Home composting and compostable plastics

Do compostable plastics degrade in home composters?

Introduction

Compostable plastics have been growing in popularity as part of a wider drive to reduce plastic waste and pollution.[i] Much of the debate has focused on if and how these materials might be incorporated into the municipal waste system. However, little attention has been given to another disposal route for compostable plastic packaging: home composting.

The UCL Plastic Waste Innovation Hub ran a citizen science project, the Big Compost Experiment to learn more about how well items really do degrade in home composters (see 'citizen science' box)

Big Compost Experiment Findings

1. Most items did not fully degrade

Our experiment found that the majority (66%) of items tested had remains that were still visible at the end of the composting period while only 34% were no longer visible/not found. The type of composter used, length of composting duration and geographical location in the UK did not appear to greatly affect results. A breakdown of our findings according to item type is shown below in figure 1. Perhaps most significantly, items that were labelled with a

Key Points

1.Home composting is not currently a viable effective or environmentally beneficial end of life option for compostable or biodegradable packaging.

2.The compostable and biodegradable plastics that are currently being sold in packaging applications do not fully degrade in home composting conditions (including those that have been certified as home compostable).

3.Although people are attracted by the idea of compostable plastics, they are confused about appropriate disposal routes. In particular, the distinction between items that are suitable for home composting versus those that require industrial composting is lost on many people.

4.Where people make their own compost at home, they typically use it for growing food crops. This means that there could be an impact on the food chain of any substances put in to a home composter. We need to know more about the potential environmental and health impacts of microplastics and the inks and glues used in compostable packaging items.

home compostable certification mark also failed to fully decompose in the majority of cases (see figure 2).

This suggests to us that there are two problems that need to be resolved if home composting is to be a viable route for disposing of compostable plastic items:

1. Material scientists need to develop new materials that degrade more effectively in home composting conditions.
2. In order to set reliable standards and certification schemes, more effective testing processes are needed that can account for the variety of packaging items and home composting conditions.

2. Confusion about what can be composted at home

Compostable plastics are popular: 85% of participants in our experiment reported that they were more likely to buy products with packaging marked 'compostable' or 'biodegradable'. (Although it should be noted that the self-selecting nature of people who chose to participate in our experiment might result in a higher interest in this issue than the average person.)

Although people are enthusiastic about buying products with compostable packaging, we encountered a great deal of confusion about how to dispose of these items in an appropriate way. In particular, the idea that some items are suitable for industrial composting *only* (and therefore not suitable for home composting) did not seem to be well understood. We asked participants to test only items that were clearly marked as suitable for home composting (see 'The Big Compost Experiment' box, above). However, we found that many participants also included items that were marked as industrially compostable or had general marketing descriptions such as 'put me in your compost bin', '100% home compostable' or 'biodegradable' but no identifiable certification or standards.

Citizen Science: The Big Compost Experiment

The UCL Plastic Waste Innovation hub conducted a citizen science project ('The Big Compost Experiment') to learn more about how well compostable plastic packaging degrades in home composting environments. Participants were asked to select a plastic item to test (such as "cutlery", "cups", "shopping bags" and "newspaper wraps"), to choose a timescale for the experiment (based on how long it usually takes them to make compost) and to then assess the extent to which the item had degraded against a 'degradation scale' at the end of the composting period. Participants were advised to only test items that displayed the following manufacturer information:

1. 'compostable'
2. 'home biodegradable'
3. 'home compostable'
4. 'suitable for home composting'
5. TUV OK Compost 'Home' certification mark
6. Din Certco 'Home Compostable' certification mark

A total of 902 households from across the UK completed the experiment and tested 1307 items. The majority of participants (64%) used outdoor closed-bin composters, but other composter types were also tested (including tumble, open-slatted, hot-bin, multi-stage, open-mesh and trench composters as well as wormeries and bokashi).

We also ran a survey alongside the experiment to learn more about attitudes and behaviours. A total of 9701 people participated in the survey.

The full results of our experiment have been published in a peer-reviewed paper.[ii]

Visit www.bigcompostexperiment.org.uk to find out more.

Figure 1: Home compost experiment item degradation level by item type

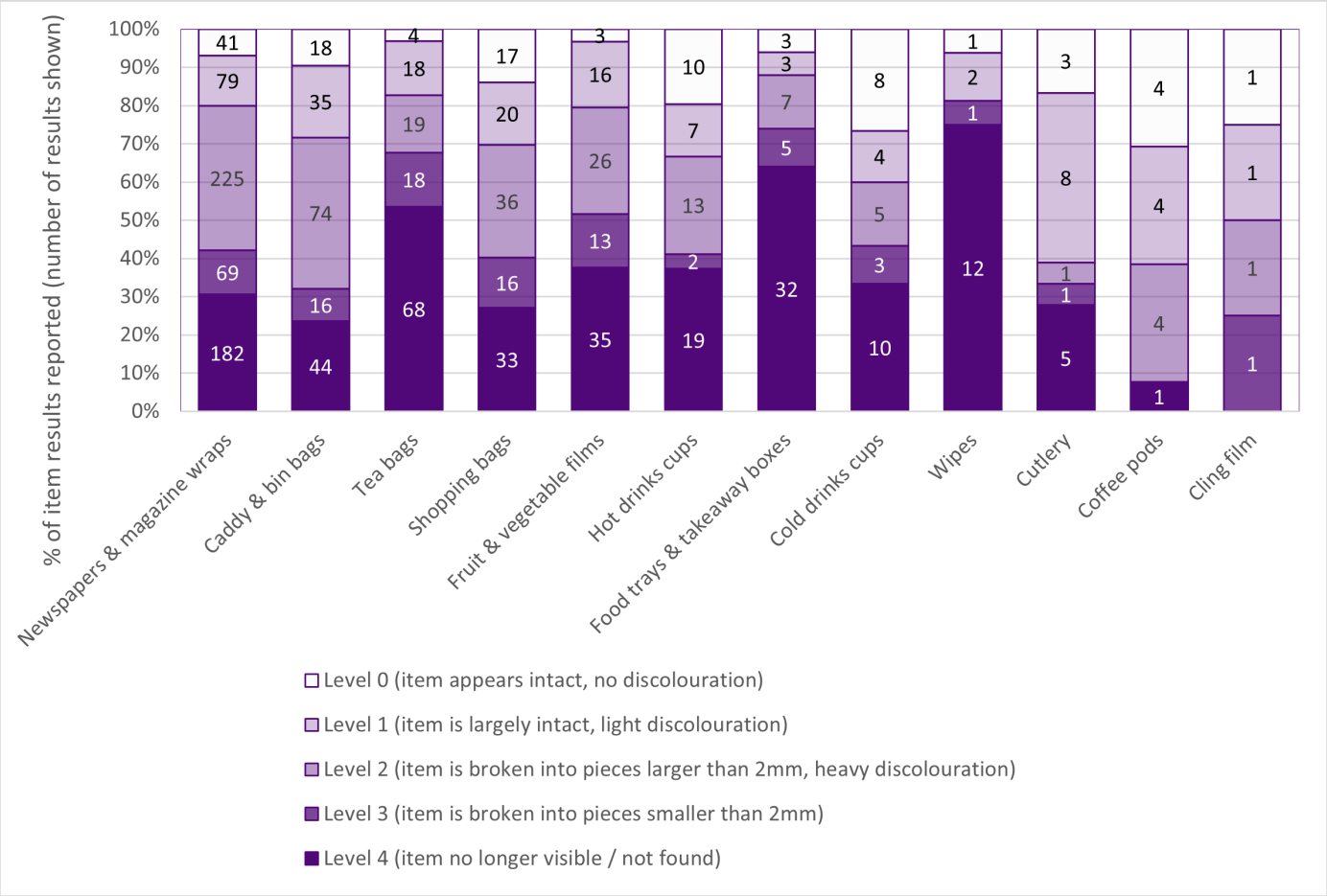

Figure 2: Home compost experiment item degradation level by certification

While labelling packaging as 'compostable' in some way might make it more appealing to consumers, current labelling practices do not seem to help people dispose of the packaging in an appropriate way.

If home composting is to be a viable route for disposal of compostable plastics, people must be able to correctly identify which items are suitable. For example, this might be through better labelling or some other means.

3. Unknown impacts on the environment and health

Four in five (83%) of our participants told us that they use their compost to enrich their soil and grow edible plants, fruit and vegetables. This is important as it indicates that the local ecology and food chain is affected by whatever substances are put into home compost.

There is growing concern around the issue of microplastics and their potential impact on both ecosystems and human health. Recent studies have found that microplastics can be taken up via roots into plants and have also been detected in human blood. Studies have also shown that microplastics have a negative effect on earthworm populations.[ii] If people are adding partially degraded plastic items from their compost to their soil, there is a question about how long microplastics might persist, how this might affect the local ecology and ultimately whether they might end up in home-grown produce destined for human consumption.

In addition, little is known about the environmental impact of the inks and glues used in compostable packaging items and it would be wise to assess this in order to understand the full environmental impact of home composting as a disposal route for plastics.

Which items should be compostable?

The environmental NGO WRAP has identified six applications where it might be appropriate to use compostable plastics.[iv]

1. Food waste caddy liners
2. Fruit and veg stickers
3. Tea bags
4. Coffee pods
5. Ready meal trays
6. Closed loop situations like at festivals or within buildings like coffee shops

A Plastic Planet (an organisation working to reduce the use of plastics) has also produced a more detailed 'red and green' list describing where it is (and isn't) appropriate to use compostable plastics.[v] The three criteria used to determine the list are:

1. Does the item carry food, beverage residues, plant waste or soil to composting or Anaerobic Digestion (AD) facilities?
2. Is the item too small, flimsy, flexible, multi-laminated and hard to recycle in any other waste stream?
3. When made of non-compostable plastic, does the product currently contaminate the biowaste stream?

The use of compostable plastics in other hard-to-recycle applications (such as nappies and personal hygiene products) is also being explored.

Policy context

Reducing plastic waste and pollution

Concerns about the environmental impacts of plastic waste have grown rapidly in recent years. In the UK this has led to a number of interventions to try to reduce the amount of plastic waste, including bans on certain single-use plastic items and the introduction of a plastic packaging tax.

Alongside elimination of unnecessary plastic packaging and increasing reuse and recycling of plastics, there has also been an increasing interest in the use of compostable plastics as part of the solution. This idea has been incorporated into strategic goals: The UK Plastics Pact (a voluntary initiative that brings together businesses, governments and NGOs) has agreed a set of targets for 2025, including:

1. 100% of plastics packaging to be reusable, recyclable or **compostable***;* and
2. 70% of plastics packaging effectively recycled or **composted**. (emphasis added)[vi]

In its 2018 Resources and waste strategy, the UK Government set out a strategic ambition to "work towards all plastic packaging placed on the market being recyclable, reusable or **compostable** by 2025". (emphasis added)[vii]

Home composting plastic packaging – standards and certification

There are some important differences between industrial composting and home composting. Industrial facilities control conditions (including temperature, moisture content and availability of oxygen among others) to optimize the process. In contrast, home composting typically takes place at lower temperatures and over a longer period of time. The conditions are also much more variable than in an industrial facility. As a result, much less is known about how compostable plastics behave in home composting conditions. This is reflected in the fact that in the UK the BS EN 13432 standard defines the criteria suitable for industrial composting that must be met for a material to be suitable for industrial composting, but the only standard for packaging in home composting conditions is the recently published BS EN 17427 'Packaging: Requirements and test scheme for carrier bags suitable for treatment in well-managed home composting installations'.

Some other countries have developed standards for home composting, including:

- UNI 11183 "Plastic materials biodegradable at room temperature – requirements and test methods" (Italy)
- AS 5810-2010 "Biodegradable plastics – Biodegradable plastics suitable for home composting" (Australia)
- NF T 51-800 "Plastics – specifications for plastics suitable for home composting" (France)

There are also some private certification schemes in operation:

- TUV OK Compost 'home' (Belgium)
- Din Certco 'home compostable' (Germany)

The seedling logo is a trademark owned by European Bioplastics, which proves that a product is certified to be industrially compostable.[viii]

The UK Government ran a consultation in 2019 on 'Standards for bio-based, biodegradable and compostable plastics'.[ix] In its response, the Government expressed a concern that 'there are currently few standard tests which accurately represent how or if plastics will biodegrade in real-world environments' and that 'there is a need to better understand rates of degradation in home composting scenarios and the environmental impacts and any health implications from using compost containing partially-composted plastics'. Finally, the response said the Government was 'minded to take forward the proposal for mandatory labelling of packaging' subject to further analysis and consultation.

Conclusion

Home composting is not at present a viable, effective or environmentally beneficial option for compostable packaging. In order for it to become viable, the following conditions need to be met:

1. Materials scientists need to design compostable plastics so that they degrade completely in home composting conditions and testing regimes need to be improved to better reflect home composting conditions.
2. Further testing must be done to understand the full environmental impacts of composting plastic packaging and returning compost to the land (such as the impacts of the inks and glues that are used and the risk of adding microplastics to the land).
3. People must be able to easily distinguish items that are suitable for home composting from those that require industrial composting or are not compostable at all (either through labelling or some other means).

About us

The authors of this briefing belong to the Plastic Waste Innovation Hub, a multidisciplinary group of academics including scientists, engineers, designers, artists and social scientists: Ayse Lisa Allison, Jenny Bird, Fabiana Lorencatto, Susan Michie, Mark Miodownik and Danielle Purkiss.

Further information about the Plastic Waste Innovation Hub is available at www.plasticwastehub.org.uk or email us on hello@plasticwastehub.org.uk

This briefing was developed with the Policy Impact Unit. Find out more at www.ucl.ac.uk/steapp/PIU or email us on: PolicyImpactUnit@ucl.ac.uk

References and further reading

i. European Bioplastics, Bioplastics market data, accessed Oct 2022

ii Purkiss, D., Allison, A.U., Lorencatto, F., Michie, S. and Miodownik, M., The Big Compost Experiment: using citizen science to assess the impact and effectiveness of biodegradable and compostable plastics in UK home composting. *Frontiers in Sustainability*, p.132.

iii Ding, W., Li, Z., Qi, R., Jones, D.L., Liu, Q., Liu, Q. and Yan, C., 2021. Effect thresholds for the earthworm Eisenia fetida: Toxicity comparison between conventional and biodegradable microplastics. *Science of The Total Environment*, *781*, p.146884;

Leslie, H.A., Van Velzen, M.J., Brandsma, S.H., Vethaak, A.D., Garcia-Vallejo, J.J. and Lamoree, M.H., 2022. Discovery and quantification of plastic particle pollution in human blood. *Environment international*, *163*, p.107199.

Azeem, I., Adeel, M., Ahmad, M.A., Shakoor, N., Jiangcuo, G.D., Azeem, K., Ishfaq, M., Shakoor, A., Ayaz, M., Xu, M. and Rui, Y., 2021. Uptake and accumulation of nano/microplastics in plants: a critical review. *Nanomaterials*, *11*(11), p.2935.

iv WRAP Compostable plastic packaging guidance, 6 February 2020

v A Plastic Planet, The Compostable Conundrum; Red and Green List, October 2021

vi WRAP, The UK Plastics Pact, accessed Oct 2022

vii Defra, Resources and waste strategy for England, 18 Dec 2018

viii TUV OK Compost 'Home' certification, accessed Oct 2022

Din Certco 'Home Compostable' certification, accessed Oct 2022

European Bioplastics 'Labels for bioplastics' accessed Oct 2022

ix Defra, Standards for biodegrdable, compostable and bio-based plastics: call for evidence, 8 April 2021