Improvement of Pasta and Noodle Flour

Hendrik Moegenburg
Mühlenchemie GmbH & Co. KG
Ahrensburg, Germany
Agenda

- Mühlenchemie: the company
- Pasta and noodles
- Why focus on pasta? Challenges in pasta flour improvement
- What quality aspects can we target?
- Enzymatic pasta flour improvement
- Reduction of oil uptake in instant noodles
- Composite flour noodles
Mühlenchemie: the company

We have been providing customized solutions and consultancy to the milling industry for 90 years.

Year of establishment: 1923
Registered offices: Ahrensburg / Hamburg
Ownership: Stern-Wywiol Gruppe, Hamburg

Specialization:
- Flour improvers
- Enzymes
- Vitamin and mineral premixes
- Technical services

Market position: International market leader
Turnover: 65 mill. USD
Number of employees: 120
Exports: > 110 countries
Pasta & Noodle Production & Consumption globally
Global Annual Production of Dried Pasta. Ten Largest Producers, 2010 (1,000 t)

<table>
<thead>
<tr>
<th>Country</th>
<th>Production (1,000 t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Italy</td>
<td>3,247</td>
</tr>
<tr>
<td>U.S.A.</td>
<td>2,000</td>
</tr>
<tr>
<td>Brazil</td>
<td>1,300</td>
</tr>
<tr>
<td>Russia</td>
<td>858</td>
</tr>
<tr>
<td>Turkey</td>
<td>741</td>
</tr>
<tr>
<td>Iran</td>
<td>364</td>
</tr>
<tr>
<td>Germany</td>
<td>325</td>
</tr>
<tr>
<td>Mexico</td>
<td>323</td>
</tr>
<tr>
<td>Egypt</td>
<td>323</td>
</tr>
<tr>
<td>Others</td>
<td>1,300</td>
</tr>
</tbody>
</table>

Total: 13,100

Global Annual Consumption of Instant Noodles. Ten Biggest Markets, 2011 (1,000 t)

- China, Hong Kong: 2548
- Indonesia: 707
- Japan: 128
- Vietnam: 170
- USA: 173
- Republic of Korea: 212
- India: 215
- Thailand: 294
- Philippines: 331
- Others: 872

Total: 5,892

Modif. from WINA Dec. 2012
Why focus on pasta?
Pasta in Asia

- Production and consumption of pasta in SEA (and also China) are still low, but on the increase
- .. but hardly any durum is being milled in the region
- .. which often leaves pasta producers with flour not ideally suited for the purpose
- .. and translates into an increasing number of requests for technical assistance from across the region to bridge perceived quality gaps
- .. while consumers, although often not accustomed to pasta (in an Italian sense), become more affluent, cosmopolitan and discerning while competition among suppliers will only increase.
Enzymatic improvement of pasta and also noodles is challenging due to low water activity and lack of dough rest / fermentation
Pasta Manufacturing Process

James E. Kruger, Robert B. Matsuo and Joel W. Dick, 1996.

"Pasta and Noodle Technology"
Noodle-Making Process

wheat → milling → flour → water, ingredients → mixing
Pasta and Mühlencemie

- But it is technically possible to use flour additives for improving pasta flour, and formerly prohibitive costs are becoming less of an issue

As a side effect...

- many (though not all) solutions workable for pasta also yield benefits when adopted in Asian noodle making
What quality aspects can we target?
Desirable Properties for Noodle Flour and Suitable Improvers

**Properties**

- **Easy processing**
  - Soft & extensible dough required

- **Uniform & quick drying**
  - Low water absorption

- **Tolerance towards moisture from fillings**
  - Firm and closed (uniform) dough structure

- **Low leaking losses upon cooking**
  - Firm and closed (uniform) dough structure
  - Low starch damage

- **High cooking tolerance (low "soakiness")**
  - Firm and closed (uniform) dough structure
  - Low starch damage
  - Good protein quality

**Improvers**

- **Enzymes; softening agents**
  - Hemicellulases; cysteine

- **Enzymes**
  - Hemicellulases

- **Emulsifiers; hydrocolloids**
  - Monoglycerides; guar gum

- **Enzymes; vital wheat gluten**
  - Carboxyl esterase; transglutaminase

- **Enzymes; vital wheat gluten**
  - Carboxyl esterase; transglutaminase
Enzymatic Pasta Flour Improvement using Carboxyl Esterases
Action of Carboxyl Esterases

Lipases

Galactolipases

Phospholipases

$R_1, R_2, R_3 =$ fatty acid residues
Action of Carboxyl Esterases

- **Polar lipids** are formed, acting as emulsifiers and interacting with the gluten

- **Free unsaturated fatty acids** are released, which can be converted by lipoxygenase (contained in flour naturally)...

- ... resulting in the formation of **hydroperoxides**, which can act as oxidants and lead to protein strengthening and bleaching (oxidation of pigments).
Objectives for pasta / noodle enzymes

- Making production of noodles from soft and hard wheat possible
- Improving color and brightness
- Increasing the firmness of cooked noodles
- Enhancing tolerance to overcooking
- Reducing oil uptake of fried instant noodles
- Reducing drying time of noodles
- Improving surface appearance and mechanical stability of dried noodle and pasta products
- Reducing raw material costs.
Texture Analyser Test
Texture Analyser Test
Improvement of Over-Cooking Tolerance with Pastazym
Firmness of Cooked Instant Noodles from Soft Wheat Made with Pastazym

![Graph showing the relationship between firmness and dosage of Pastazym. The x-axis represents dosage in g/100 kg flour, ranging from 0 to 25. The y-axis represents firmness in percentage, ranging from 100% to 107%.

As the dosage increases, the firmness of the noodles also increases, indicating a positive correlation between the two variables. The graph illustrates how Pastazym dosage affects the firmness of instant noodles made from soft wheat.](image-url)
Color of Fresh, Uncooked Noodles

![Graph showing the color (L*) of fresh, uncooked noodles as a function of dosage (g/100 kg flour) and hours after extrusion. The graph compares two dosages: 1 and 24 g/100 kg flour, with a color range from 70 to 84 L*. The graph shows a slight increase in color with increased dosage and hours after extrusion.]
Effect of Pastazym on the Color of Dry Noodles from Soft Wheat Flour

Reference

with Pastazym
Effect of Colorants on Noodle Appearance

<table>
<thead>
<tr>
<th>Durum wheat</th>
<th>Soft wheat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pastazym, tartrazin, β-carotene</td>
<td>Pastazym, folic acid, β-carotene</td>
</tr>
</tbody>
</table>
Durum Colour for Soft Wheat Pasta

Untreated soft wheat flour

Pastazym CUR

Pastazym BCN

Pastazym BCT
Effect of Pastazym CUR on the Colour of Cooked Pasta from Soft Wheat Flour

- Pastazym CUR 500 ppm
- Untreated

→ Pastazym CUR reduces the greyish shine of pasta made from soft wheat flour
Effect of Pastazym Cur, Pastazym BCN and Pastazym BCT on Firmness of Soft Wheat Noodles

- **Soft wheat flour**: +40%
- **Durum**: +41%
- **Pastazym CUR 500 ppm**: +43%
- **Pastazym BCT 200 ppm**: +37%
Effect of Pastazym Plus on Stickiness of Cooked Spaghetti not made from durum semolina

Stickiness (g·s)

<table>
<thead>
<tr>
<th>Pastazym</th>
<th>Pastazym Plus</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.04</td>
<td>0.96</td>
</tr>
</tbody>
</table>

Dosage: 200 ppm on soft wheat flour*

*soft wheat flour type 55; protein 12.1%; ash 0.6%; wet gluten 27.6%
Reduction of Starch Leaching by Pastazym Plus

Reference

Pastazym Plus, 200 ppm
Cost Advantage by Pastazym Plus in Pasta

Calculation based on January 2012 figures

200 ppm Pastazym Plus

Grist costs (USD / t)

% HRW, combined mit Durum (HADW)

Calculation based on January 2012 figures
# Properties of the Pastazym Family

<table>
<thead>
<tr>
<th>Property</th>
<th>Pastazym</th>
<th>Pastazym Plus</th>
<th>Pastazym BCT</th>
<th>Pastazym BCN</th>
<th>Pastazym CUR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colour</td>
<td>--</td>
<td>-</td>
<td>+++</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Firmness</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Stickiness</td>
<td>--</td>
<td>---</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Cost reduction</td>
<td>++</td>
<td>+++</td>
<td>++</td>
<td>++</td>
<td>+</td>
</tr>
</tbody>
</table>

- = reduction
+ = increase
Reduction of Oil Uptake into Instant Noodles
Visualization Oil Uptake into Instant Noodles by *Sudan Red* Staining

larger figures = larger reduction of oil uptake
Reduction of Oil Uptake into Instant Noodles

Negative figures = increased oil uptake

Fat reduction (%)
Reduction of Oil Uptake into Instant Noodles by Synergistic Additive Compound

![Bar chart showing Fat Uptake (%) for Standard, 300 ppm, and 700 ppm of Pastazym FR.](chart.png)
Composite flour noodles

Wheat flour substitution by tapioca flour
Improvement of the Colour of Dry Spaghetti from Composite Flour (95% wheat + 5% tapioca flour)

- Untreated
- 200 ppm Pastazym BCT Plus
- 0.1% EMCEdur BCT ETH
- Untreated
Improvement of the Colour of Dry Spaghetti from Composite Flour (80% wheat + 20% tapioca flour)
Improvement of the Colour of Cooked Spaghetti from Composite Flour (95% wheat + 5% cassava flour)

Untreated

0.1% EMCEdur BCT ETH

200 ppm Pastazym BCT Plus
Improvement of the Texture of Cooked Spaghetti from Composite Flour

Firmness (g)

0 50 100 150 200 250

Untreated 200 ppm Pastazym BCT Plus 0.1% EMCEdur BCT ETH Untreated 200 ppm Pastazym BCT Plus 0.1% EMCEdur BCT ETH

100% wheat flour 95% wheat + 5% cassava flour