CHAPTER 4.5.

CONTROL OF HAZARDS OF AQUATIC ANIMAL
HEALTH HAZARDS AND PUBLIC HEALTH
IMPORTANCE IN AQUATIC ANIMAL FEEDS

Introduction

One of the key objectives of the Aquatic Code is to help OIE Members trade safely in aquatic animals and aquatic animal products by developing relevant aquatic animal health measures. These recommendations address aquatic animal health hazards in aquatic animal feed. A key objective is to prevent the spread, via aquatic animal feed, of diseases from an infected country, zone or compartment to a free country, a free zone or a free compartment.

These recommendations do not address food safety issues in detail as this is not within the mandate of the Aquatic Code.

These recommendations should be read in conjunction with relevant recommendations of the OIE Terrestrial Animal Health Code (under study). The Food and Agriculture Organization of the United Nations (FAO) has published recommendations relevant to terrestrial and aquatic animal feed (Technical Guidelines for Responsible Fisheries – Aquaculture Development: 1. Good aquaculture feed manufacturing practice. FAO 2001; Draft Good Practices for the Animal Feed Industry – Implementing the Codex Alimentarius’ Code of Practice on Good Animal Feeding, IFIF/FAO [In preparation]) and there is a Codex Alimentarius Commission (CAC) standard (Code of Practice on Good Animal Feeding [CAC/RCP 54-2004]). OIE Members are encouraged to consult these publications.

Key considerations relevant to aquatic animal feed are as follows:

1. Concentration of aquaculture establishments heightens the risk of disease transmission, whether the pathogen enters the culture system via feed or other means.

2. For many aquatic animal species, predation (including cannibalism) is their natural way of feeding in their natural habitat.

3. Historically, animal proteins used in feed were mainly sourced from the marine environment, due to the nutritional needs of aquatic animals and for reasons of economy. This practice increases the risk of disease transmission, especially when aquatic animals are fed live or whole aquatic animals of the same or related species. There are many examples of this type of practice, e.g. early stage crustaceans fed on Artemia species and aquaculture tuna fed on whole wild caught fish.

4. The usage of feed in moist form (moisture content equal to or greater than 70%), semi-moist form (moisture content between 15 and 70%), and dry form (a moisture content equal to or less than 15%) implies different levels of risk due to the processing applied to the feed.
5. With the increasing number of species being farmed (especially marine finfish), the use of live feed and moist feed has increased. It is likely that these industries will in future use formulated feed as appropriate technologies are developed.

6. Hazards may be transmitted from feed to aquatic animals via direct or indirect means. Direct transmission occurs when the cultured species consumes feed containing a pathogenic agent (e.g., shrimp larvae consuming rotifer infected with white spot syndrome virus) while indirect transmission refers to pathogens in feed entering the aquatic environment or infecting non-target species, and thereby establishing a mechanism for indirect infection of the species of commercial interest. Pathogens that are less host-specific (e.g., white spot syndrome virus, *Vibrio* species) present a greater risk of indirect transmission as they can establish reservoirs of infection in multiple species.

7. As new species become the subject of aquaculture, new pathogens emerge in association with these hosts. The expression of disease may be facilitated by culturing species under intensive and novel conditions. Also, it is necessary to conduct research and develop new feed (and feed ingredients) that are appropriate to the species and its culture system. As more and more aquatic animal species are being cultured, it is difficult to make recommendations for all disease agent/host species combinations.

**Article 4.5.2.**

**Scope**

These recommendations document risk mitigation measures, including traceability and certification, to deal with aquatic animal health risks associated with trade in aquatic animal feed and feed ingredients. They recommend the control of hazards through adherence to recommended practices during the production (harvest, handling, storage, processing and distribution) and use of both commercial and on-farm produced feed (and feed ingredients) for aquatic animals. Hazards include pathogens that cause OIE-listed diseases and other agents that cause an adverse effect on animal and/or public health. While aquatic animals grown for food are the main focus, the same principles apply to feed for aquatic animals used for other purposes.

**Article 4.5.3.**

**Definitions**

**Hazard**

means a biological, chemical or physical agent in a feed or a feed ingredient with the potential to cause an adverse effect on animal or public health.

**Article 4.5.4.**

**General principles**

1. **Roles and responsibilities**

   The Competent Authority has the legal power to set and enforce regulatory requirements related to animal feed, and has final responsibility for verifying that these requirements are met. The Competent Authority may establish regulatory requirements for relevant parties, including requirements to provide information and assistance. Refer to Chapter 3.1. of the Aquatic Code.
It is a particular responsibility of the Competent Authority to set and enforce the regulatory requirements pertaining to the use of veterinary drugs, aquatic animal disease control and the food safety aspects that relate to the management of live aquatic animals on farm.

Those involved in the production and use of animal feed and feed ingredients have the responsibility to ensure that these products meet regulatory requirements. All personnel involved in the harvest, manufacture, storage and handling of feed and feed ingredients should be adequately trained and aware of their role and responsibility in preventing the spread of hazards. Appropriate contingency plans should be developed in case of a feed-borne outbreak of disease. Equipment for producing, storing and transporting feed should be kept clean and maintained in good working order.

Private veterinarians and others (e.g. laboratories) providing specialist services to producers and to the feed industry may be required to meet specific regulatory requirements pertaining to the services they provide (e.g. disease reporting, quality standards, transparency).

2. Regulatory standards for feed safety

All feed and feed ingredients should meet regulatory standards for feed safety. In defining limits and tolerances for hazards, scientific evidence, including the sensitivity of analytical methods, and on the characterisation of risks, should be taken into account.

3. Risk analysis

Internationally accepted principles and practices for risk analysis (see Section 2. of the Aquatic Code and relevant Codex texts) should be used in developing and applying the regulatory framework.

A generic risk analysis framework should be applied to provide a systematic and consistent process for managing hazards.

4. Good practices

Where national guidelines exist, good aquaculture practices and good manufacturing practices (including good hygienic practices) should be followed. Countries without such guidelines are encouraged to develop them.

Where appropriate, Hazard Analysis and Critical Control Point (HACCP; as defined in the Annex to the Recommended International Code of Practice on General Principles of Food Hygiene [CAC/RCP 1-1969]) principles should be followed to control hazards that may occur in feed.

5. Relationship between prions and aquatic animal species

Scientific knowledge is lacking on the relationship between prions and aquatic animal species. There is no evidence to suggest that the use of terrestrial animal by-products as ingredients in aquatic animal feed gives rise to risks in respect of prion diseases. More scientific information is desirable to enable aquaculture industries to utilise more terrestrial animal by-products as a means of reducing dependency on aquatic protein and lipid sources.

6. Bioaccumulation

Heavy metals, dioxins and polychlorinated biphenyls (PCB) persist in fatty tissues and therefore tend to accumulate through the food chain.
7. **Geographic and environmental considerations**

Aquatic and terrestrial harvest areas for feed should not be located in proximity to sources of animal health or food safety hazards. Where this cannot be avoided, preventive measures should be applied to control risk. The same recommendations apply for the processing of feed and the location of aquaculture establishments.

*Aquatic animal health considerations* include factors such as disease status, location of quarantined premises, existence of processing plants without proper biosecurity measures and the existence of zones/compartments of specified health status.

Public health considerations include factors such as industrial operations and waste treatment plants that generate pollutants and other hazardous products. The potential accumulation of pollutants in the food chain through feed needs to be considered.

8. **Zoning and compartmentalisation**

*Feed* is an important component of biosecurity and needs to be considered when defining a compartment or zone in accordance with Chapter 4.1. of the *Aquatic Code*.

9. **Sampling and analysis**

Sampling and analytical protocols for feed should be based on scientific principles and procedures, and OIE standards where applicable.

10. **Labelling**

Labelling should be clear and informative on how the feed and feed ingredients should be handled, stored and used and should comply with regulatory requirements. Labelling should provide for trace-back.

See Section 4.2. of the Codex Code of Practice on Good Animal Feeding (CAC/RCP 54-2004).

11. **Design and management of inspection programmes**

In meeting animal and public health objectives prescribed in national legislation or required by importing countries, *Competent Authorities* contribute through the direct performance of some tasks or through the auditing of animal and public health activities conducted by other agencies or the private sector.

Operators in the feed and feed ingredients business and other relevant industries should implement procedures to ensure compliance with regulatory standards for harvest, handling, storage, processing, distribution and use of feed and feed ingredients. Operators have the primary responsibility for implementing systems for process control. Where such systems are applied, the *Competent Authority* should verify that they meet all regulatory requirements.

12. **Assurance and certification**

*Competent Authorities* are responsible for providing assurances domestically and to trading partners that regulatory requirements have been met.
13. **Hazards associated with aquatic animal feed**

a) Biological hazards

Biological hazards that may occur in feed and feed ingredients include agents such as bacteria, viruses, fungi and parasites. The scope of these recommendations covers OIE-listed diseases and other agents that cause an adverse effect on animal and/or public health.

b) Chemical hazards

Chemical hazards that may occur in feed and feed ingredients include naturally occurring chemicals (such as mycotoxins, gossypol and free radicals), industrial and environmental contaminants (such as heavy metals, dioxins and PCBs), residues of veterinary drugs and pesticides and radionuclides.

c) Physical hazards

Physical hazards that may occur in feed and feed ingredients include foreign objects (such as pieces of glass, metal, plastic or wood).

14. **Cross-contamination**

It is important to avoid cross-contamination during the manufacture, storage, distribution (including transport) and use of feed and feed ingredients. Appropriate provisions should be included in the regulatory framework. Scientific evidence, including the sensitivity of analytical methods and on the characterisation of risks, should be drawn upon in developing this framework.

It is necessary that the prevention of contamination during the manufacture, storage, distribution (including transport) and the use of feed and feed ingredients and relevant provisions should be included in current regulations and standards. Scientific evidence, including the sensitivity of analytical methods and on the characterisation of risks, should be drawn upon in developing this framework.

Procedures, such as flushing, sequencing and physical clean-out, should be used to reduce the likelihood of contamination between batches of feed or feed ingredients.

Procedures such as flushing, sequencing and physical clean-out should be used to avoid cross-contamination between batches of feed or feed ingredients. National regulations should be followed in order to avoid the use of unauthorised feed ingredients with a risk of cross-contamination.

15. **Antimicrobial resistance**

Concerning the use of antimicrobials in animal feed refer to Section X.X.X. of the *Aquatic Code* (under study).

16. **Management of information**

The *Competent Authority* should establish requirements for the provision of information by the private sector in accordance with the regulatory framework.
The private sector should maintain records, in a readily accessible form, on the production, distribution, importation and use of feed and feed ingredients. These records are required to facilitate the prompt trace-back of feed and feed ingredients to the immediate previous source, and trace-forward to the next/subsequent recipients, to address aquatic animal health and/or public health concerns. The private sector should provide information to the Competent Authority in accordance with the regulatory framework.

Animal identification (in the case of aquatic animals this will normally be on a group basis) and traceability are tools for addressing animal health and food safety risks arising from animal feed (see Section 3.5, Chapters 4.1. and 4.2. of the OIE Terrestrial Animal Health Code; Section 4.3 of CAC/RCP 54-2004).

**Article 4.5.5.**

**Pathogens in feed**

1. Pathogens can be introduced into feed in the following ways:
   a) via the harvest of infected aquatic animals;
   b) during storage, processing and transport, due to poor hygienic practices, the presence of pests, or residues of previous batches of feed remaining in processing lines, containers or transport vehicles.

2. Aquatic animals can be exposed to pathogens in feed in the following ways:
   a) Direct exposure
      
      The use of unprocessed feed derived from aquatic animals to feed aquatic animals presents a direct route of exposure, particularly when feeding whole aquatic animals and unprocessed products of aquatic animals to animals of the same species. For example feeding salmonid offal to salmonids or feeding rotifers or Artemia species to crustaceans presents a heightened risk of disease transmission.
   b) Indirect exposure
      
      Pathogens in feed may be transmitted to aquatic animals in aquaculture and wild aquatic animals via contamination of the environment or infection of non-target species.

**Article 4.5.6.**

**Chemical agents in feed**

[under study]

**Article 4.5.7.**

**Physical agents in feed**

[under study]

**Article 4.5.8.**

**Recommended approaches to risk mitigation**
1. **Commodities**

   a) Safe commodities

   The following commodities undergo extensive processing such as heat treatment, acidification, extrusion and extraction. There is a negligible risk that pathogens will survive in such products if they have been produced in accordance with normal commercial practice:

   i) fish oil;
   
   ii) crustacean oil;
   
   iii) fish solubles (a by-product of the fish oil production system, comprising the product remaining when water is drawn off [evaporated] from the residual aqueous phase);
   
   iv) fish meal;
   
   v) crustacean meal;
   
   vi) squid meal and squid liver-meal;
   
   vii) bivalve meal;
   
   viii) finished feed (e.g. flake, pelleted and extruded feed).

   For these commodities, Competent Authorities should not require conditions in relation to aquatic animal diseases, regardless of the aquatic animal health status of the exporting country, zone or compartment.

   b) Other commodities

   Competent Authorities should consider the following risk mitigation measures:

   i) sourcing feed and feed ingredients from a disease free country, free zone or free compartment; or
   
   ii) confirmation (e.g. by testing) that pathogens are not present in the commodity; or
   
   iii) treatment (e.g. by heat or acidification) of the commodity using a method approved by the Competent Authority to inactivate pathogens; or
   
   iv) use of feed only in populations that are not susceptible to the pathogen(s) in question and where aquatic animals that are susceptible to the pathogen(s) in question will not come into contact with the feed or its waste products.

   In addition, risks associated with the disposal of effluents and waste material from feed processing plants and aquaculture establishments should be considered.
c) Whole fish (fresh or frozen)

The practice of trading fresh or frozen whole marine fish for use as aquatic animal feed presents a risk of introducing diseases into populations. Risk mitigation measures include sourcing fish only from stocks where there is no evidence of infection with any of the OIE-listed diseases or treatments that inactivate aquatic animal pathogens.

2. Feed production

To prevent contamination by pathogens during production, storage and transport of feed and feed ingredients:

a) flushing, sequencing or physical clean-out of manufacturing lines and storage facilities should be performed between batches as appropriate;

b) buildings and equipment for processing and transporting feed and feed ingredients should be constructed in a manner that facilitates hygienic operation, maintenance and cleaning and prevents contamination;

c) in particular, feed manufacturing plants should be designed and operated to avoid cross-contamination between batches;

d) processed feed and feed ingredients should be stored separately from unprocessed feed ingredients, under appropriate storage conditions;

e) feed and feed ingredients, manufacturing equipment, storage facilities and their immediate surroundings should be kept clean and pest control programmes should be implemented;

f) measures to inactivate pathogens, such as heat treatment or the addition of authorised chemicals, should be used where appropriate. Where such measures are used, the efficacy of treatments should be monitored at appropriate stages in the manufacturing process;

g) labelling should provide for the identification of feed and feed ingredients as to the batch/lot and place and date of production. To assist in tracing feed and feed ingredients as may be required to deal with animal disease incidents, labelling should provide for identification by batch/lot and place and date of production.

3. Importing countries

Competent Authorities should consider the following measures:

a) imported feed and feed ingredients should be delivered to feed manufacturing plants or aquaculture facilities for processing and use under conditions approved by the Competent Authority;

b) effluent and waste material from feed manufacturing plants and aquaculture facilities should be managed under conditions approved by the Competent Authority, including, where appropriate, treatment before discharge into the aquatic environment;
c) feed that is known to contain pathogens should only be used in a zone or compartment that does not contain species susceptible to the disease in question;

d) the importation of raw unprocessed feed derived from aquatic animals to feed aquatic animal species should be avoided where possible.

Article 4.5.9.

Certification procedures for feeds and feed ingredients of aquatic animal origin

When importing feed and feed ingredients of aquatic animal origin other than those mentioned in point 1a of Article 4.5.8., the Competent Authority of the importing country should require that the consignment be accompanied by an international aquatic animal health certificate issued by the Competent Authority of the exporting country (or a certifying official approved by the importing country).

This certificate should certify:

1. that feed and feed ingredients of aquatic animal origin were obtained from a country, zone or compartment that is free from relevant aquatic animal diseases; or

2. that feed and feed ingredients of aquatic animal origin were tested for relevant aquatic animal diseases and shown to be free of these diseases; or

3. that feed and feed ingredients of aquatic animal origin have been processed to ensure that they are free of relevant aquatic animal diseases.

Specific provisions for OIE-listed diseases may be found in relevant disease chapters of the Aquatic Code.

Article 4.5.10.

Risk pathways for chart of pathogen transmission and contamination through harvest, manufacture and use of aquatic animal feed

1. Pathogens can be introduced into feed in the following ways:
   a) via the harvest of infected aquatic animals;
   b) during storage, processing and transport, due to poor hygienic practices, the presence of pests, or residues of previous batches of feed remaining in processing lines, containers or transport vehicles.

2. Aquatic animals can be exposed to pathogens in feed in the following ways:
   a) Direct exposure

       The use of unprocessed feed derived from aquatic animals to feed aquatic animals presents a potential direct route of exposure. For example feeding salmonid offal to salmonids presents a heightened risk of disease transmission because tissue from a susceptible species is being fed to a susceptible species.
b) Indirect exposure

Pathogens in feed may be transmitted to aquatic animals in aquaculture and wild aquatic animals via contamination of the environment or infection of non-target species.

Figure 1 illustrates the possible pathways for transmission of pathogens within the feed production and utilisation process.

Feed ingredients of aquatic origin used in aquaculture can be a source of pathogens (viruses, bacteria and parasites) to cultured aquatic animal species. In aquaculture establishments pathogens in feed can infect the animals directly (via consumption of feed) or indirectly via environmental sources. Live feed and moist feed are more likely to contain pathogens because their ingredients are either in a raw state or subject to minimal treatment.

Feed and feed ingredients harvested from infected countries, zones or compartments may have a high pathogen load. Feed and feed ingredients from these sources should be processed (e.g. using heat or chemical treatments) to reduce, or eliminate, the pathogen load. After processing care should be taken to avoid post processing contamination during storage and transportation of these commodities. For example, when two or more batches of ingredients of different sanitary status are handled, stored and/or transported together without appropriate biosecurity measures, there is a risk of cross-contamination of the feed.

An aquaculture facility can also be a source of pathogens in aquatic animal feed. For example, feed can be contaminated with pathogens through poor hygiene practices at an infected aquaculture establishment. If the feed is redistributed from the aquaculture facility to the manufacturing facility for recycling, or distributed to another farm, pathogens can be transferred to other aquaculture establishments.
Figure 1: Risk chart of pathogen transmission and contamination through harvest, manufacture and use of aquatic animal feed

<table>
<thead>
<tr>
<th>Feed Ingredient 1</th>
<th>Harvest</th>
<th>Processing</th>
<th>Storage</th>
<th>Transportation</th>
<th>LF Live feed</th>
<th>MF Moist feed</th>
<th>SF Semi-moist feed</th>
<th>DF Dry feed</th>
<th>+++ High risk of pathogen presence</th>
<th>++ Moderate risk of pathogen presence</th>
<th>+ Low risk of pathogen presence</th>
<th>Redistribution or recycling of finished feed</th>
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</thead>
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<tr>
<td>FEED INGREDIENT 2</td>
<td>Storage</td>
<td>Manufacturing</td>
<td>Storage</td>
<td>Transportation</td>
<td>+ Possibility for risk reduction</td>
<td>+ Moderate risk of pathogen presence</td>
<td>++ High risk of pathogen presence</td>
<td>++ Moderate risk of pathogen presence</td>
<td>+ Low risk of pathogen presence</td>
<td>Redistribution or recycling of finished feed</td>
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**Legend:**
- LF: Live feed
- MF: Moist feed
- SF: Semi-moist feed
- DF: Dry feed
- +++: High risk of pathogen presence
- ++: Moderate risk of pathogen presence
- +: Low risk of pathogen presence
- Redistribution or recycling of finished feed