

Development of a method to evaluate the quality of vital wheat gluten for bread baking using a high shear based technique

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Bread

- Bread in its most basic form:
 - Flour, water, salt and yeast
- Commercial formulations become more complex based on product, processing and shelf-life considerations
 - Sugars, lipids, enzymes, dough conditioners, etc.
 - Depends on product characteristics, energy intensity of the manufacturing process, and shelf-life conditions
- Vital wheat gluten has become a required ingredient for several categories of product
 - Frozen/refrigerated doughs, bagels, multi-grain breads, etc.

Vital wheat gluten

- Vital wheat gluten usage in bakery formulations varies from 2 – 10%
- The separation process can significantly affect vital wheat gluten quality
 - Is the dough fully developed before separation?
 - How long is the gluten kept in a wet state before drying?
 - What is the drying temperature?
- Wheat source can affect vital wheat gluten quality
 - Varietal differences
 - Agronomic management
 - Growing conditions/region

Vital wheat gluten quality

- Vital wheat gluten quality is not tightly controlled
 - Starch is the high-value product whereas vital wheat gluten is the by-product
 - Supplier-to-supplier and batch-to-batch quality differences can be substantial
- Few standard methods exist for directly evaluating vital wheat gluten quality
 - AACCI Approved Method 38-21.01: Farinograph test for vital wheat gluten
- Most companies develop internal methods based on existing dough rheological tests
 - Bake tests are always the gold standard

The GlutoPeak

...where quality is measured.

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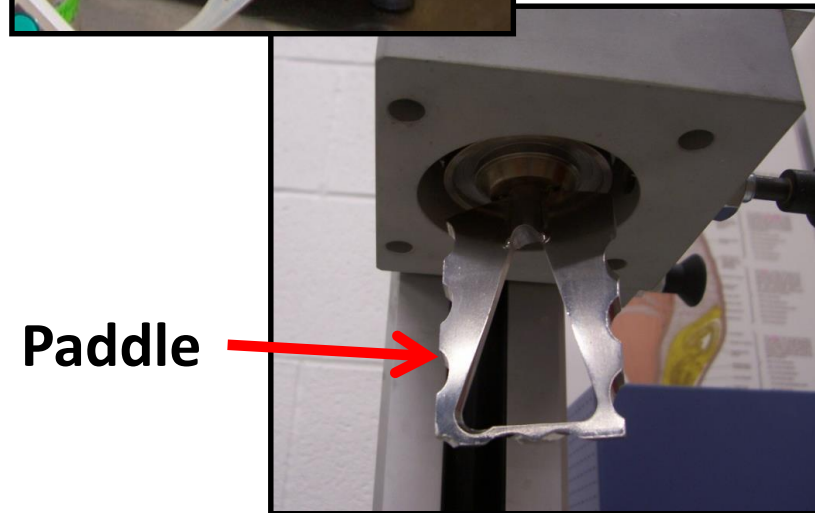
GlutoPeak test principle

- Gluten quality testing instrument developed by Brabender
 - Utilizes high shear to drive gluten aggregation in slurry systems
- Aggregation characteristics are used to differentiate among gluten-containing samples:
 - Aggregation time
 - Torque
 - Energy of aggregation
- Requires small sample sizes, short test times

GlutoPeak



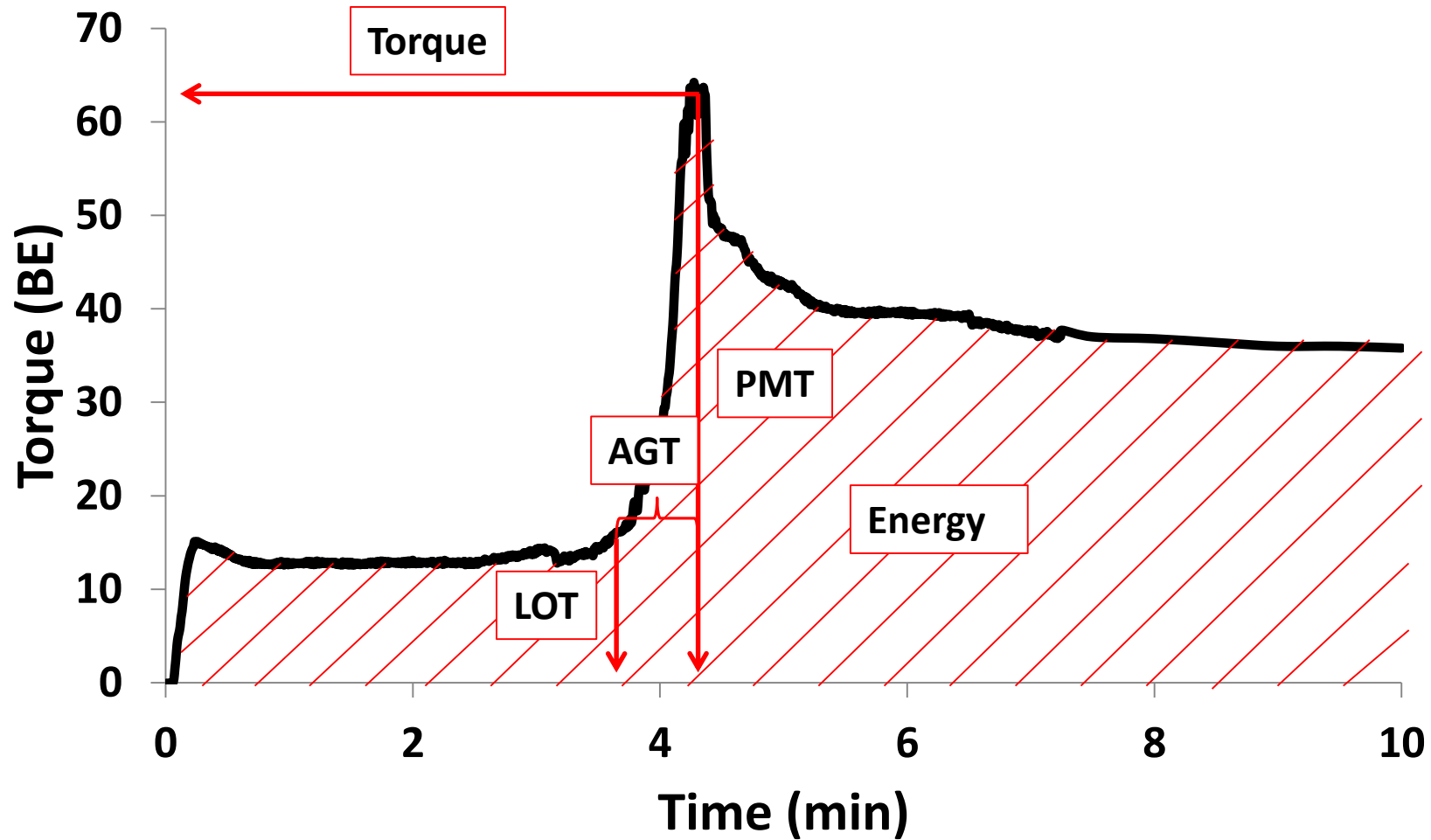
Sample Cup



Paddle

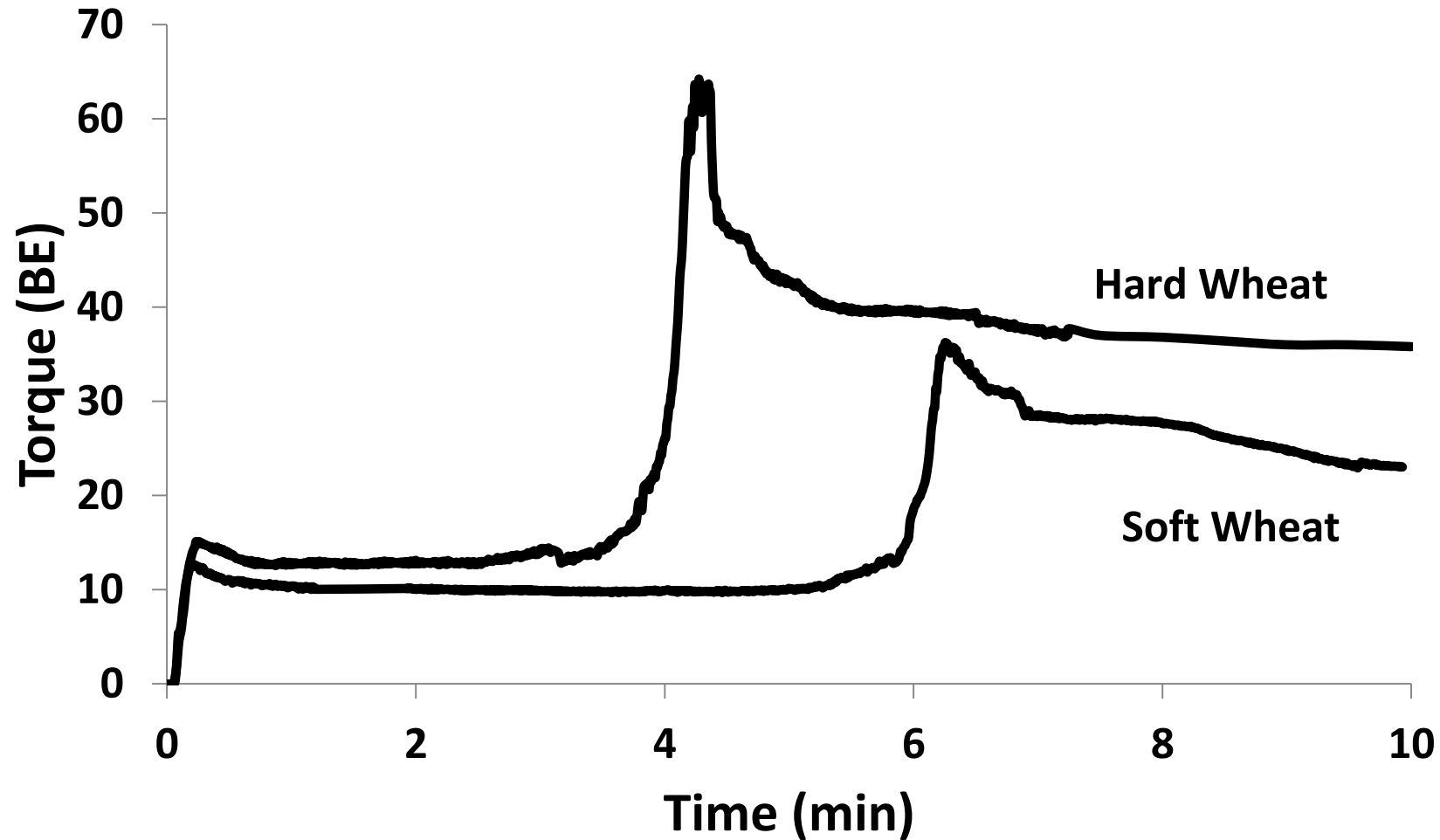
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GlutoPeak curves



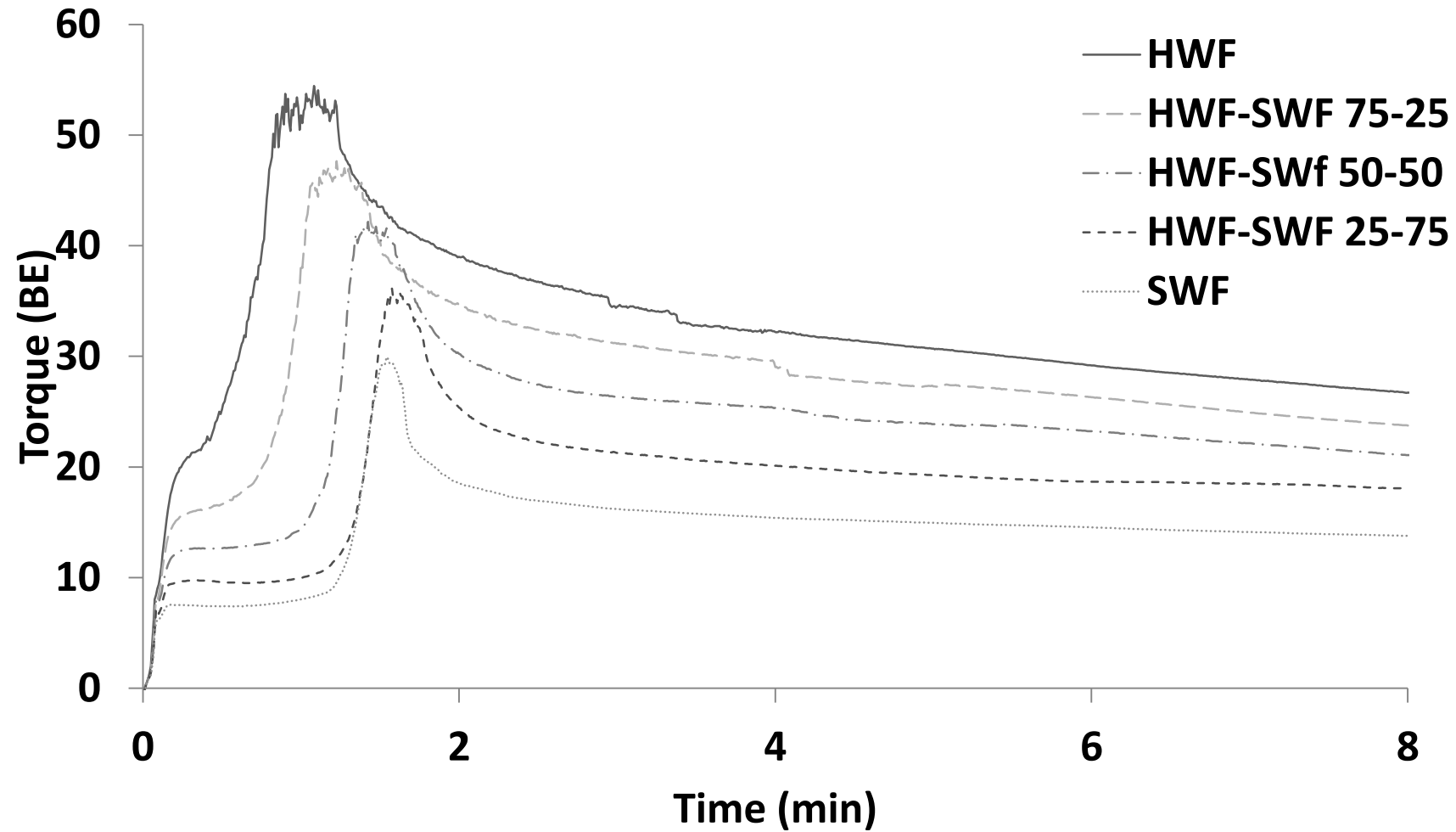
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GlutoPeak curves



...where quality is measured.

GlutoPeak curves



...where quality is measured.

Method development

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Considerations

- Solvent selection:
 - Water vs. aqueous phase of bread dough
 - NaCl
 - Sucrose
 - pH
- Sample/solvent ratio
 - Successful dispersion of sample
 - Upper torque limits under high shear conditions
- Test speed
 - Torque limits at various speeds
 - Pre-mix and rest periods for sample hydration
- Test temperature
 - Heat dispersion

Final method

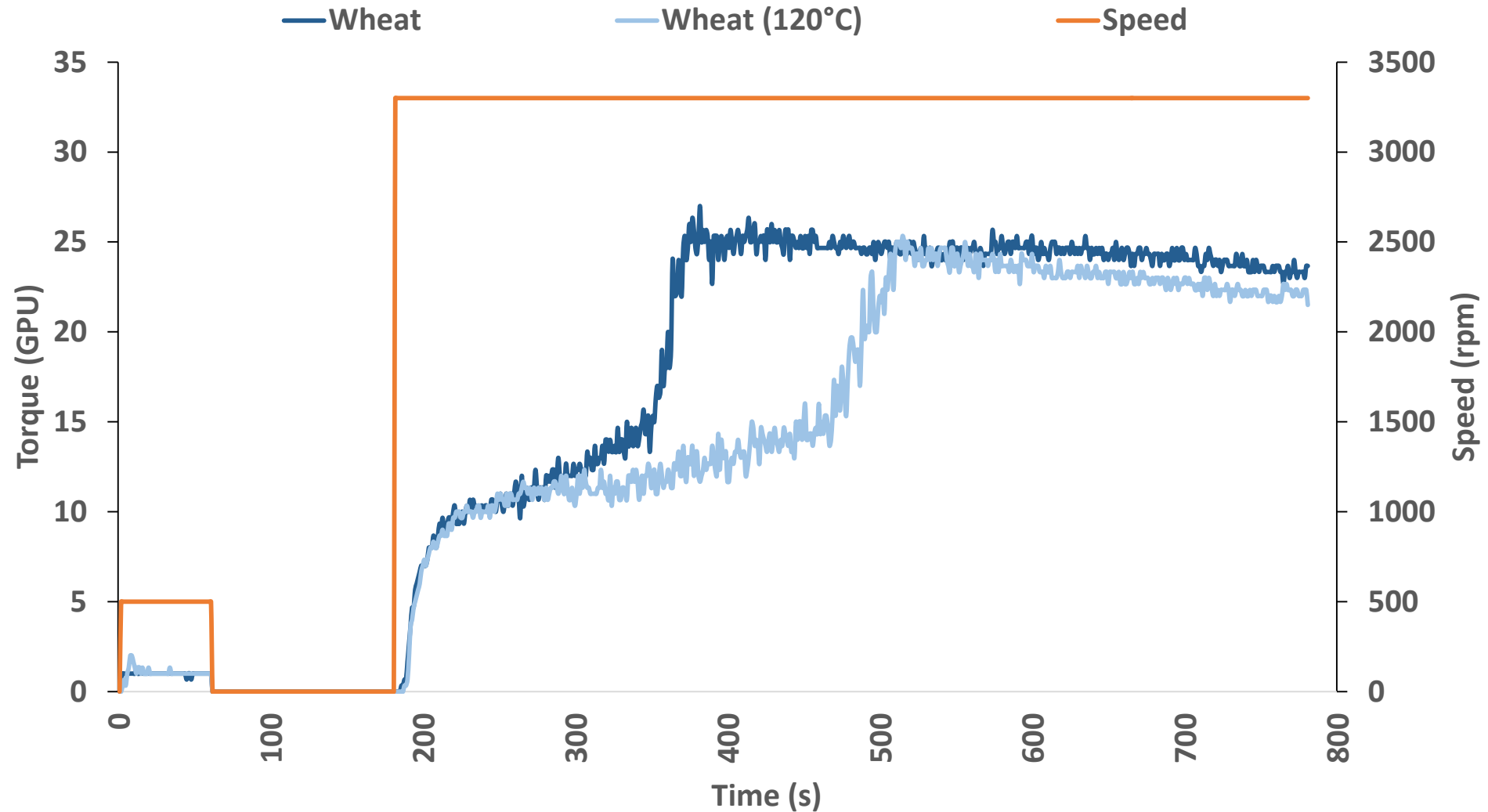
- Solvent:
 - Distilled water
- Sample/solvent ratio:
 - 2.1 g vital gluten/4.41 g distilled water
- Speed profile:
 - 1 min pre-mix at 500 rpm
 - 2 min rest
 - 10 min at 3300 rpm
- Test temperature:
 - 36°C
- Peak maximum time
 - **RSD (r)** = 1.4 – 2.7%
- Maximum torque
 - **RSD (r)** = 2.1 – 7.9%
- Aggregation energy
 - **RSD (r)** = 3.6 – 6.6%

Results

...where quality is measured.

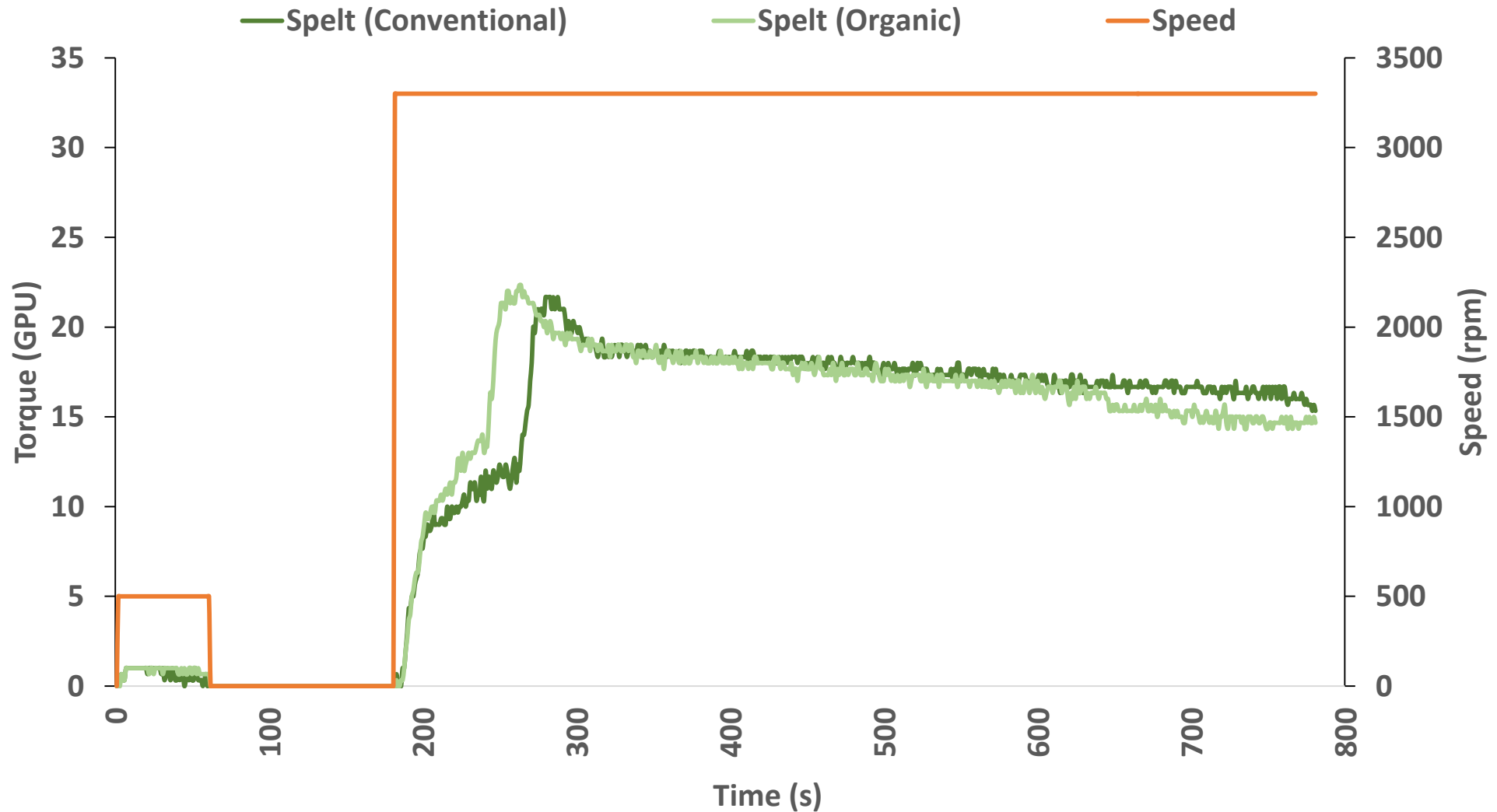
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Wheat gluten



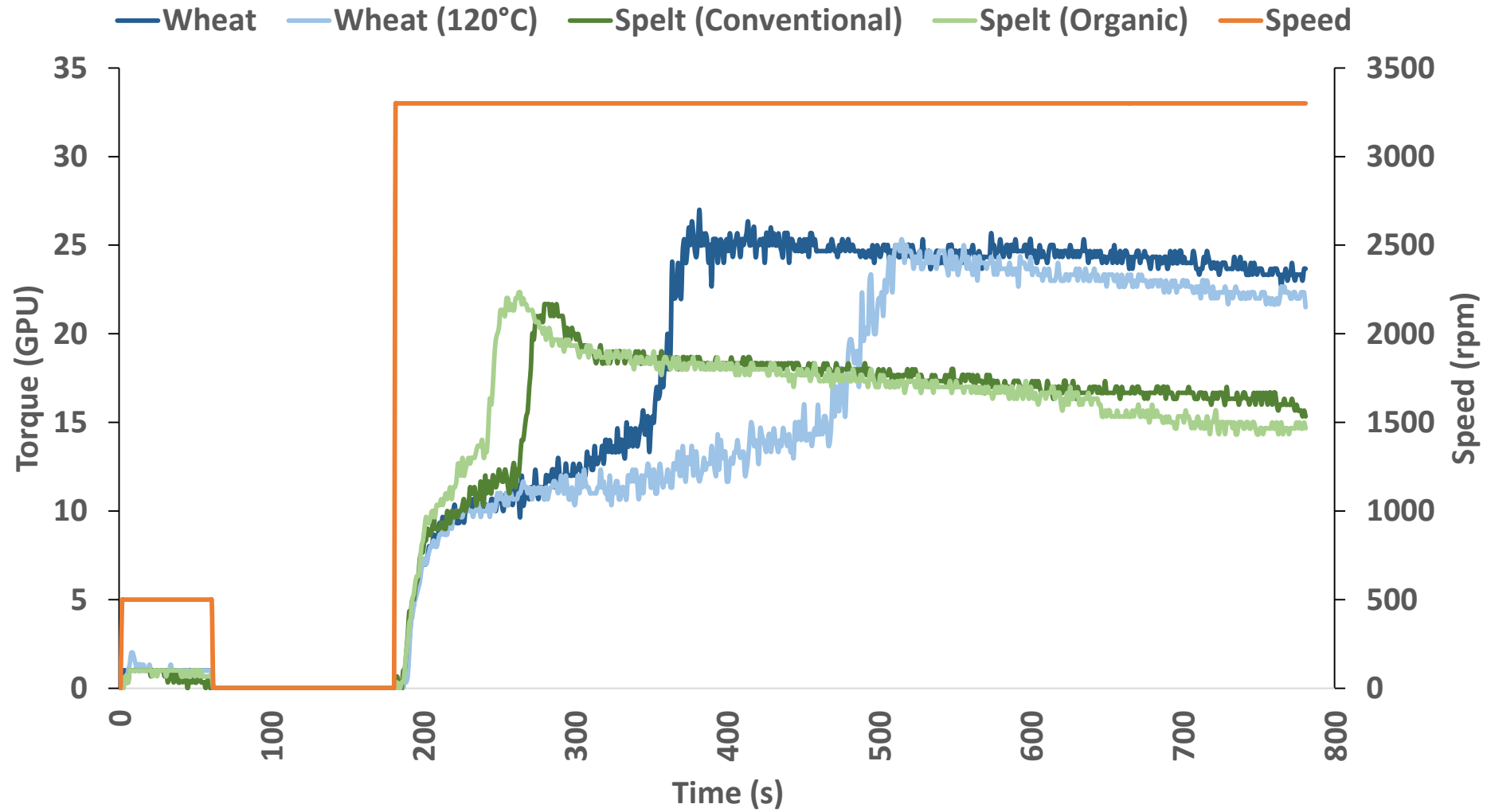
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Spelt gluten



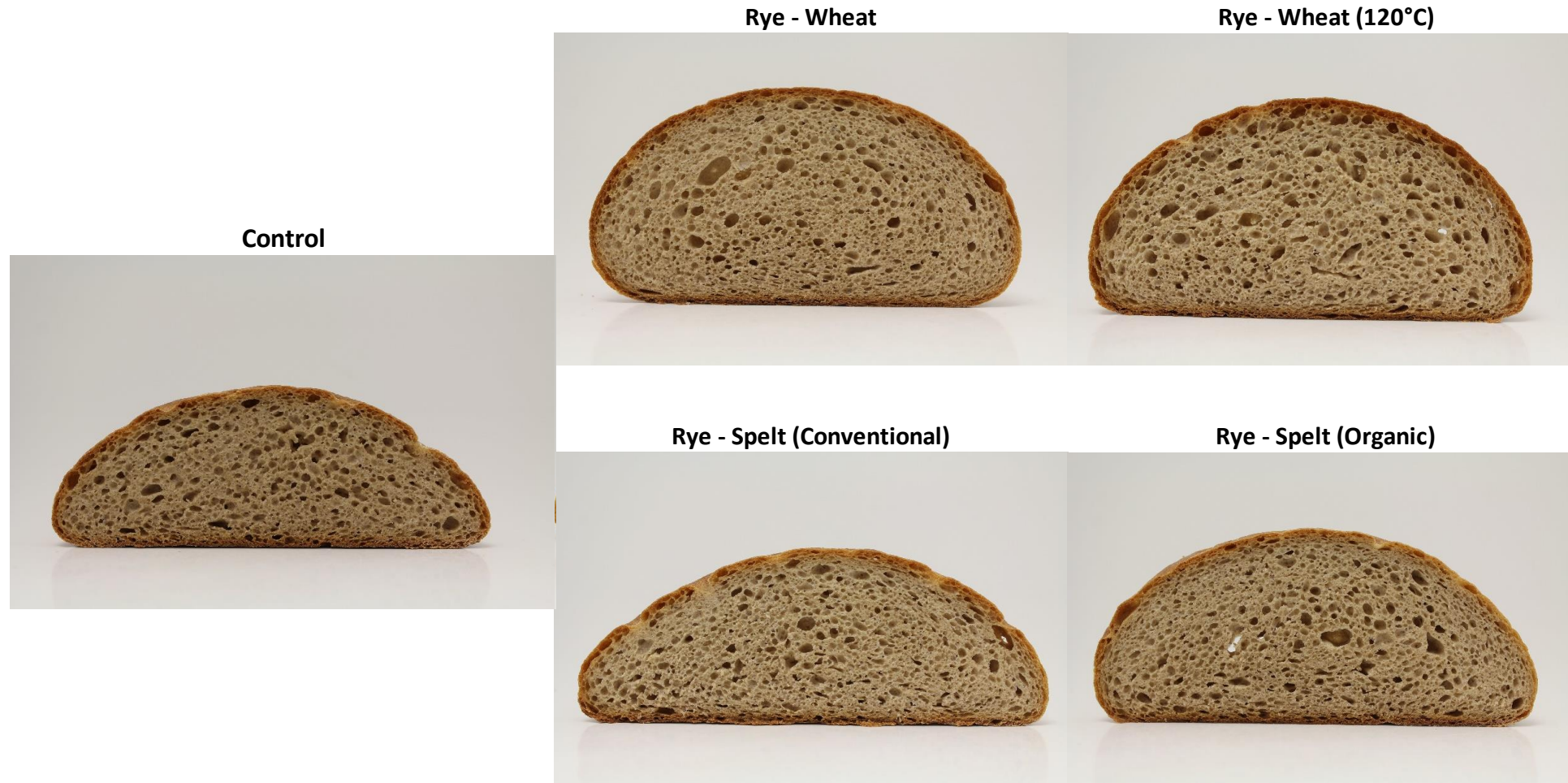
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Comparison



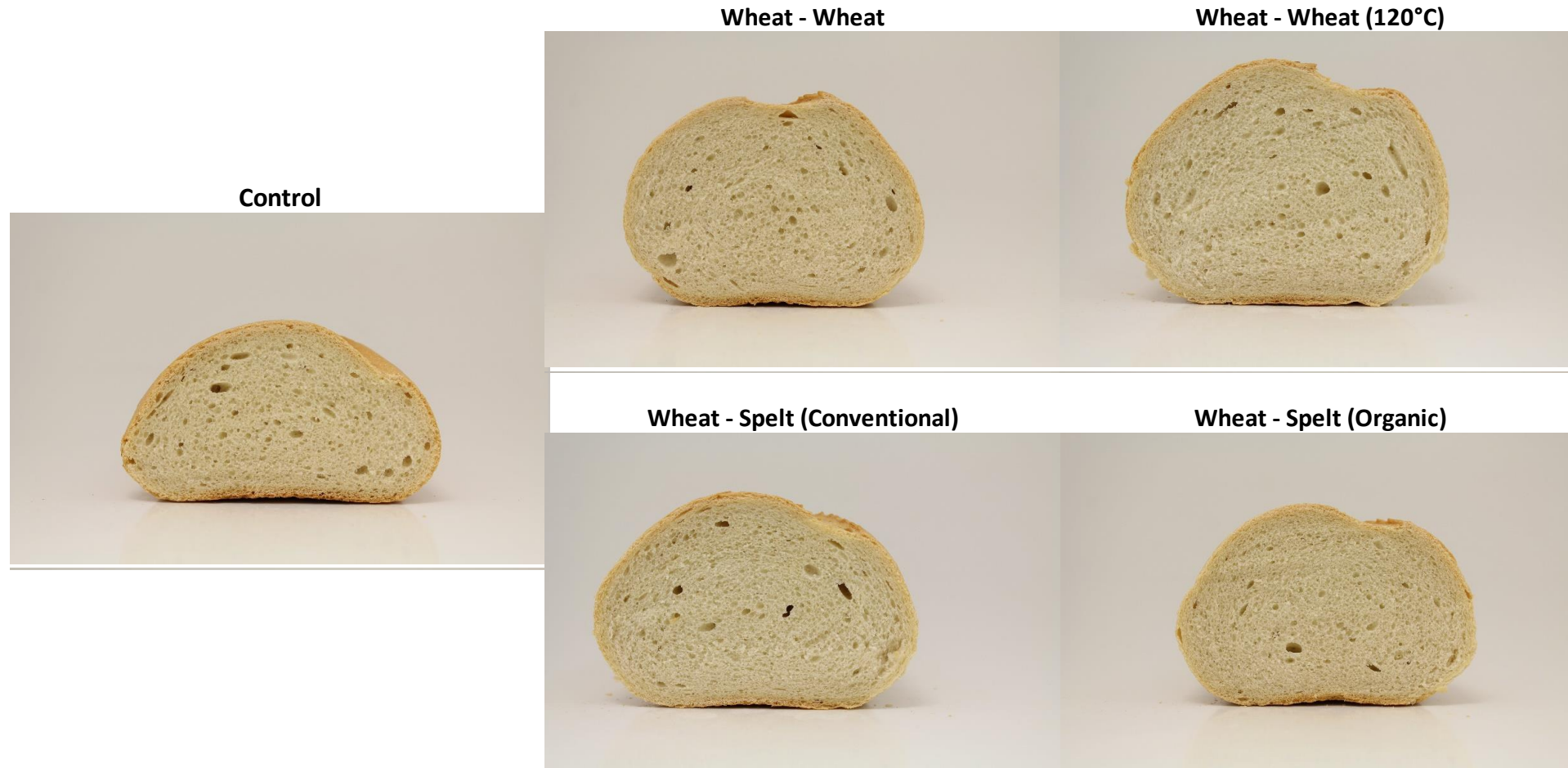
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Baking – Rye formulation



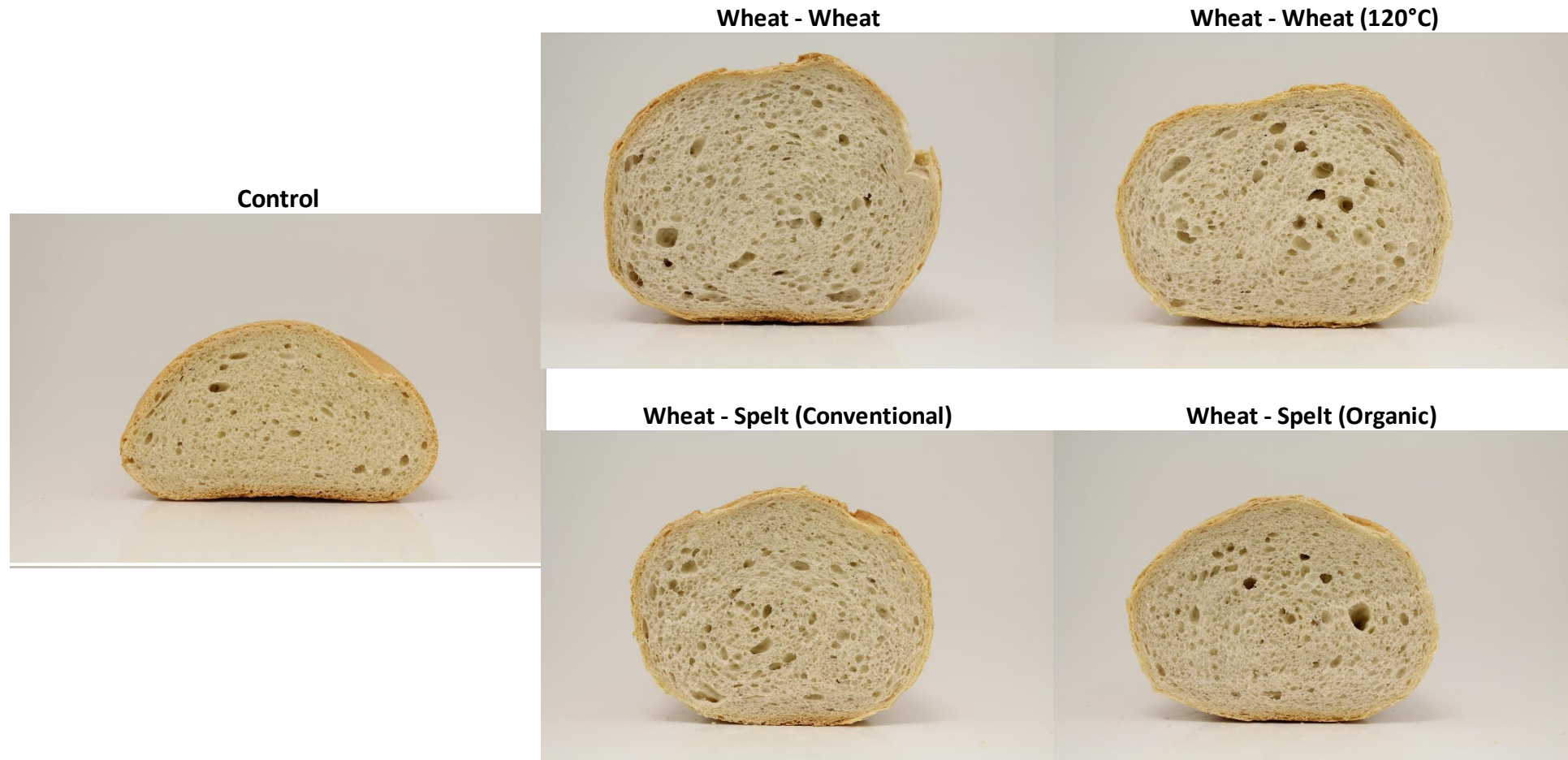
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Baking – Wheat formulation (4 min)



...where quality is measured.

Baking – Wheat formulation (12 min)



...where quality is measured.

Correlations

	<i>PMT</i>	<i>BEM</i>	<i>Aggregation energy</i>
Rye specific loaf volume	0.954	0.878	0.903
Rye height/width	0.597	0.924	0.943
Rye pore density	0.606	0.154	0.119
4 min Wheat specific loaf volume	0.935	0.518	0.535
4 min Wheat height/width	0.840	0.977	0.991
4 min Wheat pore density	-0.609	-0.090	-0.151
12 min Wheat specific loaf volume	-0.331	-0.485	-0.557
12 min Wheat height/width	-0.610	-0.957	-0.933
12 min Wheat pore density	-0.944	-0.925	-0.916

Moving forward

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Validation

- Validation trials are in progress
 - Collaboration with commercial vital wheat gluten suppliers
 - Multiple harvest years
 - Multiple sources
- Data collection
 - Repeatability and reproducibility of the method
 - Baking correlations
- Additional work
 - Linking curve parameters to gluten protein characteristics

Acknowledgements

- Ms. Jessica Wiertz
- Mr. Sergej Gall
- CSM Deutschland GmbH
- Blattmann Schweiz AG
- TTZ Bremerhaven

Questions?

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1-201-682-0597

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