



Food packaging: Innovations and sustainable solutions

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Food packaging plays a critical role in preserving food quality, safety, and shelf life, but it also generates a significant amount of waste. As a result, there is an increasing demand for sustainable food packaging solutions that minimize environmental impact while also meeting consumer needs. Here are some of the innovative and sustainable food packaging solutions.

Biodegradable packaging materials, such as bioplastics made from plant-based materials like cornstarch or sugarcane, are becoming more popular due to their ability to break down into natural elements when disposed of properly. Edible packaging, made from materials such as starches, proteins, and fats, can be consumed along with the food it contains. This eliminates the need for separate packaging disposal and also reduces waste (Beske et al., 2014).

Reusable packaging, such as glass jars, metal containers, and cloth bags, can be washed and reused multiple times, reducing waste and conserving resources. Smart packaging incorporates technologies such as sensors, indicators, and RFID tags to monitor the condition of the food and provide real-time information to consumers about freshness, quality, and safety. Recyclable packaging, made from materials such as paper, cardboard, and certain types of plastic, can be collected and processed to create new products. This reduces waste and conserves resources. Minimalist packaging, which involves using only the necessary amount of packaging material to protect the product, reduces waste and minimizes the use of resources. Compostable packaging, made from materials such as bamboo, cornstarch, and sugarcane, can be composted along with food waste, turning into nutrient-rich soil (Laibach et al., 2019).

Packaging is an essential element of response to address key challenges of sustainable food consumption on the

international scene, which is clearly about minimizing the environmental footprint of packed food. An innovative sustainable packaging aims to address food waste and loss reduction by preserving food quality, as well as food safety issues by preventing food-borne diseases and food chemical contamination. Moreover, it must address the long-term crucial issue of environmentally persistent plastic waste accumulation as well as the saving of oil and food material resources. This paper reviews the major challenges that food packaging must tackle in the near future in order to enter the virtuous loop of circular bio-economy. Some solutions are proposed to address pressing international stakes in terms of food and plastic waste reduction and end-of-life issues of persistent materials (Jimenez Rincon et al., 2022).

Among potential solutions, production of microbial biodegradable polymers from agro-food waste residues seems a promising route to create an innovative, more resilient, and productive waste-based food packaging economy by decoupling the food packaging industry from fossil feed stocks and permitting nutrients to return to the soil. To respond to the lack of tools and approach to properly design and adapt food packaging to food needs, mathematical simulation, based on modeling of mass transfer and reactions into food/packaging systems are promising tools. The next generation of such modeling and tools should help the food packaging sector to validate usage benefit of new packaging solutions and chose, in a fair and transparent way, the best packaging solution to contribute to the overall decrease of food losses and persistent plastic accumulation (Lamarche et al., 2021).

Increased awareness of environmental sustainability has led to a call for actions by producers, scientists, and consumers towards current challenges in the agri-food

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sector. In particular, food packaging has been observed to be linked with plastic waste and food loss and therefore, the use of alternative packaging materials and extension of shelf life of food could be considered as potential measures. In this review, pre- and post-packaging strategies (novel technologies, modified atmosphere packaging, and preservative agents) and packaging materials (edible and non-edible coatings, and active and intelligent packaging) were reviewed and discussed for improving the shelf life of fresh meat and marine products in the context of environmental sustainability. Thus, novel solutions were considered for their application in the food packaging process. Although the majority of these technologies are novel and show promise in extending the shelf life, further research could facilitate their extensive implementation in the food industry. Overall, there are many innovative and sustainable solutions available for food packaging. Companies should consider the environmental impact of their packaging choices and strive to implement packaging solutions that reduce waste and conserve resources (Park & Lin, 2020).

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