



Fostering the Transition to Sustainable Food Systems:
Embracing Novelty and Overcoming Challenges

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ABSTRACT BOOK

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Smart Solar Cooking with a Box Oven: Modelling and Early Validation within the SUNRISE Project

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Aim:

The SUNRISE project (Smart Use of SuNlight Radiation for Innovative and Sustainable Cooking) is a three-year interdisciplinary initiative (2025–2027) that brings together food engineering, artificial intelligence, and renewable energy. It includes four key tasks: (1) assessing the effects of solar slow cooking on food quality, (2) modelling and simulating thermal behaviour, (3) designing AI-enhanced cookers, and (4) evaluating environmental and economic sustainability. The project addresses the need for energy-efficient, quality-preserving cooking technologies that support sustainable food systems.

This contribution presents early developments from Tasks 1 and 2, focusing on the thermal modelling of a solar box oven (SunTaste®, SunOK) and the quality evaluation of solar-cooked chickpeas (*Cicer arietinum L.*).

Method:

A dynamic thermal model was developed based on energy balances, incorporating convective, radiative, and conductive heat transfers. The simulator reflects the time-dependent variation of solar radiation and is being refined to predict temperature profiles inside the oven and estimate cooking durations. Experimental trials are being conducted with chickpeas under real sunlight conditions using the SunTaste® oven. Product quality is assessed in terms of texture, visual attributes, and sensory characteristics and compared with conventionally cooked samples.

Results:

Preliminary results show that the simulator effectively captures the dynamic solar input during the cooking process. Work is underway to improve its predictive capacity. Simultaneously, chickpeas cooked in the solar oven display promising sensory and physical qualities.

Conclusion:

These first results confirm the relevance of combining simulation and experimentation to understand and improve solar cooking systems. The SUNRISE project contributes to developing intelligent, low-energy cooking solutions that promote nutritious and environmentally responsible food preparation.