

Training Modules on Food Safety Practices for Aquaculture

Food Safety Practices for Aquaculture

Introduction

This module is part of a training program on Food Safety Practices for the Aquaculture Industry.

This program was developed through a partnership facilitated by the Partnership Training Institute Network (PTIN) of the Food Safety Cooperation Forum (FSCF) of the Asia Pacific Economic Cooperation (APEC) Forum. The educational content was designed by faculty at Michigan State University. Funding for this effort was provided by The World Bank Group.

To learn more about the APEC FSCF Partnership Training Institute Network, please visit <http://fscf-ptin.apec.org/>.

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Overview

The aquaculture sector is among the most important and rapidly growing sectors of the global agrifood system. Production of aquaculture products is not only increasingly important as a key source of protein to feed the world's population, but also is of tremendous importance as a trade good in global commerce. This is particularly true for APEC economies, which accounted for 10 of the 15 leading producers of aquaculture products in 2008.

These learning modules are focused on food safety requirements for the global aquaculture sector. The Codex Alimentarius Commission's "Code of Practice for Fish and Fishery Products" (CAC/RCP 52-2003) serves as the basis for the educational content in the modules.

This concepts addressed in these modules build upon those addressed in "Training Modules on General Food Safety Plans for the Food Industry," a sister curriculum which covers general food safety considerations for the global food industry.

These modules focus on food safety issues particular for global aquaculture value chains. The curriculum focuses on recommended food safety practices that are generic for the major aquaculture sectors, and is intended to provide a general foundation of food safety knowledge for those working in the industry. Users of this curriculum should refer to the applicable laws and regulations in their country of production (and the destination country for exported products) as well as any additional requirements stipulated by their customers, as these will include detailed requirements which are beyond the scope of this module.

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Outline of Modules

The following topics will be discussed in these modules:

- Introduction: Food Safety Issues in Aquaculture
- Food Safety Hazards
- Food Safety Practices for Aquaculture Production
- Ensuring Food Safety During Harvest
- Post-Harvest / Processing
- Food Safety Management Systems / HACCP

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Introduction: Food Safety Issues in Aquaculture

Introduction

Fish and shellfish products are vitally important protein sources for much of the world's population. In 2009, capture fisheries and aquaculture supplied the world with about 145 million tons of fish. Of this production, 118 million tons was used as human food, providing an estimated apparent per capita supply of about 17 kg (live weight basis). Of the total fish and shellfish production, aquaculture accounted for 55 million tons, with the remaining 90 million tons arising from capture fisheries.

In 2007, fish accounted for 15.7 percent of the global population's intake of animal protein and 6.1 percent of all protein consumed. Globally, fish provides more than 3.0 billion people with at least 15 percent of their average per capita intake of animal protein.



Photo: Flickr – Roger Smith

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Introduction

Aquaculture Production

Aquaculture production is increasingly important as a source of the global fish supply. Whereas capture fishery yields have remained largely static for the past two decades, aquaculture production has expanded dramatically in the same time period. From 1970-2008, the production of food fish from aquaculture increased at an average annual rate of 8.3 percent.

China is by far the leading producer of aquaculture products globally, producing approximately 33 million tons of aquaculture products (excluding plants) in 2008. This is approximately 10 times the aquaculture production of the second leading producer, India, with 3.4 million tons produced in 2008.

Several other APEC economies are major producers of aquaculture products. Viet Nam, Indonesia, Thailand, Chile, The Philippines, Japan, United States of America, Republic of Korea and Chinese Taipei all rank among the top 15 global producers of aquaculture products.



Photo: Flickr – Rose Robinson

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Trade in Aquaculture Products

International trade in fisheries products is very important for several APEC economies.

China is by far the leading exporter of fishery products, having exported over 10 million tons of fishery products in 2008. Other APEC economies among the top 15 exporting countries include Thailand, Viet Nam, United States of America, Chile, Canada, Russian Federation, Indonesia and Peru. The total value of worldwide exports of fishery products was in excess of 100 billion US dollars in 2008, and exports of fishery products represents a major proportion of total exports of agricultural (including fishery) products in several APEC economies.

APEC economies also are leading importers of aquaculture products, with Japan and the United States of America being the two leading importers of fishery products in 2008. Other APEC economies among the top 15 importers of fishery products include China, Republic of Korea, Russian Federation and Thailand.

(Source: FAO. 2008. Yearbook of Fishery and Aquaculture Statistics.)



Photo: Public Domain

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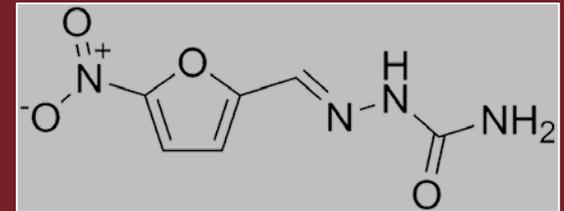
Introduction

Food Safety Issues in Fish, Crustaceans and Mollusks

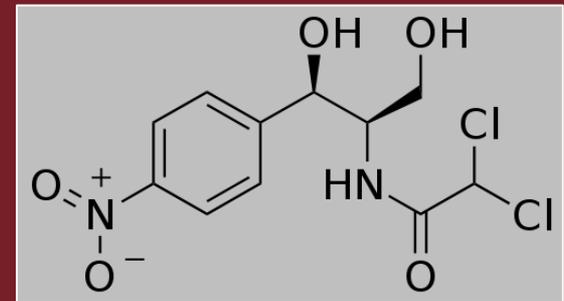
Fishery products are particularly susceptible to contamination with microbiological and chemical hazards. Food safety issues associated with these products derive from a number of factors including methods of production of aquaculture products, susceptibility to contamination and decomposition, and intentional use of non-approved chemicals.

The scope of these problems are difficult to quantify on a global basis, although considerable information can be gleaned from monitoring systems such as the European Rapid Alert System for Food and Feed (RASFF).

In 2009 fish, crustaceans and mollusks accounted for 22.3% of the 3,204 total notifications to RASFF. This was a dramatic increase from 14.8% of the 3,045 RASFF notifications in 2008. Much of the increase from 2008 to 2009 was due to a large jump in border rejections of aquaculture products due to improper use of antimicrobial compounds such as nitrofurans, although problems persist with other food safety hazards.



Nitrofurazone



Chloramphenicol

Illustrations: Wikipedia Commons

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Food Safety Issues in Fish, Crustaceans and Mollusks

In 2009, fishery products accounted for 22% of the alerts and 24% of the border rejections posted in the RASFF. The primary causes for RASFF notifications were:

Fish (467 total notifications) – pathogenic microorganisms, bad or insufficient controls, biocontaminants, heavy metals, and parasitic infestation.

Bivalve mollusks (54 total notifications) – pathogenic microorganisms and biotoxins.

Cephalopod mollusks (39 total notifications) – heavy metals and bad or insufficient controls.

Crustaceans (177 total notifications) – Residues of veterinary medical products, heavy metals, and food additives.

Trend analysis of hazards reported to the RASFF in 2009 compared to previous years indicated:

Significantly greater problems with nitrofurans, cadmium, parasites, *Listeria monocytogenes*, improper labeling, bad or insufficient controls, and spoilage.

Significantly fewer problems due to contamination with sulfites and *Vibrio sp.*

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Foodborne Illness Outbreaks – EU

The vast majority of notifications to the RASFF are based on contamination with potential hazards and not associated with active outbreaks of foodborne illness. However, it is important to recognize that fishery products are frequently associated with foodborne illness outbreaks. For example, in 2008 and 2009 the following foodborne illness outbreaks were reported through RASFF.

- Histamine in tuna from Colombia, Côte d'Ivoire, Germany, Portugal (2 instances), Spain, Sri Lanka (8 instances), and the Philippines, in sardines from Tunisia, in escolar from Viet Nam, and in yellowtail amberjack from Australia (18 separate notifications)
- Norovirus in oysters from France, Spain, Sweden and the United Kingdom (4 separate notifications)
- Staphylococcal enterotoxin (E) in deep frozen blue whiting fillets (*Micromesistius poutassou*) from the Slovak Republic, raw material from China
- Azaspiracid Shellfish Poisoning (AZP) toxins in precooked frozen mussels from Ireland
- Hepatitis A in tellina clams from Peru
- Uncharacterized foodborne illness outbreak caused by escolar (*Lepidocybium flavobrunneum*) from Panama
- suspicion of *Clostridium botulinum* (type E) in vacuum packed smoked whitefish (*Coregonus lavaretus*) from Finland, with raw material from Canada

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Food Safety Issues in Fish, Crustaceans and Mollusks

The U.S. Food and Drug Administration also maintains a database of import refusal reports that provide useful insight into prevalent food safety problems. The FDA import refusal data are available online at:

<http://www.accessdata.fda.gov/scripts/importrefusals/>

In 2008, the Economic Research Service (ERS) of the U.S. Department of Agriculture (USDA) published a report summarizing results of FDA's import refusals for 1998-2004. Fishery and seafood products ranked second (to vegetables and vegetable products) for the most import refusals of any food category during this time frame, with 14,109 violations noted during 1998-2004. The three most frequent causes of violations for fishery and seafood products during that time were 1) filthy, 2) Salmonella, and 3) no process. The full report by USDA ERS is available at: <http://www.ers.usda.gov/media/199635/eib39.pdf>

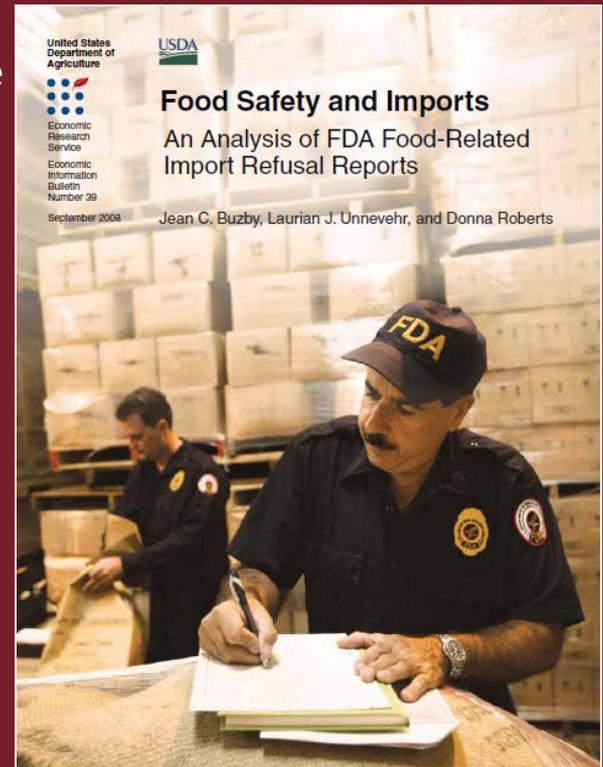


Image: USDA ERS

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Foodborne Illness Outbreaks – USA

Fishery products also have been implicated in a multitude of foodborne illness outbreaks in the United States of America. The following statistics summarize outbreaks associated with seafood (including aquaculture products) in the USA during the past two decades:

- 1,194 total outbreaks of foodborne illness were associated with seafood products in the United States of America during 1990-2007.
- 731 of these outbreaks were associated with finfish:
 - Leading causes of foodborne illness in these outbreaks:
Scombrototoxin (histamine), Ciguatoxin
 - Other causes:
Pathogenic bacteria (*Salmonella* spp., pathogenic *Escherichia coli*, *Bacillus cereus*, *Staphylococcus aureus*, *Shigella*, *Clostridium botulinum*), Norovirus, Parasites (e.g. *Anisakis*), Hallucinogenic Fish Toxin, Paralytic Shellfish Poison (saxitoxin), Tetrodotoxin, Mercury

Data Source: Center for Science in the Public Interest. Outbreak Alert Database. Accessed 9-2011.

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Foodborne Illness Outbreaks – USA

Foodborne illness outbreaks associated with seafood in the USA from 1990-2007 (continued):

- 181 of these outbreaks were associated with molluscan shellfish:
 - Leading causes of foodborne illness in these outbreaks:
Norovirus, Pathogenic bacteria (*Vibrio parahaemolyticus*, other *Vibrio*, *Campylobacter jejuni*, *Salmonella* spp., *Shigella*, *Staphylococcus aureus*), Paralytic Shellfish Poison (saxitoxin)
 - Other causes:
Ciguatoxin, Neurotoxic Shellfish Poison (brevetoxin), Scombrototoxin, Hepatitis A Virus



Data Source: Center for Science in the Public Interest. Outbreak Alert Database. Accessed 9-2011.

Photo: Flickr – Kenno_mcdonnell

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Foodborne Illness Outbreaks – USA

Foodborne illness outbreaks associated with seafood in the USA from 1990-2007 (continued):

- 75 of these outbreaks were associated with “Other Seafood”, including crustaceans:
 - Leading causes of foodborne illness in these outbreaks:
Pathogenic bacteria (*Vibrio parahaemolyticus*, other *Vibrio*, *Clostridium botulinum*, *Clostridium perfringens*, pathogenic *E. coli*, *Salmonella* spp., *Shigella*, *Staphylococcus aureus*)
 - Other causes:
Ciguatoxin, Neurotoxic Shellfish Poison (brevetoxin), Scombrototoxin, Norovirus, Hepatitis A Virus

Data Source: Center for Science in the Public Interest. Outbreak Alert Database. Accessed 9-2011.



Photo: Flickr – J. Griffin Stewart

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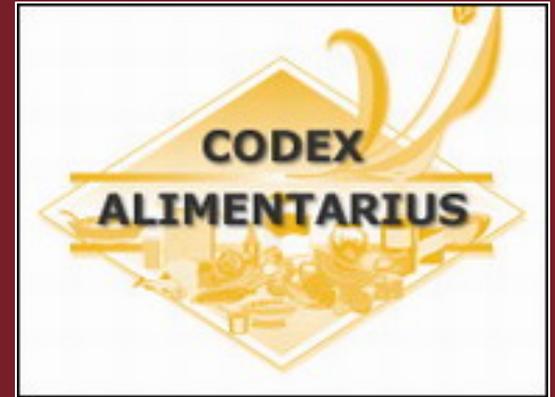
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Public Food Safety Standards

In response to the considerable food safety problems associated with seafood, these products have been subject to increasingly stringent standards to ensure their safety and quality.

Food standards generally derive from two sources. First, there are the Public Sector Standards, which include food laws and regulations implemented by governments. Depending upon the country, these regulations could be specific to the country itself, or could potentially apply to a region (e.g. the European Union) or trading block. Member countries of the World Trade Organization (WTO) recognize the Codex Alimentarius Commission as being the key resource for food standards, guidelines and related texts such as codes of practice. Codex documents often serve as the basis for country-specific laws and regulations drafted by national food control agencies.

Codex standards are subject to continuous revision through a process managed by the Joint FAO/WHO Food Standards Program. The following page provides a partial listing of Codex standards applicable to the fishery sector including aquaculture.



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Codex Standards

The following is a partial listing of Codex Standards applicable to the fishery industry including aquaculture. These are publicly available and can be accessed at:

<http://www.codexalimentarius.org>

- Code Of Practice for Fish and Fishery Products. CAC/RCP 52-2003, Rev. 2010.
- Codex Standard for Canned Salmon. Codex Stan 3-1981, Rev. 1995.
- Codex Standard for Quick Frozen Finfish, Uneviscerated and Eviscerated. Codex Stan 36-1981, Rev. 1995.
- Codex Standard for Canned Shrimps or Prawns. Codex Stan 37 - 1991, Rev. 1995.
- Codex Standard for Canned Tuna and Bonito. Codex Stan 70-1981, Rev. 1995.
- Codex Standard for Canned Crab Meat. Codex Stan 90-1981, Rev. 1995.
- Codex Standard for Quick Frozen Shrimps or Prawns. Codex Stan 92-1981, Rev. 1995.
- Codex Standard for Canned Sardines and Sardine-Type Products. Codex Stan 94-1981, Rev. 2007.
- Codex Standard for Quick Frozen Lobsters. Codex Stan 95-1981. Rev. 2004.
- Codex Standard for Canned Finfish. Codex Stan 119-1981. Rev. 1995.

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Codex Standards

The following is a partial listing of Codex Standards applicable to the fishery industry including aquaculture. These are publicly available and can be accessed at:

<http://www.codexalimentarius.org/>

- Codex Standard for Quick Frozen Blocks of Fish Fillet, Minced Fish Flesh and Mixtures of Fillets and Minced Fish Flesh. Codex Stan 165-1989. Rev. 1995
- Codex Standard for Quick Frozen Fish Sticks (Fish Fingers), Fish Portions and Fish Fillets – Breaded or in Batter. Codex Stan 166-1989. Rev. 2004. Amended 2011.
- Standard for Salted Fish and Dried Salted Fish of the Gadidae Family of Fishes. Codex Stan 167-1989. Rev. 2005.
- General Standard for Quick Frozen Fish Fillets. Codex Stan 190-1995.
- Standard for Quick Frozen Raw Squid. Codex Stan 191-1995.
- Standard for Boiled Dried Salted Anchovies. Codex Stan 236-2003.
- Standard for Salted Atlantic Herring and Salted Sprat. Codex Stan 244-2004.
- Standard for Sturgeon Caviar. Codex Stan 291-2010.
- Standard for Live and Raw Bivalve Molluscs. Codex Stan 292-2008.
- Standard for Fish Sauce. Codex Stan 302-2011.

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Private Food Safety Standards

In addition to public food safety standards which include country-specific laws and regulations, sometimes the buyer of a food product (such as a wholesaler or retailer) requires compliance against specific requirements that are defined by the private sector. These Private Sector Standards are increasingly prevalent in international commerce, and are commonly used by large multinational food companies and other customers such as importers or wholesalers.

There are many different private food safety standards that are used internationally, and some private food safety schemes are specifically designed for the aquaculture sector. The Global Food Safety Initiative (GFSI) of the Consumer Goods Forum benchmarks private food safety schemes against its Guidance Document to help ensure equivalency and mutual recognition of these private food safety requirements by the global food industry.

Additional information on the GFSI is available at:

<http://www.mygfsi.com/>

Public Sector Standards

- Country-Specific Laws and Regulations
- Codex Guidance

Private Sector Standards

- Industry-Driven
- May be required by customers

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Private Food Safety Standards

Among the numerous private food safety standards, some are specific to the aquaculture sector. The most prevalent private food safety standards for aquaculture at this time are the Best Aquaculture Practices (BAP) of the Global Aquaculture Alliance and the GlobalGAP Aquaculture Standard. Additional information on these private standards is available at:

<http://www.gaalliance.org/bap/standards.php>

<http://www.globalgap.org/>

There also are several private food safety standards that address packing and processing of food products, and compliance with these standards may be required by customers of specific fishery and aquaculture products. This is particularly likely if the products have been processed (e.g. such as by canning, smoking, or other processes). Additional discussion of these private sector standards is beyond the scope of this curriculum. Those seeking additional information on these standards should consult the GFSI (<http://www.mygfsi.com/>) or the specific standard owners for additional information if they are asked to comply with these standards.

It also should be noted that private food standards often include elements which go beyond food safety requirements. Examples of these additional requirements include environmental stewardship, social responsibility, worker safety, and other elements. As this curriculum is focused on food safety requirements, these topics will not be addressed in the modules.

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