Physicochemical properties of surplus bread as a circular resource in bakeries

Johannes Feys[1], Ingrid De Leyn[2], Katrien De Visschere[1], Melissa Camerlinck[1]

[1] Research Center AgroFoodNature, HOGENT University of Applied Sciences and Arts, Valentin Vaerwyckweg 1, 9000 Ghent, Belgium

[2] Research Unit of Cereal and Feed Technology, Department of Food Technology Safety and Health, Faculty of Bioscience Engineering, Ghent University, Valentin Vaerwyckweg 1, 9000 Ghent, Belgium

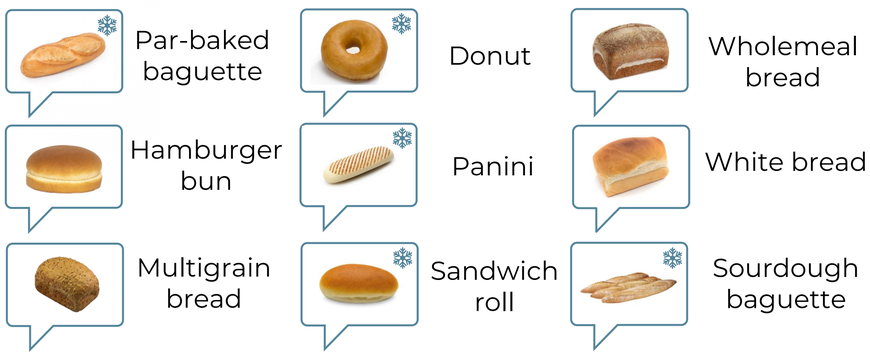
1. Introduction

Research shows that 3-9% of the total bread production in Flemish industrial bakeries is lost or wasted. Most of these bread losses are still suitable for human consumption. So far, most of the bread surplus is used for animal feed and biogas production. Instead, human consumption can be applied as a higher environmental valorisation according Lansink's model.

This study aims to develop a food-safe raw material with a prolonged shelf life that can be reused in bakeries as an ingredient. For this purpose, the bread size was reduced, dried (90 °C) and milled to create 'bread flour' with a water activity index (0.4-0.5) similar tot wheat flour. Particle size distribution and pasting properties of different 'bread flours' were analysed. Also, water binding capacity and water holding capacity were determined.

2. Experimental

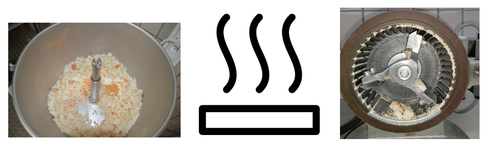
9 types of surplus bread products were selected after consulting 52 small bakeries and seven industrial bakeries in Flanders (Belgium).



❄ Freeze stored

Water activity index 0.4-0.5

Particle size < 500 µm



Grinding | Drying 90°C 18-22 min | Cross beater mill

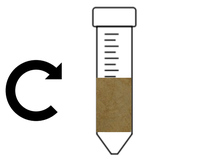
Bread Flour

Particle size distribution — 10 min on 1 mm/g

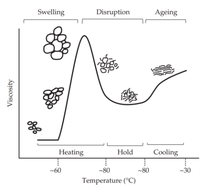
Water holding capacity — 1 g in 40 mL water for 1 hour at 25°C

Water binding capacity — 1 g in 40 mL water for 1 hour at 70°C

Pasting properties



* 3234 g for 25 min

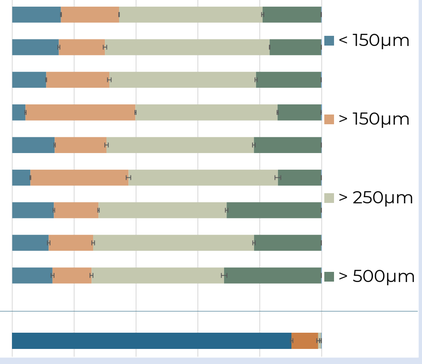


Pasting curves of bread flour blends of 14 % W%/W using an Anton Paar MRC102.

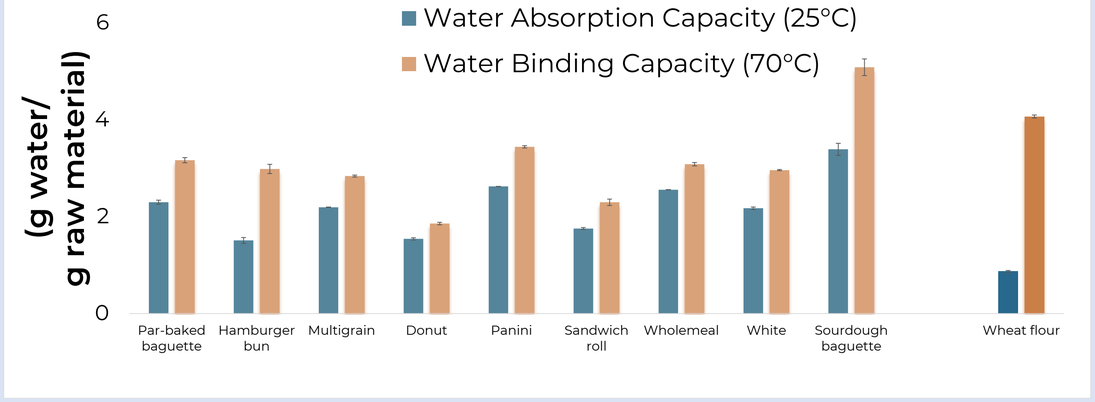
3. Results and discussion

Bread flour properties

Breadflour type	Moisture (%)	Water activity
Par-baked baguette	8.45 ± 0.05	0.422 ± 0.002
Hamburger bun	8.47 ± 0.02	0.443 ± 0.004
Multigrain bread	8.44 ± 0.03	0.416 ± 0.002
Donut	7.82 ± 0.03	0.573 ± 0.003
Panini	8.32 ± 0.05	0.441 ± 0.002
Sandwich roll	7.61 ± 0.02	0.420 ± 0.008
Wholemeal bread	8.78 ± 0.03	0.468 ± 0.001
White bread	8.67 ± 0.03	0.465 ± 0.003
Sourdough baguette	8.48 ± 0.06	0.452 ± 0.001
Wheat Flour	13.36 ± 0.02	0.404 ± 0.002



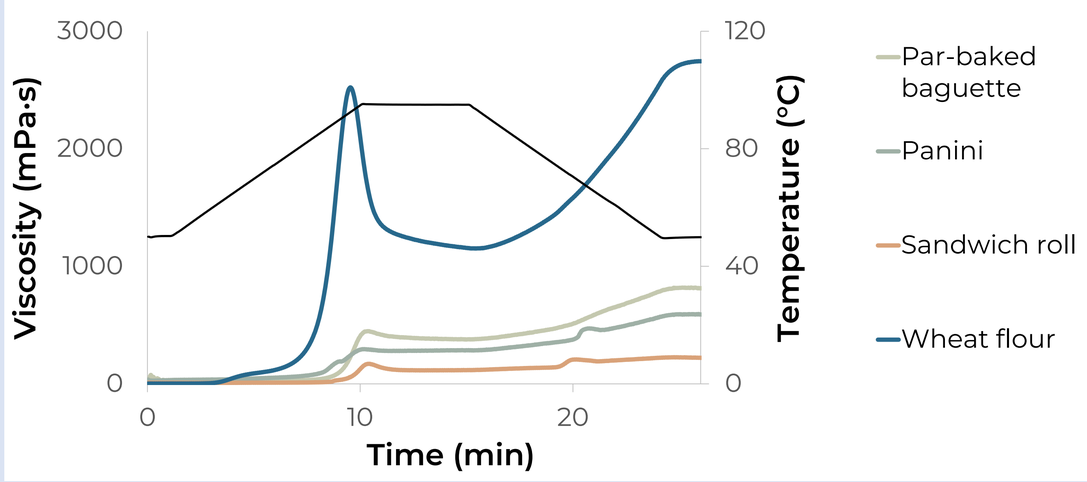
Wholemeal bread and sourdough baguette flours had a higher particle size distribution of > 500 µm compared to other bread flours. Moreover, bread products with high-fat percentages (donut and sandwich roll) had a higher particle size distribution of 150 µm-250 µm. Compared to wheat flour, all bread flours had up to 5 times bigger particle size.



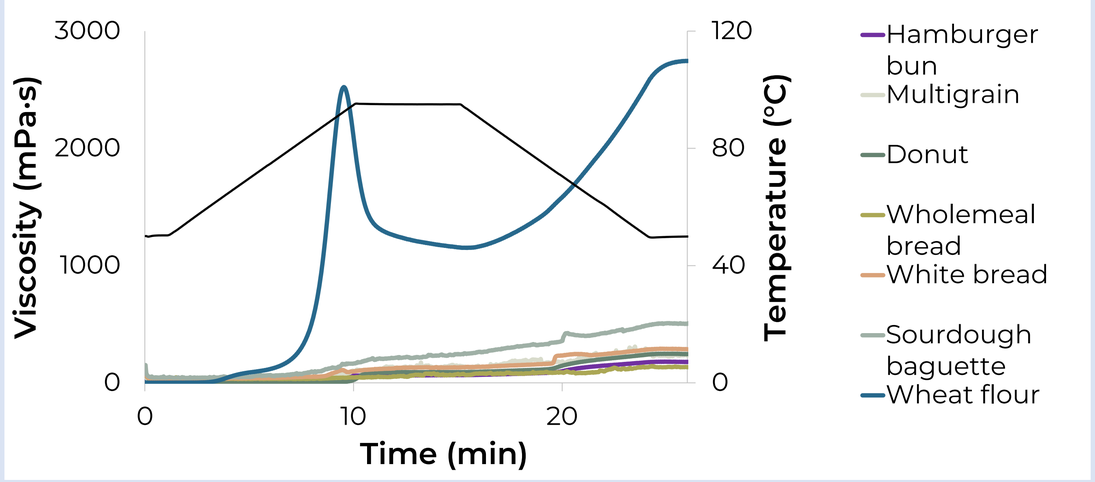
All bread flours have a similar particle size distribution compared to each other. Each of the bread flours has its own Water Absorption Capacity and Water Binding Capacity values. Bread flours have a higher water absorption capacity compared to wheat flour. Nevertheless, only sourdough baguette has a higher WBC than wheat flour, due to smaller sugar and protein chains in sourdough. When incubating wheat flour at 70°C, starch granules will swell and take up more water. At room temperature, no swelling will be induced using wheat flour.

Pasting properties

Low pasting properties



Minor pasting properties



Three bread flours gave minor pasting properties because of freeze storage and par-baked properties. A viscosity peak at 95 °C was seen for par-baked baguette (441 ± 18 mPa s), panini (314 ± 18 mPa s), and sandwich (172 ± 3 mPa s), compared to 2490 ± 33 mPa s for wheat flour at 92 °C. Par-baked baguette, panini and sandwich induced an end viscosity of 811 ± 19 mPa s, 617 ± 19 mPa s and 218 ± 5 mPa s. The end viscosity of the reference wheat flour was 2777 ± 26 mPa s. Six other bread flours showed minor pasting properties in peak viscosity (> 105 mPa s) and end viscosity (> 270 mPa s). Only sourdough baguette showed a higher end viscosity of 501 ± 57 m Pa.

4. Conclusion & Perspectives

A food safe raw material can be obtained from nine major surplus bread types by drying and grinding. Within bread flours, starch granules are already gelatinized and partially retrograded. So, when exposed to pasting temperatures mostly water binding occurs, but minor swelling or gelatinisation of starch granules takes place. Bread flours from fully baked products obtained minor pasting properties, while three par-baked and freeze stored bread products showed low pasting properties compared to wheat flour. Based on the results these new circular bread flours offer the potential for product development in bakeries and in addition they can contribute in reducing food losses.

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Bread2B.
Sustainable valorisation of bread losses in bakery and brewery

Contact

Johannes.feys@hogent.be
Melissa.Camerlinck@hogent.be