Post-harvest drying, storage and handling/value chain analysis

Catherine Brabet
with the collaboration of Danièle Clavel

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# CIRAD expertise on mycotoxins & food safety

## Previous projects on mycotoxin control in food chains

<table>
<thead>
<tr>
<th>CIRAD coordination</th>
<th>Food/Mycotoxins</th>
<th>Financing/Period</th>
<th>Geographical area</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Groundnut/AF Corn &amp; wheat /AF, FUM, ZEA… Brazil nut/AF</td>
<td>FP6 INCO-DEV (2001-06) FP5 INCO-DEV Mycotox (2003-06) STDF (WTO) Safenut (2006-08)</td>
<td>Sahel Africa (Senegal, Mali) Latin America Brazil, Amazon region</td>
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## Current projects on food safety, including mycotoxin aspects

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<th>CIRAD coordination</th>
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<tr>
<td></td>
<td>AFTER, African traditional foods 3CIvoire, Food safety</td>
<td>FP7 (2010-13) EuropeAid (2011-13)</td>
<td>Senegal, Ghana, Benin, IC, Egypt, Cameroon, Madagascar, South Africa</td>
</tr>
<tr>
<td>Other projects</td>
<td>EDES, Food safety</td>
<td>9th EDF (2010-14)</td>
<td>ACP</td>
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</table>
## Post-harvest practices for aflatoxin control (1/4)

<table>
<thead>
<tr>
<th>Critical factors</th>
<th>Proper drying as quickly as possible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low moisture content and water activity (a_w)</td>
<td><strong>Appropriate temperature &amp; time</strong>&lt;br&gt;Products should be dried to a safe moisture content (a_w &lt; 0.7)&lt;br&gt;Grains: MC &lt; 14%&lt;br&gt;Groundnuts: MC &lt; 8%&lt;br&gt;Cotton seeds: MC &lt; 10%&lt;br&gt;Process adjustments where operating limits are violated</td>
</tr>
<tr>
<td>Avoid cross-contamination</td>
<td>Cleaning of dryers</td>
</tr>
</tbody>
</table>
### Post-harvest practices for aflatoxin control (2/4)

<table>
<thead>
<tr>
<th>Critical factors</th>
<th>Proper storage</th>
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</thead>
</table>
| Low moisture content and $a_w$ to be kept after drying (avoid re-wetting) | **Control of humidity, temperature, ventilation**  
Appropriate storage facility & packaging  
Process adjustments where operating limits are violated |
| Temperature                                                                  |                                                                                                 |
| Avoid immature, mouldy & damaged products                                   | **Manual or mechanical sorting/segregation**, based on product density, colour, damages, greenish-yellow fluorescence under UV light…  
Use of antifungal treatments                                                  |
| Avoid pest physical damages                                                   | Appropriate packaging  
General hygiene  
Pest control                                                                        |
| Avoid cross-contamination                                                     | Cleaning of stores & packaging                                                                   |
**Post-harvest practices for aflatoxin control (3/4)**

<table>
<thead>
<tr>
<th>Critical factors</th>
<th>Proper transportation</th>
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<tr>
<td>Low moisture content and $a_w$ to be kept</td>
<td>Control of humidity, temperature, ventilation</td>
</tr>
<tr>
<td></td>
<td>Appropriate packaging</td>
</tr>
<tr>
<td>Avoid mouldy &amp; damaged products</td>
<td>Appropriate food state</td>
</tr>
<tr>
<td>Avoid pest physical damages</td>
<td>Appropriate packaging</td>
</tr>
<tr>
<td></td>
<td>General hygiene</td>
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<td>Pest control</td>
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<tr>
<td>Avoid cross-contamination</td>
<td>Cleaning of containers…&amp; packaging</td>
</tr>
<tr>
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<td>Containers should be clean, dry and free of insects &amp; fungal growth</td>
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</table>
### Post-harvest practices for aflatoxin control (4/4)

#### Processing

| Physical treatments | Heating (autoclaving, groundnut roasting; maize extrusion…)  
Decrees AF levels, but AF not completely destroyed |
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<td>Controlled atmosphere: AF production greatly restricted if O2&lt;1% and CO2 increased</td>
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<tr>
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<td>Milling: Separation of grains into fractions and elimination of the toxic portions (bran and germ in dry milling)</td>
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<td>Pulsed light (UVC-near IR), during 300 µs, up to 5 times/s</td>
</tr>
</tbody>
</table>
| Chemical treatments | Ozonation, but nutritional value affected  
Application in feedstuff industry: |
|                     | AF adsorption/binders: calcium alumino-silicates |
|                     | AF decomposition (95-98%): Ammoniation |
| Biological treatments | Microbial detoxification |
|                     | Fermentation, silage |

#### Existing guides of good practices
Understand fungal growth & AF production along the production chain

- Identification of critical points & factors
- Develop & validate preventive and controlling measures
- Sampling and analytical methods for AF surveillance & monitoring
- Critical Point: preparation of representative samples

Appropriation & adoption of the AF management system by the private sector

- Promoting good practice implementation

- Existing knowledge and preventive measures already tested and validated

- Nevertheless, needs to confirm critical points & factors, to adapt to the local context, test and validate technical procedures/equipment

NB: Biological control: check that other mycotoxins are not produced
### Diagnostic: gaps and needs for AF control in Africa (2/2)

**Applied & participative research actions focusing on:**

- **Preventive measures** instead of curative by limiting the risk at each stage from the field to consumption

- **Sustainable measures**: cost-effective & environmentally friendly (use of alternatives to chemicals, renewable energy…)

- **Constraints and strategies for the adoption of an AF management system**  
  Evaluation of the cost/benefit of preventive measures, promoting incentives…

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**No research without impact on society**

**Contribution to innovation dissemination and education for AF awareness**

- **Training in good practices for the private sector**

- **Strengthening laboratory and surveillance capacities**

- **Promoting information and communication (specialized media...) to encourage political support**
To summarize: proposed strategy for PACA

- **Integrated approach, from farm to fork**
  Limit the risks of AF contamination along the food chain as they are at each step

- **Concerted effort of all actors along the food production chain**
  Private sector (farmers, industries…), R&D institutes, public and regulatory authorities, NGO, Civil Society Organizations…
  - Need for adequate social organization & coordination between chain actors

- **Multidisciplinary approach**
  By integrating technical and socio-economical aspects to develop a sustainable AF management system

- **In coordination with other projects/activities, as platform for complementary actions**
  - FP7 Mycored project (2009-13) : Novel integrated strategies for worldwide mycotoxin reduction in food and feed chains
    Mycored Africa 2011, 4-6 April, South Africa
  - EDES project
  - AFTER project
  - STDF program…
Pre-harvest (GAP)

Post-harvest: drying, cleaning, storage, processing (GMP)

SOCIO-ECONOMICAL, ENVIRONMENTAL & TECHNICAL CONTEXT

NGO

Public & regulatory authorities

R&D institutes

Farmers

SMEs & Cooperatives

Traders

HUMAN FOOD

LOCAL CONSUMPTION

REGIONAL TRADE

EXPORT MARKET

ANIMAL FEEDING

DERIVED FOODSTUFF meat, milk, eggs...

HACCP

Compliance with international standards & EU regulations

Consumer & farmer health

Environmental protection