Direct market costs of aflatoxins in Kenyan dairy value chain

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Dairy industry in Kenya

- Contributes 3.5% of Kenya's GDP
- Highest per capita milk consumption in East Africa (around 100 kg/capita/year)
- Large and small scale production systems (the latter contributes 80% of milk output)
- Dairy production improves the livelihoods of households producers through nutrition, income and employment, use of organic fertilizer, as well as assets and savings
Dairy industry in Kenya

• Of the total annual cow milk production (3.6 billion litres) only about 15% is processed (formal) (FAO, 2012)

• Processing prevents a number of hazards in milk

• However, other hazards persist such as drug residues, pesticide residues, heavy metals, and biological toxins e.g. aflatoxin M1 (AFM1)
Aflatoxins are by-products of fungal metabolism synthesized by fungus of the genus *Aspergillus*.

Figure 1. Aflatoxins' potential disease pathways in humans.
Aflatoxin B1/M1

- Aflatoxin B1 consumed in dairy feeds is converted to aflatoxin M1 and secreted in milk.
- Aflatoxin B1 in dairy feeds causes a decrease in milk production, reduced feed efficiency and reduced cows fertility.
- Aflatoxin B1 is a class 1 human carcinogen (definitely carcinogenic) and aflatoxin M1 a class 2b (possible) human carcinogen.
Study sites

- Random selection of study sites in agro-ecological zones (IIASA/FAO, 2012)

<table>
<thead>
<tr>
<th>AEZ</th>
<th>Research county</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semi-arid</td>
<td>Isiolo</td>
</tr>
<tr>
<td>Sub-humid</td>
<td>Kwale</td>
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<tr>
<td>Humid</td>
<td>Tharaka Nithi</td>
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<tr>
<td>Temperate</td>
<td>Bungoma</td>
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<tr>
<td></td>
<td>Kisii</td>
</tr>
</tbody>
</table>
Sampling strategy

- Cross sectional study with two time visit: dry and rainy seasons

**Sampling 1**
(All counties)

**Sampling 2**
- T-Nithi (Humid)
- Isiolo (Semi-arid)
- Kisii (Temperate)

**Sampling 2**
- Kwale (Sub-humid)
- Bungoma (Temperate)
Analysis

• Laboratory analysis: determination of aflatoxins using competitive ELISA

• Aflatoxins cause two types of economic losses:
  ✓ Human health costs
  ✓ Direct market costs

• This presentation considers direct market costs (economic losses)

• Human health losses were also assessed but are not presented here
Analysis

• Direct market costs were estimated using the annual feed and milk production, market costs of feeds and milk and the proportion of samples exceeding the aflatoxin limits

• Use of Stata® 13 (StataCorp LP, Texas, US) for statistical analysis
Estimation of direct market costs of aflatoxins

- Kenya/FAO/WHO limit for AFB1 in feeds is 5 ppb
  - Cost is calculated base on if all feed exceeding levels at feed manufacturer level would be discarded

- AFB1 levels above 120 ppb in dairy feeds cause a reduction in milk production up to 25% (Guthrie and Bedell, 1979).
  - Cost is calculated based on a 25% decrease in milk production when the AFB1 concentration in farmers dairy feeds exceeds 120 ppb

- FAO/WHO AFM1 limit is 50 ppt
  - Cost is calculated assuming all milk above 50 ppt was discarded
## Estimation of direct market costs of aflatoxins

<table>
<thead>
<tr>
<th>Aflatoxin limits</th>
<th>Proportion of samples exceeding aflatoxin limits</th>
<th>Annual production</th>
<th>Estimated economic costs in US$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feed AFB1&gt; 5 ppb (feed manufacturers)</td>
<td>62/101 (61.4%)</td>
<td>10,982 tones of feed</td>
<td>22.2 million</td>
</tr>
<tr>
<td>Feed AFB1&gt;120ppb (dairy farmers)</td>
<td>17/118 (14.4%)</td>
<td>3.8 billion liters of cow milk</td>
<td>37.4 million</td>
</tr>
<tr>
<td>Milk AFM1&gt;50ppt(dairy farmers)</td>
<td>29/283 (10.3%)</td>
<td>3.8 billion liters of cow milk</td>
<td>113.3 million</td>
</tr>
</tbody>
</table>
Conclusions

- There is need to create public awareness on presence of aflatoxins in dairy feeds and milk.

- Aflatoxins are contributing to economic losses, and would contribute even more if regulations were strictly enforced.

- Aflatoxin costs in dairy value chain could be reduced by focusing on aflatoxin management strategies aimed at reducing aflatoxin contamination in the dairy feed value chain.
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Thank you!

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