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Effect of fermentation time and temperature on the sensory and nutritional properties of French bread.

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► **To cite this version:**

Romane Troadec, Céline Niquet-Léridon, Philippe Jacolot, Sofia Nestora, Stéphanie Regnault, et al.. Effect of fermentation time and temperature on the sensory and nutritional properties of French bread.. EFoST, Nov 2022, Dublin (Irlande), Ireland. hal-04261338

HAL Id: hal-04261338

<https://hal.science/hal-04261338>

Submitted on 26 Jan 2024

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INTRODUCTION

Consumption of bread in France:

45 kg of bread / year / person – Main source of carbohydrates in the daily diet (FEB, 2021). **Yeast bread (YB)** and **sourdough bread (SB)** mainly consumed.

Different fermentation conditions (times and temperatures) used in food industry or bakeries. Influence on:

- Fermentation aromas in the crumb : sensory properties.
- The Maillard reaction (MR) in the crust : formation of aromas (**volatile compounds**), crust color (**melanoidins**) & compounds having health effects (**melanoidins & acrylamide**)

Among MRPs in the crust, focus on :

- **Strecker aldehydes** : Volatile compounds generated by the Strecker degradation : positive sensory impact on the crust.
- **Melanoidins** formed at the last stages of MR: suggested to have health benefits (anti-inflammatory and anti-oxidant effects) (Helou et al., 2018, Jouquand et al., 2018)
- **Acrylamide** : deleterious product of MR for human health (EFSA, 2015)



AIM

Evaluate the importance of the duration and temperature of the fermentation process involved in the making of French bread process on the formation of aromas and Maillard reaction products (MRPs), playing a role in the sensory and nutritional properties of breads.



MATERIALS AND METHODS

- ❖ **YB** or **SB** making processes : Long fermentation = 26.5h at 23°C and 8°C (**artisanal** model) & Short fermentation = 5.5h at 23°C (**industrial** model).

Analyses:

- ❖ **Volatile compounds** : by GC-MS.
- ❖ Water-soluble **melanoidins** : by HPLC + fluorescence detector.
- ❖ **Acrylamide** assay: by LC-MS/MS
- ❖ Descriptive sensory analysis: by a panel of ten trained panelists.



RESULTS

1/ Impact on the sensory properties

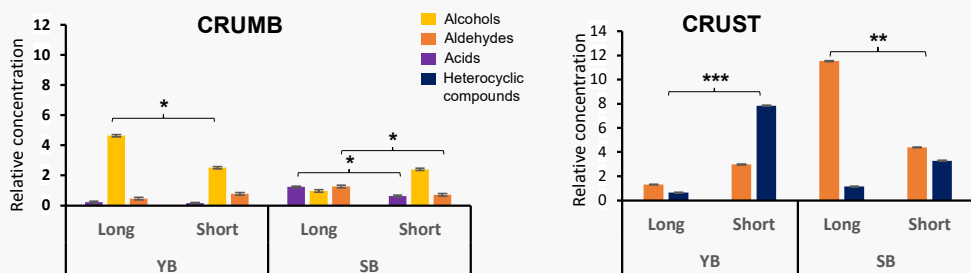


Figure 1: Volatile compounds in the crumb (fermentation aromas) and the crust (Maillard reaction product (MRPs)).

In the crumb:

YB: Long fermentation ↗ alcohols.

SB: Long fermentation ↗ acids & aldehydes (lipid oxidation).

In the crust:

YB: Short fermentation ↗ heterocyclic compounds & Strecker aldehydes.

SB: Long fermentation ↗ Strecker aldehydes.



Sensory analysis :

SB : perception of acidity & aromatic intensity long > short
YB : no difference perceived.

Opposite results for YB and SB : variation of availability of MR precursors (sugars & proteins) according to the bread studied. Confirmed by the panel for SB.

2/ Impact on nutritional properties

Table 1: Acrylamide content in bread crusts.

	Type of bread	Bread crust	
		After short fermentation	After long fermentation
Acrylamide (mg/g of dry matter)	YB	24.6 ± 6.1 a	21.1 ± 4.6 a
	SB	32.7 ± 7.4 a	19.5 ± 4.2 b

In YB & SB:

Long fermentation ↘ **acrylamide**:

less precursor available (asparagine) in the dough.

Long fermentation ↘ **melanoidins** :

less protein available for their formation.

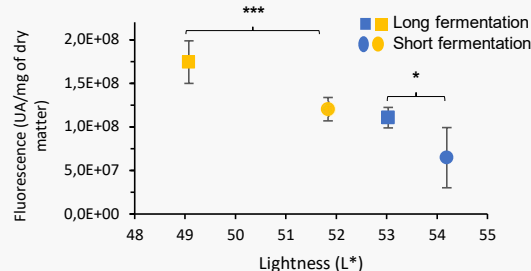


Figure 2: Melanoidins in the crust of YB (yellow) and SB (blue).



CONCLUSIONS

Significant change of the sensory and nutritional properties of breads by both the types of fermentation.

In SB, some MRPs associated with the typical and pleasant bread note more concentrated with long fermentation and perceived by the panel.

In YB, fermentation conditions with less impact on the sensory properties of the bread, and no difference noted by the panelists.

In both breads, Long fermentation => positive impact on the nutritional properties of the breads by reducing the acrylamide content (crust)