Ingredients with high nutraceutical value obtained by food by-products and environmental friendly packaging systems to increase the shelf life and reduce the waste of bakery products

Giulio Scappaticci (giulio.scappaticci@phd.unipi.it)
Dept. Food Science and Technology, University of Pisa, Italy
Tutor: Prof. Angela Zinnai; Dr. Corrado Ferrari – Opponent: Dr. Fabrizio Palla

INTRODUCTION

The shelf life of bakery goods refers to the period during which a product remains safe and suitable for consumption under recommended storage conditions (Tebben et al., 2018). In order to extend shelf life, techniques like natural preservatives, modified atmosphere packaging, and temperature control are employed. Strategies such as adding carbohydrates and hydrocolloids, using organic acids, and incorporating functional ingredients can enhance shelf life while improving nutritional profiles. These approaches also offer opportunities to utilize byproducts from other food chains for sustainability.

Bakery products are essential for daily nutrition, but they are characterized by a high perishable nature, linked to the staling process and the water migration, which depends on many factors and needs widely research activities to be understood (Fadda et al., 2014¸ O'Connor et al., 2018). According to the bakery industries, a priority is the extension of baked products shelf-life, in order to reduce food waste. This project involves the study of innovative bread formulation and storage, aiming to increase the baked goods shelf-life.

Figure 1. Products test trials

RESULTS

1. Strategic incorporation of pectin and red marcs as functional ingredients

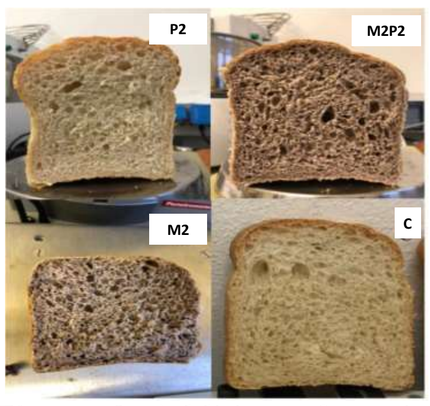


Figure 2. Addition of pectins and marcs

	C	P2	M2	M2P2
L*	64.265 ^{b}	69.28 ^{a}	41.31 ^{d}	49.635 ^{c}
a*	−1.065 ^{b}	−1.23 ^{c}	3.97 ^{a}	3.73 ^{a}
b*	13.465 ^{a}	13.665 ^{a}	7.13 ^{b}	7.79 ^{b}

Sample	a_w crumb	Penetrometric index (mm)
C	0.937 ± 0.017 ^{a}	9.77 ± 0.71 ^{a}
P2	0.916 ± 0.001 ^{bc}	9.49 ± 0.44 ^{a}
M2	0.929 ± 0.005 ^{a}	8.7 ± 0.19 ^{b}
M2P2	0.926 ± 0.002 ^{ab}	8.81 ± 0.10 ^{b}

Sample	pH	TTA (meq/g)
C	5.84 ± 0.02 ^{a}	0.0035 ± 0.0004 ^{c}
P2	5.28 ± 0.03 ^{c}	0.0065 ± 0.000 ^{b}
M2	5.34 ± 0.02 ^{bc}	0.0061 ± 0.0002 ^{b}
M2P2	4.88 ± 0.02 ^{d}	0.0131 ± 0.0002 ^{a}

The results underscore the positive impact of pectin on a_w which represent important attributes in bread shelf-life. Indeed, the addition of pectin has demonstrated the enhancement of the macromolecular aggregation of gluten and, thus, of the rheological properties of the bakery product by inducing a dense network of gluten. Furthermore reveals a synergistic effect when combining pectin and red grape pomace, particularly evident in pH levels. Finally, the formulation of bread with the addition of both pectin and red marcs leads to the best outcomes, as they allow to obtain a product with positive technological aspects if compared to the control.

2. Water distribution in bread crust with different baking tray

From the figure. 3 is possible to observe the difference on crust formation between two different type of tray, STD vs PERFORATED. Notable could be the difference in respect the water distribution on crust surface.

Using the perforated tray we can obtain a better crust with lower content of water and omogenius distribuited. A better crust help us to protect the products from the microbial contamination and of course exending the shelf-life of the bread.

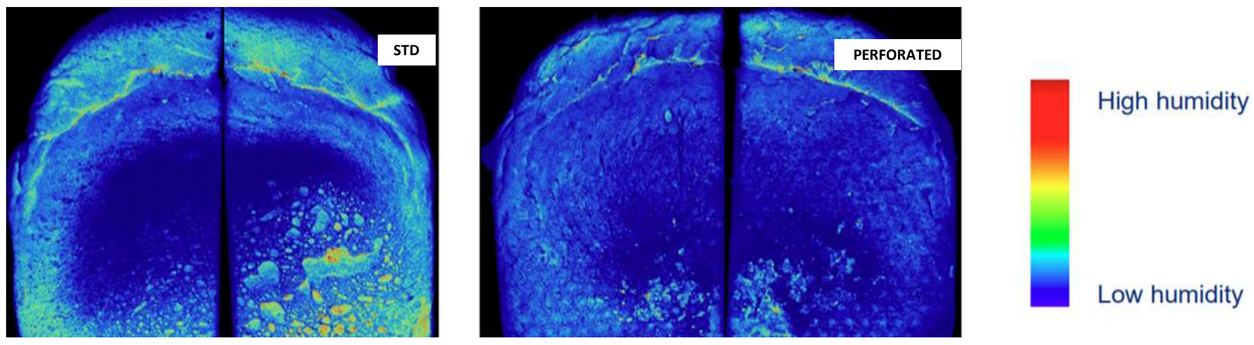


Figure 3. Spectral image analysis of bread crust

3. IR treatment of bread

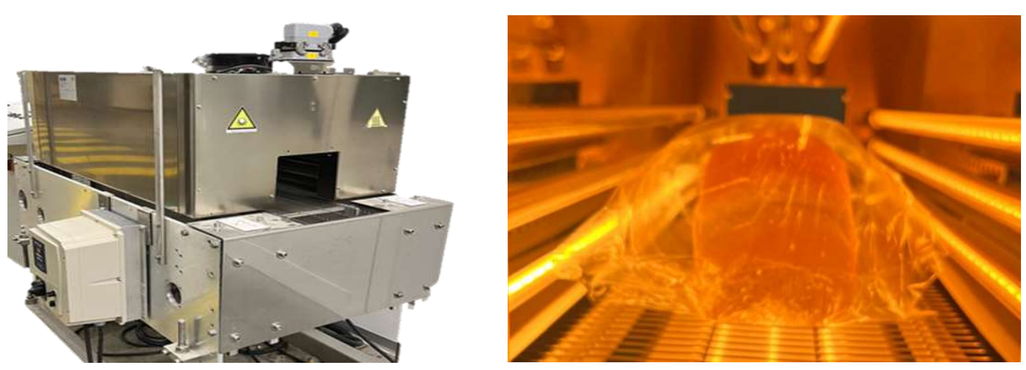
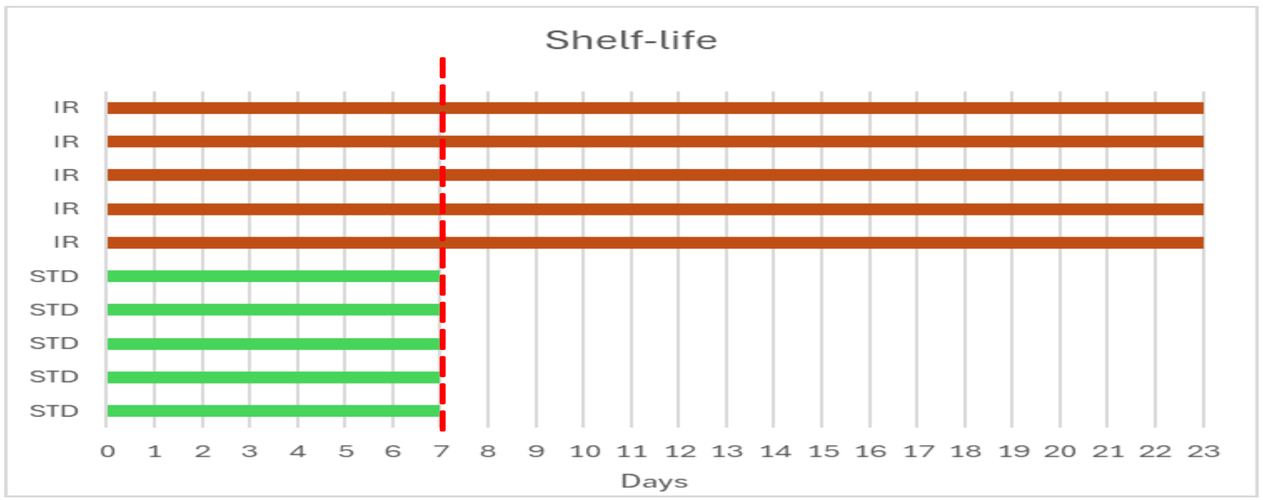


Figure 4. IR Treatment of bread (λ = 1500 nm)



REFERENCES

- Tebben, L., Shen, Y., & Li, Y. (2018). Improvers and functional ingredients in whole wheat bread: A review of their effects on dough properties and bread quality. Trends in Food Science & Technology, 81, 10-24.
- Fadda, C., Sanguinetti, A. M., Del Caro, A., Collar, C., & Piga, A. (2014). Bread staling: Updating the view. Comprehensive Reviews in Food Science and Food Safety, 13(4), 473-492.
- O'Connor, L. J., Favreau-Farhadi, N., & Barrett, A. H. (2018). Use of edible barriers in intermediate moisture food systems to inhibit moisture migration. Journal of Food Processing and Preservation, 42(2), e13512.

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