WATCH Meeting 25th October 2001

Reducing Exposure to Allergens in Bakeries
Joint Project with ABIM

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**Exposure to allergens in baking**

**Summary:** HSE / HSL undertook series of flour dust and exposure survey in large, medium and small bakeries from 1998 to 2005. This worked supported the setting in May 2001 of the Flour dust exposure limit (now WEL) 10 mg/m³ 8HrTWA. Subsequent work quantified exposure to microbial enzyme allergens, and examined whether flour dust exposures had reduced following introduction of the WEL.

- 87% +ve to wheat & enzymes
- 48% +ve to wheat only
- 13% +ve to enzyme only

- Fungal & bacterial amylase
- Hemicellulase/ Cellulase/ Xylanase
- Glucose oxidase / Amyloglucosidase
Study: Dustiness of bread improvers

- HSE funded joint study with ABIM started in 2008

- Bakery Improver
  - Flour
  - Enzymes
  - Soya flour

- Vegetables
- Calcium sulphate
- Emulsifier
- Data ester
- Calcium silicate
Aim: To investigate whether changing the proportions of ingredients in bread improver mixtures reduces their dustiness and consequently the exposure of bakers to allergens.

- Improvers contain microbial enzyme allergens.
- A process of formulating/mixing improvers is undertaken in large, medium and small bakeries.
- Modifying improver mixtures could control dustiness at source (consistent with CoSHH) rather than relying first on other aspects of a control strategy.
- Controlling dustiness at source is particularly relevant to small non-mechanised bakeries where implementing engineering controls solutions is generally prohibitive because of costs.
## Dustiness testing

<table>
<thead>
<tr>
<th>Standard dustiness testing (rotating drum)</th>
<th>User Test Exposure measurement</th>
</tr>
</thead>
</table>

- European standard EN15051 (HSE MDHS 81) separates airborne dust into three health-related fractions (inhalable, thoracic and respirable) for mass measurement. Run at 4rpm and air drawn at 38L/min

- Enclosed chamber allowing manual task to be replicated and dust personal samples and size distribution (Aerosizer™)
Characterising dustiness

Classification of dustiness according to EN15051

<table>
<thead>
<tr>
<th>Category of dustiness</th>
<th>Inhalable dustiness mass fraction (mg/kg)</th>
<th>Thoracic dustiness mass fraction (mg/kg)</th>
<th>Respirable dustiness mass fraction (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very low</td>
<td>&lt;200</td>
<td>&lt;40</td>
<td>&lt;10</td>
</tr>
<tr>
<td>Low</td>
<td>200 - 1000</td>
<td>40 - 200</td>
<td>10 - 50</td>
</tr>
<tr>
<td>Moderate</td>
<td>&gt;1000 - 5000</td>
<td>&gt;200 - 1000</td>
<td>&gt;50 - 250</td>
</tr>
<tr>
<td>High</td>
<td>&gt;5000</td>
<td>&gt;1000</td>
<td>&gt;250</td>
</tr>
</tbody>
</table>
# Dustiness: modified improvers

<table>
<thead>
<tr>
<th>Sample</th>
<th>Description of sample</th>
<th>Soya</th>
<th>Emulsifier</th>
<th>Ca sulphate</th>
<th>Oil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue</td>
<td>Control: flour and ascorbic acid only</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Red</td>
<td>Control: As blue, with fungal alpha amylase added</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Yellow</td>
<td>Same as red with soya added</td>
<td>20%</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Green</td>
<td>Same as yellow with emulsifier added</td>
<td>20%</td>
<td>20%</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Black</td>
<td>Same as green with calcium sulphate added</td>
<td>20%</td>
<td>20%</td>
<td>25%</td>
<td>None</td>
</tr>
<tr>
<td>Orange</td>
<td>Same as black with oil added</td>
<td>20%</td>
<td>20%</td>
<td>25%</td>
<td>2%</td>
</tr>
</tbody>
</table>

**Graph:**

- Blue: Inhalable
- Red: Thoracic
- Yellow: Respirable

Coded improver mixtures

Dustiness (mg/kg)
Dustiness: Improver constituents

- Flour
- CaSO$_4$
- Soya Flour
- Flour 2
- Emul
- Flour 3
- CaCO$_3$

Dustiness: Inhalable, Thoracic, Respirable
Dustiness: Emulsifier constituents

Dustiness mg/kg

Flour & Emul & CaSi

Flour & Data Ester (E472e)

Flour & CaSi

= Inhalable

= Thoracic

= Respirable
Dustiness: Calcium sulphate

Dustiness mg/kg

= Inhalable
= Thoracic
= Respirable

Flour
CaSO₄
Flour & CaSO₄
Dustiness: aerodynamic diameter

![Bar chart showing aerodynamic diameter of different flour samples and CaSi additions.](chart.png)
Dustiness: Free flow agent & allergens

WFA= Wheat flour antigen

- Inhalable
- Thoracic
- Respirable

Graph showing WFA concentrations for different treatments:
- Flour 25% CaSO4
- 20% Emulsifier
- 2% CaSi
- 1% CaSi
- 0.6% CaSi
Dustiness: Modified improver mixtures

Sample descriptions and key ingredient changes

<table>
<thead>
<tr>
<th>Sample</th>
<th>Description of change</th>
<th>Ca sulphate</th>
<th>Emulsifier</th>
<th>Oil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red2</td>
<td>Typical Improver: control sample</td>
<td>25%</td>
<td>Contains 5% Ca silicate</td>
<td>2%</td>
</tr>
<tr>
<td>Orange2</td>
<td>No Emulsifier</td>
<td>25%</td>
<td>None</td>
<td>2%</td>
</tr>
<tr>
<td>Green2</td>
<td>No Ca sulphate</td>
<td>None</td>
<td>Contains 5% Ca silicate</td>
<td>2%</td>
</tr>
<tr>
<td>Blue2</td>
<td>Reduced Ca sulphate</td>
<td>5%</td>
<td>Contains 5% Ca silicate</td>
<td>2%</td>
</tr>
<tr>
<td>Black2</td>
<td>Contains emulsifier with reduced Ca silicate</td>
<td>25%</td>
<td>Contains 3% Ca silicate</td>
<td>2%</td>
</tr>
<tr>
<td>White2</td>
<td>Contains extra oil</td>
<td>25%</td>
<td>Contains 5% Ca silicate</td>
<td>4%</td>
</tr>
<tr>
<td>Yellow2</td>
<td>Contains all 3 realistic improvements</td>
<td>5%</td>
<td>Contains 3% Ca silicate</td>
<td>4%</td>
</tr>
</tbody>
</table>
User test results: dustiness

Does the formulation of improvers affect exposure to dust?

![Graph showing dust levels with bars for Control, Max Oil, Min Ca SO₄, and Min Ca Si. The x-axis represents different treatments, and the y-axis represents dust level in mg m⁻³. The legend indicates that the blue bars represent inhalable dust.]
User test results: allergen exposure

Does the formulation of improvers affect exposure to allergens?

- Inhalable wheat flour antigen
- Inhalable soya bean trypsin inhibitor

![Bar chart showing allergen exposure](chart.png)
Acknowledgements

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