Countermeasures for specific pathogens in Ehime, Japan

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Presentation plan

• About “Ehime”
  geographic feature, cultured fishes, production of cultured fish, etc.

• What kinds of fish diseases occur in Ehime?
  trend of diseases

• How to control fish diseases in Ehime?
  vaccination (application method, effect etc.)

• Summary
Presentation plan

• About “Ehime”?
  geographic feature, cultured fish, production of cultured fish, etc.

• What kinds of fish diseases occur in Ehime?
  trend of diseases

• How to control fish diseases in Ehime?
  vaccination(delivery method, effect etc.)

• Summary
Where is Ehime located in Japan?

<table>
<thead>
<tr>
<th>Area</th>
<th>5,678km²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>1,422,117(person)</td>
</tr>
<tr>
<td>Number of households</td>
<td>593,938(households)</td>
</tr>
</tbody>
</table>
"Origin of the name, Ehime"

Japanese

愛媛

English

Ehime

Literally means

Lovely Princess

Kojiki: Records of ancient matters of Japan, published in the 8th century
Fish farm in Ehime
Fish farm in Ehime

- Yellowtail
- Red sea bream
- Tiger puffer
- Amberjack
- Flounder
- Sea bass
- Striped jack
- Filefish
- Mackerel
- etc

Fish farm in Ehime
Production of cultured fish in Ehime, Kagoshima and Japan in 2011

Ehime and Kagoshima is a leading producer of aquaculture products in Japan.
Cage farming of yellowtail in coastal waters began in early 1960’s. Since then, aquaculture has attained a high growth.

Various problems concurred with the growth of the aquaculture industry.

One of major problems was the occurrence of diseases caused by pathogenic bacteria, viruses and other infectious agents.
Loss due to diseases in finfish aquaculture in Japan

- Production loss:
  - 96%
  - 4%

- Biomass loss:
  - Yellowtail & Amberjack: 65%
  - Red sea bream: 15%
  - Flounder: 13%
  - Tiger puffer: 3%
  - Other fish: 4%

- Economical loss:
  - About 9 billion yen (US $9,000 million)
Disease is one of the most important limiting factors in aquaculture.

Countermeasures for specific pathogens in Japan (Ehime)
Presentation plan

- About “Ehime”? geographic feature, cultured fish, production of cultured fish etc.
- **What kinds of fish diseases occur in Ehime?** trend of diseases
- How to control fish diseases in Ehime? vaccination(delivery method, effect etc.)
- Summary
Distribution in fish species of the cases diagnosed at the Ehime from 1981 to 2012

Yellowtail and amberjack is susceptible to the diseases.
Diseases in yellowtail diagnosed from 1981 to 2012

Disease occurrence tendency is different according to the age.
## Disease case tendency

<table>
<thead>
<tr>
<th></th>
<th>1980s</th>
<th>1990s</th>
<th>2000s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Streptococcosis</td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>Pseudotuberculosis</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Irdoviral disease</td>
<td></td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>Other disease (unidentified)</td>
<td></td>
<td></td>
<td>●</td>
</tr>
</tbody>
</table>

## Why?

Disease control
Presentation plan

• About “Ehime”? geographic feature, cultured fish, production of cultured fish, etc.

• What kinds of fish diseases occur in Ehime? trend of diseases

• **How to control fish diseases in Ehime?** vaccination(delivery method, effect etc.)

• Summary
Strategy of disease control

Pathogens

Vaccination

Infected

Diseased

Chemotherapy

Resistant to infection

Dead

Recovered
How to give vaccines to fishes?

- Immersion
  Bath methods ⇒ freshwater fishes

- Oral
  ⇒ marine fishes

- Injection
  Intraperitoneal (alone or adjuvanted)
  ⇒ marine fishes
  standard methods
How to give vaccines to fishes?

- Immersion Bath methods
- Oral
- Injection Intraperitoneal (alone or adjuvanted)

**Advantage**
- Suitable for mass vaccination of all sizes of fish
- Reduced stress for fish

**Disadvantage**
- The large amount of vaccines required
- Lower level of protection and duration of immunity
How to give vaccines to fishes?

- Immersion
  - Bath methods  
    - for freshwater fishes

- Oral
  - for marine fishes

- Injection
  - Intraperitoneal (alone or adjuvanted)
    - for marine fishes

Advantage
- Easy to administer (Vaccines mixed with food)
- Saves labor
- Causes no stress to the fish
- Easies method for mass vaccination of all sizes of fish

Disadvantage
- Protection generally weak and of short duration
- Large quantities of antigen required
How to give vaccines to fishes?

- Immersion Bath methods
- Oral
- Injection Intraperitoneal

**Advantage**
- provides long duration of protection

**Disadvantage**
- Significant handling stress
- Local reaction
- Need sophisticated machinery or large skilled workforce
How to give vaccines to fishes?

• Immersion
  Bath methods ⇒ freshwater fishes

• Oral ⇒ marine fishes

• Injection
  Intraperitoneal (alone or adjuvant) ⇒ marine fishes
  standard methods
Vaccines licensed for aquaculture in japan

Against Bacteria
• *Vibrio anguillarum*... Trouts and Yellowtail
• *Lacotococcus garvieae*... Yellowtail
• *Streptococcus iniae*... Flounder
• *Streptococcus parauberis*... Flounder
• *Streptococcus dysgalactiae*... Amberjack
• *Photobacterium damsela subsp.piscicida*... Yellowtail and Amberjack

Against Viruses
• *Iridovirus*..... Marine species
• Nervous necrosis virus (VNN)...Sevenband grouper
## Commercial vaccines in Japan (Monovalent Vaccines)

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Fish species</th>
<th>Way of administration</th>
<th>Date on sale</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>L. garvieae</em></td>
<td>Seriola</td>
<td>Oral injection</td>
<td>1997~</td>
</tr>
<tr>
<td><em>iridovirus</em></td>
<td>Red sea bream, Seriola, Striped jack etc</td>
<td>Injection</td>
<td>2000~</td>
</tr>
<tr>
<td><em>S. iniae</em></td>
<td>Flounder</td>
<td>Injection</td>
<td>2006~</td>
</tr>
<tr>
<td>VNN</td>
<td>Grouper</td>
<td>Injection</td>
<td>2012~</td>
</tr>
</tbody>
</table>
## Commercial vaccines in Japan (Bivalent Vaccines)

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Fish</th>
<th>Way of administration</th>
<th>Date on sale</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>L. garvieae V.anguillarum</em></td>
<td>Seriola</td>
<td>injection</td>
<td>2001~</td>
</tr>
<tr>
<td><em>L. garvieae Iridovirus</em></td>
<td>Seriola</td>
<td>injection</td>
<td>2003~</td>
</tr>
<tr>
<td><em>L. garvieae P. damsela subsp. piscicida</em></td>
<td>Yellowtail Amberjack</td>
<td>injection</td>
<td>2009~</td>
</tr>
<tr>
<td><em>S. Iniae S. parauberis</em></td>
<td>Flounder</td>
<td>injection</td>
<td>2013~</td>
</tr>
</tbody>
</table>
### Commercial vaccines in Japan (Polyvalent Vaccines)

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Fish</th>
<th>Way of administration</th>
<th>Date on sale</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>L. garvieae</em> Iridovirus</td>
<td>Seriola</td>
<td>injection</td>
<td>2005~</td>
</tr>
<tr>
<td><em>V.anguillarum</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>L. garvieae</em> <em>P. damsela</em> subsp. <em>piscicida</em> <em>V.anguillarum</em></td>
<td>Yellowtail Amberjack</td>
<td>injection</td>
<td>2011~</td>
</tr>
<tr>
<td><em>L. garvieae</em> <em>V.Anguillarum S. dysgalactiae</em></td>
<td>Amberjack</td>
<td>injection</td>
<td>2011~</td>
</tr>
</tbody>
</table>
Change of vaccine delivery methods in Ehime

Modified from “Aquatic vaccine handbook (2009: Japanese)”.

Increase of use of injection in Ehime!
The use ratio of the polyvalent vaccine is increased.
Vaccination process

Continuous injection machine

Work benches for vaccination
Fish vaccination process
(Red sea bream)

Transported from net pen to anesthetizing bath

Anesthetized with FA100
Fish vaccination process
(Red sea bream)
Fish vaccination process
(Red sea bream)

Count number of fish injected
Fish vaccination process (Amberjack)

- Anesthetizing bath
- Vaccination
- Injected fish are carried to fish pen
Fish vaccination process
(Amberjack)
Fish vaccination process
(Striped jack)
Effect of vaccination
The number of the vaccinated yellowtails and the number of the cases diagnosed as Streptococcosis

Modified from “Aquatic vaccine handbook (2009: Japanese)”. 

The prevention of the outbreak of the streptococcosis
The number of the vaccinated yellowtail and the number of the cases diagnosed as iridoviral disease

Modified from “Aquatic vaccine handbook (2009: Japanese)”.  

The prevention of the outbreak of the iridoviral disease
The number of the vaccinated fish and the amount of use of antibiotics in yellowtail

The usage of the antibiotics is decreased.

Modified from “Aquatic vaccine handbook (2009: Japanese)”. 
The feed conversion ratio from 1970 to 2011 in yellowtail.

*feed conversion ratio (FCR) = dry feed intake/wet weight gain

improving the feeding performance

Modified from “Aquatic vaccine handbook (2009: Japanese)”.

Spread of Moist pelet

Spread of Extruded pelet

Oral Vaccines for *L. garvieae* on sale

Injection Vaccines for *iridovirus* on sale

Injection Vaccines for *L. garvieae* on sale
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• Summary
Summary

• In Yellowtail farming, almost all fishes stocked in sea cages have been vaccinated these years.
• Vaccine delivery method : Injection
• Vaccine type : polyvalent
• Decreased number of cases of both streptococcosis and iridovirus diseasase
• Decreased damage by fish diseases
• Improved feeding performance
Request from fish culturists

• Development of new vaccines
  Edwardsiellosis, Nocardiosis etc
• Single injection of a multivalent vaccines
  5 – 6 antigens
• Cost down

<table>
<thead>
<tr>
<th></th>
<th>now</th>
<th>future</th>
</tr>
</thead>
<tbody>
<tr>
<td>monovalent</td>
<td>27-32 yen</td>
<td>low</td>
</tr>
<tr>
<td>Bivalent</td>
<td>35-43 yen</td>
<td>low</td>
</tr>
<tr>
<td>polyvalent</td>
<td>43-44 yen</td>
<td>low</td>
</tr>
</tbody>
</table>
Thank you for your attention