FUMONISINS IN MAIZE AND MAIZE PRODUCTS
CONTENTS

1. Contamination of Fumonisins in Italian maize
   with the aim to ascertain the maize quote left below
   the proposed maximum limits;

2. Distribution of fumonisins in the maize milling
   process with the aim to ascertain the possibility to
   obtain maize products with levels of Fumonisins
   below the proposed maximum residual limits (MRLs)
   and to verify how the milling process influences
   Fumonisins re-distribution in the milling fractions.
1. CONTAMINATION OF FUMONISINS IN ITALIAN MAIZE

Italian Maize:

• First Italian crop with about 1.1 millions of hectares;
• Production over 10 million tons;
• Italy is the second country for maize production in Europe;
• Po plain is the main area for maize production.
### Table 1. SURVEYS ON FUMONISINS OCCURRENCE IN ITALIAN MAIZE

<table>
<thead>
<tr>
<th>No.</th>
<th>Sampling Area</th>
<th>Sampling points</th>
<th>Sampling methods</th>
<th>Analysis Methods</th>
<th>Scientific reference</th>
<th>No. of samples</th>
<th>No. years</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Po plain</td>
<td>Drying units; experimental fields</td>
<td>Dynamic methods</td>
<td>ELISA</td>
<td>Reg. Lombardia; CRA; Assincer; AIRES</td>
<td>1468</td>
<td>4 (1999-2004)</td>
</tr>
<tr>
<td>2</td>
<td>Po plain</td>
<td>Field</td>
<td>Dynamic methods</td>
<td>ELISA</td>
<td>Syngenta seeds Italia</td>
<td>586</td>
<td>6 (1999-2004)</td>
</tr>
<tr>
<td>3</td>
<td>Piemonte</td>
<td>Drying units; experimental and farm fields</td>
<td>Dynamic methods (drying units); 200 ears (fields)</td>
<td>HPLC</td>
<td>Univ. Torino</td>
<td>538</td>
<td>5 (2000-2004)</td>
</tr>
</tbody>
</table>
Chart 1: AVERAGE LEVELS OF FUMONISINS B1+B2 IN ITALIAN MAIZE YEARS 2004-05
FIRST CONCLUSION

• If proposed MRLs for Fumonisins of EU Regulation no. 1881/2006 will be enforced, over 70% of Italian maize will be unsuitable for human consumption.

• Substantial changes of the current contamination levels cannot be expected in a short term because the application of Good Agricultural Practices (GAPs) will not be enough to reduce Fumonisins levels in maize below 2000 ppb.
Table 2: EFFECTS OF AGRICULTURAL PRACTICES ON MYCOTOXINS CONTAMINATION

<table>
<thead>
<tr>
<th>Practice</th>
<th>Fumonisine</th>
<th>Zearalenone &amp; DON</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crop rotation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tillage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hybrid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seeding time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fertilization</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weed control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insect control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Irrigation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Harvest time</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Potential effect on concentration: "1" < 2 2-4 > 4

Reyneri et al., 2005
2. SURVEY ON DISTRIBUTION OF FUMONISINS IN THE MAIZE MILLING PROCESS

• 15 milling industries involved (milling process represents 90% of maize application in food);

• 23 milling processes analyzed;

• sampling protocol as per EU Regulation no. 401/2006, adapted to the milling process with the co-operation of the University of Torino;

• 167 aggregate samples homogenized and analyzed at the same laboratory;

• scientific reliability of data obtained under the supervision of three independent organisms: Universities of Padova, Piacenza and Torino;

**N.B.** following data does not represent neither the average Fumonisins levels of Italian maize, nor the average residual levels of products thereof, because maize lots processed for the survey have been deliberately selected to represent situations of high, medium and low starting contamination.
# MILLING PROCESS

## PRODUCTS AND BYPRODUCTS CONSIDERED

<table>
<thead>
<tr>
<th>PRODUCTS</th>
<th>SIZE (micron)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAIZE KERNELS</td>
<td></td>
</tr>
<tr>
<td>HOMINY GRITS</td>
<td>&gt; 4000</td>
</tr>
<tr>
<td>GRITS</td>
<td>250-1400</td>
</tr>
<tr>
<td>POLENTA MEAL /FLOUR</td>
<td>350-850</td>
</tr>
<tr>
<td>FLOUR</td>
<td>&lt; 350</td>
</tr>
<tr>
<td>GERM</td>
<td></td>
</tr>
<tr>
<td>FEED MEAL</td>
<td></td>
</tr>
</tbody>
</table>

1. **Raw grain**
   - (cleaning)
2. **Cleaned grain**
   - (degermination)
3. **Germ**
4. **Grits**
   - (refining flaking grits)
5. **Flour**
6. **Animal meal**
METHODS OF SAMPLING

1) Identification of products to be sampled;
2) Location of sampling points through each milling process;
3) Evaluation and timing of incremental samples drawing with reference to type of flow and lot size;
4) Calculation of drawing times for each sampling point making reference to the first sampling point (not cleaned maize) as time “zero”;
5) Sealing, labelling of each aggregate sample and sending to the official laboratory;
6) Aggregate samples collection, milling, homogenization and analysis at ISAN laboratory of Piacenza University, with the HPLC method, performing as per EU Reg. 401/2006.
METHODS OF SAMPLING

Example: Milling for production of grits

• Processed maize = 5 t/h
• Lot weight = 5 t → 40 incremental samples of 100 grams each

1 incremental sample every 90 seconds

• Aggregate sample = 4 kg

<table>
<thead>
<tr>
<th>Product</th>
<th>Sampling point</th>
<th>Start of sampling (minute)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uncleaned grain</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Cleaned grain</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Germ</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>Grits</td>
<td>4</td>
<td>15</td>
</tr>
<tr>
<td>Corn flour</td>
<td>5</td>
<td>15</td>
</tr>
<tr>
<td>Animal meal</td>
<td>6</td>
<td>15</td>
</tr>
</tbody>
</table>
Chart 2. CLEANING PHASE

\[ y = 0.6349x + 62.411 \]
\[ R^2 = 0.9013 \]
Chart 3. CLEANING PHASE

Regression calculated on experimental data

Theoretic removal of fumonisins calculated on regression between raw maize and cleaned maize.
Three tipologies of milling process have been analysed:

- hominy grits
- grits (grits + flour)
- meal (polenta meal+finest flour+flour)
Chart 4. FUMONISINS
HOMINY GRITS PROCESS

- Fumonisins (index value):
  - > 4000 hominy grits: 11 (raw), 17 (cleaned)
  - 1000-4000 fine grits: 29 (raw), 43 (cleaned)
  - Germ: 69 (raw), 108 (cleaned)
  - Feed meal: 231 (raw)

- Micron:
  - > 4000 hominy grits
  - 1000-4000 fine grits
  - Germ
  - Feed meal
Chart 5. FUMONISINS GRITS PROCESS

- Micron 250-1400 grits: Fumonisins (index value) = 21 raw, 35 cleaned
- Micron 200-400 flour: Fumonisins (index value) = 59 raw, 96 cleaned
- Micron germ: Fumonisins (index value) = 76 raw, 128 cleaned
- Micron feed meal: Fumonisins (index value) = 241 raw

Legend:
- Raw = 100
- Cleaned = 100
Chart 6. FUMONISINS MEAL PROCESS

- **Fumonisins (index value)**
  - Perl meal: 18 (raw=100) 30 (cleaned=100)
  - Break meal: 44 (raw=100) 59 (cleaned=100)
  - Flour: 66 (raw=100) 90 (cleaned=100)
  - Germ: 86 (raw=100) 121 (cleaned=100)
  - Feed meal: 286 (raw=100)

**Micron**
- 500-800
- 350-500
- < 350
Remarks

• The finer the granulation size of the flour, the higher the residual fumonisins level. Therefore, being flour, meal and grits grouped in the same category at point 2.6.2 of EU Reg. 1881/2006, the MRLs should consider the finer product (maize flour) as a reference;

• Germ has much higher contamination than flour, grits or meal;

• High variability in germ contamination levels has been observed, very likely as a consequence of different germ extraction technologies throughout the various milling processes;
Remarks

• Differentiation between milling processes mainly concerns the germ extraction procedure and the finer fractions classification;

• The germ is a byproduct addressed to the oil refining process. There is no reason to include it in the same category of finished products. It was not included in the EU Regulation 856/2005. Moreover germ is not a foodstuff by itself: only refined oil is addressed to human consumption and there is no carryover of fumonisins in it.
Chart 7. According to the surveyed data, it is possible to calculate the regression between Fumonisins in maize and residual levels in products thereof.

Reg.to 1881/06
Remarks

in the case of MRLs enforcement, a huge no. of operators will be forced to close down their activity and a significative portion of the products of the mill (flour and germ) will dramatically reduce its economic value;

The overall impact of the MRLs enforcement on the maize business is estimated in 800 milions of Euro (oil excluded);

To safeguard this market segment it is necessary to increase the MRLs;

This must be done without putting the consumer’s health under risk.
Official Toxicological studies (EU Scoop Task 3.2.10 and Italian Ministry of Health) evidence that, taking into consideration the current levels of contamination, consumer’s exposure to Fumonisins risk is extremelly lower than the Tolerable Daily Intake (TDI);
Chart 8. Exposure to Fumonisins B1 (µg/kg pc/day) of groups of Italian population
Brera C., Debegnach F., Grassi S., Miraglia M. - ISS

TDI recommended by Scientific Committee for Food (2 µg/kg pc/die)

- Maize flour
- Flakes
- Others

* AE: Average exposure
* E 95: Exposure 95 percentile
There are objective reasons to ask for higher Fumonisins MRLs than those proposed by EU Reg. 1881/2006

Without putting under risk the consumer’s health.
Chart 9. Residual contamination in the milling fractions compared to the starting contamination in maize.
Remarks

• The MRLs increase will not allow the maize chain operators to accept the current situation, on the contrary it will require a great commitment toward agricultural practices improvement;

• Milling industries are already selecting their maize supply by means of cultivation contracts, GAP’s protocols and production controls.
Chart 10. Processed maize deriving from the application of Good Agricultural Practices
Chart 11. GAP’s protocols implemented by the Italian Milling Industries
Conclusions:

• On one hand MRLs currently proposed by EU Reg. 1881/2006 for Fumonisins will give an over protection to the consumers. On the other hand it will have an economic impact of 800 million Euros on the Italian maize business;

• With the enforcement of MRLs, over 70% of Italian maize will be unsuitable for human consumption;

• Processing of maize within the current maximum limit of 2000 ppb, about 25% of milling products (flour and germ) will exceed the MRLs set for their category and will be unsuitable for human consumption;

• The inclusion of maize germ in the same category of flour and oil is unjustified because germ is a by product of the milling industry addressed to the oil refining process.
Italian milling industries and corn growers, here represented by A.I.R.E.S. GLM, according to what provided by preamble no. 36) of Eu Reg. 1881/2006 and on the base of the objective data reported by the above survey,

**DEMAND**

1) The increase of the MRLs for Fumonisins for unprocessed maize and products thereof as per the following table;

<table>
<thead>
<tr>
<th>Category</th>
<th>MRL (ppb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unprocessed maize</td>
<td>5000 ppb</td>
</tr>
<tr>
<td>Maize flour, maize meal, maize grits and refined maize oil</td>
<td>3000 ppb</td>
</tr>
<tr>
<td>Maize based foods for direct human consumption, excluding foods listed in 2.6.2 and 2.6.4</td>
<td>1500 ppb</td>
</tr>
<tr>
<td>Processed maize based food and baby foods for infants and young children</td>
<td>No increase (200 ppb)</td>
</tr>
</tbody>
</table>

2) The removal of germ from the product category of point 2.6.2. because germ is a by product of the Milling Industry addressed to the oil production.