Biodegradable polymers as potential mitigation strategy for micro and nanoplastic pollution

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The global plastic production has grown rapidly in the last twenty years reaching 390 Mt (million tons) in 2021 [1]. The unique properties of the plastic, like low-cost, lightness, stability and good mechanical performances, make it suitable for several applications [2]. The increase of plastic demand will induce an increase in post-consumer plastic waste. In 2020, 29.5 million tonnes of post-consumer plastics waste were collected in Europe [1]. Due to mismanagement of plastics at the end of life , a large amount of these materials end up in marine environment with impacts on the ecosystem [3]. Plastics were found to be largely accumulated on beaches, in sediments, in deep marine environment, etc [4]. It was esteemed that 14 million tons of plastic end up in the oceans every year [5].

Plastic objects dispersed in the environment can degrade due to environmental factors such as to UV radiation, wind, waves, seawater, and bacteria, leading to the formation of fragments classified as mesoplastics (~5–20 mm), large microplastics (~1–5 mm), small microplastics (~20–999 μm), and nanoplastics (<1 μm), depending on the chemical-physical properties of the plastic debris [6]. In this frame, several public policies have been introduced aimed at reducing use and disposal of plastic items, while encouraging recycling or even progressive phase-out of lightweight plastics [7].

Biodegradable plastics are considered promising substitutes for traditional non-degradable plastics and can be obtained from both renewable, or fossil resources such as poly(lactic acid) (PLA) and poly(hydroxyalkanoate)s (PHA), poly(ε-caprolactone) (PCL). poly(butylenesuccinate) (PBS) and poly(butylenesuccinate-co-butyleneadipate) (PBSA).

Despite their biodegradability, some of these polymers have been found as fragments in submillimetric size, i.e microplastics, in the marine environment. For example, PCL fragments were found in the Mediterranean Sea, suggesting that in some cases biodegradable polymers do not readily degrade under natural conditions and therefore do not represent an *a priori* solution for reducing marine litter [8]. Therefore, biodegradable plastics are not always degradable in environmental conditions and their long-term use could cause problems similar to those currently attributed to traditional plastics due to uncontrolled end-of-life management and subsequent accumulation in the environment.

Starting from these considerations, studies are being conducted on biodegradable plastics to evaluate the release of microplastics, which similarly to traditional ones, could adsorb many pollutants with different mechanisms effects and could release additives [9].

The research activity, undertaken within the project BioPlast4safe - *Biomonitoring of biodegradable micro and nanoplastics: from the environment to humans in a one health perspective,* aims to evaluate the applicability of biodegradable polymers to reduce micro and nanoplastic pollution . A methodological approach will be studied and defined aimed at the realization of model micro and nanoplastics using biodegradable polymers, at their determination in complex matrices through the use of conventional and advanced characterization techniques and study of the solutions for the mitigation of pollution from plastics and microplastics through the use of biodegradable materials.

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