



**Agriculture
and Markets**

Seafood Pathogens at Retail

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Introduction

- Fish and fishery products can host a wide variety of bacterial pathogens, natural toxins, spore forming toxins, parasites and viruses. They can host chemical hazards in the form of histamines, environmental chemicals (due to pollution, agriculture, etc.) and aquaculture drugs
- Collectively they are identified individually as hazards.
- We will explore seafood hazards, focusing on control in the retail food environment.

Listeria monocytogenes

- Ubiquitous pathogen which can exist on raw material, food contact surfaces, packaging materials, soil, floor drains, etc.
- 62% of surface waters on fishing grounds contaminated with *L. monocytogenes*. (1)
- High risk products include sushi, sashimi, poke bowls, cured seafoods in oil, cold smoked fish and any uncooked or partially cooked seafood products.
- Can be persistent in establishments once a resident population is established.

Listeria monocytogenes control strategies

- Purchase raw fish with letters of guarantee specifically indicating that the product has been processed as a Raw/ RTE seafood product, if no lethality treatment.
- Proper evisceration
- Conduct a SPEP (Surface Pathogen Elimination Procedure)
- Properly control refrigeration temperatures to minimize risk of growth.
- Ensure facility is properly built to minimize Listeria harborage and is properly cleaned, sanitized and maintained to control the risk of pathogenic recontamination at the retail level.

Salmonella

- Generally not thought of in relation to finfish but is being increasingly found.
- 7.4% of US oysters tested positive for Salmonella (2)
- Large outbreak 2012 (Salmonella barielly & Salmonella nchanga) in Ground Tuna Scrape (generally used for spicy tuna in sushi rolls)
- Becoming a greater risk in aquacultured seafood.
- Any seafood, raw or RTE containing Salmonella is considered adulterated.
- Enhanced sanitation program is essential, starting from the vessel.

Salmonella control strategies

- Purchase raw fish with letters of guarantee specifically indicating that the product has been processed as a Raw/ RTE seafood product, if no lethality treatment.
- Proper evisceration
- Conduct a SPEP (Surface Pathogen Elimination Procedure)
- Properly control refrigeration temperatures to minimize risk of growth.
- Ensure facility is properly built to minimize Salmonella harborage and is properly cleaned, sanitized and maintained to control the risk of pathogenic recontamination at the retail level.

Vibrio spp.

- Naturally occurring pathogens in marine waters.
- *V. vulnificus*, *V. parahaemolyticus* and *V. cholerae*
- Mainly thought of as pathogens associated with molluscan shellfish but with raw fish consumption on the rise, *Vibrio* spp are found in raw seafood products other than molluscan shellfish.
- Finfish and crustacean shellfish to be consumed raw must come from unpolluted sources with strict sanitation programs from harvest to the plate.

Vibrio control strategies

- **For control in raw molluscan shellfish:**

Shellfish must be properly tagged with relevant information required by the state shellfish control authority. The shellfish must be from approved waters and be sold by licensed harvesters and dealers.

Proper temperature control to minimize growth is essential.

Cooking, HPP, irradiation, heat shocking, IQF with extended frozen storage are methods to control *Vibrio* spp.

Vibrio control strategies continued

- **For control in finfish/crustacean shellfish:**

Purchase raw fish with letters of guarantee specifically indicating that the product has been processed as a Raw/ RTE seafood product, if no lethality treatment.

Proper evisceration

Conduct a SPEP (Surface Pathogen Elimination Procedure)

Properly control refrigeration temperatures to minimize risk of growth

Histamines

- Certain bacteria, when present on species with high levels of the amino acid Histadine, will produce the enzyme Histadine decarboxylase during growth. This enzyme when formed, converts Histadine to Histamine.
- 50ppm of histamines is the FDA action level
- Proper sanitation on the harvest vessel, proper evisceration, rapid cooling (from time of death) and controlled refrigeration are essential for preventing and controlling histamine formation.

Histamines continued

- Other biogenic amines such as Putrescine (Ornithine) and Cadaverine (Lysine) are considered histamine potentiators.
- Low levels of histamines that would likely be degraded in the small intestine are not degraded as Putrescine and Cadaverine block the small intestine's ability to degrade histamine.
- Preventing the occurrence of biogenic amine conversion is key here.

Histamine control strategies

- Ensure purchased products have been transported under continuous refrigeration at 40F or less
- Proper evisceration
- Conduct a SPEP (Surface Pathogen Elimination Procedure)
- Properly control refrigeration temperatures to minimize risk of growth.
- Fully cook seafood products to destroy histamine forming bacteria

Staphylococcus aureus

- S. aureus can exist on raw product but when competitive microorganisms are depleted while under temperature abuse conditions, bacteria can grow and toxin can form.
- S. aureus is a big concern in seafood products which are brined, dried and or coated with hydrated batters.
- Hydrated batters for seafood at retail usually will be tempura batters used for Japanese style fried battered fish.

Staphylococcus control strategies

- **Drying:**

Drying of seafood products at retail require a variance with a validated study outlining specific critical factors to ensure safe production.

- **Brining:**

Brining of seafood must be done at temperatures of 38F or less.

- **Hydrated batters:**

Batter temperatures between **51F-70F** have up to **12 hours** before toxin formation when *S. aureus* is the only pathogen of concern.

Batter temperatures above **70F** have up to **3 hours** before toxin formation when *S. aureus* is the only pathogen of concern.

Clostridium botulinum

- Clostridium botulinum creates toxin in potentially hazardous foods under anaerobic conditions combined with time/temperature abuse.

- **Products at retail of critical concern are:**

Smoked fish (vac pack and air packed)

Cured fish/ Salted Fish/ Dried Fish/Caviars

Vacuum packaged raw fish/Caviars

Seafood soups & chowders-cook/chill

Any seafood with any part under anaerobic conditions

Clostridium botulinum continued

- **Group 1- Type A and Proteolytic B & F**

Forms toxin at exposure temperatures $\geq 50\text{F}$.

Controlled with a pH ≤ 4.6 , aW of ≤ 0.935 , or WPS $\geq 10\%$.

Putrid odor emitted during toxin formation warding off consumption.

- **Group 2- Type E and Non-Proteolytic B & F**

Forms toxin at exposure temperatures above $\geq 38\text{F}$.

Controlled with a pH of ≤ 5.0 , aW of ≤ 0.97 , or WPS $\geq 5\%$.

No odor emitted during toxin formation- ***NO CONSUMER INDICATOR OF POTENTIAL TOXIN FORMATION***

Clostridium botulinum continued



Clostridium botulinum control strategies

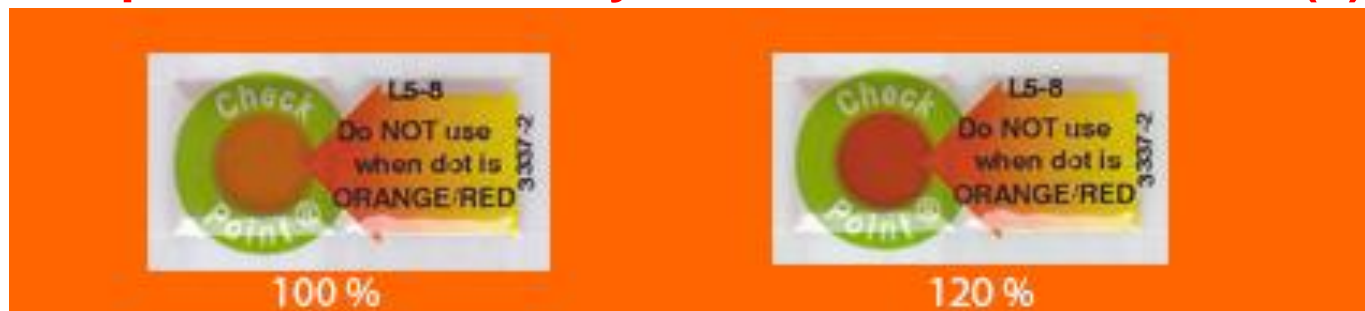
- Proper evisceration
- Brining under refrigeration of 38F or less
- Proper WPS when smoked with proper smoking temperatures
- Controlling WPS, aW and/or pH in cured seafood products
- When anaerobic conditions exist, refrigerate at 38F or less and ensure 2 barriers exist.
- Package raw product in 10K bags (breathable film)
- Cook/chill- requires 6D lethality of Non-proteolytic Type B.

Clostridium botulinum- Vitsab L5-8

- Not temperature abused beyond Skinner Larkin Curve (5)



- **Temperature abused beyond Skinner Larkin Curve (5)**



NOT ACTIVATED(5)



Parasites

- Parasites naturally exist in many species of fish.
- Nematodes (roundworms), Cestodes (tapeworms), Trematodes (flukes)
- Proper cooking will destroy these parasites in parasite containing species
- Parasite containing species consumed without a heat treatment must be properly frozen to destroy all viable parasites before consumption.
- Examples of products without a heat treatment are cold smoked fish, cured herring, ceviche, sushi, sashimi, poke, drunken crabs, undercooked grilled fish.

Parasite control strategies

- For parasite containing species not fully cooked proper freezing is the only strategy for parasite destruction.
- *Freezing until all fish are hard frozen and then storage at -4F or below for seven days.*
- *Freezing at -31F or below until solid and storage at -31F or below for 15 hours.*
- *Freezing at -31F or below until solid and storage at -4F or below for 24 hours. (2)*

Parasite control strategies continued

- Generally retailers will purchase parasite containing species prefrozen with letters of guarantee indicating product was properly frozen.
- *SUSHI GRADE???*
- Sushi chefs claim frozen fish tastes horrible when defrosted and freezing bursts cells..... WHY?????
- “**CRITICAL FREEZING ZONE**” (4)***32F to 23F*** The less time fish spends in this zone, the less cellular water loss due to freezing occurs.
- Longer time, larger ice crystals, more time for concentrated salts and minerals to cause cell membrane damage which causes water loss.

Parasite control strategies continued

- “**Critical freezing rate** is defined as the time required from the internal temperature of a fish product to drop from... (32F to 23F)” (6).
- Slow freezing (deep freezing)- freezing at 0F or less without any regard to time. (common)
- Quick or fast freezing - 2 hours or less through the critical freezing zone. (blast tunnels- plate freezers, blast chillers, etc) (moderately rare)
- Ultrarapid freezing - Using liquid nitrogen or liquid carbon dioxide. (extremely rare)

References

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Prevalence of *Salmonella* spp. in Oysters in the United States

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Questions

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