

Sustainable food packaging: Reducing waste with technology.

Weixin Yan*

Department of Food Science, University of Massachusetts, Massachusetts, USA

Introduction

In an era where environmental concerns have taken center stage, the food industry is increasingly seeking sustainable solutions to reduce its ecological footprint. One significant aspect of this endeavor is the development of sustainable food packaging. Traditional packaging materials, such as plastics, have wreaked havoc on our environment, contributing to pollution and waste. However, advancements in technology are opening up new avenues for sustainable food packaging that can help us reduce waste and preserve our planet. The problem with conventional food packaging- Conventional food packaging has long been dominated by materials like plastic, aluminum, and glass. While these materials are durable and versatile, they come with significant environmental downsides. Plastic pollution: plastic packaging, particularly single-use plastics like bags and containers, has become a symbol of the world's plastic pollution crisis [1,2].

These materials are non-biodegradable and can persist in the environment for centuries, contaminating land and waterways. Resource intensive: the production of traditional packaging materials consumes vast amounts of natural resources, including petroleum for plastics and energy for manufacturing and transportation. Carbon footprint: the carbon footprint associated with the production and disposal of conventional packaging materials is substantial, contributing to climate change and environmental degradation. Limited recycling: despite efforts to increase recycling rates, many types of packaging materials are difficult to recycle, and contamination of recyclables remains a significant issue. Food waste: conventional packaging often fails to adequately protect food from spoilage, leading to substantial food waste, which has its own set of environmental consequences. In response to these challenges, the food industry is increasingly turning to technology to develop sustainable food packaging alternatives that address these issues and reduce waste. Technological innovations in sustainable food packaging- Biodegradable materials: one of the most promising advancements in sustainable food packaging is the development of biodegradable materials [3].

These materials break down naturally in the environment, reducing the long-term impact of packaging waste. Examples include biodegradable plastics made from plant-based sources like corn starch and cellulose-based materials. Edible packaging: edible packaging takes sustainability to a whole new level by creating packaging that can be consumed along

with the food it contains. Examples include edible films made from seaweed or rice paper, which can wrap items like sushi or sandwiches. Smart packaging: technology has enabled the development of "smart" packaging that can actively monitor and extend the shelf life of food products. These packages often incorporate sensors and indicators to detect changes in temperature or humidity and provide real-time information to consumers about the freshness of the product. Recycled materials: recycled materials, particularly post-consumer recycled plastics (RPET), are becoming increasingly popular in food packaging. By repurposing materials that would otherwise become waste, these packaging options reduce the demand for new resources. Nanotechnology: nanotechnology has opened up new possibilities for creating highly efficient and sustainable food packaging. Nanomaterials can be used to enhance the barrier properties of packaging, extending the shelf life of perishable foods without the need for excess packaging material. 3d printing: 3d printing allows for the creation of custom, intricate, and sustainable food packaging designs. It enables the use of minimal materials while still providing the necessary protection and functionality [4].

Impact on the environment and future prospects- The adoption of sustainable food packaging technologies has the potential to significantly reduce waste and its associated environmental impacts. Here's how: Reduced plastic pollution: biodegradable and edible packaging options drastically reduce the accumulation of non-biodegradable plastics in landfills and oceans. Resource conservation: sustainable packaging materials often require fewer natural resources to produce, lessening the strain on ecosystems. Lower carbon footprint: the use of recycled materials and lightweight packaging options helps reduce the carbon footprint of food packaging. Extended shelf life: smart packaging and nanotechnology extend the shelf life of food, reducing food waste, which is a major contributor to greenhouse gas emissions. Consumer awareness: sustainable packaging solutions often come with labels or indicators that inform consumers about the environmental benefits of their choices, raising awareness and encouraging eco-friendly behaviors. While the adoption of sustainable food packaging is growing, challenges remain. Some sustainable materials can be more expensive than traditional options, making them less accessible to smaller businesses. Additionally, consumer education and recycling infrastructure need to improve to ensure that these innovations achieve their full potential [5].

*Correspondence to: Weixin Yan, Department of Food Science, University of Massachusetts, Massachusetts, USA, E-mail: weixinyan@umass.edu

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