OPEN ACCESS **Scientific Letters**

IV 1H-TOXRUN INTERNATIONAL CONGRESS 2025 | 08-09 MAY, 2025 Porto, Portugal

Oral Communication 4

MicroMundo@IUCS_CESPU (2022-2024): uncovering soil's hidden treasures and its impact on science and antimicrobial resistance awareness

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Abstract

Background: MicroMundo@IUCS_CESPU (MMIC) is a service-learning pedagogical approach allowing university/school students to expand their knowledge on soil biodiversity, antimicrobial resistance (AMR) and experimental sciences [1]. School students experience a real research project by processing soil samples and looking for potential antibiotic-producing microorganisms [2,3]. **Objective:** To evaluate past MMIC editions' results (2022-2024) and to explore clinically-relevant antibiotic-resistant bacteria (CAB) in soils gathered within the project. **Methods:** University students (*n*=23), guided by professors, led 12 sessions for basic/secondary Cristelo school students (*n*=60). At MMIC end, promising soil colonies with antibiosis activity against *Escherichia coli* and/or *Staphylococcus epidermidis* were saved. A post-survey evaluated student experiences. After MMIC, soil samples underwent more analysis, including extended antibiosis assays using additional species and multidrug-resistant (MDR) strains, and screening for CAB using selective media for *Enterococcus* (Slanetz-Bartley with/without ampicillin or vancomycin) and *Enterobacterales* (MacConkey with/without cefotaxime, Coliform Chromogenic, Hicrome *Klebsiella* Selective agar) identification. Typical colonies were identified by MALDI-TOF and antibiotic susceptibility was tested by disk diffusion (EUCAST/CLSI). **Results:** Most students increased their interest in Science (86% on average) and AMR awareness (89% on average) (Fig.1). Of 26 soil samples processed, 310 colonies were tested, with two *Bacillus cereus thuringiensis* isolates from a moist agricultural soil in Cristelo showing antimicrobial activity against *E. coli*, *S. epidermidis*, *S. aureus,* besides MDR *E. coli* and *S. aureus*. Among CAB isolated from soils, *E. faecium* (*n*=11) showed tetracycline (64%) and erythromycin (9%) resistance. Within *Enterobacterales* (*n*=10; 30% MDR), species included *E. coli* (60%), *Citrobacter braaki* (20%), *Escherichia marmotae* (10%), and *Klebsiella aerogenes* (10%), with resistance to ampicillin and amoxicillin+clavulanic acid (40% each), cefotaxime and gentamicin (30%), aztreonam (20%), sulfamethoxazole+trimethoprim and tetracycline (10% each). **Conclusions:** The MMIC project is positively impacting students' AMR awareness. Our findings highlight soil as

both a valuable reservoir of antibiotic-producing bacteria and a potential source of MDR bacteria, reinforcing its role in the One Health fight against AMR, and the revival of antibiotic discovery.

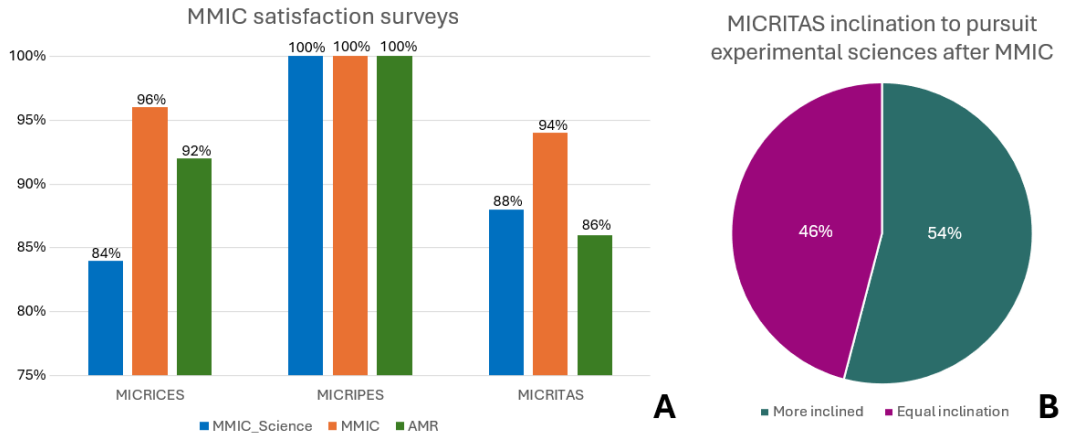

Figure 1. MMIC satisfaction surveys. A. MICRICES indicate school students, MICRIPES indicate school professors and MICRITAS indicate university students. B. MICRITAS inclination to pursuit experimental sciences after MMIC.

Keywords: MicroMundo; antibiotics; soil

Acknowledgments/Funding

This work received financial support through the annual funding of 1H-TOXRUN of the University Institute of Health Sciences (IUCS-CESPU).

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