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Best Practices in Shrimp Aquaculture

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PRODUCTION CYCLE STAGE
SPECIFIC HAZARD
PREVENTATIVE MEASURES
Validation of preventive measures
BIOSECURITY MEASURES
HUSBANDRY/FARM MANAGEMENT
GROUP 2
Broodstock
SPF/SPR/SPT STOCKS
Live Feed
CA APPROVED SOURCE/ ACCREDITATION OF SUPPLIER
AUDIT
Disinfected Water
Prudent use of Antimicrobial
Supply/ Source
Pathogens carrier
Health Certificate
SAMPLING & ANALYSIS
Alternative to live feed
Disease Occurrence
Vehicle
Home grown /domestic
ENSURE HEALTH STATUS
Quarantine measures
GAP handling Artemia
Nauplii
HATCHERY
Disease Risk
COA / SQA
CA & Registered
NO TESTING
Post-Larvae
PL quality criteria
GAqP
census inventory
Vectors
PL Quality
ENVIRONMENTAL CHANGES
TECHNICAL ASSISTANCE
Farm Standard (GAP, BAP)
NURSERY
GROW-OUT
technical assistance
Small scale Farm Biosecurity
record keeping SOP
Water discharge
waste disposal
training
Farmer Organization Cluster of farmer (for small scale)
Indicator of good production
inform cluster members
- Survival Rate
- uniformity in size
- appearance
use of chemical drug
FEED QUALITY
Feed Quality

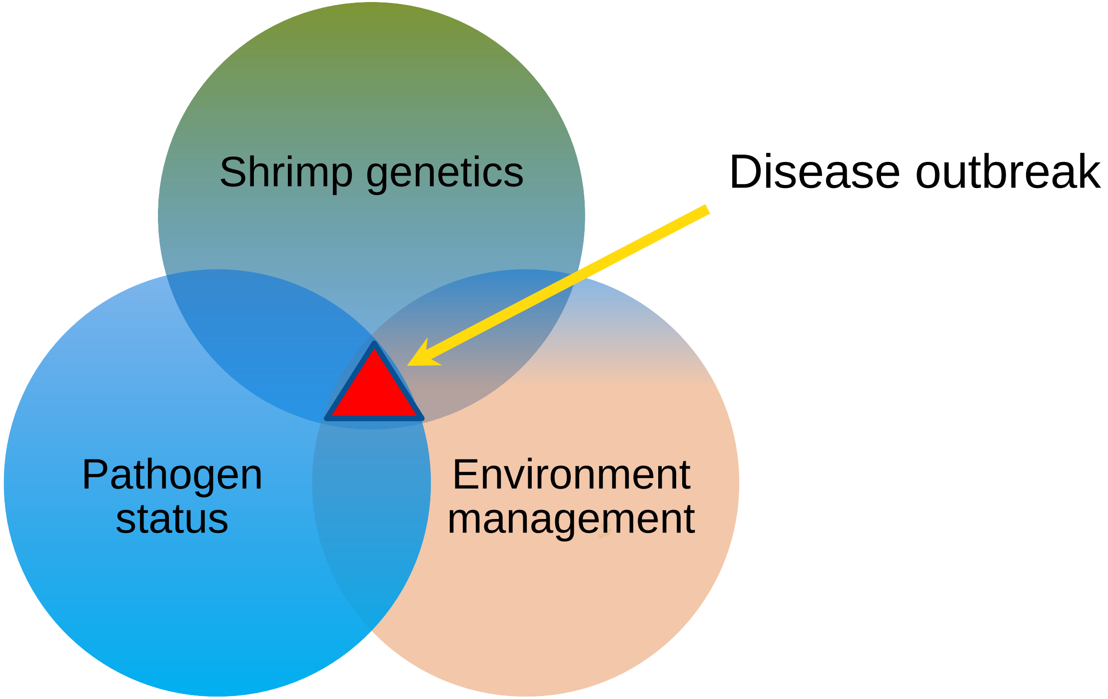
Additional Sources of Information:

- 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



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

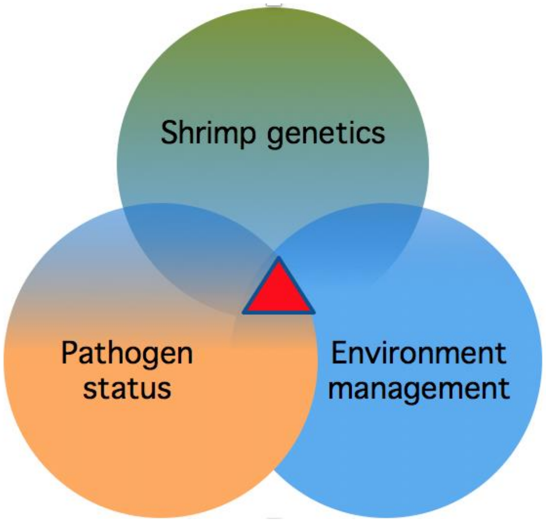
- There are critical points in the production process that can permit biological hazards.
- Spotting these needs and providing proper biosecurity throughout the shrimps’s life stages is vital and difficult.

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

Each of these components would require:

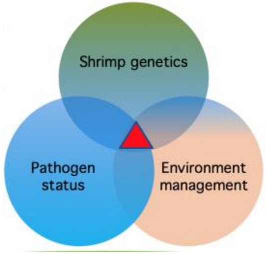
1. Clean water
2. Clean rearing facilities
3. Clean feed
4. Hygienic protocols
5. **Dry out and break cycle**

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

BROODSTOCK



- ❖ 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

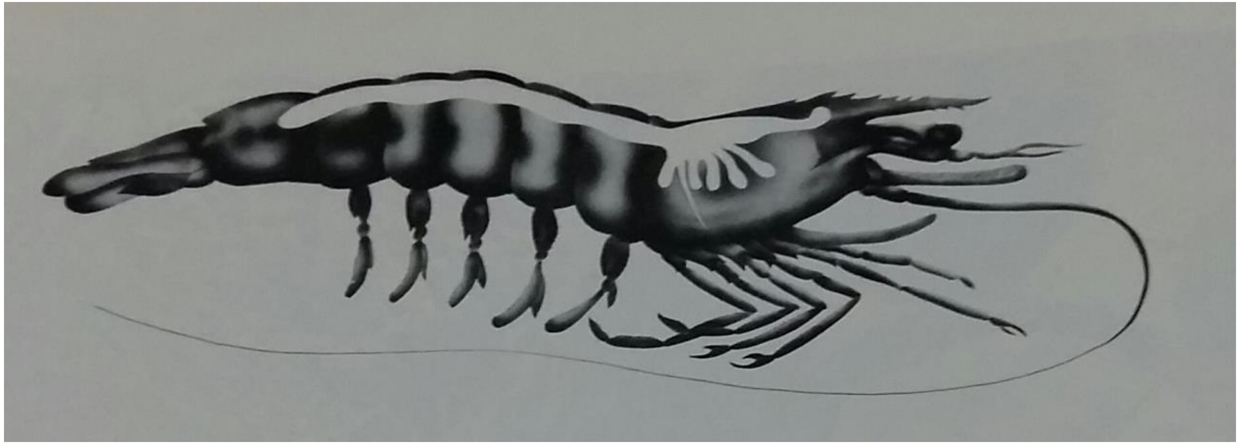
Broodstock

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

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.

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

Unknown?

AHPND

???

WSSV

TSV

IHHNV

EHP

YHV

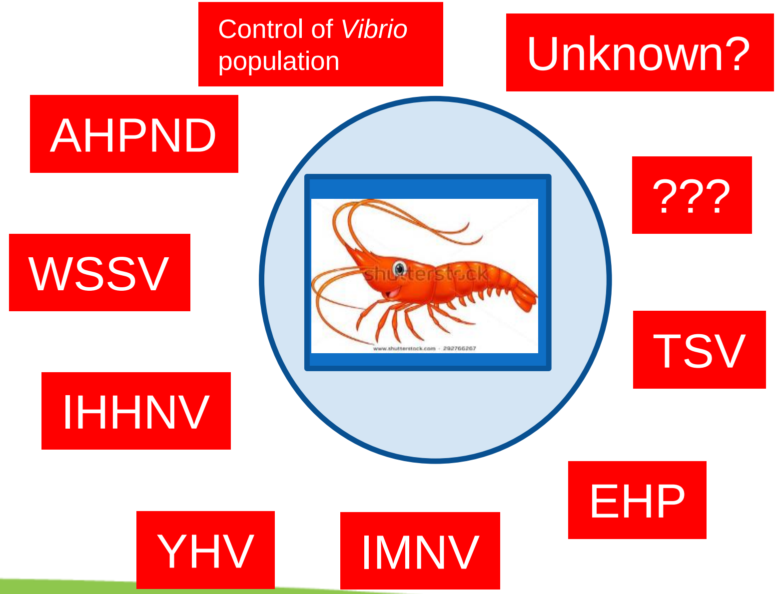
IMNV

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

SPF broodstock have **<u>known health status</u> 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.**



Quarantine of new broodstock

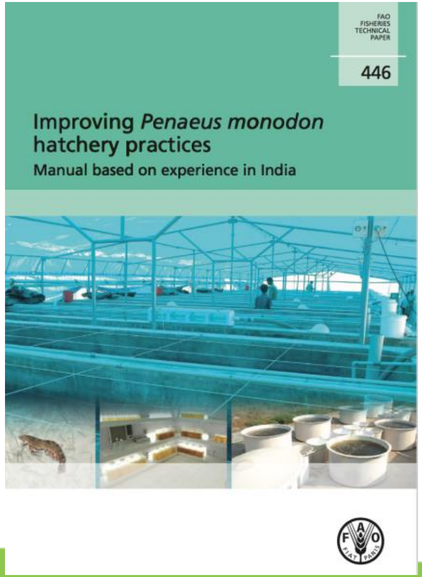
Newly-acquired broodstock should be keot separate or quarantined upon arrival and should not be mixed with existing stocks in the facility until their health status is ascertained.

Caring for Broodstock

Requirements:

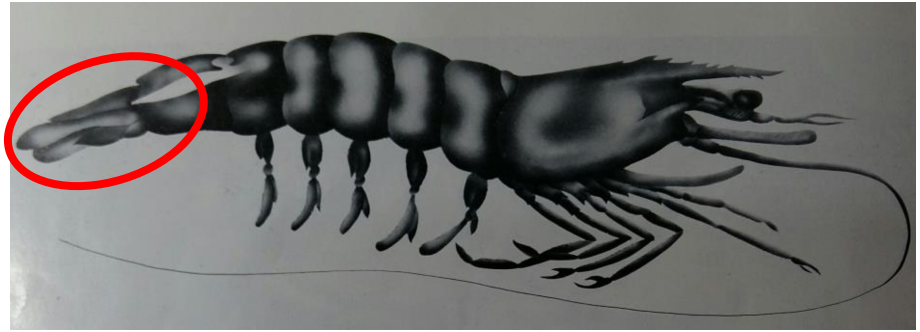
1. Clean water
2. Clean rearing facilities
3. Clean feed
4. Hygienic protocols

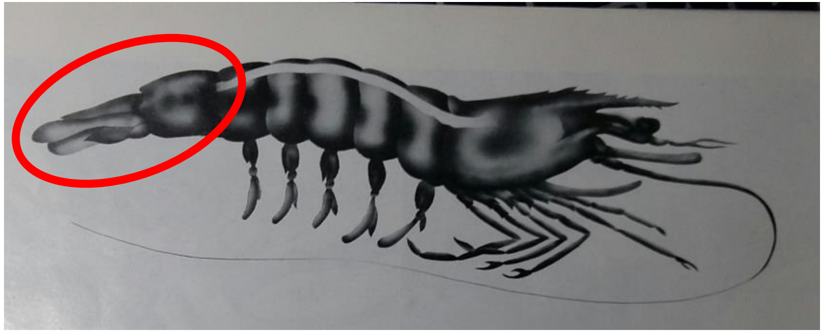
Refer to illustrations from *P. monodon* (FAO Fisheries Technical Paper 446) and *P. vannamei* (FAO Fisheries Technical Paper 450) manuals



Broodstock

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.

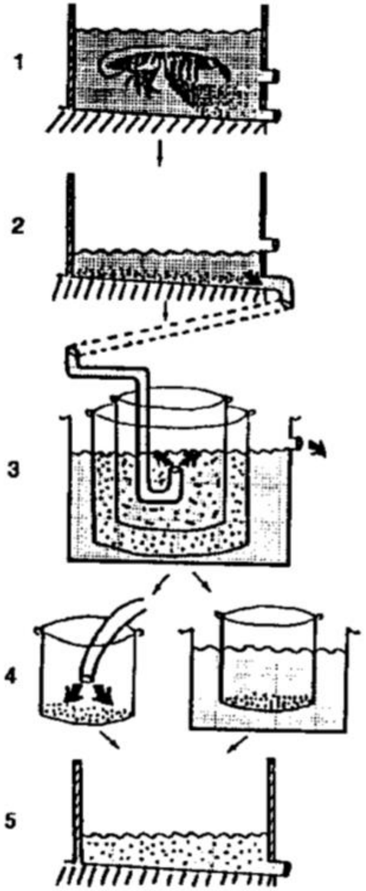




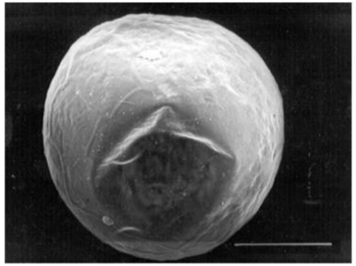
It is important to collect and wash eggs with care to prevent bacterial build-up on their surfaces. Alternatively, nauplii should be collected using their phototactic response taking very little of their hatching water into the new larval rearing tank (photos from Bell and Lightner 1988)

Steps in shrimp egg-washing

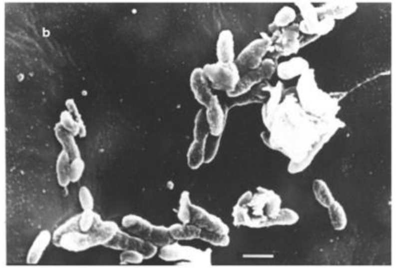
It is also important to collect eggs and wash them with care to prevent bacterial build-up on their surfaces (biofilm formation). Egg washing technique was found very effective in preventing Baculovirus midgut gland necrosis infection in *Penaeus japonicus* hatcheries, eradicating the disease almost completely. This technique will also prevent gut-associated infectious bacteria.



Sources of *Vibrio harveyi* in *Penaeus monodon* hatcheries:
Spawners release fecal material in spawning water; adherence resulted to biofilm formation on egg surface



Penaeus monodon egg with bacterial plaques on the surface



The bacterial plaques are composed of actively dividing cells similar to *Vibrio harveyi*

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

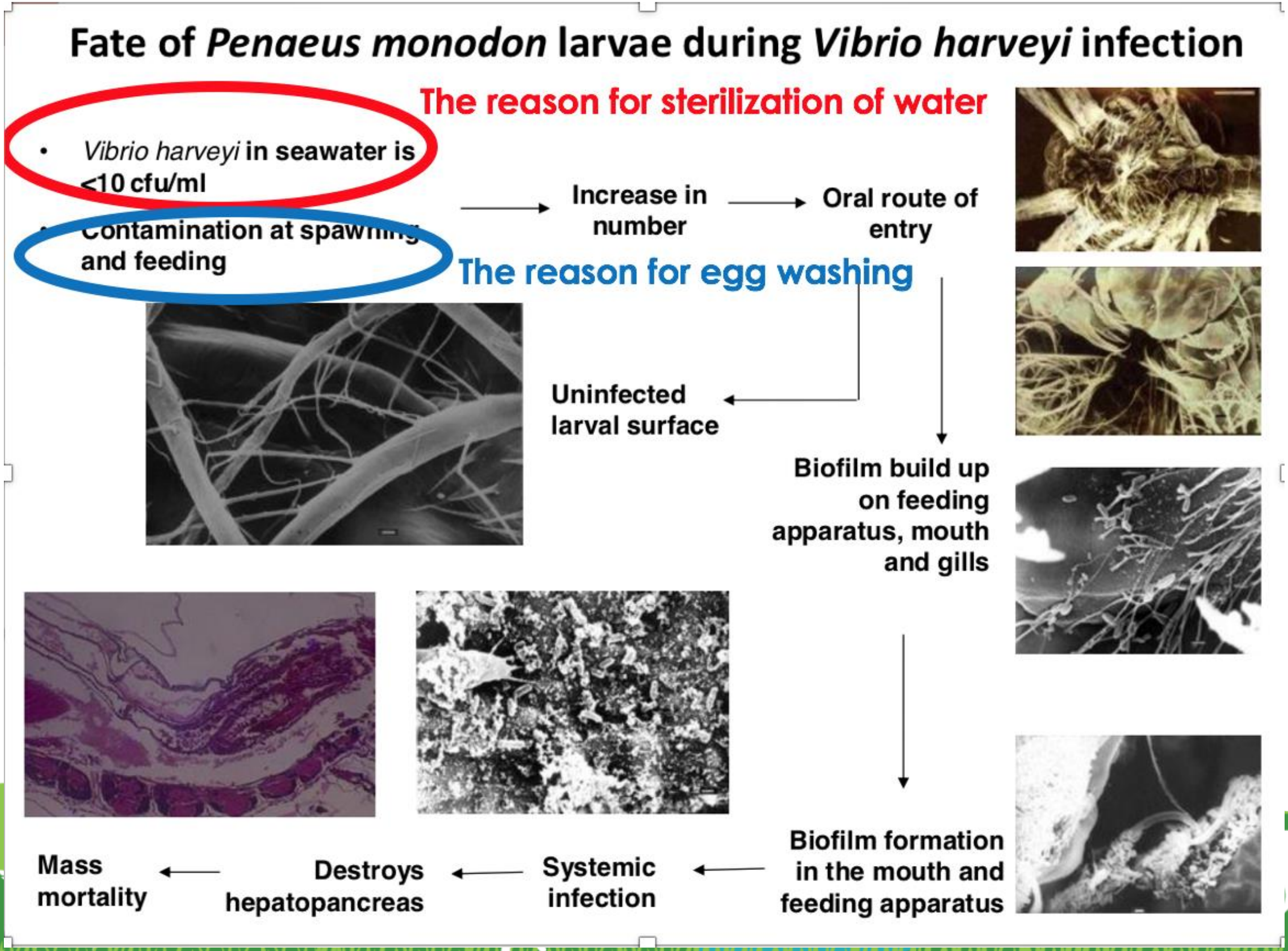
1. Broodstock source is important
2. The health status of the broodstock should be certified by the competent authority of the exporting country.
3. Purchase from accredited sources with good track record only
4. Always separate new stocks from old stocks; quarantine
5. Provide hygienic and biosecure 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

Stage	Number of Batches Examined	Batches Negative for Luminescent Bacteria (%)	Range of Associated Luminescent Bacteria
Hatchery-reared postlarvae = 272 batches			
PL 12	97	59 (61)	5.0×10^0 - 1.3×10^5
PL 13	36	12 (33.3)	2.5×10^0 - 8.9×10^4
PL 14	25	11 (44)	5.0×10^0 - 2.5×10^4
PL 15	37	11 (30)	7.0×10^1 - 1.7×10^4
PL 16	18	6 (33.3)	5.0×10^0 - 9.9×10^4
PL 17	28	9 (32)	5.0×10^0 - 3.0×10^5
PL 18	31	7 (23)	2.0×10^2 - 4.0×10^4
Wild-caught PLs	31	18 (58)	5.0×10^0 - 3.5×10^2

Hatchery: monitor bacterial population in rearing water using TCBS



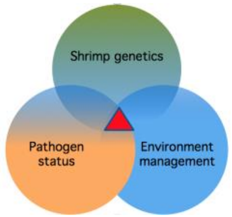
Hatchery rearing water management

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

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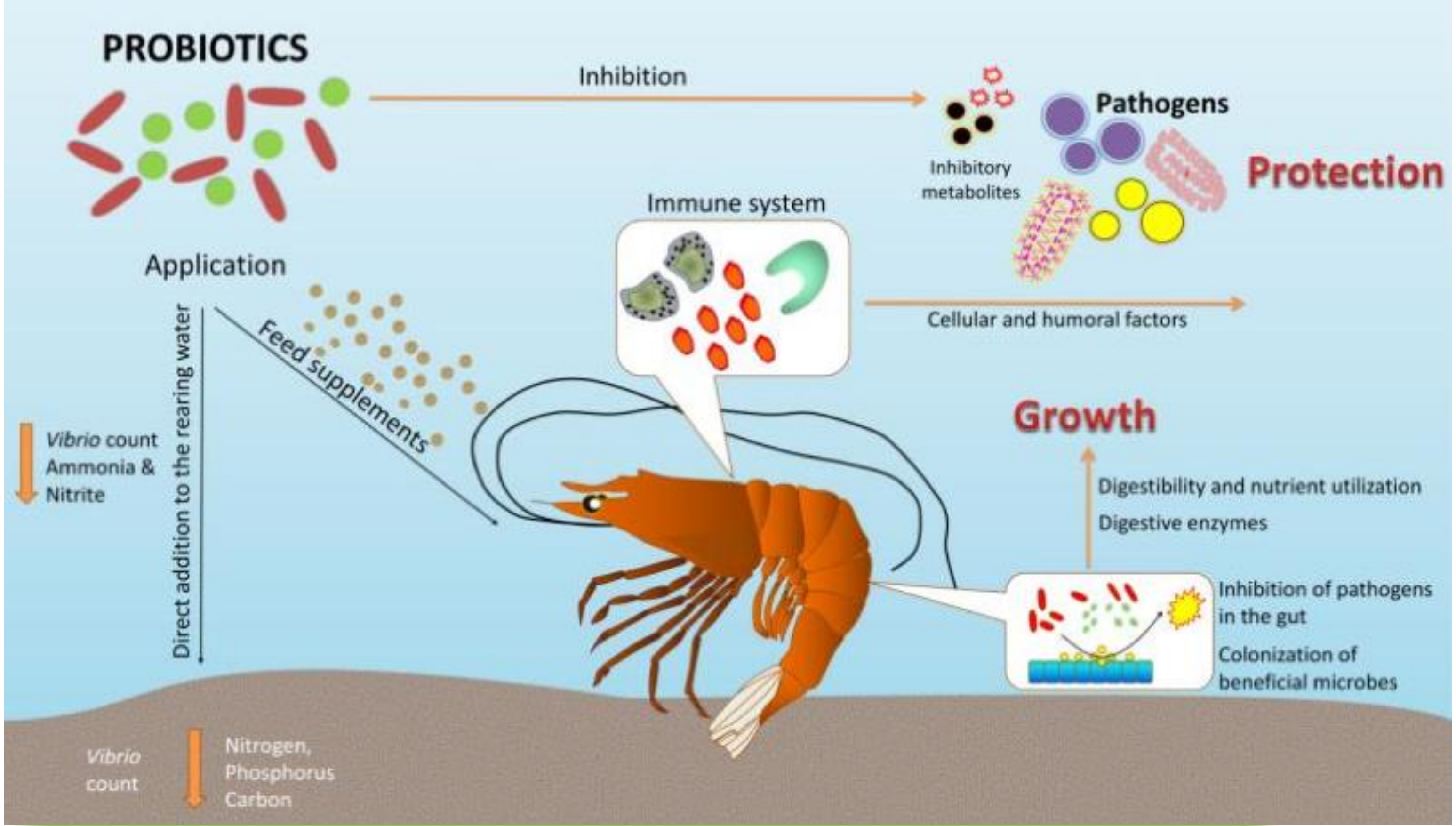
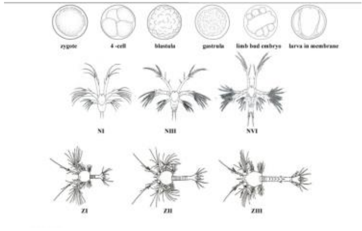
Good Water Quality Index from microbiology

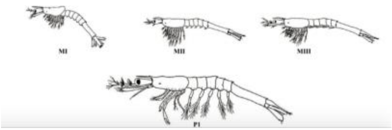
1. M = > 20 X Total *Vibrio* (T)
2. M = usually > 10^5
3. T < 10^3, and TG > TY
4. TG < 10^3, < 5 X 10^2 is better
5. Higher DO can increase shrimp tolerance to *Vibrio*

High = Dissolved oxygen 6 – 8 mg/L
Low = Dissolved oxygen < 2 to 3 mg/L

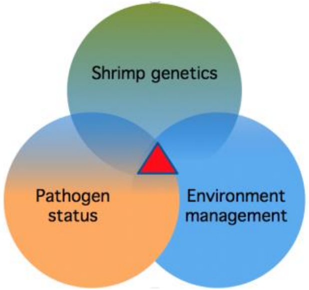
NOTE: The MI for each farm may be different.


PROBIOTICS
Inhibition
Inhibitory metabolites
Pathogens
Protection
Immune system
Cellular and humoral factors
Application
Direct addition to the rearing water
Feed supplements
Vibrio count
Ammonia &
Nitrite
Growth
Digestibility and nutrient utilization
Digestive enzymes
Inhibition of pathogens in the gut
Colonization of beneficial microbes
Vibrio count
Nitrogen,
Phosphorus
Carbon





Hatchery management

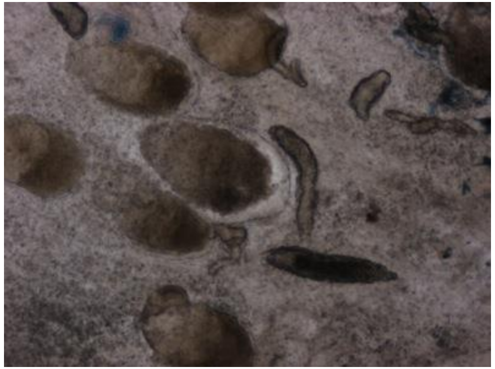


FEEDS

- ❖ 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

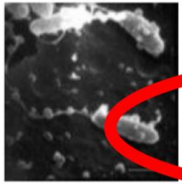
- Quality of postlarvae = various criteria applied in different countries (Refer to FAO Technical Paper 450)
- **Good quality seeds for all** = a biosecurity threat somewhere, is a biosecurity threat everywhere. Small-scale farmers should have access to good quality postlarvae from SPF broodstock.

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.

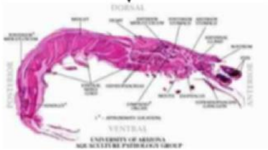


Vibrio harveyi in the environment <10 cfu/ml

The reason for sterilization of water

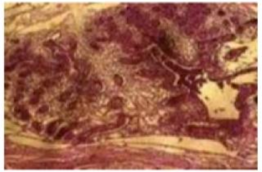
The strategy may have been wrong.

Increase in number



Build up in the hepatopancreas

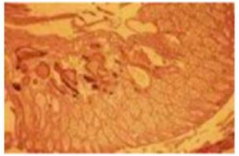
Acute Infection



Massive inflammatory response

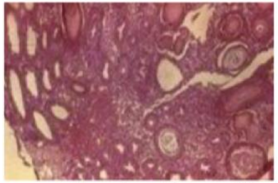
Mortality

Chronic Infection



Focal necrosis in the hepatopancreas

Recovery; slow growth



Severe melanization, fibrosis, granuloma formation

Mortality

DISEASE BARRIERS

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!