

JIFSAN Good Aquacultural Practices Program

Use of HACCP Principles to Control Antibiotic Residues in Aquacultured Products





Use of HACCP Principles to Control Antibiotic Residues

HACCP is an acronym that stands for Hazard Analysis Critical Control Point. It is accepted on a worldwide basis as a food safety management tool. It has also been used as a risk management tool for aquaculture operations. It is a preventive management system and can be used to anticipate and control hazards such as *Salmonella spp.*, unapproved antibiotics and chemicals in aquaculture operations.

HACCP is a preventive process, not reactive. It is a management tool used to protect against hazards. HACCP was pioneered in the 1960s. In the U.S. the Pillsbury food company developed a HACCP system to prevent U.S. astronauts from becoming sick from foodborne illness while in space. Food processors, the U.S. government, and other countries around the world have since adopted the tool. International use includes Codex Alimentarius, the European Union, Canada, Australia, New Zealand, and Japan.

Seven Principles of HACCP

HACCP is a two-step process. The first step is to form a team consisting of individuals with specific knowledge about the operation. The team then develops and verifies the flow diagram. The second step is to apply the seven principles of HACCP to the operation. In 1992 the U.S. National Advisory Committee on Microbiological Criteria for Foods (NACMCF) adopted seven principles of HACCP, which have been adopted by most countries worldwide and by the Codex Alimentarius, which is the world food standards setting organization.

- 1 Conduct hazard analysis and identify preventive measures.
- 2 Identify critical control points (CCPs) in the process.
- 3 Establish critical limits.
- 4 Monitor each CCP.

- 5 Establish corrective actions.
- 6 Establish verification procedures.
- 7 Establish recordkeeping and documentation procedures.

HACCP and Aquaculture

HACCP principles have been used as a risk management tool to establish biosecurity protocols for a non-native oyster hatchery in Virginia, U.S. (Jahncke and Schwarz 2004). HACCP principles have also been used as a risk management tool by the Food and Agriculture Organization (FAO) to control parasites in freshwater aquaculture ponds in Vietnam, Laos and Cambodia (Santos 1995, Son 1997), and to control exotic shrimp (e.g., Taura, White spot, Yellow head) viruses in shrimp aquaculture operations (Jahncke et al. 2002). HACCP principles as a risk management tool have been successfully used to address both human and animal aquaculture disease hazards.

Principle 1–Conduct a Hazard Analysis

- A hazard is a biological (e.g., *Salmonella spp.* or chemical agent (e.g., antibiotics, pesticides and other chemicals).
- After the hazard identification, the HACCP team conducts a hazard evaluation, a three-step process in which the list of potential hazards developed during the hazard identification is narrowed to those hazards that are significant to the aquaculture operation. The steps are: assess the severity of the hazard, determine the likelihood of occurrence of the potential hazard if not controlled, and determine using this information if the potential hazards must be controlled in the HACCP plan.
- To conduct a hazard analysis, collect and evaluate information on hazards associated with the product.
- The activities of Hazard Analysis include:
 - Constructing a flow diagram of the operation,

- Identifying microbiological and chemical hazards, and
- Evaluating hazards and identifying the control measures.

Hazards List

- Biological Hazards
- Pathogenic microorganisms (e.g., *Salmonella* spp.)
- Chemical Hazards
- Chemicals
- Pesticides
- Antibiotics (drug residues)

Examples of control measures to prevent chemical hazards (Antibiotic Residues) include:

Source Control

It is necessary to have Certificates of Conformance (COC) indicating that antibiotic residues are not present in the shrimp or feed that are supplied to the aquaculture farm. In addition, have a HACCP risk management plan in place to ensure that the identified hazards are controlled during aquaculture production.

Production Control

- Use of GAQPs in aquaculture.
- No use of unapproved antibiotics for disease treatment or disease control during culture of the shrimp.

Final Product Control

Provide analytical testing of the final product (shrimp) to ensure that there are no antibiotic residues present.

Principle 2—Identify Critical Control Points

A CCP is a specific point in the process where a control measure effectively prevents, eliminates, or reduces the hazards to an acceptable level.

A CCP is the step at which control can be applied and is essential to preventing or eliminating a hazard or reducing it to an acceptable level. Points may be identified as CCPs when hazards can be prevented. Drug residues can be prevented at the receiving step by obtaining shrimp and feeds from approved suppliers (e.g., supplier Certificate of Conformance [COC]), and periodically testing shrimp and feed.

- Production control ensures that unapproved antibiotics are not used during growing operations and final product testing will be done to ensure antibiotic free shrimp.

Principle 3—Establish Critical Limits

A critical limit represents the boundaries used to ensure that the aquaculture operation has an effective HACCP management plan.

A critical limit is a maximum and/or minimum value to which a biological or chemical hazard must be controlled at a CCP to prevent, eliminate, or reduce to an acceptable level the occurrence of the hazard. An example of Critical Limits is no unapproved antibiotic residues present in feed or in shrimp.

Principle 4—Establish Monitoring Procedures

Monitoring is a process that the aquaculture operation relies on to maintain control at a CCP. Accurate monitoring indicates when there is a lack of control at a CCP and a deviation from a CL. When a CL is compromised, a corrective action is required to bring the operation back under control. Reviewing the monitoring records and finding the last recorded value that meets the CL can determine the extent of the deviation.

Monitoring also provides a record that the HACCP management plan is being followed and is effective in controlling the identified hazards. This is needed in the verification of the HACCP plan.

Monitoring is conducting a planned sequence of observations or measurements to assess whether a CCP is under control and to produce an accurate record for future use in verification. The purpose of monitoring is to track the operation of the process and enable the identification of trends toward a critical limit that may trigger process adjustments, to identify when there is loss of control (a deviation occurs at a CCP), and to provide written documentation of the process control system.

- What will be monitored? It is important that trained personnel perform these analyses, and follow scientifically acceptable methods and an appropriate sampling plan.
 - Shrimp and Feed

- Observing if a preventive measure at a CCP is being performed. Observing operations or reviewing COC and analytical testing can accomplish monitoring.
 - Vendor’s Certificate of Conformance (COC)
 - Antibiotic analytical testing results
- Examples of monitoring may include measuring a characteristic of the operation to determine compliance with the established critical limits.
 - Examples of monitoring procedures
 - † Conducting antibiotic tests using reliable and validated analytical methods
 - † Reviewing antibiotic analytical testing results
 - † Reviewing a vendor’s Certificate of Conformance (COC)

Equipment chosen for monitoring at the CCP must be accurate to ensure control of the hazard.

- Who will monitor? The person responsible for monitoring CLs at each CCP must be trained and understand the importance of collecting real-time, accurate information.

Those responsible for monitoring should:

- Be trained in CCP monitoring techniques
- Fully understand the importance of CCP monitoring
- Have ready access to the monitoring activity
- Accurately report each monitoring activity
- Immediately report critical limit infractions so that immediate corrective actions can be taken

Principle 5—Establish Corrective Actions

When critical limits are violated at a CCP, the predetermined documented corrective actions should be implemented. These corrective actions should state procedures to restore control. It may be possible to correct the problem on the spot.

There are several procedures to be followed when a deviation occurs.

Corrective Action Components are designed to correct and eliminate the cause of the deviation and

- restore control. Corrective actions must bring the CCP back under control. A corrective action should address the immediate (short-term) problem as well as provide a long-term solution. The objective is to provide a short-term fix, so that control can be re-established and the operation started again as soon as possible with out further deviations at the CCPs. They bring CCP back under control and determine the cause of deviation to prevent future recurrence. The Corrective Action Components identify the aquaculture component that was affected by the deviation and determine its disposition.

- Corrective Action Options include

- isolating and holding product for safety evaluation,
- diverting the affected product or ingredients where deviation would not be considered critical, and
- destroying product.

- Example (Corrective action reports are usually written in an “If”–“Then” format.)

- If Deviation:

Antibiotic residues found in shrimp

- Then Corrective Action:

Separate and/or quarantine shrimp and test the shrimp

Determine proper disposition of the shrimp

Principle 6—Establish Verification Procedures

- Those activities, other than monitoring, that determine the validity of the HACCP plan and that verify the system is operating according to the plan are verification procedures.

- One of the more complex HACCP principles is verification. Although it is complex, the proper development and implementation of the verification principle is fundamental to the successful execution of the HACCP plan. The purpose of verification is to provide a level of confidence that the plan is based on sound scientific principles, and is adequate to control the hazards associated with the aquaculture operation, and that the HACCP plan is being followed.

- Targeted Sampling and Testing ensures vendor compliance with purchasing specifications by

quarterly testing of feed for antibiotic residues and monthly or quarterly testing of shrimp for antibiotic residues.

Systematic Verification Activities should occur at a frequency that ensures the HACCP plan is being followed continuously. This frequency depends on a number of conditions such as changes in suppliers of larval shrimp, feed, etc. Systematic verification activities include on-site observation and record reviews. An unbiased person who is not responsible for performing the monitoring activities should perform the reviews. They should occur frequently to ensure that the HACCP plan is being followed.

Validation of HACCP Plan

Validation can be performed by the HACCP team or by an individual qualified by training or experience. Validation activities may be similar in scope and time commitment to the original HACCP plan development. Validation involves a scientific and technical review of the rationale behind each part of the HACCP plan from hazard analysis through each CCP verification strategy.

An HACCP team should conduct the validation of the HACCP plan or an individual qualified by training or experience. Validation is a scientific and technical review of the rationale behind each part of the HACCP plan from hazard analysis through each CCP verification strategy. Validation should be conducted when factors warrant. The validation of the plan may be warranted by a change of the aquaculture feed and shrimp supplier, or the presence of unapproved antibiotics or chemicals found in shrimp and/or feed.

Principle 7—Establish Record Keeping Procedures

Establish recordkeeping and documentation procedures. There are four kinds of categories that are kept as part of the HACCP system:

- HACCP plan and support documentation used in developing the plan,
- Records of CCP monitoring,
- Records of corrective action, and
- Records of verification activities.

HACCP Plan support documents include:

- the hazard-analysis worksheet,

- records related to performing hazard analysis and establishing critical limits,
- HACCP team members and their responsibilities, a summary of preliminary steps taken in the development of a HACCP plan,
- prerequisite programs,
- Certificates of Compliance indicating that antibiotics have not been used, and
- analytical testing results of shrimp and feed for antibiotic residues.

Required Record Information

This is the minimum information needed on a record form. A record should be a stand-alone document that is easily understood by an auditor or an assigned reviewer of the information.

All records should be on forms that contain the following minimum required information:

- Form title,
- Company name and location,
- Time and date,
- Description of aquaculture operation (e.g., hatchery, pond, etc.),
- Actual observations or analytical measurements taken,
- Critical limits,
- Operator's signature or initials,
- Reviewer's signature or initials, and
- Date of review.

HACCP is a preventive system for ensuring safe aquaculture products, but it is not a stand-alone system.

References

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