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## ECO-DESIGN OF PACKAGING: A CHALLENGE FOR THE SUPPLY CHAIN OF FOOD

Sandra Domenek

Université Paris-Saclay, INRAE, AgroParisTech, UMR SayFood, 91120, Palaiseau, France.  
sandra.domenek@agroparistech.fr

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**Introduction.** Packaging is an active partner for the conservation and distribution of foods. Its main functions are transport, communication with the customer, protection of food against chemical, physical, and microbial contamination. The packaging system for a given products has different components which are i) primary packaging, *i.e.* the material directly in contact with the food, ii) secondary packaging, *e.g.* boxes containing several consumer units, and iii) tertiary or transport packaging, which includes larger transport boxes, pallets, cling films, containers, etc.

Plastics are the main material used in packaging and represent roughly one third of the mass of the packaging system. Faced with the plastic pollution of the environment, which is largely caused by single use plastics, improvements in the packaging system to decrease its environmental impact are necessary. Recent legislations in the EU aim directly at the decrease, and even interdiction, of single use plastics (SUP directive EU 2019/904). Because packaging is a facilitator of the supply chain, it has both, direct and indirect, environmental impacts. Direct impacts are caused by the fabrication and disposal of the materials in themselves, while indirect impacts are caused by food loss, inefficient logistics, design problems, etc. (1).

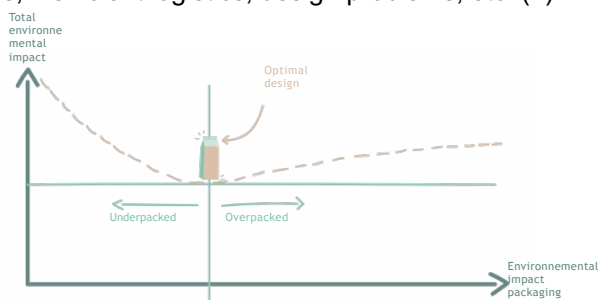


Fig. 1. Scheme of the environmental impact of a given service unit which is the packaging and the contained food

With this respect, an optimum has to be found taking into account the environmental impact of the packaging system and the impact of lost food (Fig. 1).

Furthermore, packaging materials need to be integrated in circular economy flows. In the case of food packaging, this could be achieved by increasing their circularity in the technosphere by recycling or by composting or anaerobic digestion together with food wastes in the biosphere (Fig.2).

**Results.** One of the main hurdles for recycling of plastics into high added value products, such as food packaging, is the presence of contaminants coming from the process or various sources in an open system (2,3). The unpredictability of contaminants is a huge challenge to risk evaluation by analytical chemistry and risk management.

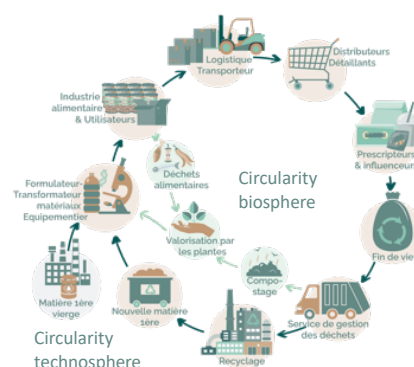


Fig. 2. Circular economy schemes for the food/packaging system

Examples are shown how non-targeted chemical analysis can be coupled to calculation-based risk evaluation methods (4). Circularity in the biosphere could be achieved using by-products of agriculture and forestry to product new biobased and biodegradable materials (5). Those materials need of course to comply with the safety and performance standards of food packaging. Different examples are discussed concerning the formulation of polylactides (PLA) in the aim to increase ductility and biodegradability using byproducts of the vegetable oil industry (5). The barrier properties of PLA towards oxygen are lower than petrochemical benchmarks. Active antioxidant packaging is one means to achieve performing materials and using under-exploited resources such as natural antioxidants (6). Recently, large improvements in oxygen barrier properties were achieved using nanocelluloses and innovative material architectures (7). Blended poly-hydroxyalkanoates potentially produced from agricultural byproducts could be shown to be suitable for the packaging of frozen foods (8).

**Conclusions.** To bring these promising research results into the market and increase circularity of the whole supply chain, a co-development with all members is necessary to increase acceptability and avoid shifting impacts from one place to the other. We are working now actively in generating these trade-offs with the members of the supply chain (project Chaire CoPack) (9).

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