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Biodegradation of Plastics

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ABSTRACT

Plastic pollution of marine and terrestrial environments has sparked debate about the possibility of utilising biodegradable polymers instead of traditional, nonbiodegradable plastics to reduce pollution. While we find these conversations to be beneficial and forward-thinking, we have seen that a number of recently published pieces have failed to fully acknowledge the foundation. These articles are divided into two groups. The first group includes articles that purport to evaluate plastic biodegradation but fail to include the necessary experimental data (i.e., data on microbial assimilation of plastic carbon). The biodegradability of certified biodegradable plastics is questioned in publications in the second category, based on discoveries of insufficient biodegradation polymers. Based on insufficient biodegradation of these plastics in conditions other than those for which they were certified biodegradable we are afraid that such publications, especially when they receive a lot of media attention, would misdirect the entire discussion about the role of biodegradable plastics in reducing plastic pollution, leading to misunderstandings and, eventually, adversity.

Description

The need to emphasise that plastic biodegradation is a multistep process in which microorganisms in a plastic-receiving system metabolically utilise the organic building blocks of that plastic is highlighted by publications in the first category (i.e., papers that claim to assess biodegradability but provide no direct experimental evidence). The plastic is used both to gain energy and to keep the construct from collapsing. In aerobic systems, carbon dioxide is produced; in anoxic (anaerobic) systems, carbon dioxide and methane are produced, and new cellular biomass is formed. As a result, quantifying the biodegradation of a particular plastic necessitates quantitative measurements of the plastic's carbon conversion to CO2 (or CO2 and CH4). Second, these respirometric data must be thoroughly discussed in the context of the study. combination specified incubation conditions (such as duration, temperature, and relative humidity) and essential polymer-specific features (1) Some goods for which biodegradability has been claimed, such as oxo-"bio"degradable plastics (i.e., formulations incorporating additives that reportedly render otherwise persistent plastics such as polyethylene) currently lack such respirometric data and debate. Because system elements are so important, terms like "biodegradable" and "insufficiently biodegradable" are only valid when considered not the context of the specific system in which biodegradation is measured. This means that a plastic's biodegradability in a specific system (e.g., industrial compost or agricultural soil) cannot be guaranteed. Because of the great reliance of plastic biodegradation on system conditions, caution should be used when reporting the finding of novel microorganisms isolated from specific setting capable of digesting polymers that are nonbiodegradable in most natural situations. It's critical to avoid drawing the incorrect inference that such a microbe will make nonbiodegradable polymers biodegradable in any environment. Instead, we believe that such findings should be communicated in a way that highlights the exciting potential of newly found microbes and their plastic depolymerases for plastic recycling in designed systems. Given that both the material properties of the plastic and the characteristics of the receiving environment strongly affect plastic biodegradation, assessing plastic biodegradation necessitates a thorough characterization of both. Biodegradable plastics aren't a panacea for all of the difficulties that come with plastic pollution. We see advantages in replacing nonbiodegradable plastics with entirely biodegradable plastics for specific uses and end-of-life scenarios as a crucial step in reducing environmental plastic pollution. Plastics used as packaging materials that breakdown in industrial composts and anaerobic digesters are examples. Biodegradable–compostable plastics associated with food, paper, and biowastes can be transferred from landfills and open dumps to managed composting systems at the end of their useful lives. Similarly, we view the usage of biodegradable polymers rather than traditional plastics to be environmentally friendly. Plastics used in agricultural food production (such as plastic mulch films covering agricultural soils) and plastics utilised in the marine environment are examples of these applications (such as pots, nets, and buoys). Not only is it generally impossible to collect all of the plastic used in these situations due to weathering and physical attrition, but the fraction of plastic recovered is also extremely small. As a result, replacing conventional plastics with biodegradable plastics that totally biodegrade in the respective settings within a given time frame is an essential step toward reducing environmental plastic pollution in all of these uses.

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