FLIES AS POTENTIAL CARRIERS FOR DISEASE IN PORK BUTCHERIES IN KAMPALA

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The number of pigs in Uganda has increased rapidly [1]

Uganda has the highest per capita consumption of pork in East Africa

70% of pork is consumed in urban areas [2]

Road-side butcheries (known as pork joints) are very common

**Pigs in Uganda (FAOSTAT)**
Higher risk in low-income areas with poor sanitary conditions

- Second most common cause of deaths in children under five [4]

Foodborne diseases a health concern worldwide [3]

- Salmonellosis is one of the most common and globally distributed [5]

Disability-adjusted life year for diarrhea per 100,000 inhabitants in 2004

- no data
- less than 9,250
- 9,250–16,000
- 16,000–22,750
- 22,750–29,500
- 29,500–36,250
- 36,250–43,000

- 43,000–49,750
- 49,750–56,500
- 56,500–63,250
- 63,250–70,000
- 70,000–80,000
- more than 80,000
Background III – flies

- Synantrophic flies feed on human foodstuffs and waste
- Potential to transmit pathogens causing diarrhoea and dysentery [6]
Project objectives

I. Flies' role as carrier for disease in pork joints
II. Butchers' and consumers' perception of flies
III. Prevalence of *Salmonella* ssp. in pork joints
IV. Impact of insecticide-treated nets on the number of flies in pork joints
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Material and methods - baseline

- Random selection of 60 pork joints from geo-referenced survey conducted by J. Kungu in 2014 [7]
  - Interviews with 1 butcher and 4 customers from each joint

- Structured questionnaires
  - Socioeconomics
  - Market-related characteristics
  - Attitudes in preparing pork and relishes (butchers)
  - Purchase and consumption habits (customers)

<table>
<thead>
<tr>
<th>Most important</th>
<th>Attribute</th>
<th>Least important</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Colour of the meat</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Presence of flies in the butchery</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The butcher is wearing coat</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Type of building structure</td>
<td></td>
</tr>
</tbody>
</table>
Material and methods - intervention

- 18 pork joints from baseline were netted
  - 5 non-netted as controls

- Net installation on wall or as window frame
  - Material: ZeroFly®, 270 mg Deltamethrin/m²

- Monitoring for 3 months
  - Glue traps hung once per week for 48 consecutive hours
  - Phenotypic fly identification
  - Sample of nets collected monthly to test efficacy
Material and methods – sampling

- Sampling of *Salmonella* ssp. as indicator pathogen
  - Based on previous studies on food and animals in Kampala [5;11;12]

- Sampling (ISO 6579:2002)
  - Raw and processed pork
  - Water
  - Fresh vegetables
  - Hands’ surface
  - Equipment
  - Flies’ midguts

**cultural isolation of *Salmonella***

```
material
fly sample
(1:10)
pre-enrichment (liquid, non-selective)
1% buffered peptone water
37°C 18±2 h
0.1ml
selective enrichment (liquid)
RVS 42°C 24±3 h
(>37°C possible but more background)
XLD 37°C 24±3 h
Isolation via selective agar
confirmation: biochemistry, serologic from colonies grown on non-selective agar
```

RVS: Rappaport Vassiliadis
XLD: xyloses-lysine-deoxcholate agar
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Results – baseline

- **Sampled butchers’ demographics:**
  - Male-dominated (93%)
  - 50% greater than middle school education
  - 12% owners, 20% managers, 68% workers

- 87% cooked pork is served with raw relishes

- Flies present in 80% of butcheries

- Other pest animals in 50%
# Results – baseline retailers

Importance of attributes within the best-worst scaling

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Most total</th>
<th>Least total</th>
<th>BW score</th>
<th>Standardized BW score (mean)</th>
<th>Standard deviation</th>
<th>SQRT (B/W)</th>
<th>Standardized ratio scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meat from the same day</td>
<td>175</td>
<td>7</td>
<td>168</td>
<td>0.700</td>
<td>1.139</td>
<td>5.00</td>
<td>100.00</td>
</tr>
<tr>
<td>Cleanliness of the butchery</td>
<td>153</td>
<td>7</td>
<td>146</td>
<td>0.608</td>
<td>0.769</td>
<td>4.68</td>
<td>93.50</td>
</tr>
<tr>
<td>Trust in the butcher</td>
<td>154</td>
<td>14</td>
<td>140</td>
<td>0.583</td>
<td>0.871</td>
<td>3.32</td>
<td>66.33</td>
</tr>
<tr>
<td>Color of the meat</td>
<td>128</td>
<td>51</td>
<td>77</td>
<td>0.321</td>
<td>0.929</td>
<td>1.58</td>
<td>31.68</td>
</tr>
<tr>
<td>The butcher is wearing a coat</td>
<td>63</td>
<td>20</td>
<td>43</td>
<td>0.179</td>
<td>0.928</td>
<td>1.77</td>
<td>35.50</td>
</tr>
<tr>
<td>Butchery close to main road</td>
<td>36</td>
<td>26</td>
<td>10</td>
<td>0.042</td>
<td>0.764</td>
<td>1.18</td>
<td>23.53</td>
</tr>
<tr>
<td>Price</td>
<td>12</td>
<td>30</td>
<td>-18</td>
<td>-0.075</td>
<td>0.514</td>
<td>0.63</td>
<td>12.65</td>
</tr>
<tr>
<td>Type of building structure</td>
<td>19</td>
<td>44</td>
<td>-25</td>
<td>-0.104</td>
<td>0.567</td>
<td>0.66</td>
<td>13.14</td>
</tr>
<tr>
<td>Bony meat</td>
<td>10</td>
<td>76</td>
<td>-66</td>
<td>-0.275</td>
<td>0.418</td>
<td>0.36</td>
<td>7.25</td>
</tr>
<tr>
<td>Presence of flies in the butchery</td>
<td>15</td>
<td>127</td>
<td>-112</td>
<td>-0.467</td>
<td>0.628</td>
<td>0.34</td>
<td>6.87</td>
</tr>
<tr>
<td>Fat layer of the meat</td>
<td>2</td>
<td>120</td>
<td>-118</td>
<td>-0.492</td>
<td>0.181</td>
<td>0.13</td>
<td>2.58</td>
</tr>
<tr>
<td>Pest animals in/around the butchery</td>
<td>5</td>
<td>127</td>
<td>-122</td>
<td>-0.508</td>
<td>0.279</td>
<td>0.20</td>
<td>3.97</td>
</tr>
<tr>
<td>Age of the animal</td>
<td>8</td>
<td>131</td>
<td>-123</td>
<td>-0.513</td>
<td>0.468</td>
<td>0.25</td>
<td>4.94</td>
</tr>
</tbody>
</table>
Results – intervention

Fly monitoring

Trapped flies during Intervention (n=9532)

84%

Musca Chrysomya Others

Netting installation

Fly numbers

Control
Intervention
Linear (Control) Linear (Intervention)
Results – microbiological sampling

- Pathogens **on** and **in** flies found in pretests:
  - *E. coli*
  - *S. aureus*
  - *S. enteritidis*
  - *Klebsiella* sp.
  - *S. dysgalactiae*
  - Coliforms
  - *B. cereus*
  - *Proteus* sp.
## Results – *Salmonella enteritidis*

<table>
<thead>
<tr>
<th>Sample</th>
<th>Number</th>
<th>Positive</th>
<th>Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw pork</td>
<td>77</td>
<td>25</td>
<td>31%</td>
</tr>
<tr>
<td>Flies</td>
<td>55</td>
<td>16</td>
<td>29%</td>
</tr>
<tr>
<td>Tomatoes</td>
<td>77</td>
<td>6</td>
<td>8%</td>
</tr>
<tr>
<td>Cabbage</td>
<td>77</td>
<td>4</td>
<td>5%</td>
</tr>
<tr>
<td>Onions</td>
<td>77</td>
<td>2</td>
<td>3%</td>
</tr>
<tr>
<td>Roasted pork</td>
<td>77</td>
<td>1*</td>
<td>1%</td>
</tr>
<tr>
<td>Hands surface</td>
<td>77</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Equipment</td>
<td>77</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Water</td>
<td>15</td>
<td>0</td>
<td>0%</td>
</tr>
</tbody>
</table>

*S. gallinarum*
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- Sharing feedback with butchers
- WTP with butchers from baseline
- Post-sampling in netted butcheries
- Molecular biological analysis and antimicrobial resistance of *Salmonella* samples
- Testing net efficacy
- Sampling for environmental contamination
- Further analysis, interpretation and writing
Discussion

1. Most butchers are aware of flies in their pork joints and try to reduce them with limited success
2. Efficacy of insecticid treated nets depends strongly on local conditions and implementation
   - Butchers' and customers' acceptance for the net varies strongly
   - Proper use of insecticides requires users to know certain key facts in order to avoid resistances and environmental and health risks
3. Half of butchers obtain their pork from backyards or non-gazetted abattoirs
4. “We’re Africans – we don’t die of flies”
Some conclusions

- *Salmonella* is highly prevalent in flies and raw pork

- *Insecticide treated nets* can reduce flies, but further research about (practicability of) *implementation* is necessary

- Research disciplines combined like *epidemiology, microbiology* and *economics* to study the mechanisms under which pork in pork butcheries is produced, marketed and consumed could improve the understanding of how the growing pork joint industry impacts public health

- Butchers are willing to learn and to invest in their business but there is still a major *lack of awareness* and *understanding* about food safety risks and public health
References


