JIFSAN Good Aquacultural Practices Program

Appendix

Case Study-Shrimp Aquaculture Hazard Analysis Worksheet

Firm Name: Culture Production Method: Hatchery and Pond Growout

Firm Address:

(1) Aquaculture Production Step	(2) Identify potential hazards introduced, controlled or enhanced at this step.	(3) Are any potential food-safety hazards significant? (Yes/No)	(4) Justify your decision for column 3	(5) What preventative measure(s) can be applied to prevent the significant hazards?	(6) Is this step a critical control point? (Yes/No)
Hatchery Breeding/Brood stock Production	BIOLOGICAL: Pathogens (e.g., Salmonella)	Yes	Shrimp, feeds, and/or culture systems may be contaminated with Salmonella	Periodic testing for Salmonella, Certificate of Compliance (COC) ensuring that the shrimp, feeds, etc., are Salmonella free.	Yes
	CHEMICAL: Pesticides, Antibiotics	Yes	Water may be contaminated with chemicals or pesticides, antibiotics are sometimes used to control diseases	Periodic testing of water for chemicals and pesticides, Use only approved antibiotics under the direction of a veterinarian	
Hatchery Maturation Reproduction	BIOLOGICAL: Pathogens (e.g., Salmonella)	Yes	Shrimp, feeds, and/or culture systems may be contaminated with Salmonella	Periodic testing for Salmonella, Certificate of Compliance (COC) ensuring that the shrimp, feeds, etc., are Salmonella free.	Yes
	CHEMICAL: Pesticides, Antibiotics	Yes	Water may be contaminated with chemicals or pesticides, antibiotics are sometimes used to control diseases	Periodic testing of water for chemicals and pesticides, Use only approved antibiotics under the direction of a veterinarian	
Hatchery Larval System	BIOLOGICAL: Pathogens (e.g., Salmonella)	Yes	Shrimp, feeds, and/or culture systems may be contaminated with Salmonella	Periodic testing for Salmonella, Certificate of Compliance (COC) ensuring that the shrimp, feeds, etc., are Salmonella free.	Yes
	CHEMICAL: Pesticides, Antibiotics	Yes	Water may be contaminated with chemicals or pesticides, antibiotics are sometimes used to control diseases	Periodic testing of water for chemicals and pesticides, Use only approved antibiotics under the direction of a veterinarian	
Hatchery Nursery	BIOLOGICAL: Pathogens (e.g., Salmonella)	Yes	Shrimp, feeds, and/or culture systems may be contaminated with Salmonella	Periodic testing for Salmonella, Certificate of Compliance (COC) ensuring that the shrimp, feeds, etc., are Salmonella free.	Yes
	CHEMICAL: Pesticides, Antibiotics	Yes	Water may be contaminated with chemicals or pesticides, antibiotics are sometimes used to control diseases	Periodic testing of water for chemicals and pesticides, Use only approved antibiotics under the direction of a veterinarian	
Pond Growout	BIOLOGICAL: Pathogens (e.g., Salmonella)	Yes	Shrimp, feeds, and/or culture systems may be contaminated with Salmonella	Periodic testing for Salmonella, Certificate of Compliance (COC) ensuring that the shrimp, feeds, etc., are Salmonella free.	Yes
	CHEMICAL: Pesticides, Antibiotics	Yes	Water may be contaminated with chemicals or pesticides, antibiotics are sometimes used to control diseases	Periodic testing of water for chemicals and pesticides, Use only approved antibiotics under the direction of a veterinarian	

Hazard Analysis Worksheet

(1) Ingredient/ processing step	(2) Identify potential hazards introduced, controlled or enhanced at this step.	(3) Are any potential food-safety hazards significant? (Yes/No)	(4) Justify your decision for column 3	(5) What preventative measure(s) can be applied to prevent the significant hazards?	(6) Is this step a critical control point? (Yes/No)
	BIOLOGICAL CHEMICAL PHYSICAL				
	BIOLOGICAL CHEMICAL PHYSICAL				
	BIOLOGICAL CHEMICAL PHYSICAL				
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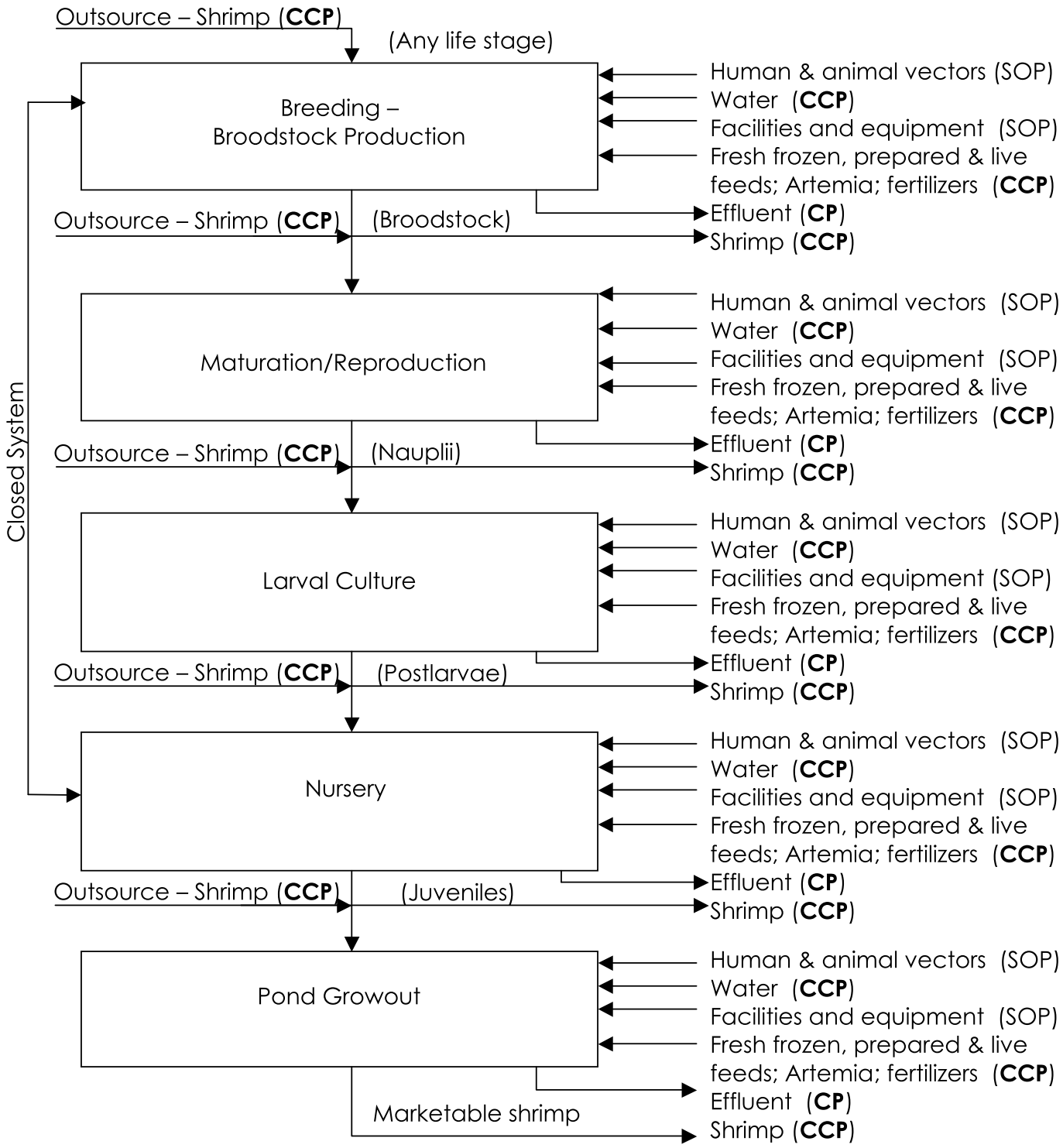
Figure 1. Operational flow diagram for a closed system hatchery and a shrimp pond.



CCP – Critical Control Point; **CP**-Control Point
SOP – Standard Operating Procedure

AQUACULTURE HACCP Plan Form

Firm Name: Production Method:

Firm Address: Hatchery: Breeding/Broodstock Production

(1) Critical Control Point (CCP)	(2) Significant Hazards	(3) Critical Limits for each Preventive Measure	(4) Monitoring	(5) Monitoring	(6) Monitoring	(7) Monitoring	(8) Corrective Actions(s)	(9) Verification	(10) Records
			What	How	Frequency	Who			
Hatchery Breeding Broodstock Production	Pathogens (e.g., Salmonella)	No Salmonella on shrimp	Testing for Salmonella	Analytical Tests	Weekly or as needed	Aquaculture Production Manager	If: Salmonella is present on shrimp, Then: quarantine shrimp and consult a veterinarian	Review of shrimp analytical test results	Test result records
		No Salmonella in feeds	Testing for Salmonella	Analytical Tests	Weekly or as needed	Aquaculture Production Manager	If: Salmonella is present in feed, Then: treat or heat feed or destroy feed	Review of feed analytical test results	Test result records
		No Salmonella in culture system	Testing for Salmonella	Analytical Tests	Weekly or as needed	Aquaculture Production Manager	If: Salmonella is present in culture systems, Then: clean and sanitize culture systems	Review of culture system analytical Salmonella test results	Test result records
			Certificate of Compliance (COC) indicating Salmonella free shrimp and feed	Review COC	Every Shipment	Aquaculture Production Manager	If: COC does not accompany feed and/or shrimp shipment, Then: Isolate feed, quarantine shrimp and/or reject feed and shrimp shipment	Review of COC documentation	COC forms for each shipment
Hatchery Breeding Broodstock Production	Pesticides, Antibiotics	No unapproved pesticides or antibiotics in the shrimp	Analytical testing of shrimp for pesticides and antibiotics	Analytical Testing of shrimp	Monthly	Production manager	If: unapproved antibiotics or pesticides are found Then: consult with a veterinarian and/or destroy shrimp,	Review of shrimp analytical test results for antibiotics and pesticides	Analytical test records
		No unapproved antibiotics or pesticide residues in feed	Analytical testing of feeds for pesticides and antibiotics	Analytical Testing of feeds	Every Batch	Production Manager	If: feeds contain pesticides or antibiotic residues, Then: Destroy feeds and replace feed	Review of feed analytical test results for antibiotics and pesticides	Analytical test records
			Feed supplier facility/feed/acquisition handling protocols	Periodic feed production site visits and/or review of records	Yearly	Production Manager	If: site visits indicate a problem, Then: change feed manufacturer	Periodic site visits	Record of site visits
		No pesticides and/or antibiotics in the culture water	Analytical testing of culture water	Analytical Tests	Monthly	Production manager	If: tests indicate presence of pesticides and/or antibiotics in culture water, Then: determine source of contamination and switch water supply systems	Review of culture water analytical test results for antibiotics and pesticides	Analytical test results for pesticides and antibiotics

CASE STUDY AQUACULTURE HACCP PLAN

Firm Name: Production Method:

Firm Address: Hatchery: Maturation/Reproduction

(1) Critical Control Point (CCP)	(2) Significant Hazards	(3) Critical Limits for each Preventive Measure	(4) Monitoring	(5) Monitoring	(6) Monitoring	(7) Monitoring	(8) Corrective Actions(s)	(9) Verification	(10) Records
Maturation / Reproduction	Pathogens (e.g., Salmonella)	No Salmonella on shrimp	What	How	Frequency	Who			
			Testing for Salmonella	Analytical Tests	Weekly or as needed	Aquaculture Production Manager	If: Salmonella is present on shrimp, Then: quarantine shrimp and consult a veterinarian	Review of shrimp analytical test results	Test result records
		No Salmonella in feeds	Testing for Salmonella	Analytical Tests	Weekly or as needed	Aquaculture Production Manager	If: Salmonella is present in feed, Then: treat or heat feed or destroy feed	Review of feed analytical test results	Test result records
		No Salmonella in culture system	Testing for Salmonella	Analytical Tests	Weekly or as needed	Aquaculture Production Manager	If: Salmonella is present in culture systems, Then: clean and sanitize culture systems	Review of culture system analytical Salmonella test results	Test result records
			Certificate of Compliance (COC) indicating Salmonella free shrimp and feed	Review COC	Every Shipment	Aquaculture Production Manager	If: COC does not accompany feed and/or shrimp shipment, Then: Isolate feed, quarantine shrimp and/or reject feed and shrimp shipment	Review of COC documentation	COC forms for each shipment
Maturation/Repro -duction	Pesticides, Antibiotics	No unapproved pesticides or antibiotics in the shrimp	Analytical testing of shrimp for pesticides and antibiotics	Analytical Testing of shrimp	Monthly	Production manager			
		No unapproved antibiotics or pesticide residues in feed	Analytical testing of feeds for pesticides and antibiotics	Analytical Testing of feeds	Every Batch	Production Manager	If: unapproved antibiotics or pesticides are found Then: consult with a veterinarian and/or destroy shrimp,	Review of shrimp analytical test results for antibiotics and pesticides	Analytical test records
			Feed supplier facility/feed/acquisition handling protocols	Periodic feed production site visits and/or review of records	Yearly	Production Manager	If: feeds contain pesticides or antibiotic residues, Then: Destroy feeds and replace feed	Review of feed analytical test results for antibiotics and pesticides	Analytical test records
		No pesticides and/or antibiotics in the culture water	Analytical testing of culture water	Analytical Tests	Monthly	Production manager	If: site visits indicate a problem, Then: change feed manufacturer	Periodic site visits	Record of site visits
							If: tests indicate presence of pesticides and/or antibiotics in culture water, Then: determine source of contamination and switch water supply systems	Review of culture water analytical test results for antibiotics and pesticides	Analytical test results for pesticides and antibiotics

CASE STUDY AQUACULTURE HACCP PLAN

Firm Name:

Firm Address:

Production Method:

Hatchery: Larval Culture

(1) Critical Control Point (CCP)	(2) Significant Hazards	(3) Critical Limits for each Preventive Measure	(4) Monitoring	(5) Monitoring	(6) Monitoring	(7) Monitoring	(8) Corrective Actions(s)	(9) Verification	(10) Records
Larval Culture	Pathogens (e.g., Salmonella)	No Salmonella on shrimp	What	How	Frequency	Who			
			Testing for Salmonella	Analytical Tests	Weekly or as needed	Aquaculture Production Manager	If: Salmonella is present on shrimp, Then: quarantine shrimp and consult a veterinarian	Review of shrimp analytical test results	Test result records
		No Salmonella in feeds	Testing for Salmonella	Analytical Tests	Weekly or as needed	Aquaculture Production Manager	If: Salmonella is present in feed, Then: treat or heat feed or destroy feed	Review of feed analytical test results	Test result records
		No Salmonella in culture system	Testing for Salmonella	Analytical Tests	Weekly or as needed	Aquaculture Production Manager	If: Salmonella is present in culture systems, Then: clean and sanitize culture systems	Review of culture system analytical Salmonella test results	Test result records
			Certificate of Compliance (COC) indicating Salmonella free shrimp and feed	Review COC	Every Shipment	Aquaculture Production Manager	If: COC does not accompany feed and/or shrimp shipment, Then: Isolate feed, quarantine shrimp and/or reject feed and shrimp shipment	Review of COC documentation	COC forms for each shipment
Larval Culture	Pesticides, Antibiotics	No unapproved pesticides or antibiotics in the shrimp	Analytical testing of shrimp for pesticides and antibiotics	Analytical Testing of shrimp	Monthly	Production manager	If: unapproved antibiotics or pesticides are found Then: consult with a veterinarian and/or destroy shrimp,	Review of shrimp analytical test results for antibiotics and pesticides	Analytical test records
		No unapproved antibiotics or pesticide residues in feed	Analytical testing of feeds for pesticides and antibiotics	Analytical Testing of feeds	Every Batch	Production Manager	If: feeds contain pesticides or antibiotic residues, Then: Destroy feeds and replace feed	Review of feed analytical test results for antibiotics and pesticides	Analytical test records
			Feed supplier facility/feed/acquisition handling protocols	Periodic feed production site visits and/or review of records	Yearly	Production Manager	If: site visits indicate a problem, Then: change feed manufacturer	Periodic site visits	Record of site visits
		No pesticides and/or antibiotics in the culture water	Analytical testing of culture water	Analytical Tests	Monthly	Production manager	If: tests indicate presence of pesticides and/or antibiotics in culture water, Then: determine source of contamination and switch water supply systems	Review of culture water analytical test results for antibiotics and pesticides	Analytical test results for pesticides and antibiotics

CASE STUDY AQUACULTURE HACCP PLAN

Firm Name: Production Method:

Firm Address: Hatchery:Nursery

(1) Critical Control Point (CCP)	(2) Significant Hazards	(3) Critical Limits for each Preventive Measure	(4) Monitoring	(5) Monitoring	(6) Monitoring	(7) Monitoring	(8) Corrective Actions(s)	(9) Verification	(10) Records
Nursery	Pathogens (e.g., Salmonella)	No Salmonella on shrimp	What	How	Frequency	Who			
			Testing for Salmonella	Analytical Tests	Weekly or as needed	Aquaculture Production Manager	If: Salmonella is present on shrimp, Then: quarantine shrimp and consult a veterinarian	Review of shrimp analytical test results	Test result records
		No Salmonella in feeds	Testing for Salmonella	Analytical Tests	Weekly or as needed	Aquaculture Production Manager	If: Salmonella is present in feed, Then: treat or heat feed or destroy feed	Review of feed analytical test results	Test result records
		No Salmonella in culture system	Testing for Salmonella	Analytical Tests	Weekly or as needed	Aquaculture Production Manager	If: Salmonella is present in culture systems, Then: clean and sanitize culture systems	Review of culture system analytical Salmonella test results	Test result records
			Certificate of Compliance (COC) indicating Salmonella free shrimp and feed	Review COC	Every Shipment	Aquaculture Production Manager	If: COC does not accompany feed and/or shrimp shipment, Then: Isolate feed, quarantine shrimp and/or reject feed and shrimp shipment	Review of COC documentation	COC forms for each shipment
Nursery	Pesticides, Antibiotics	No unapproved pesticides or antibiotics in the shrimp	Analytical testing of shrimp for pesticides and antibiotics	Analytical Testing of shrimp	Monthly	Production manager			
		No unapproved antibiotics or pesticide residues in feed	Analytical testing of feeds for pesticides and antibiotics	Analytical Testing of feeds	Every Batch	Production Manager	If: unapproved antibiotics or pesticides are found Then: consult with a veterinarian and/or destroy shrimp,	Review of shrimp analytical test results for antibiotics and pesticides	Analytical test records
			Feed supplier facility/feed/acquisition handling protocols	Periodic feed production site visits and/or review of records	Yearly	Production Manager	If: feeds contain pesticides or antibiotic residues, Then: Destroy feeds and replace feed	Review of feed analytical test results for antibiotics and pesticides	Analytical test records
		No pesticides and/or antibiotics in the culture water	Analytical testing of culture water	Analytical Tests	Monthly	Production manager	If: site visits indicate a problem, Then: change feed manufacturer	Periodic site visits	Record of site visits
							If: tests indicate presence of pesticides and/or antibiotics in culture water, Then: determine source of contamination and switch water supply systems	Review of culture water analytical test results for antibiotics and pesticides	Analytical test results for pesticides and antibiotics

CASE STUDY AQUACULTURE HACCP PLAN

Firm Name: Production Method:

Firm Address: Pond: Grow Out

(1) Critical Control Point (CCP)	(2) Significant Hazards	(3) Critical Limits for each Preventive Measure	(4)	(5)	(6)	(7)	(8) Corrective Actions(s)	(9) Verification	(10) Records
			Monitoring						
			What	How	Frequency	Who			
Pond Growout	Pathogens (e.g., Salmonella)	No Salmonella on shrimp	Testing for Salmonella	Analytical Tests	Weekly or as needed	Aquaculture Production Manager	If: Salmonella is present on shrimp, Then: Consult a veterinarian	Review of shrimp analytical test results	Test result records
		No Salmonella in feeds	Testing for Salmonella	Analytical Tests	Weekly or as needed	Aquaculture Production Manager	If: Salmonella is present in feed, Then: treat or heat feed or destroy feed	Review of feed analytical test results	Test result records
			Certificate of Compliance (COC) indicating Salmonella free shrimp and feed	Review COC	Every Shipment	Aquaculture Production Manager	If: COC does not accompany feed and/or shrimp shipment, Then: Isolate feed, quarantine shrimp and/or reject feed and shrimp shipment	Review of COC documentation	Test result records COC forms for each shipment
Pond Growout	Pesticides, Antibiotics	No unapproved pesticides or antibiotics in the shrimp	Analytical testing of shrimp for pesticides and antibiotics	Analytical Testing of shrimp	Monthly	Production manager	If: unapproved antibiotics or pesticides are found Then: consult with a veterinarian and/or destroy shrimp,	Review of shrimp analytical test results for antibiotics and pesticides	Analytical test records
		No unapproved antibiotics or pesticide residues in feed	Analytical testing of feeds for pesticides and antibiotics	Analytical Testing of feeds	Every Batch	Production Manager	If: feeds contain pesticides or antibiotic residues, Then: Destroy feeds and replace feed	Review of feed analytical test results for antibiotics and pesticides	Analytical test records
			Feed supplier facility/feed/acquisition handling protocols	Periodic feed production site visits and/or review of records	Yearly	Production Manager	If: site visits indicate a problem, Then: change feed manufacturer	Periodic site visits	Record of site visits
		No pesticides and/or antibiotics in the pond water	Analytical testing of pond water	Analytical Tests	Monthly	Production manager	If: tests indicate presence of pesticides and/or antibiotics in pond water, Then: determine source of contamination, flush ponds and/or switch water supply systems and analyze shrimp	Review of culture water analytical test results for antibiotics and pesticides	Analytical test results for pesticides and antibiotics

CASE STUDY AQUACULTURE HACCP PLAN

Firm Name: Production Method:

Firm Address: Hatchery: Larval Culture

(1) Critical Control Point (CCP)	(2) Significant Hazards	(3) Critical Limits for each Preventive Measure	(4) Monitoring	(5) Monitoring	(6) Monitoring	(7) Monitoring	(8) Corrective Actions(s)	(9) Verification	(10) Records
Larval Culture	Pathogens (e.g., Salmonella)	No Salmonella on shrimp	What	How	Frequency	Who			
			Testing for Salmonella	Analytical Tests	Weekly or as needed	Aquaculture Production Manager	If: Salmonella is present on shrimp, Then: quarantine shrimp and consult a veterinarian	Review of shrimp analytical test results	Test result records
		No Salmonella in feeds	Testing for Salmonella	Analytical Tests	Weekly or as needed	Aquaculture Production Manager	If: Salmonella is present in feed, Then: treat or heat feed or destroy feed	Review of feed analytical test results	Test result records
		No Salmonella in culture system	Testing for Salmonella	Analytical Tests	Weekly or as needed	Aquaculture Production Manager	If: Salmonella is present in culture systems, Then: clean and sanitize culture systems	Review of culture system analytical Salmonella test results	Test result records
			Certificate of Compliance (COC) indicating Salmonella free shrimp and feed	Review COC	Every Shipment	Aquaculture Production Manager	If: COC does not accompany feed and/or shrimp shipment, Then: Isolate feed, quarantine shrimp and/or reject feed and shrimp shipment	Review of COC documentation	COC forms for each shipment
Larval Culture	Pesticides, Antibiotics	No unapproved pesticides or antibiotics in the shrimp	Analytical testing of shrimp for pesticides and antibiotics	Analytical Testing of shrimp	Monthly	Production manager	If: unapproved antibiotics or pesticides are found Then: consult with a veterinarian and/or destroy shrimp,	Review of shrimp analytical test results for antibiotics and pesticides	Analytical test records
		No unapproved antibiotics or pesticide residues in feed	Analytical testing of feeds for pesticides and antibiotics	Analytical Testing of feeds	Every Batch	Production Manager	If: feeds contain pesticides or antibiotic residues, Then: Destroy feeds and replace feed	Review of feed analytical test results for antibiotics and pesticides	Analytical test records
			Feed supplier facility/feed/acquisition handling protocols	Periodic feed production site visits and/or review of records	Yearly	Production Manager	If: site visits indicate a problem, Then: change feed manufacturer	Periodic site visits	Record of site visits
		No pesticides and/or antibiotics in the culture water	Analytical testing of culture water	Analytical Tests	Monthly	Production manager	If: tests indicate presence of pesticides and/or antibiotics in culture water, Then: determine source of contamination and switch water supply systems	Review of culture water analytical test results for antibiotics and pesticides	Analytical test results for pesticides and antibiotics

CASE STUDY AQUACULTURE HACCP PLAN

Firm Name: Production Method:

Firm Address: Hatchery: Maturation/Reproduction

(1) Critical Control Point (CCP)	(2) Significant Hazards	(3) Critical Limits for each Preventive Measure	(4) Monitoring	(5) Monitoring	(6) Monitoring	(7) Monitoring	(8) Corrective Actions(s)	(9) Verification	(10) Records
Maturation / Reproduction	Pathogens (e.g., Salmonella)	No Salmonella on shrimp	What	How	Frequency	Who			
			Testing for Salmonella	Analytical Tests	Weekly or as needed	Aquaculture Production Manager	If: Salmonella is present on shrimp, Then: quarantine shrimp and consult a veterinarian	Review of shrimp analytical test results	Test result records
		No Salmonella in feeds	Testing for Salmonella	Analytical Tests	Weekly or as needed	Aquaculture Production Manager	If: Salmonella is present in feed, Then: treat or heat feed or destroy feed	Review of feed analytical test results	Test result records
		No Salmonella in culture system	Testing for Salmonella	Analytical Tests	Weekly or as needed	Aquaculture Production Manager	If: Salmonella is present in culture systems, Then: clean and sanitize culture systems	Review of culture system analytical Salmonella test results	Test result records
			Certificate of Compliance (COC) indicating Salmonella free shrimp and feed	Review COC	Every Shipment	Aquaculture Production Manager	If: COC does not accompany feed and/or shrimp shipment, Then: Isolate feed, quarantine shrimp and/or reject feed and shrimp shipment	Review of COC documentation	COC forms for each shipment
Maturation/Repro-duction	Pesticides, Antibiotics	No unapproved pesticides or antibiotics in the shrimp	Analytical testing of shrimp for pesticides and antibiotics	Analytical Testing of shrimp	Monthly	Production manager			
		No unapproved antibiotics or pesticide residues in feed	Analytical testing of feeds for pesticides and antibiotics	Analytical Testing of feeds	Every Batch	Production Manager	If: unapproved antibiotics or pesticides are found Then: consult with a veterinarian and/or destroy shrimp,	Review of shrimp analytical test results for antibiotics and pesticides	Analytical test records
			Feed supplier facility/feed/acquisition handling protocols	Periodic feed production site visits and/or review of records	Yearly	Production Manager	If: feeds contain pesticides or antibiotic residues, Then: Destroy feeds and replace feed	Review of feed analytical test results for antibiotics and pesticides	Analytical test records
		No pesticides and/or antibiotics in the culture water	Analytical testing of culture water	Analytical Tests	Monthly	Production manager	If: site visits indicate a problem, Then: change feed manufacturer	Periodic site visits	Record of site visits
							If: tests indicate presence of pesticides and/or antibiotics in culture water, Then: determine source of contamination and switch water supply systems	Review of culture water analytical test results for antibiotics and pesticides	Analytical test results for pesticides and antibiotics

Sample Record Forms

Supplier's Guarantee
Shrimp Supplier Co.

ABC Shrimp Co.

Dear Mr. Smith:

This certifies that, in accordance with your purchasing specification, this shipment of shrimp was tested and found to be *Salmonella* and antibiotic free.

Yours truly,
I. M. Honest
QC Director

Corrective-Action Report
ABC Aquaculture Co.

Date: Lot I.D.:
Description of Problem:
Shrimp was analyzed using Official Recognized Methods (AOAC 2006) and found to contain chloramphenicol residues

Action Taken:
Shrimp shipment was rejected
Date Problem Solved:

Current Status:
An investigation is underway to evaluate the operation of the shrimp farm
Supervisor:
Reviewer: Date:

Corrective-Action Report
ABC Aquaculture Co.

Date: Lot I.D.:
Description of Problem:
Shrimp feed was analyzed using Official Recognized Methods (FDABAM 2006) and was found to contain *Salmonella*

Action Taken:
Shrimp feed was rejected and returned to the supplier
Date Problem Solved:

Current Status:
Additional *Salmonella* free feed was ordered

Supervisor:
Reviewer: Date:

A-One Laboratory Report for:
ABC Aquaculture Co.

Date: Sample No: 5432
Vendor: Antibiotics: Negative
Examined by: I'm the Best

Remarks:
The above sample was analyzed using Official Recognized Methods (AOAC 2006) and was found negative for the presence of antibiotic residues.

Irvine R. Wright
Laboratory Director
A-One Laboratories

Employee-Training Record
ABC Aquaculture Co.

Employee:

Training Course	Date of Course
Sanitation at the aquaculture farm 4-hour course	
Employee training how to properly store feed and chemicals	

CLEANING AND SANITATION PROGRAMS

Shrimp Operations

The proper selection of detergents and sanitizers, their concentrations and method of application will depend on several factors including:

1) Nature of the soil (soil is defined as matter out of place and includes meat, waste, grease, etc.)
2) Degree of cleaning and sanitation required.
3) Type of equipment used to clean and sanitize.
4) Whether or not the surface being cleaned is a food contact surface.

Sanitizer alone cannot be depended upon to remove microorganisms. A cleaning system contains five steps:

1) dry clean, 2) pre-rinse, 3) detergent application, 4) post-rinse, and 5) sanitizer application.

Sanitizers may or may not be rinsed off before the start of processing, depending upon the sanitizer being used and its concentration. Dry cleaning is simply using a broom, brushes or squeegee to sweep up shrimp processing waste and soil from the surfaces. Brooms and brushes should only be used in specified areas. At no time should brushes or brooms used for nonfood purposes (e.g., cleaning outside trash bins) be used in product handling and packing areas.

Pre-rinsing uses water to remove small particles missed in the dry cleaning step and prepares surfaces for detergent application. However, scrupulous removal of particles is not necessary prior to application of detergent. Each detergent is different and it is important to follow directions. Alkaline or chlorinated alkaline detergents are recommended. Chlorinated alkaline products are very caustic and should not be used on corrodible surfaces. They are especially effective for heavy soil surfaces, such as processing waste (shrimp waste) barrels. Application of detergents in a foam cleaning system is recommended for tables, walls, floors, etc. A brush or a "green" pad (e.g., 3-M Scotch-Brite™) can be used to remove adhering soil. (The brushes or pads should be used only for designated purposes).

The sanitizing step involves the application of approved sanitizers. Methods for applying sanitizer may include the use of a low pressure tank sprayer or hose-end applicator (foamer). Inexpensive foamers are effective means for applying quaternary ammonium (quat) sanitizers. Use separate foamers for detergent and quat. Chlorine or quats are effective for floors and coolers. (Note: chlorine is more effective at low temperatures than quats.) For table tops (grading, weighing and packing tables, etc.) and other surfaces that come into direct contact with the product, 100-200 ppm chlorine, 25 ppm iodine, or 200 ppm quat sanitizer is used. At these levels, surfaces do not require rinsing but must drain.

For non-food contact surfaces, such as floors and walls, the sanitizer concentration is doubled. (Note: some sanitizers have detergent-like properties and may be slick when floors are wet.) When sanitizers are used in footbaths, dips or as an applied sanitizing solution the concentration must be confirmed using test strips.

The five step cleaning process performed at the end of the day should be followed in the morning by a light application of sanitizer to tabletops and other food contact surfaces, just prior to the start of operations. Re-dip clean knives and bowls in sanitizer just before use.

Verification of Sanitation

Periodically (e.g., weekly) packing plant surfaces should be evaluated for cleanliness with contact plates containing bacterial growth media to confirm that the plant is adequately cleaned and sanitized. These test procedures are very simple and require no special equipment. After the contact plates are stored for a couple of days, properly cleaned surfaces (e.g., tabletops and door handles) will produce very few colonies. Unsanitary surfaces will give rise to many colonies. This makes an excellent training tool for employees and provides positive reinforcement for a job well done. Specific guidelines are provided in the Practicals section of this manual and commercial literature on contact plates will be provided. Alternatively, surfaces can be asceptically swabbed and plated from serial dilutions.

The following program is implemented for each operation.

A. On-farm shrimp washing and icing (Daily):
   1. Shrimp crates are received in clean condition from packing plant and stored in clean, dry area on pallets (see C.1.).
   2. Farm equipment used to haul shrimp from ponds to packing area is cleaned by scrubbing with general purpose detergent (daily).
   3. Workers and equipment do not pass between shrimp areas and non-shrimp farm areas (livestock, manure handling, etc.). If necessary, to do so, employees must first wash hands and change all outer clothing, boots and gloves, and all equipment must be cleaned and sanitized following the 5-step method in an area that does not risk recontaminating shrimp handling surfaces or employees.
   4. Ice is made from potable water, and chipped, stored and shoveled with cleaned and sanitized equipment, using the 5-step method (daily).
   5. Boxing/icing station surfaces are cleaned using the 5-step method (daily).

B. Trucks and shrimp transport equipment:
   1. Truck beds are sprayed with double-strength sanitizer (daily).
   2. Truck beds are cleaned using detergent and sanitizer (weekly).

C. Shrimp receiving area, packing facility (Daily):
   1. Only potable water is used in the facility. Ice is made from potable water, and chipped, stored and shoveled with cleaned and sanitized equipment, using the 5-step method (daily).
   2. Shrimp crates are cleaned daily with alkaline or chlorinated alkaline detergent after all shrimp and ice are unloaded.
   3. Workers are prevented from handling both shrimp and unsanitary non-shrimp equipment unless hands, smocks and gloves are sanitized between operations. If carts and employees must enter shrimp areas from non-shrimp areas, they must pass through a footbath containing double strength sanitizer (e.g. 400ppm quaternary ammonium sanitizer (quat)).
   4. Cross contamination of shrimp with other raw seafoods is avoided. This is achieved by separation of activities, by controlling product and personnel movement and by proper use of handling devices.
   5. The shrimp receiving area is cleaned and sanitized at the end of operations, using the five step process.

D. Grading/Packing room (Daily):
   1. Place packing trays and utensils in alkaline detergent soak tank. At end of clean-up, rinse and dip in sanitizer.
   2. Dry clean tables, bins, graders, floors, scales, etc,. and remove processing waste barrels.
   3. Thoroughly clean and sanitize tables, graders, bins and hand sinks using the 5 part system. Since these are food contact surfaces, normal strength sanitizer is used (100-200 ppm chlorine, 25 ppm iodine or 200 ppm quat). Also, sanitize with chlorine or quat during breaks or every four hours. Excess sanitizer applied during breaks should be removed with paper towels or a sanitized squeegee.
   4. Floors, splash zone of walls (four feet to floor) and sinks are cleaned daily using the f5 part system and sanitized with double strength sanitizer.
   5. Processing waste barrels must be cleaned after each use, before they are returned to the packing area. The full 5 part system is followed daily: dry cleaning, pre-rinse, detergent application, post rinse and sanitizer application. A detergent soak tank (alkaline or chlorinated detergent) minimizes hand detailing and improves contact coverage. Waste barrels are cleaned in an area separate from other washing areas, and away from product.
   6. A footbath is located at the entrance to the packing room. The bath contains 400 ppm quat or 400 ppm chlorine. The concentration of sanitizer in the bath must be checked at the start of the work day

before the workers arrive and every two hours during times of use.

7. Trays or pans used for shrimp are sanitized before each use with 100 ppm chlorine or 25 ppm iodine.
8. Empty weigh scales as often as possible and sanitize. Wipe off excess sanitizer with a paper towel.

E. Shrimp processing waste (solid waste) handling area:

1. At the end of the day, the processing waste barrel wash area, waste handling carts and any other waste handling equipment are cleaned and sanitized by the five part procedure using alkaline or chlorinated alkaline detergent and double strength sanitizer.

F. Shrimp cooler:

1. Dry clean and spray floors with 200-400 ppm chlorine or 400 ppm quat (weekly)

Monthly (after a shipment):

1. Clean and sanitize using the five part system.
2. Sanitize the evaporator drip pan by pouring quat (400 ppm) into the pan.

G. Miscellaneous:

1. Thoroughly clean door handles/push plates, sinks and faucets with green pads, detergent and sanitizer following the 5 part method (daily).
2. Doors and walls should be cleaned and sanitized daily in splash zone (four feet to floor) and weekly in higher areas.
3. Clean ceilings of all coolers (refrigeration rooms) by the 5 part method using detergent and double strength sanitizer (twice per year).

Your Company

Your Town, Your Country

Daily Sanitation Audit Form p. 1

Sanitation Condition	Time _____ Pre-Op Pass/Fail	Time _____ Pass/Fail	Time _____ Pass/Fail	Comments/ Corrections
1. Equipment cleaning and sanitizing				
a. Equipment and utensils cleaned and sanitized before start-up.				
b. Shrimp baskets/crates cleaned and sanitized before returning to farm.				
c. Concentration of sanitizer used for sanitizing equipment (type/ppm).				
d. Product residue removed during breaks.				
e. Shrimp equipment (bowls, trays, etc.) cleaned and sanitized before reuse.				
2. Employee attire				
a. Gloves, boots and aprons clean and in good repair.				
3. Cross-contamination				
a. Employees' hands, gloves, equipment and utensils that contact unsanitary objects are washed and sanitized before contacting products.				
b. Employees from non-food areas do not contact shrimp work surfaces unless hands, gloves and aprons are washed and sanitized.				
4. Hand washing and sanitizing facilities.				
a. Adequate supplies				
b. Conc. (ppm) of chlorine in hand dips.				
Shrimp receiving area				
Inside grading/packing room				

Daily Sanitation Audit Form

Sanitation Condition	Time _____ Pre-Op Pass/Fail	Time _____ Pass/Fail	Time _____ Pass/Fail	Comments/ Corrections
5. Protection from adulterants				
a. Cleaning compounds labeled and stored properly.				
b. Lubricants labeled and stored properly				
c. Pesticides labeled and stored properly				
d. Product protected from condensate				
e. Product protected from floor splash				
6. Cooler storage				
a. Unpackaged shrimp separated from other raw products. No significant condensate.				
7. Employee health				
a. Employees do not show signs of medical problems that could compromise product				
8. Toilet facilities				
a. Toilets are clean, supplied with toilet paper, and functioning properly				
9. Pests				
a. Pest control systems working effectively				

Date:_____
Supervisor/Technician:_____

Your Company
Your Town, Your Country
Monthly Sanitation Audit Form

Sanitation Condition	Time _____ Pass/Fail	Comments/Corrections
No cross-connections between potable and non-potable or wastewater systems		
Processing equipment and utensils in suitable condition		
Physical condition of building and layout of equipment suitable to minimize risk of contamination		

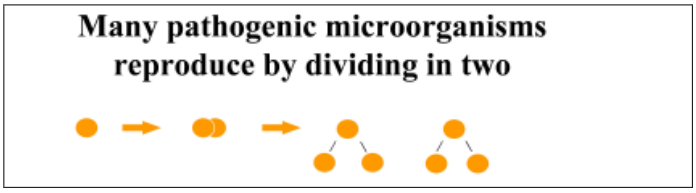
Date:_____ Supervisor/Technician: _____

Factors Affecting Growth and Survival of Bacteria and Product Quality and Safety

Microorganisms are the main source of quality and safety problems in seafood. Organisms too small to be seen with the naked eye are called microorganisms. They live everywhere, air, dirt, flesh, salt water, skin, hair, animal fur and plants. They can be classified into groups. Thousands of microorganisms exist but only a few pose a hazard to humans. All raw seafoods contain microorganisms and microorganisms come in several forms. We are most concerned with bacteria. These microorganisms, and others added during harvest, handling and processing, can cause spoilage and illness unless we control or destroy them. Microorganisms (bacteria) that cause illness are called pathogens.

Bacteria in foods can be classified into two general groups:

- Spoilage Bacteria: These bacteria are generally harmless to human health, but can cause changes in the color, flavor, odor, and texture of seafood. These are mostly of commercial importance.
- Pathogenic Bacteria: These bacteria cause illness in humans. They can produce toxins or cause infections that are harmful to human health and can, in some instances, be life threatening.



Bacteria reproduce by a process called binary fusion or "dividing in two." Under the right conditions, bacteria can double in number every 20 minutes. When they grow the microorganisms also produce by-products that are sometimes harmful.

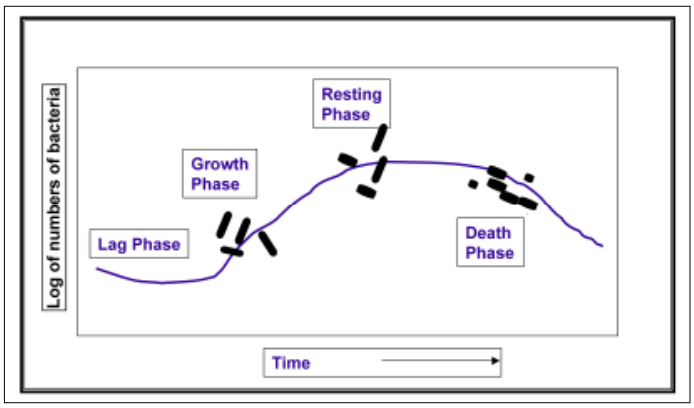
Under the right conditions, bacteria can double in number every 20 minutes.

Bacterial Growth Curve

The first part of the growth curve is the lag phase. When bacteria find a new or different food source, they need time to familiarize themselves with their new surroundings. During this phase the bacteria are producing enzymes that will allow them to digest the new food. Little growth occurs during this phase. After adaptation, the bacteria enter into the Log Phase. During the log phase growth is rapid and exponential. During the resting phase or stationary phase, some bacteria are dying while others are still growing. With time, the population moves into the death phase. At this point toxic wastes produced by the bacteria have polluted the environment, and the population is dying.

Bacteria can Double Every 20 Minutes

Noon	1
1:00	8
2:00	64
3:00	512
4:00	4,096
5:00	32,768
6:00	262,144
7:00	2,097,152
8:00	16,777,216



Controlling Bacterial Growth

Microorganisms can grow under a wide range of conditions. Bacteria require specific nutrients, such as carbon, nitrogen, vitamins, minerals, and water. These factors can affect the growth and multiplication of bacteria and can be used to control bacterial growth in foods. Most important are:

- nutrients
- pH
- water activity
- temperature
- oxygen

Although microorganisms are too small to be seen without a microscope, they are alive and have certain needs to live and grow. Without adequate food, water and temperature, microorganisms stop growing and multiplying. Some die and others stop functioning until they get the elements they need. Foods high in protein content, such as fish and shrimp are an excellent source of all of these nutrients and therefore, serve as a good growth medium for bacteria.

Water Activity

Water activity (**aw**) is the free, unbound moisture available to microorganisms. Bacteria have a maximum, optimum, and minimum aw for growth. The minimum **aw** at which growth can occur is important in prevention of microbial growth in foods. The **aw** of food can be lowered by removing water (dehydration), by adding solutes (sugar, salt), or by freezing.

Why is water activity important? The bacterial cell has no mouth and its food must be in soluble form to be brought through the cell wall. Without adequate moisture, bacteria cannot get food and will not grow. Some water in the product binds to salts, sugars and other ingredients and is not available to microorganisms. The amount of water that is available to microorganisms is the water activity.

pH

The pH is a measure of the degree of acidity or alkalinity of a substance on a scale of 1-14. For example a:

- pH of 1 is very acid
- pH of 7 is neutral
- pH of 14 is very alkaline

Bacteria have a maximum, optimum, and minimum pH requirement for growth. Most bacteria have an optimum pH of 7.0. The pH value of seafood is important for bacterial growth. Most bacteria grow best at a pH of 7, which is the pH of most fresh seafood. Bacteria grow slowly or not at all below pH 4.

pH

SEAFOOD	pH
Shrimp	6.8 - 8.2
Crab	6.8 - 8.0
Scallops	6.8 - 7.1
Cod, small	6.7 - 7.1
Cod, large	6.5 - 6.9
Catfish	6.6 - 7.0
Herring	6.1 - 6.6
Oysters	5.9 - 6.6
Halibut	5.5 - 5.8

Temperature

Bacteria are grouped by their ability to grow within certain temperature ranges. Although microorganisms can grow over a wide range of temperatures those bacteria of primary interest to us are the psychrotrophic bacteria.

Temperature is one of the most important and easily controlled environmental factors that can be used to regulate the growth of bacteria. Low temperatures can be used to inhibit the growth of most disease-causing bacteria and to slow the growth of most spoilage bacteria. High temperatures can also be used to inactivate bacterial enzymes and control bacterial growth.

Oxygen

Bacteria are also classified by their ability to grow in the presence of air or free oxygen. Most seafood spoilage bacteria require oxygen to grow. These are aerobes and grow best on surfaces of seafood and equipment where air is available. Facultative anaerobes can grow in the presence or absence of oxygen. Some bacteria cannot grow if oxygen is present. These are classified as anaerobes. Most bacteria are able to grow in either the presence or absence of free oxygen. These bacteria are facultative anaerobes and include the seafood borne illness-causing bacteria *L. monocytogenes* and *Salmonella*.

Harvesting Recommendations

u All workers involved in aquaculture operations should follow good hygiene and sanitation procedures.

- Avoid direct contact of product holding containers with the soil.
- All containers, baskets or empty boxes for shipping or holding harvested fishery products should be clean and free from visible signs of dirt, oil/grease and chemical contaminants.
- Packing containers should be stored in a clean, dry place and should be transported and handled under sanitary considerations.

Proper sanitation and good employee hygienic practices are essential to maintain quality and safety of the harvested product.

Handling and Processing

Proper handling and processing is a critical component of producing safe seafood. The following steps should be followed in the handling and storage of shrimp to control contamination and possible growth of *Salmonella*, *L. monocytogenes*, and other pathogenic bacteria that may be present:

- Wash product in chlorinated water (<10 PPM)
- Keep the product cold during and after harvesting*
- Avoid cross-contamination from raw materials to other steps in processing
- Freeze shrimp

*Cooling methods using water and ice as the cooling mediums have the greatest potential for contamination of fishery products. Water and ice used for cooling operations are potential sources of contamination. Water should be potable (i.e, free of pathogenic bacteria, pro tozoa and viruses). Ice must be made from potable water and held under sanitary conditions. Potable water must be used for cooling product and making ice.