Strong And long-term Partnership

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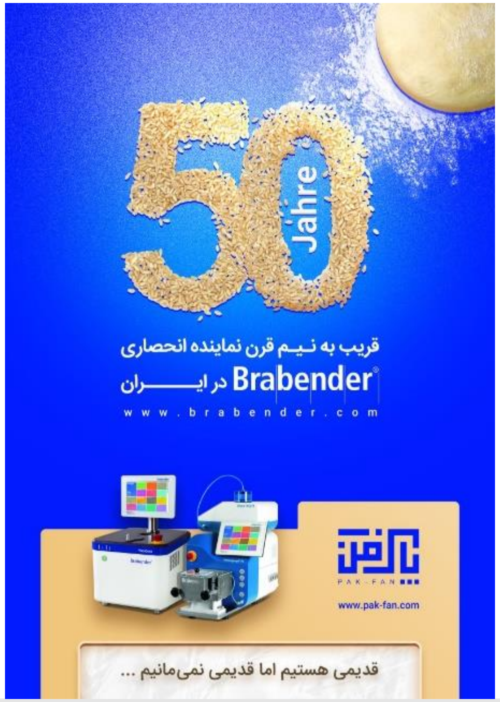

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IranGrain Conference
2nd Annual Grain Conference
May 10 & 11, 2022
Tehran, Iran

Glutopeak Technology to Determining Quality of Flour & Gluten

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Wheat Quality: Description and Effect

Definition Wheat Quality

- Different wheats/flours for different products
- Same protein content but different products/applications
  - Composition ⟷ functionality
    - Composition: list of components
    - Functionality: the quality of being suited to serve a purpose well; practicality

"Functional properties of food proteins are those physical and chemical properties which affect the behaviour of proteins in food systems during processing, storage, preparation, and consumption" (Kinsella, 1976) *Crit Rev Food Sci Nutr, 1976, 7, 219-280.*

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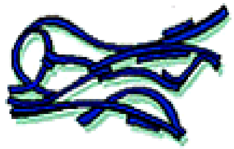
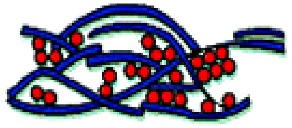
Definition Wheat Quality

 +  = 

GLIADIN + **GLUTENIN** = **GLUTEN**

extensibility viscosity + **elasticity tenacity** = **visco-elasticity**

 +  = 

Excess of Gliadins
Too tensile, weak dough

Excess of Glutenins
Too stiff, strong dough

EXTENSIBILITY

The gluten network deforms instead of breaks

ELASTICITY

The gluten network enables the product to keep its shape during mechanical stresses

It is able to resume its normal shape after being stretched

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Effect of the Gluten Composition

Composition

Bread

Pasta

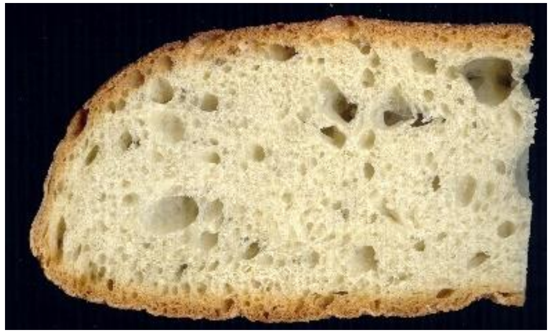
Durum Wheat Semolina

	[%]
Protein	**10 - 16**
Fiber	**4 - 6**
Ash	**0.90 - 1.7**
Starch	**75 - 78**

Pagani, unpublished

Common Wheat Flour

	[%]
Protein	**9 - 15**
Fiber	**4 - 6**
Ash	**0.55 - 1.7**
Starch	**78 - 80**



Pagani, unpublished

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Who cares about wheat quality?

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Who cares about wheat quality?

Breeders
Farmers

Milling industry

Baking and pasta industry

Each sector/industry wants to use the optimal raw materials (grain – flour) for its needs, or produce end products (bread, pasta) with consistently high quality.

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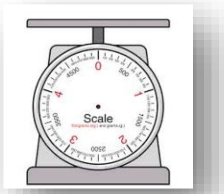
Who cares about wheat quality?

Breeders Farmers → **Milling industry** → **Baking and pasta industry**

- ❖ Information at the beginning of the value chain
- ❖ Optimal collection and evaluation of the delivered raw materials
- ❖ Prediction of the expected baking and processing properties

- Rheological “fingerprint” of the flour
- Time, sample size, reliability and predictability



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Who cares about wheat quality?

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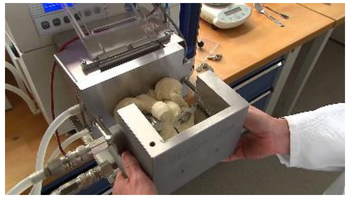

PROCESSING

Test	Time*	Sample amount	Influence of the analyst
Farinograph	~45 min**	50g, 300g	low
Alveograph	~40 min	250g	high
Extensograph	~150 min**	300g	medium
Rheofermentometer	~200 min	300g	low
Gluten Index	~15 min	10g	high
Glutograph	~20 min	10g	high
Kieffer Test	~60 min**	10g	high
Mixolab	~60 min**	50g	low

** including sample preparation and cleaning*
*** including the step for the determination of the optimal water absorption*

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The GlutoPeak Procedure

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Features of the GlutoPeak and the process

- Useful for flour, whole meal flour, baking mixes, vital gluten and more
- Supplementary to the Brabender 3-Phase-System
- Creates a rheological „fingerprint“ of the test material
- Paddle speed up to 3300 min^{-1}
- Quick method (30 s – 10 min.)
- Small sample amount (2,5-12 g)
- No sample preparation necessary
- Raw material-dependent methods and evaluations available
- Simple handling

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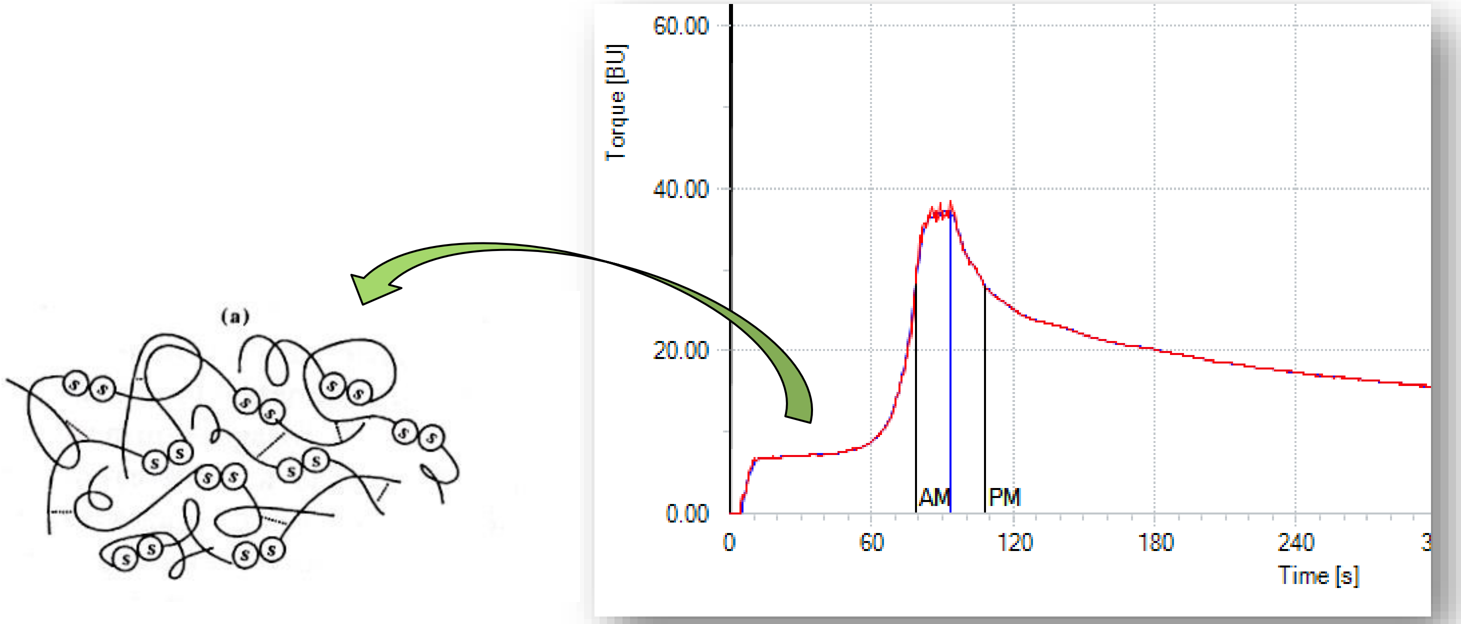
Effect on the Gluten Network

- Preparing of a slurry with flour and water during low speed
- Increased energy input due to increase in speed



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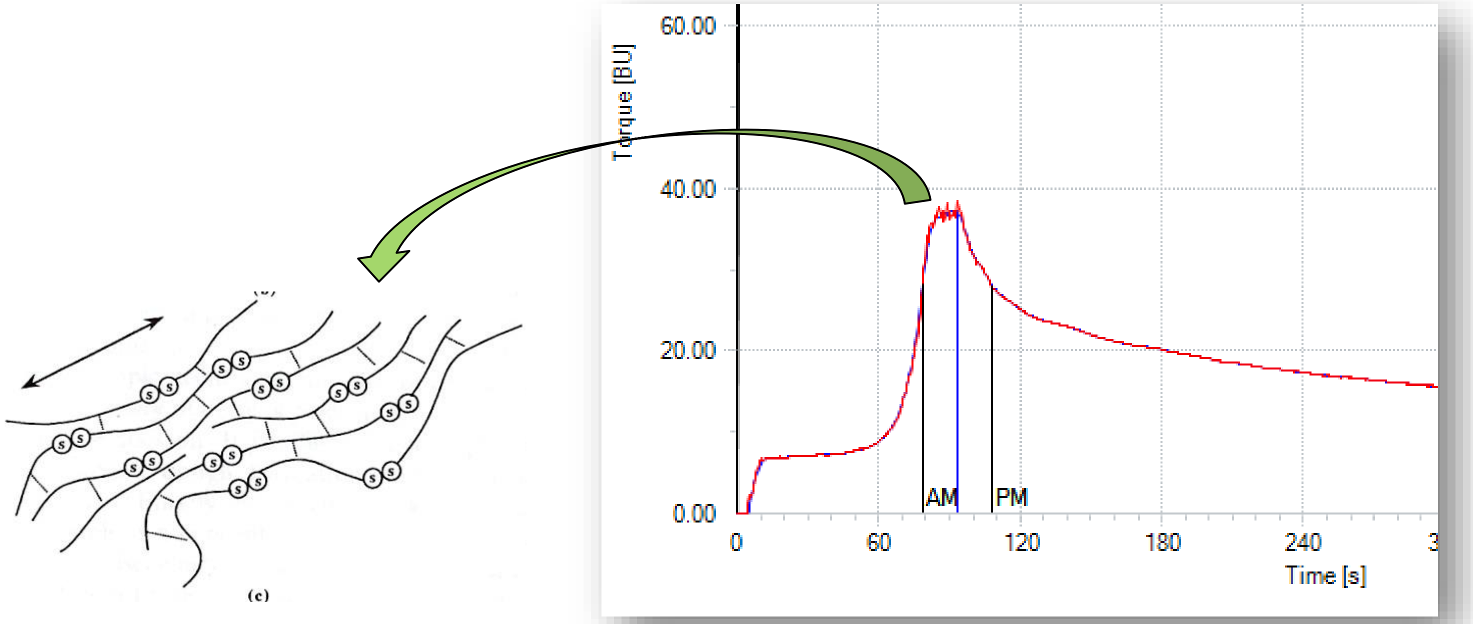
Effect on the Gluten Network

- Preparing of a slurry with flour and water during low speed
- Increased energy input due to increase in speed
- After a time (dependent on the property of the sample), the gluten aggregates
- A uniform gluten network is formed, which results in a strong increase in torque



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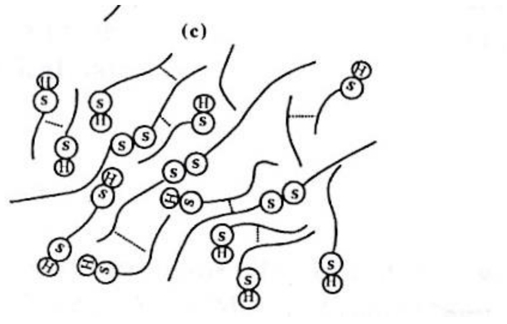
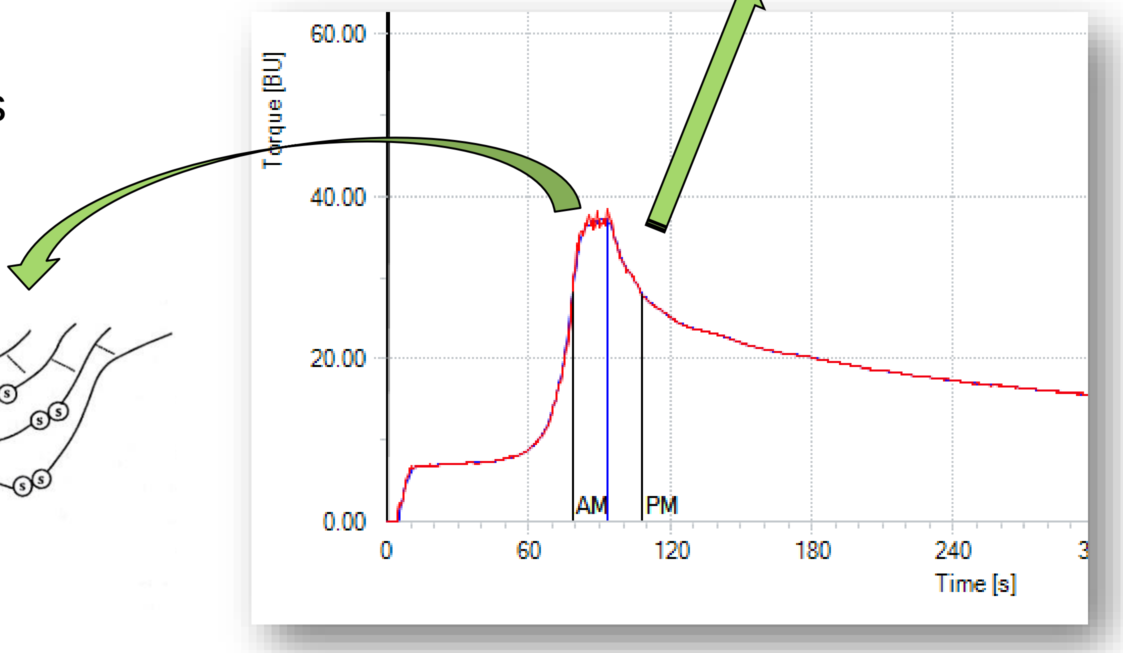
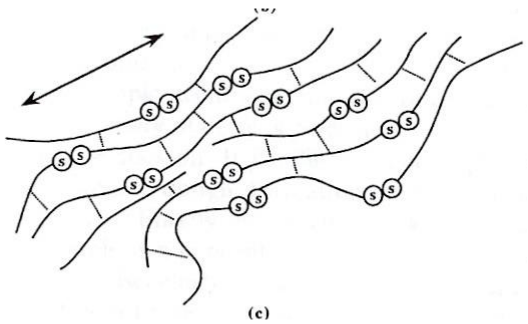
Effect on the Gluten Network

- Preparing of a slurry with flour and water during low speed
- Increased energy input due to increase in speed
- After a time (dependent on the property of the sample), the gluten aggregates
- A uniform gluten network is formed, which results in a strong increase in torque
- Further mixing destroys the network, the torque decreases







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Description of the Evaluation

Peak Maximum Time (PMT) [s]

→ Time until the gluten aggregates and the highest torque, before the gluten get damaged

→ **Correlate with the Gliadin content (R = 0,70) *)**

Peak Maximum Torque (BEM) [BU]

→ Torque when the peak happened

→ Correlate with the Glutenin content (R = 0,72) *)

Torque [BU]

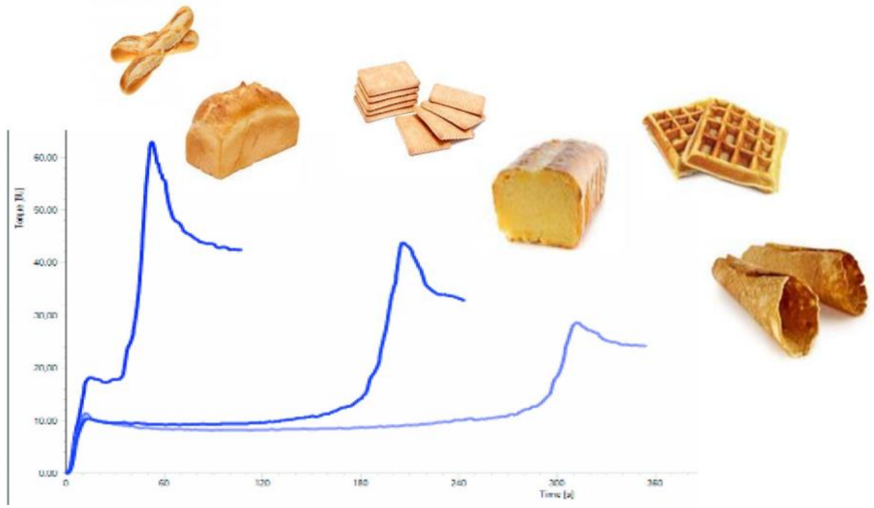
→ 15 s before Maximum (AM)

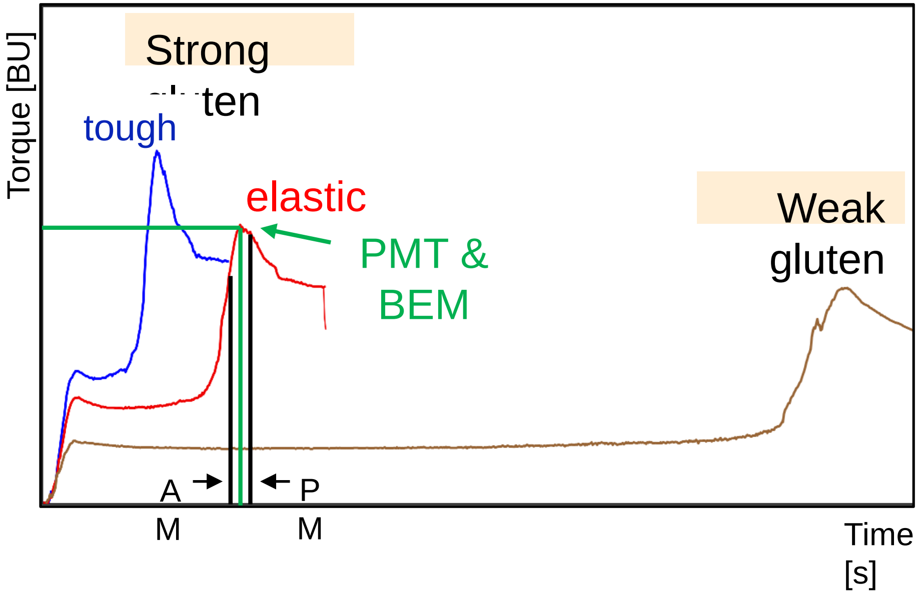
→ 15 s after Maximum (PM)

Energy (cm²)

→ Area under the curve

→ Correlate with the Glutenin content (R = 0,77) *)





*) Marti et al. J Cereal Science 66, 89-95

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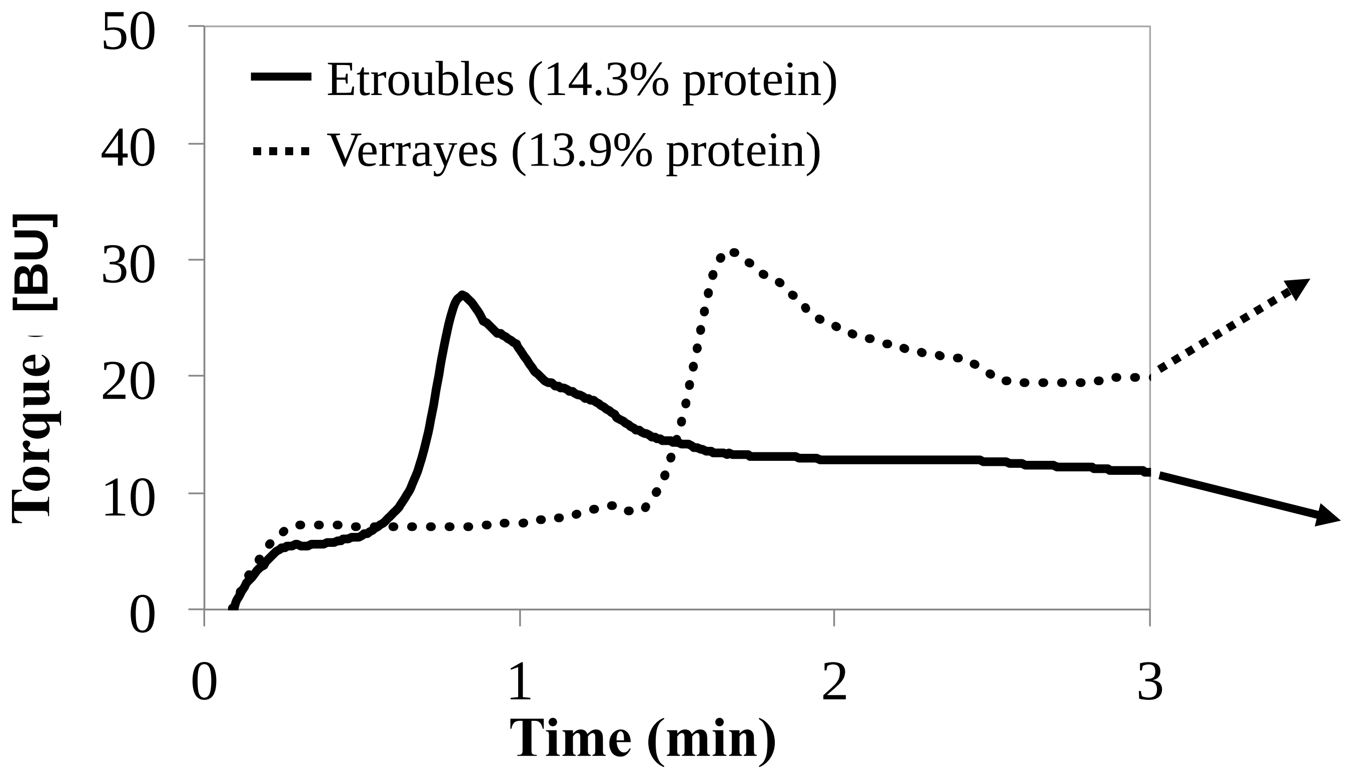
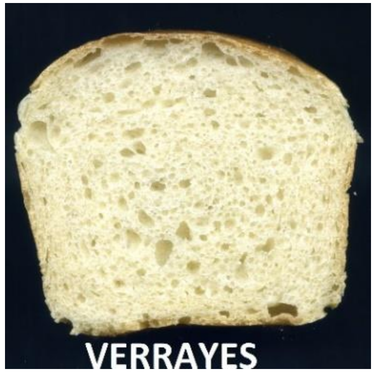
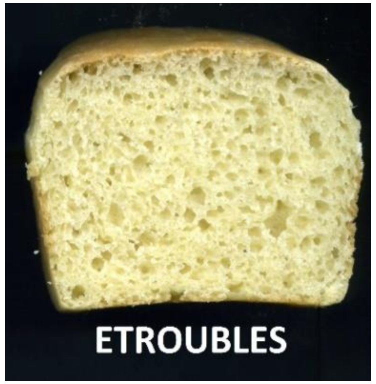
GlutoPeak versus Protein Content

Similar protein content but different bread-making performance





- Elastic gluten
- Good volume increase due to gas expansion in the fermentation and baking process
- Soft crumb



- Tough gluten (rigid)
- The fermentation gases could not expand through the strong gluten
- Limited volume increase

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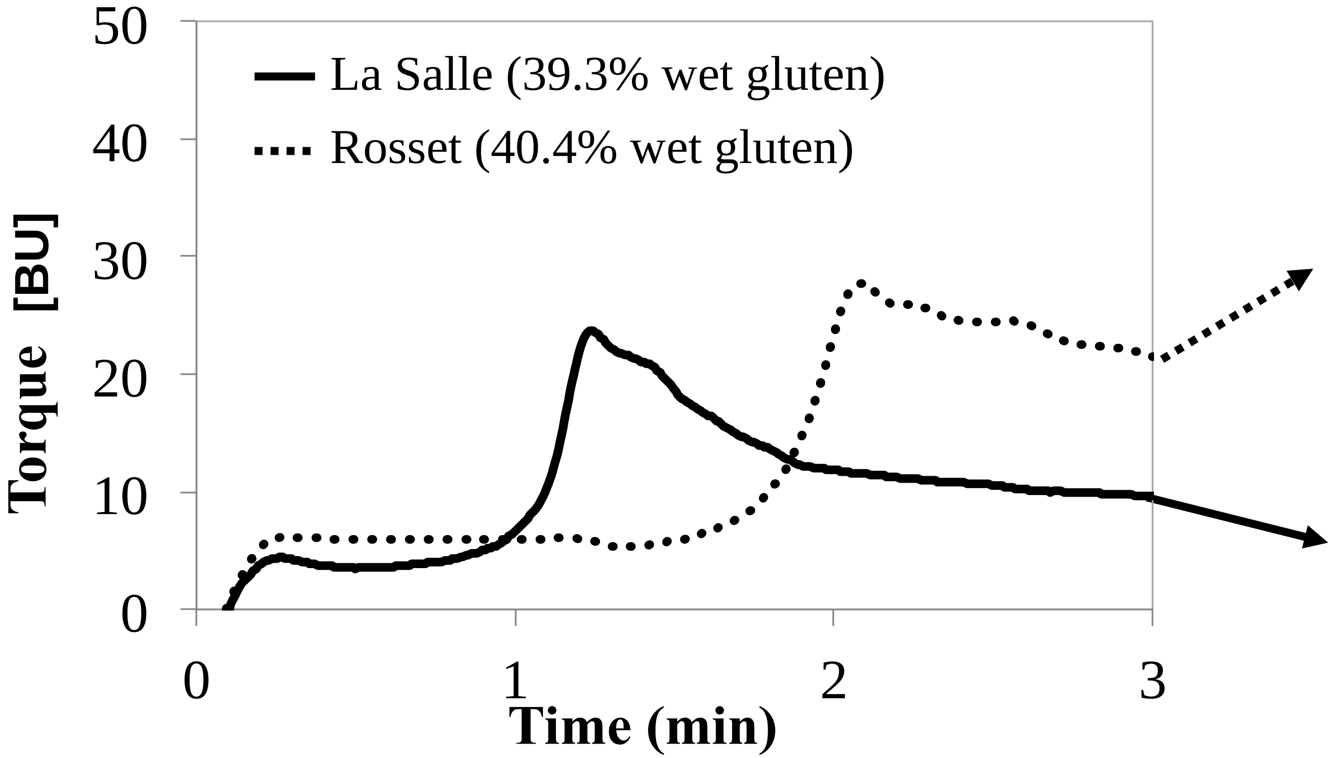
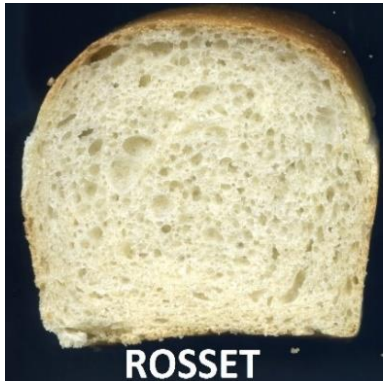
GlutoPeak versus Wet Gluten Content

Similar wet gluten content but different bread-making performance





- Elastic gluten
- Good volume increase due to gas expansion in the fermentation and baking process
- Soft crumb

- Tough gluten (rigid)
- The fermentation gases could not expand through the strong gluten
- Limited volume increase

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GlutoPeak Methods & Applications

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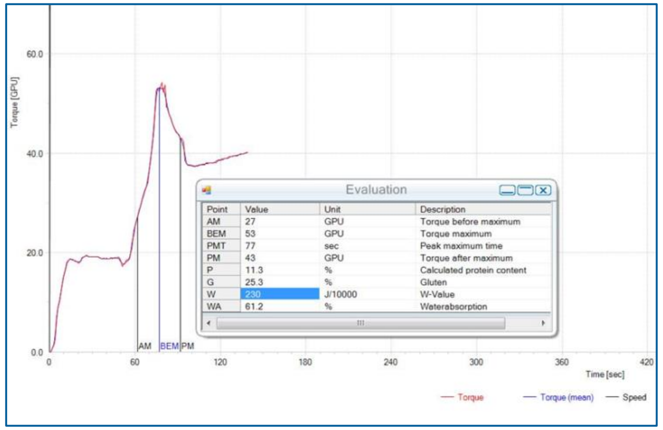
Method: Rapid Flour Check

Wheat flour with approx. 11 – 15 % protein

Method	
Flour	9 g
Liquid (dist. water)	9 g
Temperature	36 °C
Speed	2750 min^{-1}
Time (max. approx.)	300 s



Correlation
• Water absorption
• Protein content
• Wet gluten content
• W-value (Alveograph)

→ Quick raw material analysis with wheat flour/grain

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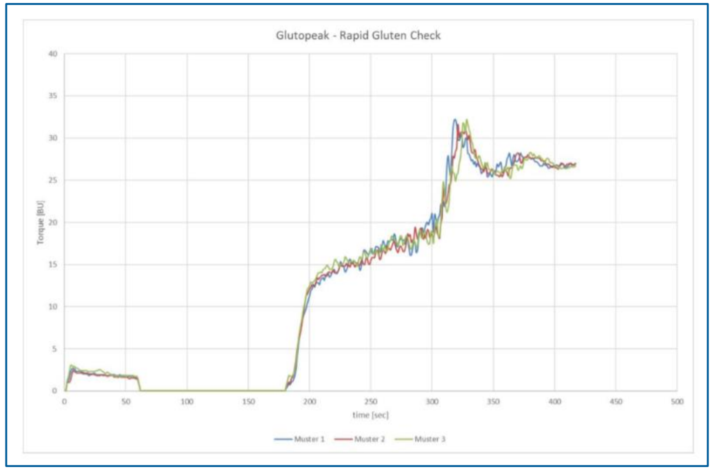
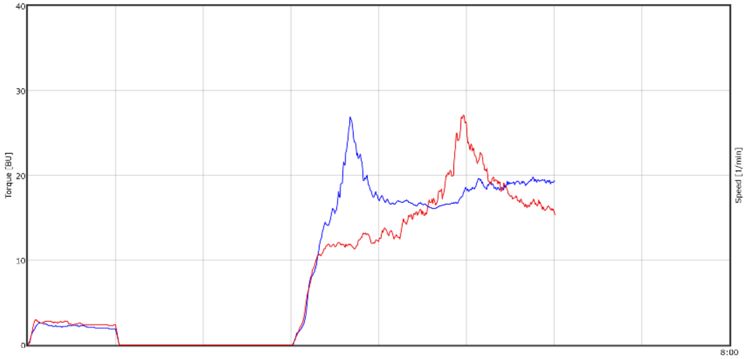
Method: Rapid Gluten Check

Method		
Vital Gluten	2,1 g	
Liquid (dist. water)	4,4 g	
Temperature	36 °C	
Speed	500 min^{-1} 0 min^{-1} 3.300 min^{-1}	(1 min) (2 min) (7 min)
Time	< 10 min	



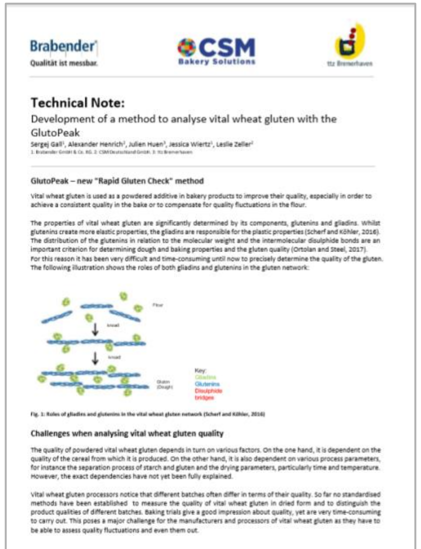
Gluten with similar rheological behaviours



Gluten with different rheological behaviours

(ttz Bremerhaven)

Technical Note:



(Gall, S. et. al., 2018)

→ *Quick quality control of dried (vital) gluten and ist properties for the baking process*

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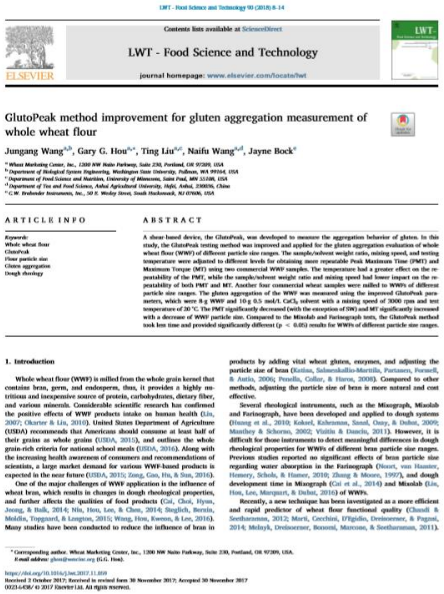
Method: Whole Meal Flour (U.S.)

Method	
Whole meal flour	8,0 g
Liquid ($CaCl_2$ Solution, Concentration: 55,49 g/l)	10,0 g
Temperature	20 °C
Speed	3.000 min^{-1}

(Wang et. al., 2018)

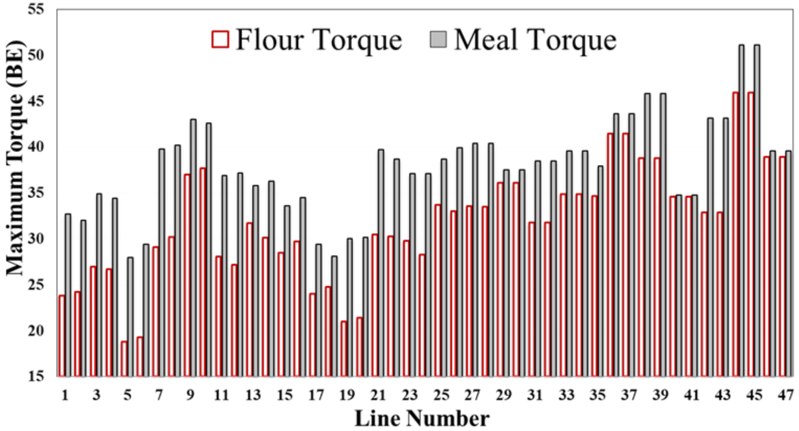

LWT - Food Science and Technology

GlutoPeak method improvement for gluten aggregation measurement of whole wheat flour

Jungang Wang, Gary G. Hou, Ting Liu, Naifu Wang, Jayne Bock

(Wang et. al., 2018)

Peak Maximum Torque of White Flour and Whole Meal Flour



Dr. Sanaa Ragaee – University of Guelph, Canada

Effects of particle size:

- *The particle size has a significant influence on the results*
- *The methods has a higher accuracy if the particle size is smaller*

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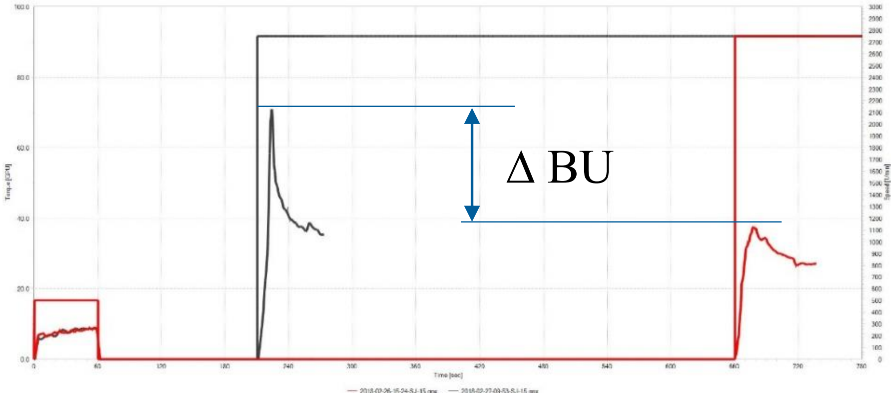
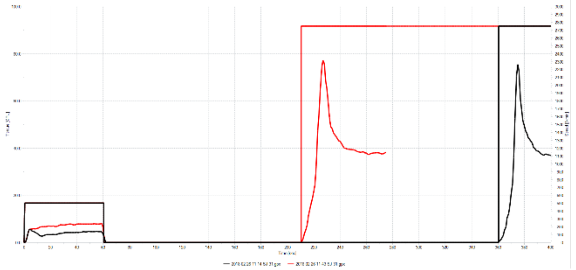
Method: Suni-bug Damage

Suni-bug Method		
	1. Test	**2. Test**
Whole meal flour	9g	9g
Dist. Water	10g	10g
Temperature	40 °C	40 °C
Speed	500 min^{-1} (60 s) **0** min^{-1} **(150 s)** 2.750 min^{-1} (150 s*)	500 min^{-1} (60 s) 0 min-1 (**600 s**) 2.750 min-1 (150 s*)
* Stop latest 15s after the peak		



High tendency for suni-bug damage



Low/no tendency for suni-bug damage

→ High reduction of the peak maximum → Tendency for suni-bug damage

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Method for Wafer Flour (Low Protein Flour)

Project Haas-Bühler AG Austria & Brabender Germany

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Method Development Wafer Flour

Challenges in Wafer Production

- Gluten (also in flours with low protein content) can lead to blockages in the dosing nozzles
- Deviations in flour quality lead to non-optimally filled wafer moulds
- Conventional flour analyses (ICC) take up a relatively large amount of time

Task of the Project

- Optimization of the flour analysis
- Development of a fast method with good correlations to common measurement methods

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Method Development Wafer Flour

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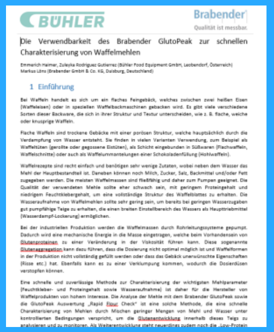
Project Description

20 flour samples → Measuring with the GlutoPeak RFC Method → Comparison of the results GlutoPeak and ICC → Optimization of the GP-Method → LPC (Low Protein Check) →

Comparison of the results GlutoPeak and ICC → *Wafer baking trials* → Evaluation flour analysis / baking trials *(not part of this presentation)* →


BÜHLER
Brabender
Die Verwendbarkeit des Brabender GlutoPeak zur schnellen Charakterisierung von Waffelmehlen
1 Einführung

All test trials (Analysis & baking) were done in the Haas-Bühler Technology Center Leobendorf, Austria

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Description of the Baking Trials

Laboratory baking pan and a corresponding core plate (Wafer cone baking oven)

- Mould heating temperature : 180 °C
- Core heating temperature: 190 °C
- Sample size: 7 ml
- After closing the oven:
  - 2 s open
  - 2 s close
  - 2 s open
  - 2 s close

  „Breath“

- Baking time: 80 s
- Cooling down 10 min. at room temperature
- Foil sealed storage at 8 °C

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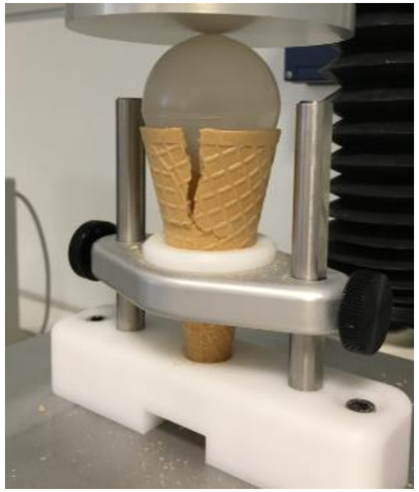
Texture Analysis of the Waffles

Measurements were done with a TA.XT.plus Texture Analyze (Stable Micro Systems)

- Measurement of the force necessary to produce a fracture
- Force transducer: spherical
- Pressing the ball into the wafer opening
- Recorded texture parameters
  - Distance travelled by the ball
  - Force required to break the wafer
- 10 wafer cones were tested per flour



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Results and Discussion

Project Haas-Bühler AG Austria & Brabender Germany

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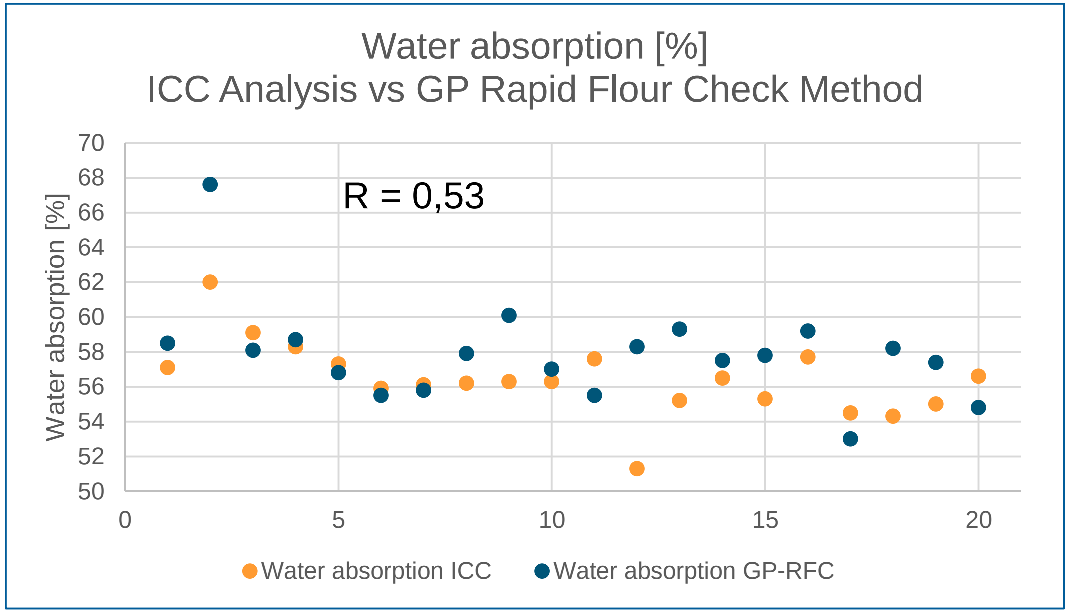
Evaluation with the GlutoPeak RFC Method

No optimal correlations to the reference analysis (ICC)

- Protein R = 0,85
- Wet gluten R = 0,75
- Developed for wheat flours with approx. 11 – 15 % protein
- Protein content of the project flours: 9,0 – 11,4 (15) %



→ Optimisation of the existing method →

Method	RFC	LPC*)
Flour	9 g	11 g
Liquid (dist. water)	9 g	12 g
Temperature	36 °C	35 °C
Speed	2750 min^{-1}	2500 min^{-1}
Time (max., approx.)	300 s	300 s

*) Low Protein Check

←

Korrelationen
• Water absorption
• Protein content
• Wet gluten content

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Project Participants

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FHW Franz Haas Waffelmaschinen GmbH, Leobendorf, Austria

(Planning, carrying out and evaluating the experiments in the Haas-Bühler technical centre)

Mr. Markus Löns

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Brabender GmbH & Co. KG, Duisburg, Deutschland

(GlutoPeak and laboratory technology)

"... a valuable alternative to the ICC methods..."

"... the flexibility of the GlutoPeak with its low sample volume and short test time proves to be a suitable alternative for the characterisation of wafer flours."

(Bühler, 2020)

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Rapid analytics in the value chain

Milling

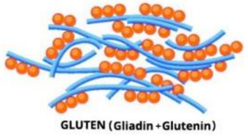
Starch production/ Gluten separation

Breeding

GlutoPeak analyses along the grain, flour and gluten value chain

Gluten analysis

R & D



(Wafer-) Baking

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