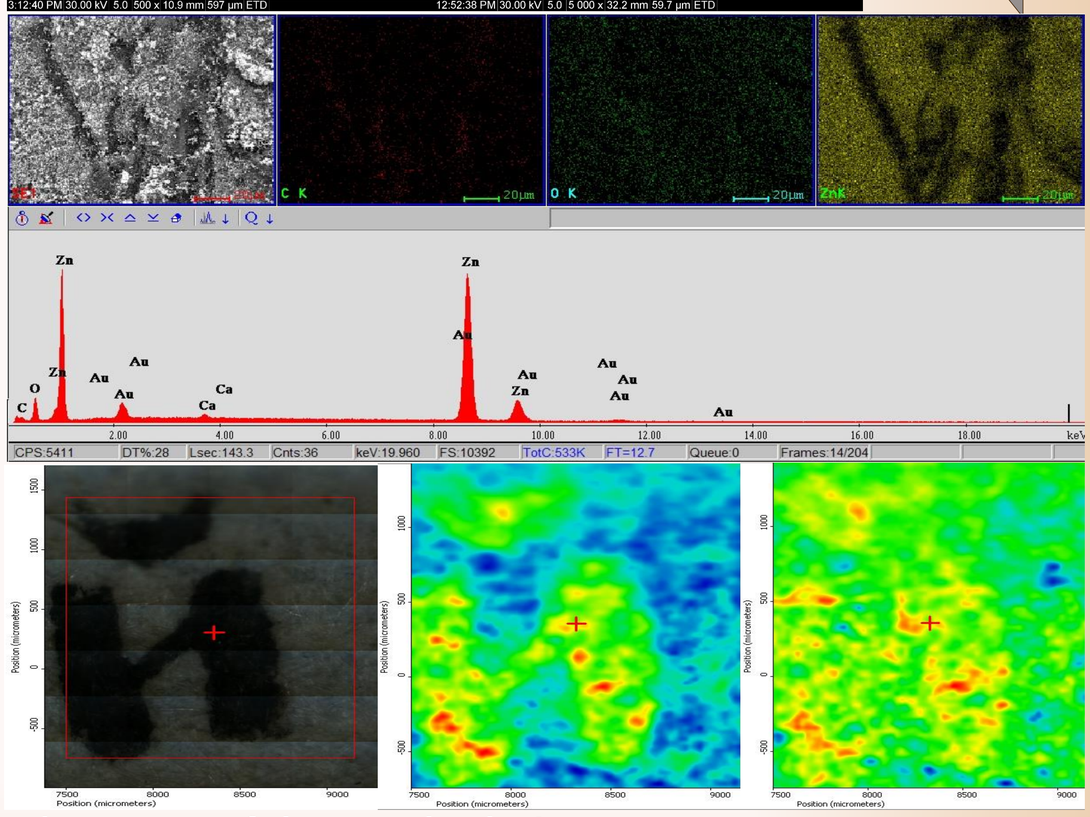


Infested paper from XVI-XVIII

Paper samples after cellulose/ZnO gel treatment



Treated paper with cellulose and ZnONPs



Advantages of the novel solution types

The composition disclosed in this patent involves the use of a gel consisting of cellulose derivatives with citronellol-loaded ZnO nanoparticles. Thus, immediately after application, by evaporation of the solvent, a cellulose film with a thickness of microns can be obtained, which is much thinner than the thinnest Japanese paper. In addition, the cellulosic film will exhibit antimicrobial activity due to ZnO nanoparticles and citronellol. The documents restored with this composition will have in their structure nanoparticles of ZnO and citronelol, so in this way they confer an antimicrobial activity and can be protected from future infestations. ZnO particles are covalently bound to the fibrillar structure of cellulose and also remain trapped in the fiber network, as in a mesh, and will provide a permanent antimicrobial activity, which will prevent the reappearance of pathogens and the development of microbial flora. Citronellol will potentiate this ZnO activity through synergism.

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