Alternatives to single-use plastics: Discussion and areas for further consideration

6.1 Strengths of the research

Systematic process guiding the literature review: Clear protocols were developed with the FSA and our academic advisor to guide the search for relevant literature in two databases (Appendix B). These were further adapted as appropriate based on feedback from the expert panel. The revised approach was validated by the FSA before proceeding with the search, to ensure agreement from each involved party. The two databases used for the search were Web of Science and SCOPUS, which have extensive, international records both from sciences and social sciences. We followed a systematic process for the literature review, guided by PRISMA style of reporting to monitor the number of records included/ excluded at each stage of the screening with clear reasons for exclusion as set out in the search and screening protocol (see methodology for details). Finally, we used the framework developed and recommended by Defra (footnote 1) to undertake critical assessment of the evidence by rating the quality of the articles in terms of robustness and relevance.

Coverage of research questions: The findings from the literature review showed that the search and screening process resulted in a high volume of articles, in particular related to research theme two on current adoption of single-use plastics in the UK food industry. These were also supplemented wherever possible with insights gained from our expert panel.

Expert panel membership: Uptake for expert panel membership was high in comparison to the number of experts invited. This meant that there was representation from experts across a variety of sectors (for example, academia, industry and policy) and a diverse range of views have been incorporated into this research.

Peer-review by FSA and academic advisor: All outputs from this project, from the development of the search protocols, draft and final reports and presentation slides, were peer-reviewed by our academic advisor, Dr Samuel Short, who is an Industrial Associate from the Institute of Manufacturing (IfM) at the University of Cambridge. All outputs have also been peer-reviewed by the FSA project team.

6.2 Limitations of the research

Research gaps in literature: There were relatively few results related to research theme three on forecasted trajectory of alternative packaging development and use or research theme four on adapting UK food regulation. Gaps were followed up through expert panel workshops and one-to-one consultation with the panel. Where literature was available to support these findings, it has been cited within the text.

Intellectual property: To fulfil opportunities within the market for alternatives to single-use plastics, innovation is required. However, to protect their organisation against competitors, it is likely that developers of new materials will be unwilling to release information on their innovations until intellectual property rights have been granted (for example, patents). As a result, it is unlikely

that all potential alternatives to single-use plastics could be captured by this research.

Publication time scales and availability of reports: Due to the fast pace of innovation within the industry, there is a gap between the pace at which innovations are introduced and the pace at which research relating to these innovations can be published. Also, much research and commercialisation are being done outside universities and so falls outside the academic journal knowledge base.

Tight timescales for the project: An additional barrier came from the fact that the project had tight timescales (as a rapid evidence review). As a result, some experts were unable to engage in the expert panel within the specified timeframes which meant that their views could not be incorporated.

6.3 Conclusions

Research question 1 - What are the emerging alternatives to single-use plastics in food production and packaging?

Two broad groups of alternatives were established: material/product alternatives (traditional materials, natural fibres, biopolymers synthesised from biomass, biopolymers synthesised from bioderived monomers, biopolymers produced by microorganisms) and, and system/process alternatives (reducing, reusing and recycling food packaging and, active and intelligent packaging).

Research question 2 - To what extent are the alternatives already in use within the UK?

There was insufficient data available to get a clear picture of the extent of usage in the UK. However, five case studies were selected purposively for this work, to capture a variety of different products that are currently in within the UK and Europe. These included: The London Marathon (seaweed), The University of Cambridge Library Services (traditional alternatives, biopolymers and PLA), Wagamama UK (recycled materials, cardboard and cPET), McDonald's Europe (traditional alternatives, fibre, edible packaging) and, Loop/ Tesco Trial (reusable packaging made from traditional alternatives such as glass and aluminium).

Alternatives brought a number of benefits in each case. However, companies typically encountered a number of trade-offs when introducing alternatives. For example, the majority of McDonalds products are consumed off-site meaning they are dependent on consumers and adequate infrastructure for their recyclable packaging to be of maximum benefit.

Research question 3 - What trajectory are the alternatives likely to take, over the next ten years, in terms of innovation, adoption, spread, and becoming established in the UK food industry?

Global production capacity of bioplastics is anticipated to increase from 2.1 million tonnes in 2019 to 6.3 million tonnes by 2027 (1% of current plastic packaging market, increasing to about 3% by 2027). This will largely be driven by growth in production of PLA and PHAs. Current and upcoming legislation in the UK and Europe will encourage a continued focus on the 3R's (reduce, reuse, recycle) and the circular economy.

Enablers for the growth of alternatives to single-use plastics include increased consumer awareness of environmental issues and, existing regulation and legislation. Barriers that may pose a challenge to the growth of this industry include established industry regimes, consumer practices, perceptions and awareness, high production cost of bio-plastics and a lack of available waste management guidance.

Research question 4 - Are there any changes required to UK food regulation in the context of the alternatives, and if so, what are the potential changes at the legislative, governance, training and enforcement levels?

The application of existing legislation to novel materials which serve as an alternative to single-use plastics is unclear. Clarity is needed with regards to the following factors for new materials: appropriate treatment and disposal of packaging, labelling standards and guidance on how to demonstrate safety of new materials.

Overall, fossil-based plastics are a very cheap, versatile material compared with the alternatives currently being developed and tested. Conventional plastics will probably remain the preferred choice for certain applications for the foreseeable future, while the alternatives are optimised and scaled into commercial products for application in real world industries. As such, there is a need for caution in driving the transition to more sustainable solutions.

Based on the reviewed evidence, a sustainable food packaging system is likely to involve multiple levers and a combination of different materials/products and processes, rather than a singular system solution (Kearney, 2023). This could include circularity in terms of harvesting waste and by-products from the food industry to form the raw materials for the production of alternative packaging, incentivising and innovating within the food supply chain to reduce, reuse and recycle plastics as well as alternatives, and improving the industrial composting of packaging mixed with domestic organic waste.

1. The Defra website provides more information on the production of quick scoping reviews and rapid evidence assessments, including critical assessment of evidence, Production of quick scoping reviews and rapid risk assessments (PDF)