Antibiotic resistance in Gram negative bacteria isolated from fish

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So, what does this really mean?

• Gram-negative bacteria:
  Classification of bacteria based on structure

• Antibiotic:
  A drug used to treat bacterial infection

• Antibiotic resistance:
  The ability of bacteria to resist the effects of antibiotics

Image retrieved from: Harvard Medical School (2016).
Why is antibiotic resistance (AR) important?

• Rates of AR are rising
  • Antibiotic misuse
  • Human medicine
  • Animal production

• AR threatens public health
  • Increased mortality and morbidity
  • Burden on the health care system

Image retrieved from: Centers for Disease Control and Prevention (2017).
Study Purpose and Objectives

1. To investigate whether antibiotic residues are present in seafood for sale in Western Australia
2. To analyse the occurrence of antibiotic resistance in Gram-negative bacteria isolated from fish samples sold in Perth, Western Australia
3. To determine whether country of origin correlates with the presence of antibiotic residues and antibiotic resistant bacteria in seafood samples
Background Information
Where does the seafood Australians eat come from?

- 67% Imported
- 33% Domestic Production

Biggest suppliers:
1. Thailand
2. China
3. Vietnam
4. New Zealand
5. Malaysia
6. Indonesia
Asian Aquaculture and Antibiotic Use

Antibiotic purpose:

• Control infection
• Promote growth

Why is use common?

• Minimal legislation
• Limited enforcement activity
• Ease of purchase
• Poor knowledge of purpose

Red tilapia being raised in a net pen in Northern Thailand (International Development Research Centre, 2015).
Exposure Risk to Humans

Antibiotic application at the farm

Antibiotic contamination in the environment and aquatic animal

Antibiotic residues in seafood

Antibiotic resistant bacteria
Methodology and Results
Antibiotic Residues
Antibiotic Residues
Local Health Authorities Analytical Committee (LHAAC) data

- 253 seafood samples
- Analysed for 8 antibiotic residues
- 1 non-compliant sample
  - From Thailand
  - Low-levels of erythromycin
  - No immediate health risk

The portion of seafood samples compliant with the Food Standards Code
Methodology and Results
Antibiotic Resistant Bacteria
Bacterial Isolation

Growth of bacteria on agar after 48 hours incubation
Bacterial Identification Tests

• Preliminary tests:
  1) Gram stain
  2) Oxidase test
• Matrix-assisted laser desorption ionization time-of-flight mass spectrometry (MALDI-TOF)

The number of Gram negative bacteria (n=35) identified by genus
## Pathogenic Bacteria Species

<table>
<thead>
<tr>
<th>Bacteria Species</th>
<th>Route of exposure</th>
<th>Negative health outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Aeromonas hydrophilia</em></td>
<td>Ingestion</td>
<td>Gastrointestinal illness</td>
</tr>
<tr>
<td><em>Aeromonas hydrophilia, Stenotrophomonas maltophilia, Serratia fonticola</em></td>
<td>Direct contact with open skin</td>
<td>Wound infection</td>
</tr>
</tbody>
</table>

Image adapted from: NIDDK image library (n. d.) and Public Health (n. d.).
Disc Diffusion Test

Antibiotic action is effective (inhibited bacterial growth)  
Antibiotic action is ineffective (bacterial growth)
# Potential Acquired Antibiotic Resistance

<table>
<thead>
<tr>
<th>Bacterial Genera</th>
<th>Antibiotic Resistance</th>
<th>Fish Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Acinetobacter</em></td>
<td>Ampicillin</td>
<td>Australia Farmed</td>
</tr>
<tr>
<td><em>Acinetobacter</em></td>
<td>Ampicillin and Streptomycin</td>
<td>Vietnam Farmed</td>
</tr>
<tr>
<td><em>Acinetobacter</em></td>
<td>Nalidixic acid</td>
<td>Vietnam Farmed</td>
</tr>
<tr>
<td><em>Acinetobacter</em></td>
<td>Streptomycin</td>
<td>Vietnam Farmed</td>
</tr>
<tr>
<td><em>Rhizobium</em></td>
<td>Trimethoprim</td>
<td>China Farmed</td>
</tr>
</tbody>
</table>

Image modified from Google (2018).
Summary

- Minimal risk of antibiotic residues in seafood
- Limited risk of antibiotic resistant infection from the consumption of fish
- Further research is required:
  - Bigger sample size
  - Gram positive bacteria
  - Assess the influence of country of origin on the presence of antibiotic resistance in bacteria
Figure References


Questions?