Less common grains in bakery industry: product and process

optimization

Alessio Sergiacomo (alessio.sergiacomo@unimi.it)

Department of Food, Environmental and Nutritional Sciences

(DeFENS) Università degli Studi di Milano, Milan, Italy

Tutor: Prof. Alessandra Marti

This paper describes the main research activities conducted in the first 18 months. The aim of the project is to set-up technological and bio-technological processes to enhance the enrichment of baked goods with minor cereals, pseudocereals and/or legumes. Specifically, the main results of the sprouting process applied to oats are here presented. Initially, a literature research was conducted to highlight the knowledge gaps on sprouted oats and to establish the process conditions to be used on a laboratory scale. After that, the effects of sprouting time were studied by assessing the rheological properties of wheat-dough enriched in sprouted oats.

Impiego di cereali minori, pseudocereali e legumi nell’industria dei prodotti da forno: ottimizzazione di prodotto e di processo

Questo lavoro descrive le attività condotte nei primi 18 mesi di dottorato. L’obiettivo del progetto è la messa a punto di processi tecnologici e bio-tecnologici per migliorare i prodotti da forno arricchiti in cereali minori, pseudocereali e/o legumi. Nello specifico vengono qui presentati i principali risultati del processo di germinazione applicato all’avena. È stata dapprima condotta una ricerca bibliografica per evidenziare aspetti ancora poco conosciuti riguardanti l’avena germinata e stabilire le condizioni di processo da utilizzare su scala di laboratorio. Successivamente, sono state valutate le proprietà reologiche di impasti di frumento arricchiti in avena germinata per tempi differenti.

**Key words**: oats, sprouting time, dough properties.

# **1. Introduction**

This report presents the main results of the 18 months of my PhD project. In accordance with the previously described project for the PhD thesis (Sergiacomo, 2022), this poster reports the main results of the first three activities concerning: (A1) Literature review, (A2) Set up of the process conditions and (A3) Effect of the sprouting on the functionality of blends.

# **2. Materials and Methods**

The literature research was conducted by consulting Web of Science and PubMed electronic databases. The keywords used in the research were as follows: (sprout\* OR germinat\*) AND (oat) NOT (pre-harvest OR preharvest). After removing the duplicates and excluding the irrelevant records, 26 articles were selected. Commercial dehulled oats kernels were sprouted in a climatic chamber (Memmert, Schwabach, Germany) at 22°C and 90% relative humidity. Seeds were soaked in water (kernels:water ratio of 1:2) for 8 h, sprouted for 48 and 72 h and then dried at 50 °C until moisture content decreased below 14%. Unsprouted oats was used as control. All the samples were grinded to a particle size of less than250microns. Pasting properties of unsprouted and sprouted oats were assessed as reported by Suárez-Estrella et al. (2020). Samples were mixed with a commercial wheat flour at 10, 20 and 30% replacement levels. Dough mixing properties were performed by means of the Farinograph-E (Brabender GmbH & Co. KG, Duisburg, Germany) with a 50 g kneading bowl, following the ICC 115/1 Approved Method (ICC, 1992). Three-dimensional extension properties were evaluated with the Alveograph (Chopin, Villeneuve La Garenne, France) following the method AACC 54-30.01 (AACC, 2001).

One-way analysis of variance (ANOVA) followed by Tukey-HSD test (p < 0.05) was carried out using Statgraphics Plus 5.1 (StatPoint Inc., Warrenton, USA).

# **3. Results and Discussion**

The literature review (A1) highlighted that most of the studies: (1) investigated the changes in macro and micronutrients during sprouting for 72-96 h; (2) did not investigated the changes occurring at earlier stages of the process and the potential use of oats as ingredient in baked goods. Thus, oats were sprouted for 48 h and 72 h (A2).

Sprouting decreased the pasting properties of oats, as a function of sprouting time (Figure 1). Specifically, the pasting temperature significantly increased upon sprouting (from 61.8±1.2 °C for unsprouted to 85.5±0.1 and 86.3±0 °C after 48 h and 72 h respectively). Moreover, sprouting decreased the hot viscosity suggesting a limited swelling and gelatinization capacity due to the starch hydrolysis by the amylases developed during sprouting. The decrease in setback values (from 437±7.1 BU for unsprouted oats to 201±1.4 and 149.5±0.1 BU after 48 h and 72 h respectively) upon sprouting suggested a lower ability of starch granules to reorganize during cooling and a lower tendency to retrograde.

### **Figure 1** *Pasting profile of unsprouted oats (black line), sprouted oats for 48 h (dark grey line) and 72 h (light grey line). Dotted line refers to temperature profile used during the test. BU: Brabender Units.*

As regards the dough rheological properties, by necessity of synthesis only the results related to 20% substitution level will be presented in figures and table.

****

As expected, replacing wheat with unsprouted oats increased the water absorption (+1-2% as the replacement level increased) and decreased both dough development time (by about 4.5 min) and stability (by about 14 min), likely due to both gluten dilution and protein-fiber interference (Figure 2). To obtain an optimal dough using sprouted oats, a decrease in the amount of water (by 3-4% according to the sprouting time) and mixing time (by 1-4 min based on sprouting time and enrichment level) should be considered.

### **Figure 2** *Mixing properties of wheat alone (black dotted line) and with 20% of unsprouted oats (black line), sprouted oats for 48 h (dark grey line) and sprouted oats for 72 h (light grey line).*

Regarding the dough extensional properties, the addition of oats decreased the dough tenacity (Table 1). The greatest effect was observed when sprouted oats were used; however, neither sprouting time nor enrichment level did affect any further dough tenacity. Considering dough strength, both sprouting time and enrichment level had an effect in dough weakening. Finally, sprouting did not affect the extensibility of oat-enriched dough, whereas the enrichment level did. Overall, sprouting (at 20% substitution level) helped keeping a P/L ratio similar to that of wheat dough.

***Table 1*** *Extensional properties of wheat alone (WF) and with 20% of unsprouted oats (WF+USO), sprouted oats 48 h (WF+SO48) and sprouted oats 72 h (WF+SO72). Means followed by different letters in the same column are significantly different, according to the Tukey-HSD (p<0.05)*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Tenacity** | **Extensibility** |  | **Strength**  |
|  | **P**(mmH2O) | **L**(mm) | **P/L** | **W**(\*10-4J) |
| WF | 69c±3 | 115b±14 | 0.61a±0.1 | 295c±26 |
| WF+USO  | 66c±2 | 76a±4 | 0.86b±0.03 | 122b±8 |
| WF+SO48  | 43b±3 | 66a±9 | 0.66a±0.1 | 63a±9 |
| WF+SO72 | 31a±1 | 63a±7 | 0.49a±0.05 | 37a±3 |

# **4. References**

AACC (2001) American Association of Cereal Chemists International. *Approved Methods of Analysis, 11th ed*; American Association of Cereal Chemists International: St. Paul, (MN, USA), 2001.

ICC (1992) International Association for Cereal Science and Technology. *Standard No. 115/1, Method for Using the Brabender Farinograph*; International Association for Cereal Science and Technology: Vienna (Austria), 1992.

Sergiacomo A (2022) Less common grains in bakery industry: product and process optimization, *Proceeding of the 26th Workshop on the Developments in the Italian PhD Research on Food Science, Technology and Biotechnology,*Asti (Italy), 19th-21st September, 2022, pp. 175-176.

Suárez-Estrella, D. et al. (2020) Sprouting as a pre-processing for producing quinoa-enriched bread, *J Cereal Sci* **96:** 103111

Progetto finanziato nell’ambito PON: “Ricerca e Innovazione” 2014-2020, Asse IV “Istruzione e ricerca per il recupero” con riferimento all’Azione IV.4 “Dottorati e contratti di ricerca su tematiche dell'innovazione” e all’Azione IV.5 “Dottorati su tematiche green”. DM 1061/2021