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Innovative Approaches in The Development Of Novel Organic Food Products By Applying Careful Processing

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Background

The organic industry is growing rapidly, driven by increasing health and environmental awareness. Italy's market is particularly strong, with consumers favoring certified organic products. While primary organic production, such as fresh produce, has expanded, organic processing lags due to strict regulations and limited guidelines, posing challenges for small and medium-sized enterprises (SMEs). Research and support are needed to improve organic processing and short local supply chains. This project focuses on different case studies starting with organic wheat to create sourdough bread using spontaneous fermentation and sprouted seeds, aiming to enhance innovation in organic food processing. Recently, sourdough is used in 30% of European bread production due to its enhanced flavor, shelf life, and nutritional benefits, thanks to its unique mix of lactic acid bacteria and yeasts. Incorporating sprouted seeds like sorghum, chickpeas, and wheat boosts the bread's nutrient bioavailability, flavor, and health benefits by increasing bioactive compounds and reducing anti-nutritional factors (Minervini, et al. 2014).

Aim and objectives

The project aims to enhance the organic food sector by improving the quality of organic processed foods and adding value for processors and consumers. It seeks to develop sourdough from organic wheat flour as a starter for baked goods and create an oven-dried starter that retains microbial viability. The project provides feasible processing technique for small and medium-scale farmers and processors. Additionally, it focuses on creating novel organic sourdough bread with germinated seeds and evaluating sensory qualities of the developed products.

Materials and methods

The experimental plan is shown in Figure 1 and Figure 2. Two types of sourdoughs were prepared to understand the difference between the use of grape water and tap water, the influence on the microbial dynamics and the overall performance of sourdoughs. Both prepared motherdoughs were subjected to spontaneous fermentation and backslopped for at least 10 days. Then parts of both sourdoughs were used directly in bread making and the other were subjected to a drying process before use in bread.

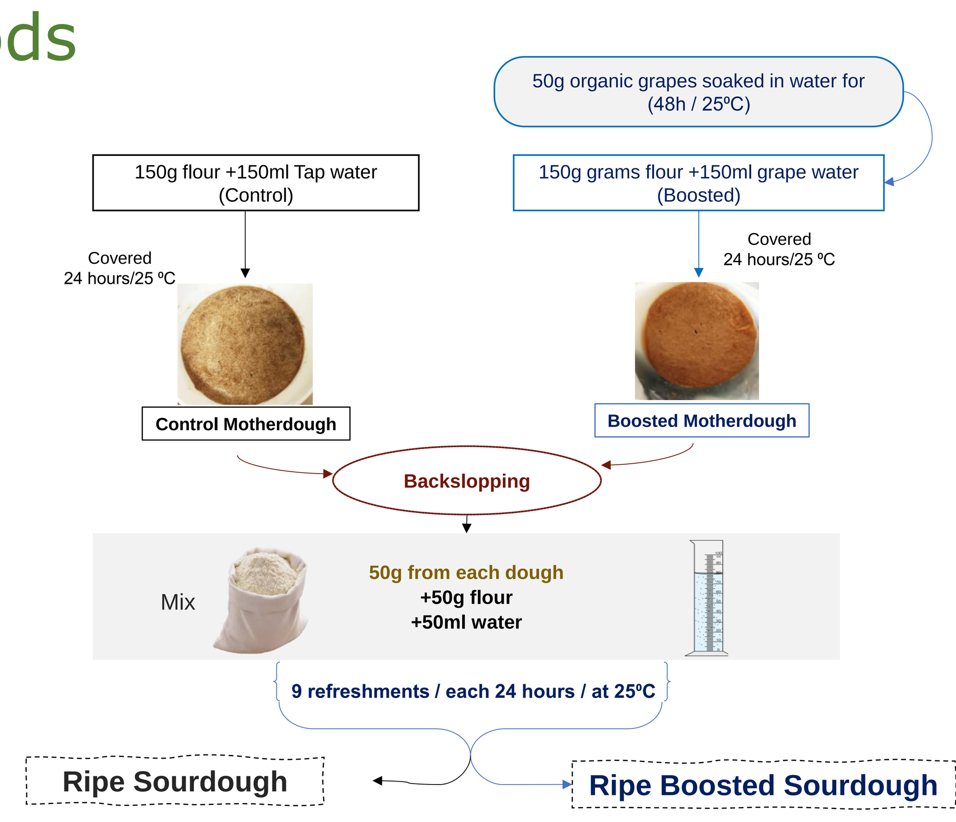


Figure 1. Steps of sourdough preparation

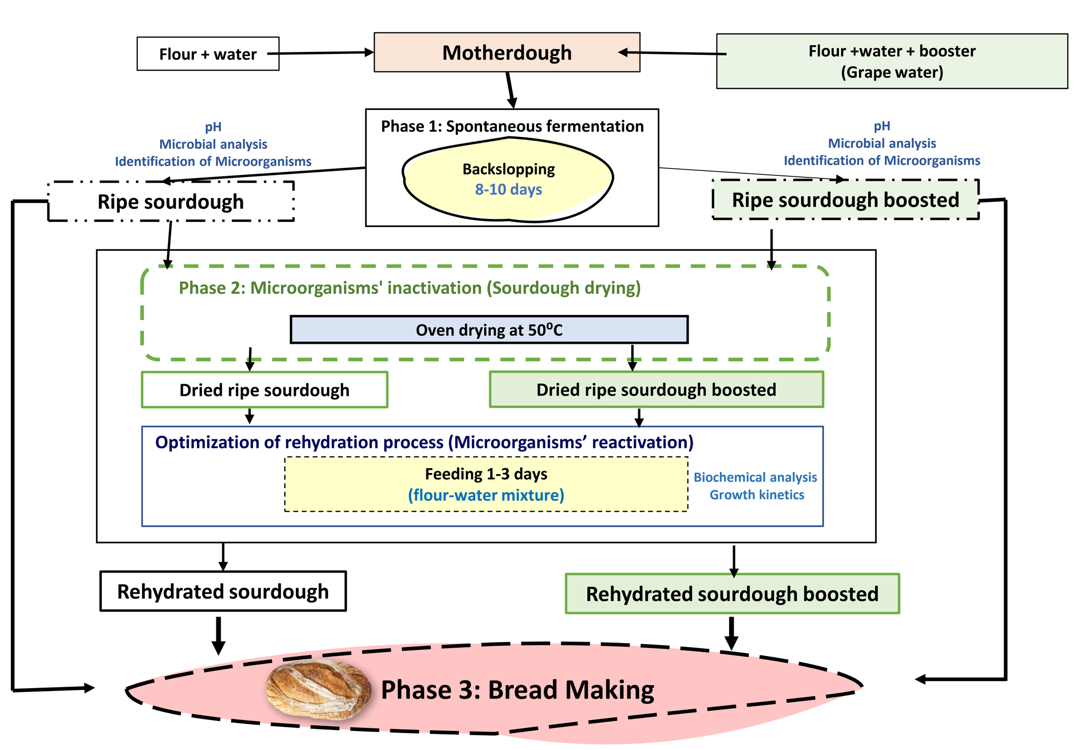


Figure 2. Experimental protocol for sourdough and bread making

The analysis of sourdough, both fresh and dried, involves pH, microbial analyses. For sourdough bread incorporating germinated seeds, microbiological analysis and descriptive sensorial analysis are conducted to assess both the microbial profile and sensory attributes. For dried sourdough bread, image analysis is used to assess texture and structure, while specific volume measurements provide insights into the bread's aeration. As well as triangle test for measuring the technological sensory performance on bread with dried sourdough.

Conclusion

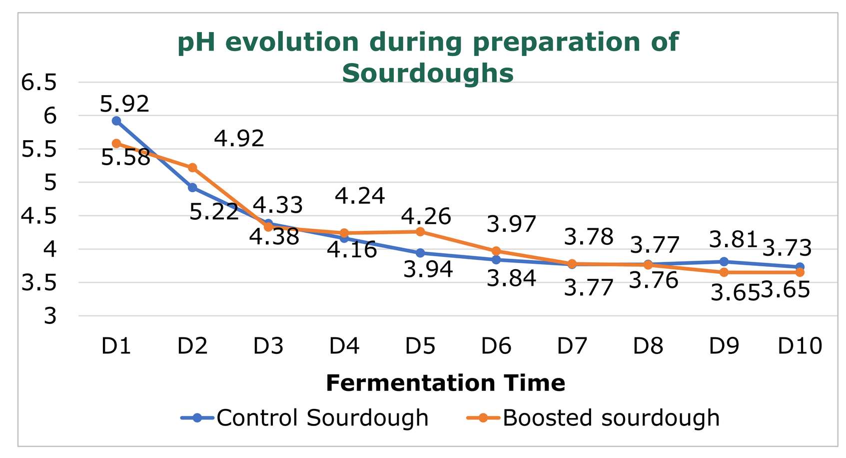
This case study focused on enhancing organic sourdough bread and underscores the value of collaboration between enterprises and researchers. The addition of germinated seeds introduced unique attributes to the bread, suggesting potential for exploring various seeds. Grape water did not influence the fermentation but may impact microbial activity after rehydrating dried sourdough. Drying and rehydrating sourdough did not alter the bread's technological performance, though optimizing the microbial rehydration process remains crucial. The findings have implications for small to medium-scale producers and offer opportunities for market commercialization.

References

Minervini, F., De Angelis, M., Di Cagno, R., and Gobbetti, M. (2014). Ecological parameters influencing microbial diversity and stability of traditional sourdough. International Journal Of Food Microbiology, 171: 136-146

Results

1.Acidification in sourdoughs



The pH of sourdough started to decrease from the first day of fermentation and this trend continued for 10 days. At the end of day 3, both sourdoughs were characterized by pH values lower than **4.5**, which is a threshold that avoid growth of undesired bacteria, such as Enterobacteriaceae (De Angelis et al. 2019).

2.Microbiological analysis (expressed in log_{10} cfu/g) of sourdoughs during the feeding process of 10 days.

Both sourdoughs approximately maintained the same high counts of mesophilic coccus-shaped and rod-shaped LAB. The inclusion of grape water had a limited influence on promoting fermentation conditions, suggesting the possibility of its elimination or multiple use during backslopping to achieve a substantial effect.

Feeding	SD Type	Yeasts	Mesophilic coccus-shaped LAB	Mesophilic rod-shaped LAB
1	CSD	<1.0a	5.92±0.15a	4.61±0.03a
	BSD	<1.0a	6.17±0.22b	4.82±0.01b
3	CSD	2.37±0.09c	7.88±0.15d	6.74±0.04c
	BSD	2.16±0.11b	7.64±0.02c	6.91±0.06d
7	CSD	5.73±0.18e	9.67±0.15ef	9.22±0.04e
	BSD	5.32±0.03d	9.57±0.08e	9.39±0.07ef
10	CSD	6.51±0.12g	9.79±0.06f	9.48±0.02f
	BSD	6.06±0.04f	9.63±0.02ef	9.51±0.09fg

Data are shown as the average value obtained from 3 replicates ±standard deviation. Values with different letters within the column are significantly different (P<0.05) Tukey's test for one-way ANOVA.

3.pH and microbiological analysis (expressed in log_{10} cfu/g) of dried sourdoughs during revitalization process.

Feeding	SD Type	pH	Yeasts	Mesophilic coccus-shaped LAB	Mesophilic rod-shaped LAB
0	CSD	4.1±0.1[cd]	<1.0[a]	3.88±0.09[a]	3.91±0.06[a]
	BSD	4.0±0.1[c]	<1.0[a]	4.41±0.09[b]	5.42±0.08[b]
1	CSD	5.1±0.1[d]	5.71±0.09[cd]	8.04±0.04[c]	8.57±0.09[c]
	BSD	5.2±0.1[de]	5.42±0.1[b]	9.08±0.04[d]	8.90±0.05[e]
2	CSD	4.0±0.1[c]	5.92±0.06[e]	9.38±0.03[e]	8.73±0.03[d]
	BSD	3.9±0.1[b]	5.69±0.09[c]	10.12±0.15[g]	9.26±0.02[f]
3	CSD	3.6±0.1[a]	6.49±0.12[g]	9.68±0.06[f]	9.21±0.07[f]
	BSD	3.6±0.1[a]	6.04±0.04[f]	10.37±0.17[h]	9.55±0.08[g]
4	CSD	3.7±0.1[ab]	6.65±0.05[h]	9.65±0.06[f]	9.22±0.06[f]
	BSD	3.6±0.1[a]	6.43±0.13[g]	10.32±0.13[h]	9.52±0.07[g]

-The pH evolution reflects the active sourdough fermentation process influenced by microbial metabolic activities for 3 days.
-Microbial and yeast counts of BSD are higher than of CSD.

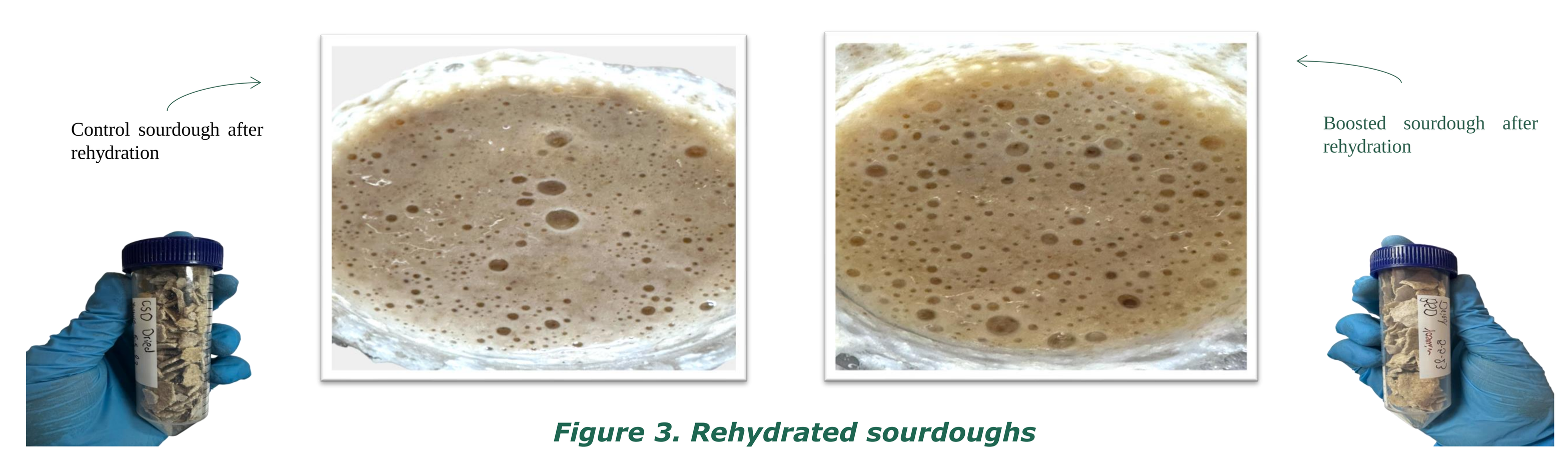


Figure 3. Rehydrated sourdoughs

Seeds	Germination %
Lentils	91%
Triticum aestivum L.	89%
Chickpeas	86%
Triticum monococcum	17%
Barley	10%

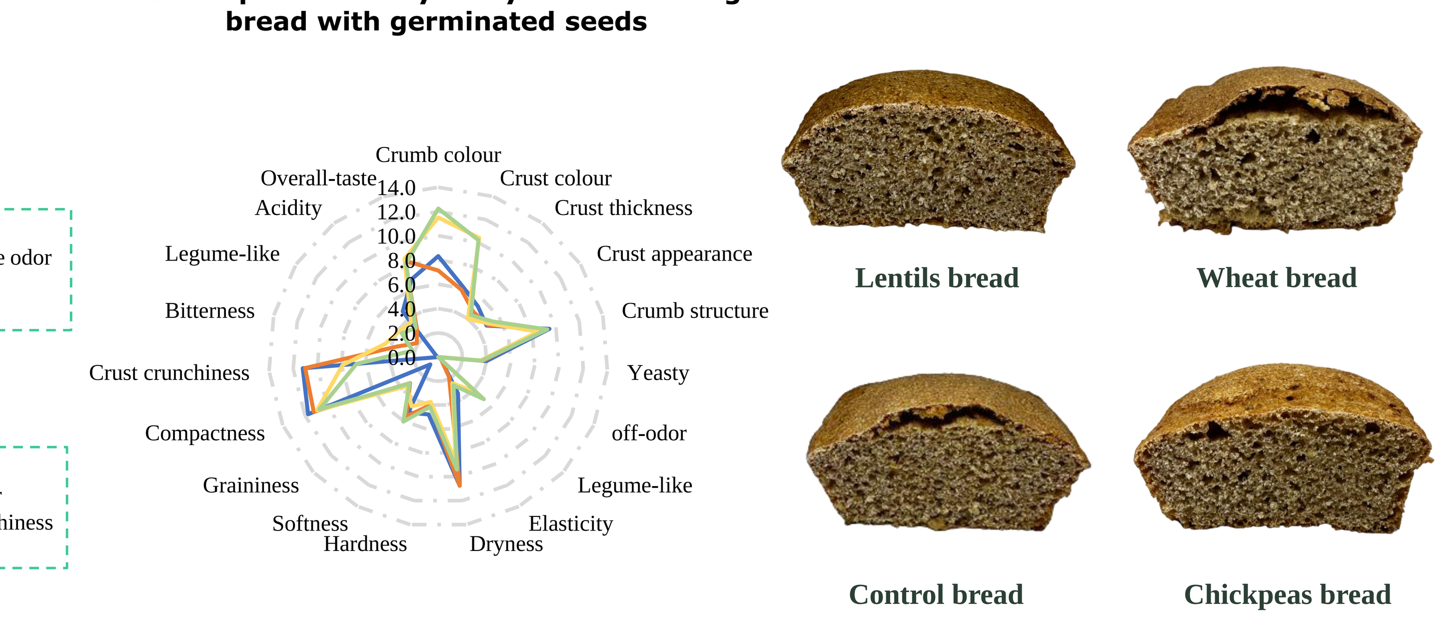
Figure 4. Germination percentage of seeds after 24 hrs at 25℃

4. Descriptive sensory analysis of sourdough bread with germinated seeds

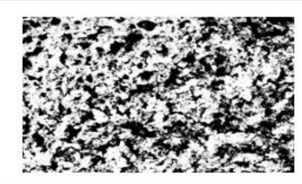
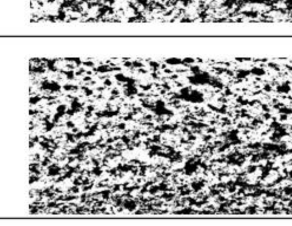
Lentil bread
-Higher bitterness

Chickpeas bread
-Higher legume-like odor
-High softness
-High overall taste

Wheat bread
-Higher yeasty odor
-Higher crust crunchiness
-High overall taste



5. Specific volume, black pixel percentage and image analysis of bread with fresh sourdough (FSD) and revitalized sourdough (DSD)

Bread types	Specific volume (cm3 g)	Black pixel percentage	Image analysis	
FSD	1.81±0.22[a]	63.06%[a]		
DSD	1.79±0.21[a]	63.79%[a]		

-The drying and revitalization of sourdough did not notably impact the visual characteristics of the bread, and both types maintain a similar appearance and specific volume.

Out of the ten panelists, one panelist (10%) correctly identified the different sample (Sample C) in the triangle test, while the remaining panelists did not discriminate between the samples.