PROGRAMUL DE FINANTARE: EUROPEAN AND INTERNATIONAL COOPERATION
SUBPROGRAM: 3.5: Other European and international initiatives and programs – Eureka Traditional projects, Eureka Cluster

TITLUL PROIECTULUI/ACRONIM: Development of new textile materials with bioactive compounds – NOVAHEAL

CONTRACT NO.: 133/2020

TOTAL PROJECT BUDGET: 1,726,600.00 RON **INCDTP'S BUDGET:** 1,050,000.00 RON

PROJECT STARTING DATA: 01/01/2020 **PROJECT ENDING DATA:** 31/12/2022

PAGINA WEB: http://www.novaheal.ro/

PARTNERS:

1. HOFIGAL EXPORT-IMPORT SA	
2. NATIONAL RESEARCH-DEVELOPMENT INSTITUTE FOR TEXTILE AND LEATHER	
3. KIVANÇ TEKSTiL San. ve Tic. A.S	

GENERAL OBJECTIVE:

The project aims to develop antimicrobial textile materials to prevent the spread of bacteria and to create an antimicrobial shield for the human body. Innovations involve the use of bioactive compounds in various forms, such as those incorporated into blue clay or micro-encapsulated. By utilizing these processes, the side effects of commonly used antibiotics are minimized, and additional properties are developed, including reducing the risk of bacterial growth, disinfecting the skin, and even facilitating tissue regeneration. Another innovative point is the use of blue clay, recognized for its high concentration of trace elements. Last but not least, one of the main innovations is the development of antimicrobial nanofibers with controlled release of active compounds.

SPECIFIC OBJECTIVES/ EXECUTION PHASES:

1. Preparation of new extracts based on Aloe Vera, Wormwood, Thyme, Rosemary, Tea tree, St. John's Wort, Valerian, etc., and blue clay with bioactive compounds for the development of antimicrobial textiles.
2. Evaluation of the pharmacological properties of extracts with bioactive compounds and the mixture of extracts with blue clay: analysis of disinfectant, antibacterial, anti-inflammatory, and/or regenerative properties.
3. Development of the microencapsulation process for the incorporation of active components in the natural /synthetic polymer shell, with controlled drug release functions.
4. Development of dispersions containing bioactive compounds, incorporation in blue clay, and treatment of textile materials.
5. Development of antimicrobial textiles with control and slow release of the active compound for optimal antimicrobial effect.
6. Product safety assessment and validation: toxicity tests in various primary dermal cells and macrophages, and *in vitro* test of components and prototypes against wound-specific bacteria

NOVELTY ELEMENTS/ SCIENTIFIC CONCEPT:

1. New types of plant extracts and their combinations, with the potential to promote antimicrobial, anti-inflammatory, and tissue regeneration due to the synergistic effects of bioactive compounds; lyophilized extract was obtained by Hofigal SA from Aloe Vera, Wormwood, Plantain, Marigold, and Propolis.
2. New types of active ingredient-controlled release microcapsules: materials used as a shall to encapsulate plant extract are biocompatible, biodegradable, allowing a slow release of active compounds and respond to various stimuli (such as pH); microcapsules were obtained by Turkey partner – Kivanc Tekstil, in collaboration with Romanian partners - Hofigal SA and the National Research and Development Institute for Textiles and Leather.
3. Textiles with increased wound healing efficiency, improved antimicrobial activity, minimizing exudation levels, promoting debridement, improving granulation and re-epithelialization; result was obtained by the National

Research and Development Institute for Textiles and Leather following the collaboration with the two partners Hofigal SA and Kivanc Tekstil.

EXPECTED EXPLOITABLE RESULTS:

R1. Technology for extraction and purification of bioactive compounds from plants: extraction of active ingredients (Hofigal).

R2. Technology for microcapsule preparation: the extracts were encapsulated using *in situ* polymerization of suitable monomers and coacervation of natural materials.

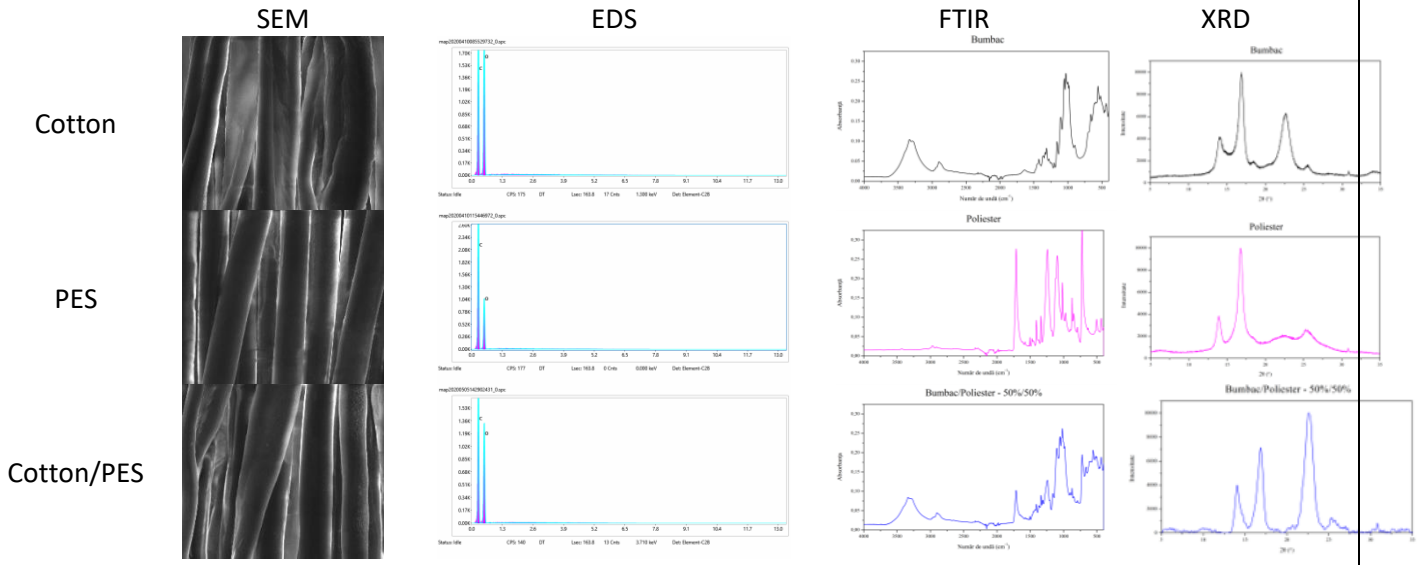
R3. Method for dispersing bioactive compounds from plants together with blue clay.

R4. Development of textiles with antimicrobial properties, effect obtained from the use of plant extracts and blue clay.

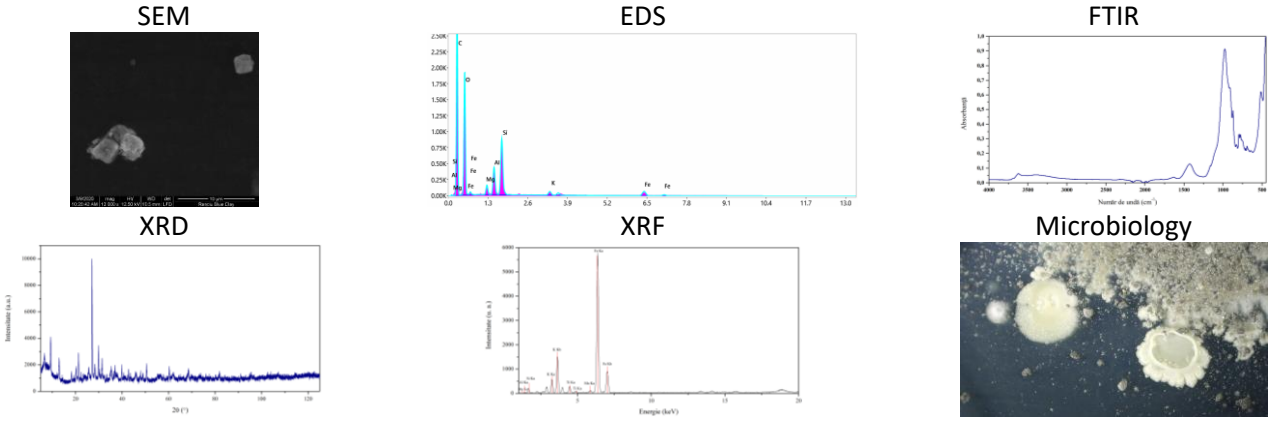
OBTAINED RESULTS:

1. Study on the functionalization of textile materials and their antimicrobial properties.

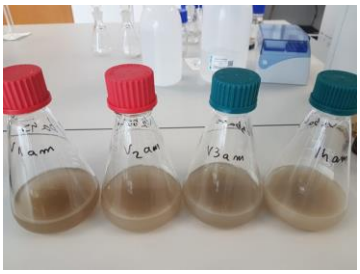
2. Evaluation and characterization methods of selected textile materials using Scanning Electron Microscopy (SEM) coupled with Energy Dispersive X-ray Spectroscopy (EDS), Fourier Transform Infrared Spectroscopy (FTIR), X-ray Diffraction (XRD), as well as physical-mechanical characterization methods.



3. Physico-chemical characterization methods of blue clay that will be incorporated into antimicrobial textiles. The techniques used were: Scanning Electron Microscopy (SEM) coupled with Energy Dispersive X-ray Spectroscopy (EDS), Fourier Transform Infrared Spectroscopy (FTIR), X-ray Diffraction (XRD), X-ray Fluorescence (XRF), and microbiological methods.



4. Technology for preparing dispersions of bioactive compounds with clay and methods of their characterization.

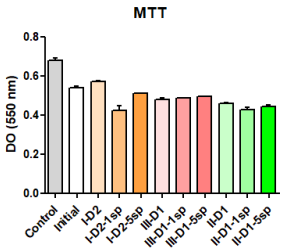


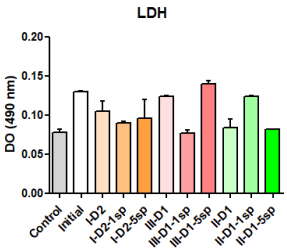
5. Technological process for deposition/impregnation of dispersions of bioactive compounds with blue clay on textile materials and evaluation methods of the resulting functionalized textiles.

a. Padding machine for textile impregnation with polymeric and functionalization substances (ROACHES, UK)

b. Drying-thermofixation-condensation equipment for advanced finishing operations (ROACHES, UK).

6. Toxicological methods for *in-vitro* testing of antimicrobial textile materials. The toxicological characterization of antimicrobial textiles was carried out within the Research Platform in Biology and Systemic Ecology – Faculty of Biology, University of Bucharest. The textiles were tested on the standardized L929 cell line. Sterilized textiles were incubated for 24 hours with L929 cells (10^5 cells/well). Biocompatibility testing was performed using MTT and LDH assays.





7. Market segmentation study.

The global wound care market was valued at USD 20.6 billion in 2021 and is expected to expand at a compound annual growth rate (CAGR) of 4.1% from 2022 to 2030. The market is highly fragmented in nature, with both small and large producers present. Competitive rivalry and the degree of competition in the wound care market are expected to intensify due to the presence of numerous players. In addition, leading players are engaged in collaborations, product launches, mergers, and acquisitions to strengthen their product portfolios.

DISSEMINATION, PATENT APPLICATIONS, AWARDS:

- **BDI published papers:**

1. Review on different types of clay and their use as antimicrobial agents for textiles treatment, **M.C. Lite, E.C. Tănăsescu, L.O. Secăreanu, I.M. Săndulache, O. Iordache, E. Perdum,** TEXTEH X International Conference Proceedings, 2021, vol.10, pag. 321, ISSN 2068 – 9101

2. Formulation and optimization of clay-based dispersion for textile functionalization, **Tanasescu Elena-Cornelia, Lite Mihaela-Cristina, Sandulache Irina Mariana, Secareanu Lucia-Oana, Iordache Ovidiu, Constantinescu Roxana,** Annals of the University of Oradea Fascicle of Textiles, Leatherwork, 2022, vol.23, nr.2, pag. 75-80, ISSN 1843 – 813X

- **Scientific communicationsComunicari stiintifice:**

1. Review on different types of clay and their use as antimicrobial agents for textiles treatment, **M.C. Lite, E.C. Tănăsescu, L.O. Secăreanu, I.M. Săndulache, O. Iordache, E. Perdum,** TEXTEH X International Conference Proceedings, 2021, vol.10, pag. 321, ISSN 2068 – 9101

2. Prezentarea proiectului în cadrul WORKSHOP-ului 3D ELECTROTEX PN 19 17 01 01, ”Materiale avansate pentru inovare în domeniul industriei textile” organizat de INCDTP în data de 07.11.2022

3. Green synthesis of silver nanoparticles with potential application in textile artefacts preservation, autori **Mihaela Cristina Lite**, Nicoleta Badea, **Roxana Constantinescu, Elena Cornelia Tănăsescu,** Andrei Kuncser, în cadrul Conferinței Internaționale ” Romanian International Conference on Chemistry and Chemical Engineering (RICCCE)” ediția 22, care a avut loc în perioada 07.09.2022-09.09.2022 în Sinaia, România.

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