The state and problems of aquaculture in Japan and development of technology for the solution

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Contents of speech

Status of Aquaculture in Japan

Problems of Aquaculture in Japan

Solution and future direction
Mariculture production in Japan

- Seaweed
- Shellfish
- Fin Fish

(ton)
Production of farmed marine fish

- Japanese flounder: 27%
- Red sea bream: 6%
- Tiger puffer: 3%
- Coho salmon: 2%
- Yellowtail and greater amberjack: 58%
Income of marine fish farmers

(million JPY)

2006 2007 2008 2009
Comparison among blue fish tuna and main farmed species

<table>
<thead>
<tr>
<th></th>
<th>Blue fin tuna</th>
<th>Yellowtail (including greater amberjack)</th>
<th>Red sea bream</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production (× 1,000ton)</td>
<td>4~5</td>
<td>158</td>
<td>67</td>
</tr>
<tr>
<td>No. of farm</td>
<td>30~50</td>
<td>1,000</td>
<td>800</td>
</tr>
<tr>
<td>Seed</td>
<td>Wild</td>
<td>Wild</td>
<td>Artificial</td>
</tr>
<tr>
<td>Feed</td>
<td>Frozen fish</td>
<td>Frozen fish Formula feed</td>
<td>Formula feed</td>
</tr>
<tr>
<td>Market price (/kg)</td>
<td>3,500 yen</td>
<td>900 yen</td>
<td>700 yen</td>
</tr>
</tbody>
</table>
Production cost in RSB farming

High density (17kg/m$^3$)
Production cost: 853 JPY/kg

Low density (8kg/m$^3$)
Production cost: 584 JPY/kg
Why is it necessary to promote aquaculture?

- Benefit of fish eating
- Increase of income

Spread of fish eating on a world-wide scale

Increasing of demands for fisheries resources

Excessive fishing

Decrease of fisheries resources
Why is it necessary to promote aquaculture?-continued

Aquaculture is feasible….

- Stable supply
  - Supply fish that is poor in natural resources
  - Year-round supply
- Easy to control product’s quality
- Easy to guarantee safety of the products
- Production edible fish without influence on natural resources
Critical Factors for Sustainable Aquaculture

- Good quality seed
- Increase of competitiveness
  - Decline of production cost
  - ✔ Aqua-feed and fish health management
- Aquaculture environment and ground
- Product quality and safety
  - Proper management system
  - Value added products
  - Marketing
Problems of seed

Seeds of blue fish tuna, yellowtail, greater amberjack, Japanese eel has still depended on the wild juvenile fish

Development of technology for artificial seeds production

- Prevention of initial mortality
- Prevention of malformation
  - Knowledge on Nutrition in fry and brood stock
- Improvement of Feed organism production
Survival rate of fish in completely controlled aquaculture of blue fin tuna, 2010.
(Completely controlled aquaculture of blue fin tuna, 2010)

Aeration system
Illumination
Eggs quality
Viability of fry
Morphological abnormality

Nasal septum defect
Physsostomous anomaly

Pigment anomaly
Improvement of Feed organism production

- Space saving
- Stable and Systematic production
- Excellent nutrition value

Breeding of feed organisms
Intensive culture system
Continuous culture system
Preservation of feed organisms

Decrease of production cost
Breeding
Suitable diet for brood stock

Good quality seed

Breeding by marker assist selection

Specific disease resistant
Japanese flounder

Lymphocystis disease
Problems of aqua-feed

- Increase of demand for fishmeal
- Decrease of supply of fishmeal
- Increase of feed price

Counter measures against increase of feed cost
Low or non-fish meal diet

- Plant proteins
  - Anti-nutritional factors
  - Essential AA (taurine)

- Trash fish

- Waste from processing factory
  (Removed fish viscera)
Feed-born contamination with chemicals

Leuco-malachite green
Detected in farmed greater amberjack

![Graph showing Cd in liver (ppm) for different diets over time](image)
Low or fish meal free diet

**Merit of fish meal free diet feeding**
Feeding of fishmeal free diet would be an effective measures to reduce the risk of feed-born chemical contamination accumulation in farmed fish.

**Demerit of fish meal free diet feeding**
Feeding of fish meal free diet causes the loss of disease resistance.

*The critical nutrients from fish meal on disease resistance is taurine.*
<table>
<thead>
<tr>
<th>Ingredients (%)</th>
<th>Control</th>
<th>D-1</th>
<th>D-2</th>
<th>D-3</th>
<th>D-4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fish meal (Jack Mackerel)</td>
<td>50</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Soy protein concentrate</td>
<td>0</td>
<td>33.2</td>
<td>33.2</td>
<td>33.2</td>
<td>33.2</td>
</tr>
<tr>
<td>Feed oil</td>
<td>11.5</td>
<td>14</td>
<td>0</td>
<td>14</td>
<td>0</td>
</tr>
<tr>
<td>Cholesterol enriched fish oil</td>
<td>0</td>
<td>0</td>
<td>14</td>
<td>0</td>
<td>14</td>
</tr>
<tr>
<td>Taurine</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

**Proximate composition:**

<p>| | | | | | |</p>
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</thead>
<tbody>
<tr>
<td>Crude protein (%)</td>
<td>44.9</td>
<td>43.4</td>
<td>45.6</td>
<td>44.1</td>
<td>45.0</td>
</tr>
<tr>
<td>Crude lipid (%)</td>
<td>23.1</td>
<td>24.4</td>
<td>22.3</td>
<td>22.5</td>
<td>23.5</td>
</tr>
<tr>
<td>Cholesterol (mg/kg)</td>
<td>2850</td>
<td>1800</td>
<td>10700</td>
<td>1490</td>
<td>8600</td>
</tr>
<tr>
<td>Taurine (mg/kg)</td>
<td>322</td>
<td>71</td>
<td>116</td>
<td>797</td>
<td>762</td>
</tr>
</tbody>
</table>
The effects of supplementing taurine and cholesterol in a non-fish meal diet on Ht values and mortality due to artificial infection with *Lactococcus garvieae* at 60 days.

Different superscripts are significantly different at $p < 0.05$. 
Fish health management

Spread of vaccination
Research on fish health management

Practical technology
  Improvement of disease resistance by feed additives
  probiotics, immune-stimulants, polyphenol, etc.
  Disease control by supplementation of oxygen

Seeds
  Development of DNA vaccine
  Development of recombinant INFβ
Disease control by supplementation of oxygen
Practical use of oxygen generator
Aquaculture environment and ground

Red tide has been occurred and damaged economically.
Offshore Aquaculture

The most outstanding advantage of the offshore aquaculture is “aquaculture activity in the waters having higher carrying capacities”, thus providing sustainability.

Avoid damage of red tide
Rapid growth
Reduce mortality due to diseases

But...
Strength of equipment
Reduce of feeding due to stormy seas
Inland closed recirculation system

- Fish farming is not affected by red tide, infectious diseases, stormy seas and so on.
Problems of aquaculture industry in Japan

- Large amount of small-scale farms
- Weak management bases
- Strengthening management bases
- Expansion of size of business

Increase competitiveness
Strategic marketing

Continuous aquaculture