IOC/WESTPAC Workshop

Enhance the Awareness on Toxic Marine Organisms

Toxic Marine Organisms in Singapore

Sandric CY Leong
Singapore

Singapore only produces a small proportion of its total fresh food consumption and is reliant primarily on food imports.

Singapore does not have any beef, pork or fruit production, and only produces small volumes of chickens, fish including seafood, eggs and vegetables for local consumption.
Food Import in Singapore

- Singapore's consumption of fish/seafood is estimated to be 100,000 tonnes per year of which about 5-8% is accounted for by local foodfish aquaculture.

- This is mainly from coastal fish farms. They produce marine foodfish species like groupers, seabass, snappers and milkfish as well as green mussels and crustacean (shrimp/mangrove crabs). There are also freshwater foodfish farms.
Food fish farming in Singapore

Even limited available sea space, Singapore has a small but thriving and increasingly important food-fish industry.
### Farming Activities in Singapore as at March 2009

<table>
<thead>
<tr>
<th>Category</th>
<th>No. of Farms</th>
<th>Net Area (Hectares)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FISH</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aquarium fish (breeding/export)</td>
<td>92</td>
<td>171.160</td>
</tr>
<tr>
<td><strong>FOODFISH AND SHRIMP (land-based)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freshwater</td>
<td>2</td>
<td>8.464</td>
</tr>
<tr>
<td>Marine</td>
<td>3</td>
<td>19.173</td>
</tr>
<tr>
<td><strong>ANIMALS AND BIRDS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Layer (hen eggs and SPF eggs)</td>
<td>6</td>
<td>75.065</td>
</tr>
<tr>
<td>Quail and other gamebirds</td>
<td>2</td>
<td>4.724</td>
</tr>
<tr>
<td>Exotic birds</td>
<td>4</td>
<td>10.175</td>
</tr>
<tr>
<td>Dairy cattle and goats</td>
<td>4</td>
<td>9.396</td>
</tr>
<tr>
<td>Frogs and crocodiles</td>
<td>3</td>
<td>9.859</td>
</tr>
<tr>
<td>Dogs (breeding/boarding/training)</td>
<td>10</td>
<td>9.510</td>
</tr>
<tr>
<td><strong>PLANTS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegetables (including mushrooms, bean sprouts, etc)</td>
<td>55</td>
<td>110.240</td>
</tr>
<tr>
<td>Fruits</td>
<td>1</td>
<td>3.545</td>
</tr>
<tr>
<td>Orchid and ornamental plants</td>
<td>82</td>
<td>297.228</td>
</tr>
<tr>
<td>Aquatic plants</td>
<td>2</td>
<td>11.743</td>
</tr>
<tr>
<td>Fodder crops</td>
<td>1</td>
<td>4.700</td>
</tr>
<tr>
<td><strong>TOTAL (land-based)</strong></td>
<td>267</td>
<td>744.982</td>
</tr>
</tbody>
</table>

Foodfish/crustaceans/molluscs (sea-based) | 105 | 85
Seafood Poisonings

- Overall risk from seafood poisonings within Singapore is low.

- Major risk comes from imported contaminated seafood.

- The presence of toxic dinoflagellate species in Singapore waters that produce PSP and DSP toxins indicates that there is a credible threat to the shellfish industry.
Seafood Poisonings

- **Early 80s**
  - First outbreak of paralytic shellfish poisoning (PSP) from green mussels collected from northern Singapore which resulted in two deaths and five people poisoned.
  - Unfortunately, the causative organism was never identified.

- **16 December 2003 to 4 January 2004**
  - The first norovirus gastroenteritis outbreaks in Singapore were reported.
  - They were all associated with the consumption of imported raw frozen oysters.
  - A total of 305 people were infected and their clinical symptoms included diarrhoea, abdominal cramps, vomiting and fever.
Seafood Poisonings

- August 2005
  - A low level of malachite green residues in samples of imported eels.
  - No poisoning reported.
  - Products were recalled.

- Minor cases
  - Statistical reports of minor seafood poisoning cases are not available to the public.
  - There are few reports of DSP contamination of tropical shellfish, however, no confirmed reports of human poisoning.
Threats from Toxic Organisms

- The presence of toxic species such as dinoflagellates in Singapore waters that produce paralytic shellfish poisoning (PSP) and diarrhetic shellfish poisoning (DSP) toxins indicates that there is a credible threat to the shellfish industry.

- Contamination of locally produced and imported shellfish by PSP and DSP toxins pose a realistic threat to the public health in Singapore.

- The population densities of these harmful/toxic species in the Singapore waters are low.

- No guarantee that these species will not cause any problem in the future.
Toxic Organisms in Singapore waters

- There is a number of dinoflagellate species that produce toxins that kill marine organisms.

- Singapore waters contain many toxin-producing dinoflagellates which sometimes form blooms in both the Singapore and Johor Straits. However, there is no evidence of fish kills caused by these toxic species.

- Singapore waters also contain a number of marine dinoflagellate that produce toxins that can accumulate through food chains to cause human poisoning.

A minor bloom of Trichodesmium (cyanobacteria) observed in Singapore Water, off Bedok Coast, on 31 July 1997.
List of Toxic/Harmful Organisms

**Dinoflagellates:**
- Gymnodinium catenatum
- Cochlodinium sp.
- Alexandrium leei
- Dinophysis caudata
- Dinophysis ovum
- Dinophysis sacculus
- Dinophysis caudata
- Phalacroma rotundatum
- Gambierdiscus sp.

**Raphidophytes:**
- Chattonella marina
- Chattonella subsala
- Fibrocapsa japonica
- Heterosigma akashiwo
First Harmful Algal Bloom

Massive fish kill was observed for the first time in Singapore waters during late December 2009, killing 200,000 farm fish.

However, the causative organism was not identified.

Plankton Bloom Hits Pulau Ubin Fish Farm
(Straits Times, 2 Jan 2010)
Monitoring Program for HABs

• To date, there is no established HABs monitoring program in Singapore.

• At present, there are on-going discussions on establishing a monitoring program for HABs by Government Agencies.

• A few research groups have started their own monitoring project (mainly academic groups and small projects).

• To protect public health and economic vitality, a program for monitoring HABs need to be established.
Research Challenges for HABs in Singapore

- Poor knowledge of plankton dynamics in Singapore waters.
- Integrating multiple data sources to optimize existing monitoring programs currently undertaken by different groups operating in Singapore waters.
- Need for new technologies to increase capacity to detect pre-HAB conditions.
- Knowledge-based approaches for HABs risk management to mitigate impacts on Singapore’s mariculture industry.
Food Safety Legislation

The following acts provide the regulatory framework of food safety in Singapore:

(a) Agri-Food and Veterinary Authority Act, which establishes the Agri-Food and Veterinary Authority (AVA), a statutory agency that regulates food safety;

(b) Fisheries Act, which controls the use of fishing ports and harbours, and the marketing and distribution of fish that is landed directly from fishing vessels;

(c) Wholesome Meat and Fish Act, which regulates the processing, packing, inspection, import, distribution, sale, transhipment and export of meat products and fish products;

(d) Sale of Food Act, which prescribes standards for the wholesomeness and purity of food products.
Food Safety Regulation System

As more than 90% of Singapore's food is imported. Sources supplying food products to Singapore must meet the import requirements for food safety.

The food safety regulatory system generally consists of the following six elements:
(a) trade licence system *(must obtain a valid licence)*;

(b) inspection of food products and establishments *(monitor imported seafood for chemicals, heavy metals)*;

(c) accreditation of foreign farms and establishments;

(d) laboratory testing *(next slide)*;

(e) enforcement activities *(ensure no illegal import)*;

(f) food recalling system.
Table 6 — List of possible tests carried out by the Veterinary Public Health Laboratory

<table>
<thead>
<tr>
<th>Primary produce/products</th>
<th>Food safety hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meat and meat products</td>
<td>Heavy metals, preservatives and additives, polychlorinated biphenyls, radioactivity, beta-agonist, nitrofurans, chloramphenicol, other antibiotics, staphylococcal enterotoxins, E.coli O157:H7, salmonella, listeria monocytogenes, vancomycin resistant enterococci, campylobacter, parasites and anthrax contamination.</td>
</tr>
<tr>
<td>Seafood and seafood products</td>
<td>Heavy metals, preservatives and additives, formaldehyde, sulphur dioxide, radioactivity, nitrofurans, chloramphenicol, other antibiotics, marine toxins, salmonella, vibrio, noroviruses, hepatitis A and other viruses, parasites, allergen (histamine) and anthrax contamination.</td>
</tr>
<tr>
<td>Vegetables and fruits</td>
<td>Pesticide residues, sulphur dioxide, E.coli O157:H7, salmonella, listeria, anthrax contamination, parasites and heavy metals.</td>
</tr>
<tr>
<td>Processed food</td>
<td>Micro-organisms, synthetic organic colours, Sudan dyes, chemical preservatives, artificial sweetening agents, mycotoxins, heavy metals, migration of metals, antioxidants, 3-monochloro-propane-1, 2-diol, 1,3-dichloropropanol, polychlorinated biphenyls, polycyclic aromatic hydrocarbons, formaldehyde, residual chemicals in food-contact articles, migration of chemicals from food-contact articles, ethyl carbamate, N-nitrosamines, mineral hydrocarbons, bromate, pesticide residues, drug residues, radionuclide contaminants, trihalomethanes, screening of irradiated food, poisons and adulterants, and food proximate.</td>
</tr>
</tbody>
</table>

Source: Agri Food and Veterinary Authority (2005a).
ENSURING FOOD SAFETY

• AVA requires all imports of frozen oysters to be accompanied with a health certification issued by the relevant overseas authorities.

• High risk food products (certain seafood products) are subject to close control.

• Assistance to Local Fish Processing Industry: AVA provides consultancy services and advice in seafood safety, fish quality preservation and etc.

• Monitor the water quality around local fish farm areas, however, information on seafood toxins, in general, is not available to the public.
AVA provides food safety education to the public:

- **Web sites**
- **Posters**
- **Brochures**
References


Thank You!