Risk assessment for food safety management in developing countries

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Outline

• Burden of foodborne disease (FBD) and informal market foods
• Evidence from risk assessment for food safety: case studies, food safety in a One Health/Ecohealth context
• Research and policy
Growing concern about food safety

In low and middle income countries:

• Many/most reported concern over food safety (40-97%)

• Willing to pay 5-10% premium for food safety

• Buy 20-40% less during animal health scares

• Younger, wealthier, town-residing, supermarket shoppers willing to pay most for safety

Grace (2015), IJERPH
Animal source food (ASF) demand driven revolutions: livestock products > fish
FBD - a new priority – most probably from ASF
Millions DALYs lost per year (global)

Havelaar et al. (2015)
Most ASF sold in wet markets: risky for FBD but important for livelihoods & nutrition

Benefits of wet markets

- Cheap,
- Fresh,
- Local breeds,
- Accessible,
- Small amounts
- Sellers are trusted,
- Credit may be provided

(results from PRAs with consumers in Safe Food, Fair Food project)

<table>
<thead>
<tr>
<th></th>
<th>Wet market milk</th>
<th>Supermarket milk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most common price/litre</td>
<td>56 cents</td>
<td>One dollar</td>
</tr>
<tr>
<td>Infants consume daily</td>
<td>67%</td>
<td>65%</td>
</tr>
<tr>
<td>Boil milk</td>
<td>99%</td>
<td>79%</td>
</tr>
</tbody>
</table>

Survey in supermarkets and wet markets in Nairobi in 2014
And also gender! Women have an important role in traditional markets but often forced out with formalisation

<table>
<thead>
<tr>
<th>Product</th>
<th>Production</th>
<th>Processing</th>
<th>Marketing</th>
<th>Consumed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk (cow)</td>
<td>men (x Nairobi)</td>
<td>women</td>
<td>women (x Abidjan)</td>
<td>both</td>
</tr>
<tr>
<td>Milk (goat)</td>
<td>men (w milk)</td>
<td>women</td>
<td>women</td>
<td>both</td>
</tr>
<tr>
<td>Beef/goat</td>
<td>men (w assist)</td>
<td>men</td>
<td>men (butcher,pub)</td>
<td>both</td>
</tr>
<tr>
<td>Poultry</td>
<td>women</td>
<td>women</td>
<td>women</td>
<td>both</td>
</tr>
<tr>
<td>Pigs</td>
<td>women</td>
<td>men</td>
<td>men</td>
<td>both</td>
</tr>
<tr>
<td>Fish, crabs</td>
<td>men</td>
<td>women</td>
<td>women</td>
<td>both</td>
</tr>
</tbody>
</table>
Pork risk assessment
Risk assessment

- *Salmonella* risk pathways developed for producers, slaughterhouse and consumers
- Quantitative RA (risk for consumer)
- Chemical risk assessment

**1275 samples** (farms, SH, market) collected during 1 year
### PigRISK - microbial contamination

<table>
<thead>
<tr>
<th>Actor</th>
<th>Sample type</th>
<th>Prev (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Producer</td>
<td>Drink-FA</td>
<td>19.4</td>
</tr>
<tr>
<td>Producer</td>
<td>Floor Swab-FA</td>
<td>36.1</td>
</tr>
<tr>
<td>Producer</td>
<td>Waste Water-FA</td>
<td>38.9</td>
</tr>
<tr>
<td>Slaughterhouse</td>
<td>CarcassM Swab</td>
<td>38.9</td>
</tr>
<tr>
<td>Slaughterhouse</td>
<td>Feces</td>
<td>33.6</td>
</tr>
<tr>
<td>Slaughterhouse</td>
<td>Mesenteric LN</td>
<td>35.6</td>
</tr>
<tr>
<td>Slaughterhouse</td>
<td>SwabFlo-SH</td>
<td>22.4</td>
</tr>
<tr>
<td>Slaughterhouse</td>
<td>Water-SH</td>
<td>20.4</td>
</tr>
<tr>
<td>Market</td>
<td>Overall</td>
<td>34.1</td>
</tr>
</tbody>
</table>
514 pig feed, kidney, liver and pork samples were pooled into 18 samples were analyzed for antibiotic residues, β-agonists, and heavy metals, compared with current regulations.

Presence of banned substances (e.g. chloramphenicol and the growth promoter salbutamol in pig feed and sold pork)

Most of samples: negative or did not exceed current MRL
Selected key results: Food safety

**Streptococcus suis** in slaughter pigs (N=147):

S. *suis* type 2, low prevalence (1.4%)

**Potential risky behaviour** such as consumption of “Tiet canh”

– a raw pig blood food was common in slaughterhouse workers (43.1%)

**Cross-contamination survey** (*Salmonella*) (N=153)

Experiments found cross-contamination was common: using the same cutting board induced the highest risk of cross-contamination with *Salmonella* (66.7%), followed by the same knife (11.1%) respectively

**Health risk by QMRA:** The annual incidence rate of salmonellosis was estimated to be 12.6% (90% CI: 0.5 – 42.6). The factors most influencing the estimate were household pork handling practice followed by prevalence in pork sold in the central market.
PigRISK key messages

• “One Health” food safety risk assessment
• Risk misperception: what people worry about and what makes them sick are not the same
  • Chemical risk is low
  • *Salmonella* risk is high (annual incidence rate of salmonellosis was estimated to be 12.6%)
• The factors most influencing the estimate were household pork handling practice followed by prevalence in pork sold in the central market.
Wastewater reuse and food safety
Example of Ecohealth research on human and animal waste management in Vietnam: VAC model

Crop

Livestock

Fishery

Health and environmental issues & livestock?

Nguyen-Viet et al. (2014)
Analysis of interrelations between environmental sanitation systems, health status and well-being

Critical control points: comprehensive biomedical, epidemiological, ecological, social, cultural and economic assessment

Interventions (biomedical, systems, engineering, behavioral or in combination): Efficacy, effectiveness and equity studies measured in relation to risks
Risk assessment: Vegetables and fish from wastewater in Hanam

- High risk from eating morning glory and tilapia (diarrhoea risks due to *E. coli* 13%, *G. lamblia* and *C. parvum*: 0 – 23%, respectively
- Highly contaminated Pb level, but low risk for tilapia
- Local people seem to know the risk
- They sell contaminated vegetable and fish to other towns

Truc et al. (2014)
Dioxin and food safety

AGENT ORANGE/DIOXIN IN VIET NAM
EHRA AND PUBLIC HEALTH INTERVENTION PROGRAMS
**EHRA**

- **Bien Hoa and Da Nang airbases**: storages for AO & other herbicides; spills occurred several times. 2/7 severe dioxin hot spots in VN
- 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) in soil, mud, food, blood and milk samples were high (*Hatfield Consultants 2006, 2009, 2011; Arnold Schecter et al. 2003...*)
- Local residents living at dioxin hot spots are at high risk of being exposed to dioxin in the environment, especially in foods (*Tuyet-Hanh et al. 2010*).
Risk characterization

- **High risk foods:** local fresh water fish, snail, free-ranging chicken meat and eggs, free-ranging duck meat and eggs, beef.

- **If consuming local high risk foods:**
  - Estimated DI = 60.4 to 102.8 pg/kg bw/day (Bien Hoa)
  - Estimated DI = 27.0 to 148.0 pg/kg bw/day (Da Nang).
  - > TDI recommended by WHO (1-4 pg/kg bw/day)

- **If consuming foods originate from other areas:**
  - Estimated DI = 3.2 to 6.2 pg/kg bw/day (Bien Hoa)
  - Estimated DI = 1.2 to 4.3 pg/kg bw/day (Da Nang)
  - TDI: Health Canada (10 pg/kg bw/day); WHO (1-4 pg/kg bw/day).

- **Practical implications for local residents and authorities**
Dioxin “Rich picture” 

- Consuming fish, shrimps at contaminated ponds
- Consuming cattles at contaminated lands
- Consuming chicken, ducks at contaminated areas
- Consuming carrot, pumpkin, vegetables at contaminated land
- Consuming fish, shrimps at contaminated ponds
- Consuming cattles at contaminated lands
- Consuming chicken, ducks at contaminated areas
- Consuming carrot, pumpkin, vegetables at contaminated land
- Dermal absorption
- Inhaling contaminated soil/dust
- Breast-feeding contaminated milk
- Consuming food items cultivated or raised in contaminated areas
- Low KAP
- No interventions
- Livelihood, low economic status
- Dioxin exposure
- Costly research, environmental remediation
- Soils, mud, ponds are polluted
- Environmental remediation efforts
- Fishers, Military in airbases, Fish traders, Farmers, Food handlers, householders, Local authorities, Tourists, Soldiers & families, Political leaders, Scientists, Industries, Political sensitive
Can we solve the problem?
International experiences
Issues

• Upgrading markets and GAHP show little evidence
• Supermarket is not safer than wet market
• Demand side: increased awareness of consumers
• Need for evidence on health impacts of food safety
Improvements are feasible, effective, affordable

- Training and branding for butchers in Nigeria:
  - 20% more meat samples met standards
  - Cost $9 per butcher
  - Saved $780/per butcher per year from reduced cost of human illness

- Providing information on (rational drug use) to farmers
  - Knowledge increase x 4
  - Practice improvement x 2
  - Disease decrease by 1/2
Policy translation in food safety: Risk assessment taskforce
Policy translation: food safety

2011 Meeting with VFA, Photo: CENPHER

2012 Meeting with DAH Photo: CENPHER

2016 Meeting with DPM Vietnam, 2 Dec 2016 Photo: Tuyet Hanh
National and regional initiatives

- Vietnam One Health Partnership (OHP)
- Vietnam One Health University Network (VOHUN)
- EcoHealth Field Building Initiative in SE Asia (FBLI)

17 UNIVERSITIES/FACULTIES
Sustainable food system

Secure, safe, sustainable food systems: safe today, optimal for the future

http://oheh2016.org/category/food-systems/
Take-home messages

- Most FBD is due to microbes and worms in fresh foods
- Balance between formal and ‘wet/traditional’ markets
- Risk assessment: useful tool for food safety management but adaptation and capacity are needed
- Control and command approaches don’t work but solutions based on working with the informal sector are more promising
- Food safety policy influence: persistence, opportunistic and time-sensitive
- System approach/global partnership for food safety
better lives through livestock

ilri.org