Best Practices in Shrimp Aquaculture

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PRODUCTION CYCLE STAGE
Broodstock

SPECIFIC HAZARD
SPF/SPR/SPS Stocks, Live Feed

PREVENTATIVE MEASURES
Pathogen carrier, Supply/Source, Alternative to live feed

VALIDATION OF PREVENTION MEASURES
Health Certificate, CA approved source/acculization of quarantined

BIOSECURITY MEASURES
CA, Sampling, Analysis

HUSBANDRY/FARM MANAGEMENT
Disinfected Water

GROUP 2

Vehicle

HATCHERY
Hatchery, Disease Risk

NURSERY
Post Larvae, No testing

GROW-OUT
Diseases, PL quality, Quarantine, Records

SPR/SPS Stocks, Live Feed

Pathogen carrier, Supply/Source, Alternative to live feed

Ensure Health Status, Health Check

Disease Risk, NO TESTING

PL Quality

Environmental changes, Disease, PL quality

Train, Recognize, Records

Feed, Feed quality

Small scale farm security, GAP, BAF

vector

Technical Assistance, GAP handling, Artemia

GAAP

Vehicle

Water discharge, Infection, Surveillance

Indoer cluster farmer (for small scale)

Small scale farm security

GAP handling, Artemia
Additional Sources of Information:

- Shrimp production matrix (tabulated guide in Putra Jaya for WG 2)
- Collated information from Dr Victoria Alday
- Manuals and publications

All phases of shrimp culture can aim for:

**GOOD BIOSECURITY = NO DISEASE = NO ANTIBIOTIC USE = HEALTHY HARVEST = GOOD PROFIT**
Modified Snieszko circle

- Shrimp genetics
- Pathogen status
- Environment management
- Disease outbreak
Definition of Biosecurity

(from FAO Monodon Manual section 2.5 page 15)

“...sets of practices that will reduce the probability of a pathogen introduction and its subsequent spread from one place to another...”. Biosecurity protocols are intended to maintain the “security” of a facility with respect to certain disease-causing organisms that may not already be present in a particular system. Biosecurity encompasses policy, regulatory and programme frameworks (including instruments and activities) in response to managing risks associated with diseases.

(from Omar’s PJ presentation)

“Strategic and integrated approach that encompasses the policy and regulatory frameworks (including instruments and activities) that analyse and manage risks in the sectors of food safety, animal life and health, and plant life and health, including associated environmental risks.”
Biosecurity needs in the life of shrimp

There are critical points in the production process that can permit biological hazards.

Spotting these needs and providing proper biosecurity throughout the shrimps’s life stages is vital and difficult.

Illustrate the production cycle and the different components of each (sample below)

Each of these components would require:

1. Clean water
2. Clean rearing facilities
3. Clean feed
4. Hygienic protocols
5. Dry out and break cycle
Site Selection and Environment

- **Site selection**
  - Far from incursions
  - Clean water

- **Facility design**
  - Modular
  - Reservoir
  - Effluent containment

- **Hygiene**
  - Siphon out dead shrimp
  - Waste management of treated water
Choose right shrimp genetics
• tolerant shrimp for low biosecurity
• SPF & high performers for high biosecurity systems

Keep pathogens out!
• Dry out facilities regularly
• Disinfect water
• Feeds
• Prevent air & droplets contamination

Limit visitors (vehicles, humans, birds, other carriers)

Install hand-wash stations, foot baths, and wheel washes or tyre baths

Put up warning signs

Change footwear/ wear boots
Biosecurity in shrimp aquaculture starts with clean broodstock that supply eggs and nauplii for hatcheries.

- Certification of broodstock health status is supported by disease surveillance records, audit records of rearing facilities, and on-growing protocols, including feeds and feeding.

- Specific pathogen free (SPF) broodstock are guaranteed free of specific diseases through periodic testing of shrimp and their rearing facilities.

A female broodstock (gravid female) exhibits an ovary filled with mature eggs that runs from the head down to the tail (white structure as illustrated (from Bell and Lightner 1988).
Sources and Kinds of Broodstock

1. Non-SPF and locally-sourced
   a. Wild-caught
   b. Home-grown from grow-out ponds

2. Imported specific pathogen free (SPF) stocks
   a. Direct importation from Hawaii and the US
   b. Multiplication centers within countries

Regardless of source, new broodstock should be quarantined

Non-SPF broodstock have unknown health status and may have been exposed to known and unknown pathogens

- AHPND
- WSSV
- IHHNV
- YHV
- IMNV
- EHP
- TSV
- ???

Newly-acquired broodstock should be kept separate or quarantined upon arrival and should not be mixed with existing stocks in the facility until their health status is ascertained.
Sources and Kinds of Broodstock

1. Locally-sourced
   a. Wild-caught
   b. Home-grown from grow-out ponds

2. Specific Pathogen Free (SPF) stocks
   a. Directly imported from Hawaii, Florida, Singapore and other countries
   b. Produced in multiplication centers within countries

Quarantine of new broodstock

Newly-acquired broodstock should be kept separate or quarantined upon arrival and should not be mixed with existing stocks in the facility until their health status is ascertained.

SPF broodstock have **known health status** and are certified free from certain known pathogens. However, freedom from pathogens is merely through physical barriers and strict biosecurity of their closed holding systems. Thus, SPF status is temporary and dependent upon provision of similar level of biosecurity of the new facility, in case of transfer.
Caring for Broodstock

Requirements:

1. Clean water
2. Clean rearing facilities
3. Clean feed
4. Hygienic protocols

Refer to illustrations from *P. monodon* (FAO Fisheries Technical Paper 446) and *P. vannamei* (FAO Fisheries Technical Paper 450) manuals.
A female broodstock releases fecal material during spawning. The feces contains gut-associated bacteria, many of which are opportunistic vibrios, as well as gut-infecting parasites and viruses. A management practice or device that effectively prevents the release of the spawner’s fecal material into the spawning water would drastically prevent opportunistic bacterial infection in larvae.

It is important to collect and wash eggs with care to prevent bacterial build-up on their surfaces. Alternatively, nauplii should be collected using their phototactic response taking very little of their hatching water into the new larval rearing tank (photos from Bell and Lightner 1988).
It is also important to collect eggs and wash them with care to prevent bacterial build-up on their surfaces (biofilm formation). Egg washing technique was found very effective in preventing Baculovirus midgut gland necrosis infection in *Penaeus japonicus* hatcheries, eradicating the disease almost completely. This technique will also prevent gut-associated infectious bacteria.

Alternatively, nauplii could be collected using their phototactic response taking very little of their hatching water into the new larval rearing tank (drawing from Momoyama and Sano (1992)).
Take Home Messages Broodstock and Hatchery

1. Broodstock source is important
2. The health status of the broodstock should be certified by the competent authority of the exporting country.
3. Purchase from accredited sources with good track record only
4. Always separate new stocks from old stocks; quarantine
5. Provide hygienic and biosecure facilities for broodstock
6. Some diseases originate from female spawners necessitating re-evaluation of spawning techniques and hatchery management
7. Husbandry techniques in hatcheries could influence the associated bacterial flora of postlarvae
8. Keep up-to-date records
Hatchery: avoid prophylactic use of antibiotics

Comparison of luminescent bacterial load of hatchery-reared and wild-caught postlarvae

<table>
<thead>
<tr>
<th>Stage</th>
<th>Number of Batches Examined</th>
<th>Batches Negative for Luminescent Bacteria (%)</th>
<th>Range of Associated Luminescent Bacteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>PL 12</td>
<td>97</td>
<td>59 (61)</td>
<td>$5.0 \times 10^0 - 1.3 \times 10^5$</td>
</tr>
<tr>
<td>PL 13</td>
<td>36</td>
<td>12 (33.3)</td>
<td>$2.5 \times 10^0 - 8.9 \times 10^4$</td>
</tr>
<tr>
<td>PL 14</td>
<td>25</td>
<td>11 (44)</td>
<td>$5.0 \times 10^0 - 2.5 \times 10^4$</td>
</tr>
<tr>
<td>PL 15</td>
<td>37</td>
<td>11 (30)</td>
<td>$7.0 \times 10^1 - 1.7 \times 10^4$</td>
</tr>
<tr>
<td>PL 16</td>
<td>18</td>
<td>6 (33.3)</td>
<td>$5.0 \times 10^0 - 9.9 \times 10^4$</td>
</tr>
<tr>
<td>PL 17</td>
<td>28</td>
<td>9 (32)</td>
<td>$5.0 \times 10^0 - 3.0 \times 10^5$</td>
</tr>
<tr>
<td>PL 18</td>
<td>31</td>
<td>7 (23)</td>
<td>$2.0 \times 10^2 - 4.0 \times 10^4$</td>
</tr>
<tr>
<td>Wild-caught PLs</td>
<td>31</td>
<td>18 (58)</td>
<td>$5.0 \times 10^0 - 3.5 \times 10^2$</td>
</tr>
</tbody>
</table>

Hatchery-reared postlarvae = 272 batches
Hatchery: monitor bacterial population in rearing water using TCBS

Fate of *Penaeus monodon* larvae during *Vibrio harveyi* infection

- *Vibrio harveyi* in seawater is <10 cfu/ml
- Contamination at spawning and feeding

The reason for sterilization of water

- Increase in number
- Oral route of entry

The reason for egg washing

Uninfected larval surface

Biofilm build up on feeding apparatus, mouth and gills

Mass mortality

Destroys hepatopancreas

Systemic infection

Biofilm formation in the mouth and feeding apparatus
Hatchery rearing water management

Incoming water disinfection:
- Ozone or
- Sand filter (washing and disinfection of sand every 6 months with 200ppm calcium hypochlorite)

- Calcium hypochlorite 30ppm

- Validation of water treatment: microbiology (TCBS no green colonies) (PHOTOS)

- Addition of probiotics to disinfected water prior stocking to mature the water

An Example of Microbiological Index (MI)

- Marine Agar plate (M): for total bacterial count

- TCBS Agar plate (T): for total *Vibrio* count
  - Yellow colony (TY): generally for less harmful *Vibrio* species
  - Green colony (TG): generally for harmful *Vibrio* species

Good Water Quality Index from microbiology

1. $M > 20 \times \text{Total } *Vibrio* \ (T)$
2. $M = \text{usually} > 10^5$
3. $T < 10^3$, and $TG > TY$
4. $TG < 10^2$, $< 5 \times 10^2$ is better
5. Higher DO can increase shrimp tolerance to *Vibrio*

NOTE: The MI for each farm may be different.
FEEDS
- Clean pure cultures of algae or diatoms
- Disinfected brine shrimp, *Artemia*

PL quality and health assessment
- No melanization, no tubular constrictions, no deformities
- Confirm PL health by PCR for WSSV, EHP, AHPND (incubation of PLs in general bacteriological media for 24h prior to PCR)
- Stress test: 32ppt to 0ppt with >90% survival
- Microbiology (TCBS no green colonies)
Best practices for shrimp grow-out

- Quality of postlarvae = various criteria applied in different countries (Refer to FAO Technical Paper 450)

- **Good quality seeds for all** = a biosecurity threat somewhere, is a biosecurity threat everywhere. Small-scale farmers should have access to good quality postlarvae from SPF broodstock.

**QUALITY OF Environment**

- Thorough drying of pond bottom and pond preparation
- Aeration for water circulation
- Others
Fate of *Penaeus monodon* juveniles to sub-adults after infection with *Vibrio harveyi*

Examine closely the strategies for creating “microbially mature” water and application of probiotics.

**Vibrio harveyi** in the environment <10 cfu/ml

Increase in number

The reason for sterilization of water

The strategy may have been wrong.

**Acute Infection**

- Massive inflammatory response
- Mortality

**Chronic Infection**

- Focal necrosis in the hepatopancreas
- Recovery; slow growth

**Build up in the hepatopancreas**

- Severe melanization, fibrosis, granuloma formation
- Mortality
Good shrimp strains and genetic improvement

Good nutrition and immunostimulation

Minimize risk factors

Reduce infectious pressure

Vigilant surveillance and diagnosis

Prudent use of antibiotics
Thank you for your attention!