Innovative methods in breadmaking, packaging and distribution able to increase nutraceutical value, extend shelf-life and reduce waste of Bakery products

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State of Art

Bread is a key symbol of local communities due to its reliance on locally sourced ingredients. While consumers prefer artisanal bread, its shorter shelf life compared to industrial products poses a challenge (Chiavaro et al., 2008). To improve both shelf life and nutraceutical value, innovative solutions are required.
For instance, using pomace powder in bread enhances fiber, polyphenols, and antioxidants (Tolve et al., 2021) or seaweed (*U. lactuca*) has also shown promise in improving bread's nutritional profile (Mohan et al., 2023). Additionally, modified atmosphere packaging (MAP) and natural additives like lactic acid bacteria (LAB) in selected PDO Tuscan bread sourdough can effectively extend shelf life while maintaining quality (Iosca et al., 2023).

This research aims to extend bakery products' shelf life and improve their nutritional value using PDO sourdough, fortification with food by-products, and compostable Modified Atmosphere Packaging (MAP).

- **Sourdough fermentation** enhances shelf life by reducing pH, slowing staleness, and increasing nutrient bioavailability;
- **Antioxidant-rich ingredients** and hydrocolloids from food-by product help control moisture and preserve product quality;
- **Compostable MAP** will be tested using smart-devices to further prolong shelf life and reduce plastics

Objectives and Milestones

A1) ***Study and determination of rheological behaviour of biopolymer films for a new packaging system*** will help to establish the correct usage of these materials or optimize them based on the final product (A1.1). Additionally, shelf-life monitoring tests will be conducted using smart sensors (A1.2).

A2) ***Develop new bakery recipes using the selected Sourdough of Tuscan Bread PDO*** to evaluate its performance as a leavening agent, shelf-life promoter, and biopreservation-enhancer. Monitor and test the physicochemical characteristics of the new products made with the selected sourdough (A2.1).

A3) ***Scale up new process models to enhance shelf-life and distribution of sourdough bakery products.*** Acquire data on ingredient changes (A3.1) and conduct storage tests using MAP, biopolymer films, and smart sensors (A3.2).

A4) Writing ***and Editing*** of the PhD thesis, scientific papers and oral and/or poster communications.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
A1)	***Study and determination of rheological behaviour of Biopolymer films for new packaging system***																								
	1) Optimization of the processes																								
	2) Storage and shelf-life monitoring with smart sensors																								
A2)	***Develop new recipes of bakery products using the selected Sourdough of Tuscan Bread PDO***																								
	1) Test and monitoring physico-chemical characteristics of sourdough and new bakery goods																								
A3)	***Scaling-up of new processes models to increase the shelf-life and distribution of sourdough bakery products***																								
	1) Data acquisition of the effects of the changes made by ingredients																								
	2) Storage tests conducted using MAP, Biopolymers films, smart sensors																								
A4)	***Thesis and Paper Preparation***																								

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