First Virtual Workshop on the Developments in the Italian PhD Research on Food Science, Technology and Biotechnology

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Freie Universität Bozen
Libera Università di Bolzano
Università Liedia de Bulsan

The role of microplastics on ecosystem functioning: a focus on antibiotic resistance spread in input for agricultural purposes

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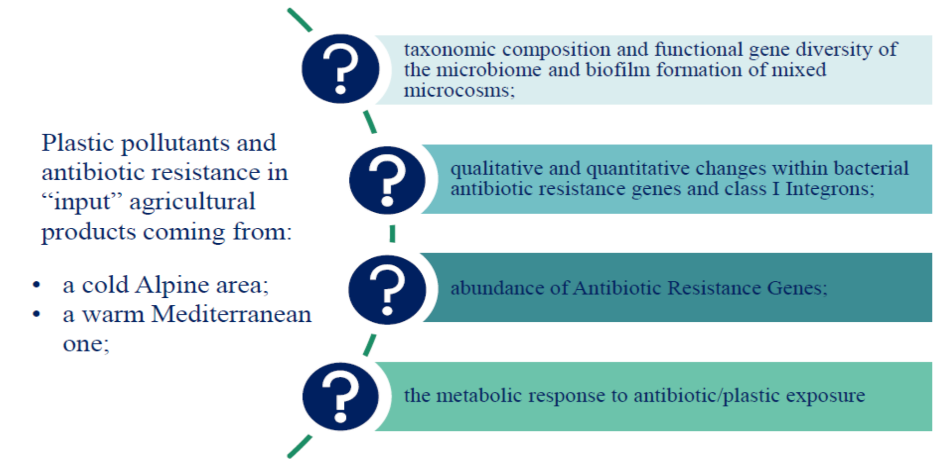
STATE OF THE ART

Globally, one of the most complex health challenges to date is antimicrobial resistance (AMR): Decades of overuse and misuse in human healthcare, animal farming, agriculture, and dispersion into the environment have led to an estimated global annual production of antibiotics to be as high as 100-200 thousand tons, and to the production of more than 1 billion tons since 1940, with the direct consequence of infections to become increasingly incurable: Therefore, a wide range of interconnected human, animal, and environmental habitats may contribute to the appearance, growth, and dissemination of AMR with an impact on both the environment and human health. Microplastic pollution may be a major stressor on the environment, causing relevant ecological implications. Previous research have shown that synthetic polymer particles (diameter < 5mm) can be found worldwide, from the arctic sea ice, to the waters of mountain lakes, to agricultural soils representing new submerged surfaces for microorganisms colonization, pollutant dispersal, nutrient cycling, but mostly biofilm formation. Moreover, on this microparticles, Horizontal Gene Transfer (HGT) between different bacteria is enhanced, favouring the transfer of pathogenicity and antibiotic resistance in the environment: Agricultural practices like irrigation and amendment are considered to be significant microplastic transportation pathways and antibiotic resistance. However, still little is know about the microbiological activity involved. Nowadays, although the plastic ban remains practically unobtainable, new biodegradable plastics (BPs) have been developed representing an attractive alternative in the short to medium term at least. In this context, the so-called Mater-Bi® is already widely used in packaging for producing shoppers or waste bags since at the end of its life, it is transformed in harmless compounds, suitable for agricultural uses like composting. Also in this case, few is known on the interaction of BPs micro particles and antibiotics on microbial communities in the environment.

RESEARCH QUESTIONS



PARTNERS & TIMELINE

• Dr. Leonardo Pagani, Unità di Chemioterapia antimicrobica; Central Hospital of Bozen/Bolzano (Bolzano, Italy);
• Prof. Luciano Beneduce, University of Foggia (FG, Italy);
• Dr. Odd-Gunnar Wikmark, GenØk - Centre for Biosafety (TromsØ, Norway);
• Dr. Maria Concetta Tomei, Water Research Institute C.N.R. (Rome, Italy).

➢ This PhD thesis project can be subdivided into the following activities according to the Gantt diagram given in Table 1.

WORKPLAN

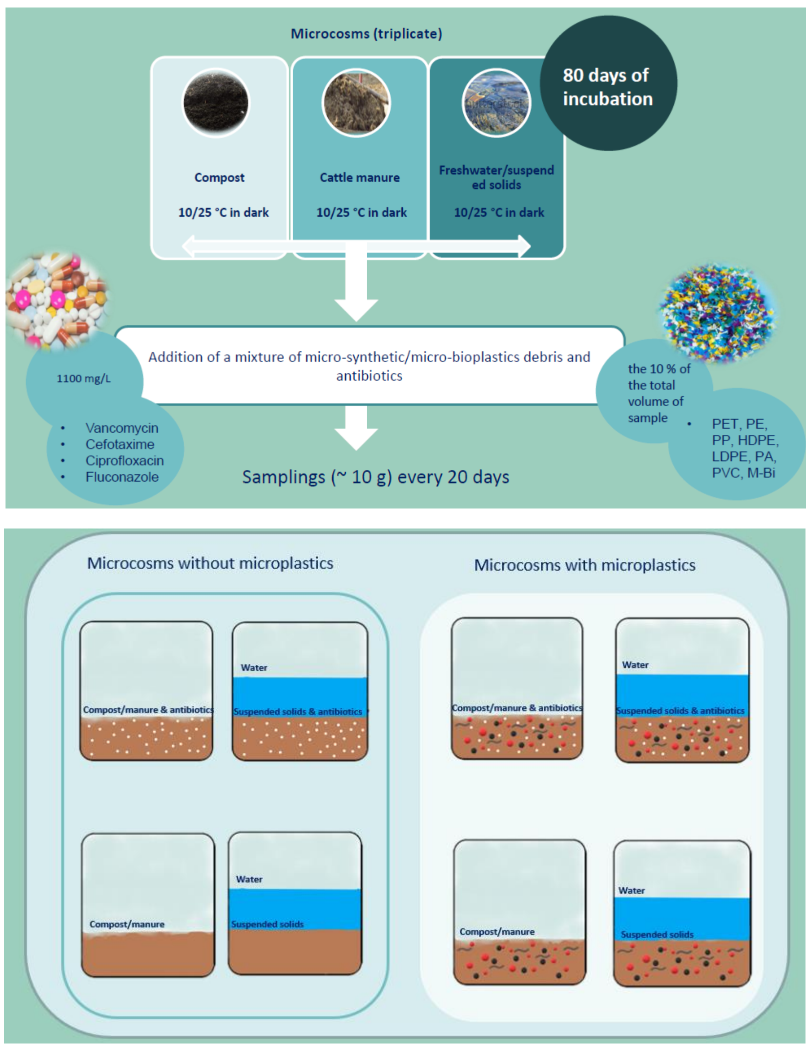


Figure 1 *Example of the experiment as it is going to be performed.*

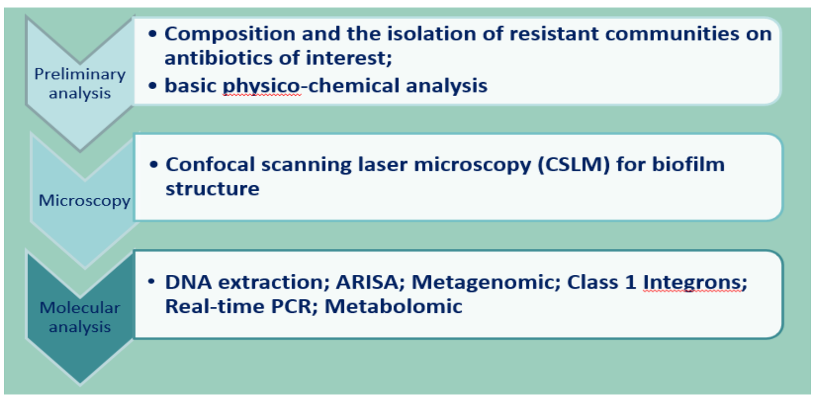


Figure 2 *Example of analysis planned.*

PRELIMINARY RESULTS

In a preliminary study, the antibiotics (in particular Ciprofloxacin) considered for this project, were found to influence the microbial communities of soils and sediments irrigated with wastewaters.

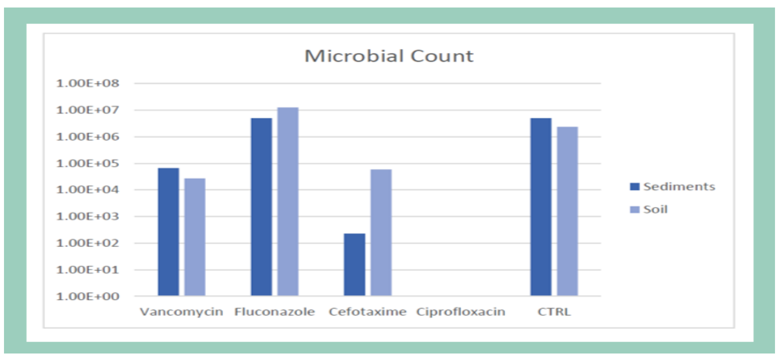


Figure 3 *Graph reporting the preliminary results.*

Milestones	1st year				2nd year				3rd year			
Terms	I	II	III	IV	I	II	III	IV	I	II	III	IV
M1 –Literary review, design of the experiment	■	■	■									
M2 –Collection of samples, microcosms set-up		■	■	■								
M3 –Microscopy and molecular analysis			■	■	■	■	■	■				
M4 –Bioinformatics analysis and data processing						■	■	■	■	■		
M5 –Interpretation of results						■	■	■	■	■		
M6–Conferences, papers writing and thesis discussion	■	■	■	■	■	■	■	■	■	■	■	■

Table 1 *Gantt diagram for this PhD thesis project.*

Andersson DJ, Hughes D (2010) *Antibiotic resistance and its cost: is it possible to reverse resistance?*. Nat Rev Microbiol **8**:260-271.
Magni S, Bonasoro F, Della Torre C, Parenti C C, Maggioni D, Binelli A (2020) *Plastics and biodegradable plastics: ecotoxicity comparison between polyvinylchloride and Mater-Bi® micro-debris in a freshwater biological model*. Sci Total Environ **720**: 137602.
Eckert EM, Di Cesare A, Kettner MT, Arias-Andres M, Fontaneto, D, Grossart HP, Corno G, 2018. *Microplastics increase impact of treated wastewater on freshwater microbial community.* Environ Poll **234**: 495-502.