Optimization Potenzial in the Baking Industry
Quality Control in Production and Product Development
Introduction
In which steps of the grain value chain is quality control involved?

...where quality is measured.
Introduction
In which steps of the grain value chain is quality control involved?

Farmer → trader’s silo → flour mill → bakery

...where quality is measured.
Quality control in the **bakery**
Where is quality control involved?

1. **Incoming raw material inspection**

2. **Production control of dough**

3. **Efficient selection of raw material in product development**

...where quality is measured.
Quality control in the bakery
Where is quality control involved?

1. Incoming goods control
   - Raw materials / Ingredient weighing
   - Mixer
   - Divider
   - Rounder

2. Production control
   - Oven
   - Prover
   - Moulder
   - Check Weigher
   - Depanner
   - Cooler
   - Slicer / Bagger / Metal Detector / Weigher

...where quality is measured.
Quality control in the bakery
Measuring criteria: Optimal dough consistency

What kind of problems do we have when we are mixing a dough?

- Too dry
- Too strong
- Too viscous
- Too wet

Hard to make a good dough
Hard to handle during process

...where quality is measured.
Quality control in the bakery
What can bakers achieve and avoid with quality control?

1. Incoming raw material inspection

- Quality control for the incoming flour
- Test flour and baking characteristics of flour and find the optimum ones
- Find the right application for different flours and define specifications
- Control the production process and minimize production waste
- Control additive effects (enzymes and other baking improvers)
- Result can be used to optimize the production lines

...where quality is measured.
Quality control in the bakery
Measuring criteria: **Flour water absorption**

**Benefits for the daily practice:**

- Optimization of water absorption
  - → More water
  - → Best baking products

- Adaption of the kneading process on raw materials and production facilities
  - → Perfect dough
  - → Optimized mixing time saves energy

...where quality is measured.
Quality control in the bakery
Measuring criteria: Flour water absorption

Benefits for the daily practice:

- High quality baking products
  → Satisfied customers
  → Less waste, less cost

- Less loss through non-sellable products
  → Less production costs
  → Higher yield of baking products

...where quality is measured.
Benefit for a bakery because of using the Farinograph® (Example calculation)

- Consumption of flour per day 30 t
- Bread price in Turkey approx. 1,2 TL per kg
- With Farinograph® tests more water in the dough (1,0 %) because of
  - Calculation of the best water absorption
  - Optimal mixing/kneading process
- 30,000 kg flour = 300 kg more water
- Baking loss approx. 15% = 45 kg

(TL = Turkish Lira / date of calculation 02/2017)
Quality control in the bakery
Measuring criteria: Amortisation of lab equipment

Benefit for a bakery because of using the Farinograph®
(Example calculation)

- 255 kg more baking product / bread (300 kg – 45 kg)
  ⇒ 306 TL baking product
  ⇒ -150 TL higher flour price (0.005 TL per kg)
  ⇒ 156 TL per day
  ⇒ 46,800 TL after 300 days
  ⇒ approx. 12,500 € / $ 13,000

- Not calculated yet is loss/cost for
  - production time - turnover
  - waste - …

(TL = Turkish Lira / date of calculation 02/2017)

...where quality is measured.
Quality control in the flour mill
Measuring criteria: Flour water absorption

Benefit for a flour mill because of using a Farinograph®
(Example calculation)

- Production of flour per day 100 t
- Price of wheat flour in world trade approx. 1.30 TL per kg
- Product optimization with Farinograph®
  - Higher WA of 1.0 [%]
  - Optimal gluten properties
- Better flour quality = 0.005 TL / kg higher sales price
- 100,000 kg flour per day
- ⇒ 500 TL more per day

(TL = Turkish Lira / date of calculation 02/2017)

...where quality is measured.
Quality control in the flour mill
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- 100,000 kg flour per day
- ⇒ 500 TL more per day
- ⇒ 150,000 TL after 300 days (a year)
- ⇒ approx. 39,000 € / $ 41,000

(TL = Turkish Lira / date of calculation 02/2017)

...where quality is measured.
Quality control in the bakery
Measuring criteria: Dough resistance / extensibility

Why is this important for bakers?

- Flour supplied from the mill can be checked if it meets the specifications for the given application
- Influence of flour additives like ascorbic acid, enzymes (proteinases), and emulsifiers can be made evident.

Examples of applicable methods:

- Extensograph
- Alveograph
- Glutograph
- Gluten Peak Test
- ...

...where quality is measured.
Quality control in the bakery
Measuring criteria: Dough resistance / extensibility

Influence of additives

Ascorbic acid
- no addition
- low addition
- high addition

...where quality is measured.
Quality control in the bakery
Measuring criteria: Dough resistance / extensibility

- Strong flour and extensible, elastic dough
- Light, voluminous baking products with a good volume

- Rigid, tough dough structure and poor extensibility
- Results in small pieces of dough with poor spring

- Flour producing a wet, plastic dough
- Small baking volume

…where quality is measured.
Quality control in the bakery
Measuring criteria: **Starch properties / enzyme activity**

Why is this important for bakers?

- Flour supplied from the mill can be checked if it meets the specifications for the given application
- Control of enzyme addition

Example of applicable methods:

- Amylograph
- Falling Number
- …

...where quality is measured.
Quality control in the bakery
Measuring criteria: Enzyme activity/gelatinization properties

The Amylograph evaluation:

![Graph showing viscosity vs. AU (arbitrary units)]

- **Low enzyme activity**
- **Appropriate enzyme activity**
- **Enzyme activity too high**

...where quality is measured.
2. Production control of dough

Analysis of dough in terms of:

- Optimum dough consistency

Applicable methods:

- Dough mixing/kneading test

...where quality is measured.
Quality control in the bakery
Measuring criteria: Optimal dough consistency

The measuring mixer test:

- A 450 g sample is weighed and filled in a measuring mixer bowl.
- The dough is mixed at a defined speed (100 rpm).
- Test time 2-6 min. (depending from kind of dough).
- The consistence will be evaluated by predefined specifications.

...where quality is measured.
3. Efficient selection of raw material in bakery product development

Gluten aggregation kinetics as a tool for predicting wheat quality and end-use

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University Milano, Italy

...where quality is measured.
Breeders
Millers
Bakers
Pasta-makers

WHEAT VALUE CHAIN

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WHEAT VALUE CHAIN

- Breeders
- Millers
- Bakers
- Pasta-makers

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WHEAT VALUE CHAIN

Breeders

Millers

Bakers

Pastamakers

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## WHEAT VALUE CHAIN

<table>
<thead>
<tr>
<th>Test</th>
<th>Time*</th>
<th>Sample amount</th>
<th>Influence of the analyst</th>
</tr>
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<tbody>
<tr>
<td>Farinograph</td>
<td>~ 45 min**</td>
<td>50g, 300g</td>
<td>low</td>
</tr>
<tr>
<td>Alveograph</td>
<td>~ 40 min</td>
<td>250g</td>
<td>high</td>
</tr>
<tr>
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<td>medium</td>
</tr>
<tr>
<td>Rheofermentometer</td>
<td>~ 200 min</td>
<td>300g</td>
<td>low</td>
</tr>
<tr>
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<td>high</td>
</tr>
<tr>
<td>Kieffer Test</td>
<td>~ 60 min**</td>
<td>10g</td>
<td>high</td>
</tr>
<tr>
<td>Mixolab</td>
<td>~ 60 min**</td>
<td>50g</td>
<td>low</td>
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* including sample preparation and cleaning
** including the step for the determination of the optimal water absorption
### WHEAT VALUE CHAIN

#### GLUTOPEAK®

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<td>50g</td>
<td>low</td>
</tr>
<tr>
<td><strong>GlutoPeak</strong></td>
<td>5-10 min</td>
<td>&lt; 10g</td>
<td>very low</td>
</tr>
</tbody>
</table>

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

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Influence to obtain an optimal baking product (e.g.)

- Quality of raw materials
- Recipe
- Technological process parameters
- Baking process
- Customer demands
- ...
Criterias of raw materials

- Composition (protein, moisture, ash, fat, ...)
- Properties of the ingredients
- Final: Quality of flour in general
- Technological processing properties
- ...

GLUTEN AGGREGATION
GLUTEN AGGREGATION

Brabender® GlutoPeak® (GP)

- A new rapid method
- In addition to the Brabender® 3-Phase-System
- Rheological “fingerprint” of the flour, obtained within minutes
- Additional info for additional benefit
The Brabender® GlutoPeak®

- Measures flour, wholemeal flour, vital gluten and baking mixes
- Special application for wafer flour
- High correlation to protein content and baking volume
- Small sample size (3-10 g)
- Results within some minutes (1-10 min.)
- Reduce time for analytics
- Easy handling
Flour or wholemeal flour

Suspension High Speed

Liquid

TORQUE

Results by
- Evaluation software
- Correlation software

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GLUTEN AGGREGATION
GLUTEN AGGREGATION

GlutoPeak

![Image of gluten aggregation experiment](image)

- **100 μm**
- **Torque**
- **Torque (mean)**
- **Speed**
- **Speed profile**

*Image of gluten aggregation experiment with graph showing torque and speed over time.*
GlutoPeak

GLUTEN AGGREGATION

100 μm

1

2

100 μm

[Graph showing torque and time with labels and markers]

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GlutoPeak

GLUTEN AGGREGATION

100 μm

1

2

3

100 μm

Graph showing torque and speed over time.
GLUTEN AGGREGATION

Typical curves of flours for different applications
**GLUTEN AGGREGATION**

- **GlutoPeak vs Protein content**

*Similar protein content but different bread-making performance*

![Graph showing torque vs time for Etoubles (14.3% protein) and Verrayes (13.9% protein).](image)

```
<table>
<thead>
<tr>
<th>Torque (BE)</th>
<th>Time (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>20</td>
<td>2</td>
</tr>
<tr>
<td>30</td>
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GLUTEN AGGREGATION

- **GlutoPeak vs Protein content**
- **GlutoPeak vs Gluten content**

*Similar gluten content but different bread-making performance*

![Graph showing torque vs time for La Salle (39.3% wet gluten) and Rosset (40.4% wet gluten)]

- Torque (BE)
- Time (min)
- La Salle (39.3% wet gluten)
- Rosset (40.4% wet gluten)
GlutoPeak test and bread quality

\[ y = 0.0137x + 1.6677 \]
\[ R^2 = 0.67559 \]

\[ r = 0.82 \]
THANKS TO...

- Prof. Maria Ambrogina Pagani (University of Milan)
- Prof. Alessandro Ulrici (University of Modena and Reggio Emilia)
- Prof. Peter Koehler (Deutsche Forschungsanstalt für Lebensmittelchemie)
- Dr. Maria Grazia D’Egidio (CREA)
- Molino Quaglia spa
- Brabender GmbH & Co. KG
Studies / Content of the presentation

1. Alessandra Marti – University of Milano, Italy
2. Dr. Sanaa Ragaee – University of Guelph, Canada
3. Dr. Peter Köhler/Dr. Markus Brunnbauer
   • Deutsche Forschungsanstalt für Lebensmittelchemie
   • Hans-Dieter-Belitz-Institut für Mehl- und Eiweißforschung
     Freising, Germany
4. Prof. Koushik Seetharaman – University Guelph
5. Summery

...where quality is measured.
Dr. Sanaa Ragaee – University of Guelph, Canada
Comparison whole meal flour and flour

Peak Torque of White Flour and Whole Meal Flour

...where quality is measured.
Peak Torque of White Flour and Whole Meal Flour

\[ r^2 = 0.888 \]
\[ n = 23 \]

...where quality is measured.
Flour qualities

- **E (n = 2)** → \( E_1, E_2 \) excellent baking quality
- **A (n = 2)** → \( A_1, A_2 \) good baking quality
- **B (n = 3)** → \( B_1, B_2, B_3 \) moderate baking quality
- **C (n = 2)** → \( C_1, C_2 \) poor baking quality

Flour preparation:

- Milling with Quadrumat® Junior
- Sieving (0.2 mm)
Dr. Peter Köhler/Dr. Markus Brunnbauer, Instituts Freising, Germany
Comparison GlutoPeak® - Baking test (10g procedure)

Peak maximum time – dough development time

Torque maximum – Work on extension after 45 min

Torque maximum – baking volume

...where quality is measured.
Summary

- Standardization of flour quality is essential in food production
- Dough control during production avoid production error
- Amortisation of lab investments paid back shortly
- Additional rapid method for the first „quality finger print“
- GlutoPeak has potential to shorten product development time

...where quality is measured.
The Brabender® GlutoPeak®
Summery and Explanation in a quick way

Quality
- High
- Medium
- Low

...where quality is measured.
Crucial factors in grain and flour quality control

Conclusion

- Raw materials do not have good or bad technological properties, but there is a right or wrong application for them.
- Brabender® is your partner when you want to find the right application for the supplied grain and the produced flour.

…where quality is measured.