

SISTERS

Systemic Innovations for a Sustainable reduction of the European food waste

The SISTERS project aims to reduce food loss and waste in the main stages of the Food Value Chain in Europe through innovations targeted to each stage of the chain:

New tools for **primary producers** for promoting direct and Short Chain sales; new technological innovations in packaging for **processors and retailers**; and awareness solutions for retailers and **consumers** on food loss and waste.



KEY OBJECTIVES

- ✓ Optimize **biobased packaging materials** for food applications
- ✓ Integrate **enzymes** to achieve **home-compostable** packaging based on **PLA**.
- ✓ **Scale up production** from pilot to industrial level
- ✓ **Demonstrate improved shelf life** and **ensure food safety**
- ✓ Assess the **economic feasibility** of the developed solutions

PACKAGING SOLUTIONS UNDER DEVELOPMENT

SISTERS is producing and testing various biobased biodegradable, home-compostable packaging materials under real conditions with different types of food. Innovative bioactive extracts from food waste are being added to prolong food shelf life.

We are also integrating **smart labelling technologies** to monitor freshness, reduce waste, and inform consumers.

DEVELOPED PACKAGING TYPES

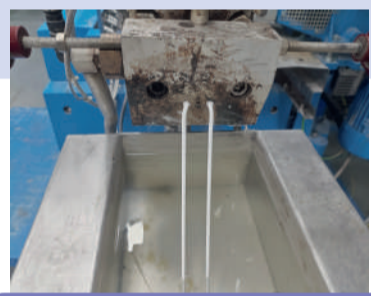
We have produced **four innovative packaging formats** using **three distinct production technologies**:

- ➔ **Stretch Film:** Produced by film blowing and cast extrusion
- ➔ **Flow Pack & Sealed Film:** Developed via film blowing and cast extrusion
- ➔ **Clamshells:** Created with cast extrusion and thermoforming
- ➔ **Rigid Packaging:** Manufactured using injection moulding

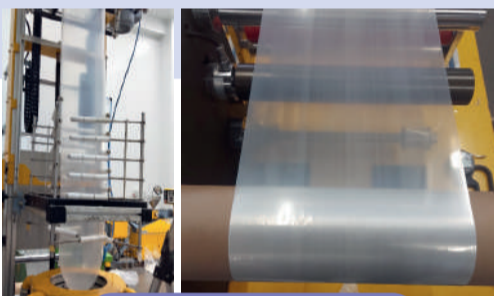
FROM PILOT TO INDUSTRIAL SCALE

Pilot Scale Production

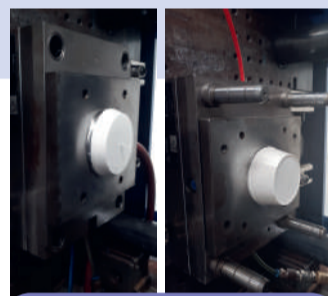
- ➔ 46 formulations tested (more than 400 Kg produced)
- ➔ Promising candidates pre-selected for industrial trials.



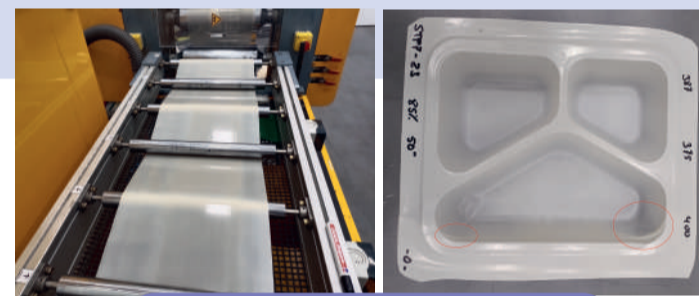
Extrusion compounding



Film blowing



Injection moulding



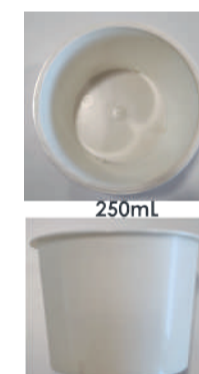
Thermoforming

Industrial Scale Production

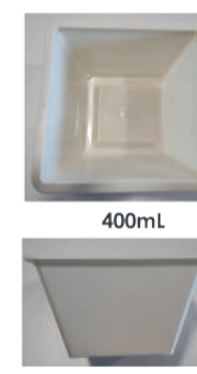
Semi-industrial and industrial validation of top-performing materials (6 formulations, 1600 Kg produced)



Industrial production



250ml



400ml



450ml



INDUSTRIAL VALIDATION



- ➔ Trays demonstrated excellent performance, and heat sealing tests successful for specific films.
- ➔ HOME biodegradability tests all samples above 90% within 1 year
- ➔ No ecotoxicity on final composted residues
- ➔ Compostability at HOME reached for samples below 565 mm

VERIFICATION OF THE COMPLIANCE OF DEMONSTRATORS WITH REGULATION (EU) 1935/2004 & (EU) 10/2011 AND COMPOSTABILITY

- ➔ SISTERS packaging showed comparable performance to standard PET packaging for raspberries and provided a more controlled microenvironment for sliced apples.
- ➔ Preliminary results indicated that while PLA packaging performed well initially, commercial packaging showed better conditions after 9 days in flow pack for peppers.
- ➔ Trays tested with performed better than cardboard with Broccoli (usability and microbiology)
- ➔ Arugula, Spinach and some lettuce mixes showed slight improvement or comparable behaviour in both quality and shelf life when packaged with SISTERS films. However, lamb's lettuce and iceberg lettuce performed worse exhibiting reduced shelf life and sensory quality. These results emphasize the importance of tailoring packaging solutions to specific product requirements and the mechanical robustness of the films.
- ➔ Regulatory compliance (Food contact) was verified for all the applications in contact with food considering all types of food: 60°C for 10 days

CONSUMER ACCEPTANCE TESTS

- ✓ All SISTERS packaging exceeded the acceptability threshold.
- ✓ SISTERS packaging performed equal or better in acceptability than conventional packaging in the case of bags, films and trays, but worse in the case of clamshell (lack of transparency).
- ✓ Opacity, satin finish, absence of odors, ease of opening, practicality, and elegance are key sensory and functional drivers of acceptability.

In general, sensory and functional properties do not represent a barrier to the adoption of bioplastic packaging.



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