Possibility of disease control by ambient dissolved oxygen level

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Counter measures against infectious diseases in Aquaculture

Food safety issues by drug residues

Chemotherapy → Vaccination
                Probiotics
                Feed additives
Concept of disease outbreaks in farmed fish

(Snieszko, 1974)
Hypoxia and infectious diseases

• Hypoxia (including Low Oxygen uptake by gill damage) are extremely common in aquaculture systems.

• Low dissolved oxygen in water has brought high mortality due to infectious diseases.
<table>
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<tr>
<th>Author and year</th>
<th>Finding</th>
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<tr>
<td>Fukuda, Maita et al. 1997</td>
<td>Influence of dissolved oxygen concentration on mortality of yellowtail experimentally infected with Enterococcus seriolicida</td>
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<td>Scapigliati et al., 1999</td>
<td>Hyperoxygenation of sea water resulted in a two-fold increase of immunoglobulins of sea bass compared to running seawater.</td>
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<td>Barton, 2000</td>
<td>Hypoxia is strong enough to alter homeostatsis of fish, more energy in fish body might be allocated for maintain integrity and less will be remain for immunity</td>
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<td>Boleza et al., 2001</td>
<td>Hypercapnic hypoxia compromises bactericidal activity of fish anterior kidney cells against opportunistic environmental pathogens</td>
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<td>Cecchini and Saroglia, 2002</td>
<td>Specific antibody response of sea bass against human-γ-globulin was reduced after hypoxia exposure than fish in hyperoxia or normoxia</td>
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<td>Welker et al., 2007</td>
<td>Sub lethal hypoxia compromises immune response of channel cat fish and increase susceptibility to Enteric septicemia</td>
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<tr>
<td>Choi et al., 2007</td>
<td>Acute hypoxia compromises immunity of fish</td>
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In human, it is well known that the **oxygen-dependent bactericidal activity** plays an important role to protect from bacterial infection (Johnston et al. 1975) and decreased environmental oxygen inhibits the NBT reduction activity, production of reactive oxygen species and the respiratory burst of leukocytes (Jarstrand et al. 1989; Gabig et al. 1979).

**Objective of this study**

To investigate the effects of **Hypoxia, Hypoxia–reperfusion on mortality and immune response** in fish and find the possibility of disease control by ambient oxygen management.
In this study Hypoxia is defined as “low oxygen level (50% DO saturation) where no physiological or behavioral changes could be observed”
Challenged fish and non-challenged fish were cohabited in same tank.
Mortality due to experimental challenge in LDO was significantly higher.

Horizontal transmission was easy to occur in moderate hypoxic condition.
All groups of fish were challenged with pathogens.

- 110~120% DO-saturation
- 40~50% DO-saturation

Groups:
- H-H
- L-H
- H-L
- L-L
Mortality of infected fish that were transferred to the hyperoxic condition were significantly lowered.

Infected fish reared in hypoxic condition would cause high mortality but the mortality could lowered by transfer to hyperoxic condition.
Both group of fish were reared at normoxic tank (80~90% saturation).
If the dissolved oxygen level after infection maintain higher than acclimated level, the mortality could be decreased.
Cumulative mortality of rainbow trout challenged with *Vibrio anguillarum*

- LDO→HDO
- LDO→LDO
- control

Days after the challenge

Cumulative mortality (%)
Recommendation

- The dissolved oxygen levels in rearing water should be monitored frequently to know the oxygen levels that fish are acclimated.
- If a few diseased fish are found, oxygen should be supplied into the water.

Awaiting solution

- Optimum farm management procedure on dissolved oxygen should be established.
- Suitable equipment of oxygen supply should be developed.
Practical use of oxygen generator