

Proper fish handling for quality and safety

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Whether you are fishing to earn spare money or working as a full-time commercial fisherman, it is very important that you know how to handle fish properly. This is for your own safety, the safety of those who will be eating the fish, and so that the fish you deliver to the customer will be of high quality and have the highest value possible.

Introduction

Fish have intrinsic qualities that are unique to each species (e.g. flavour and texture) that are otherwise beyond the control of the fisherman; and extrinsic qualities that are a result of how they were handled by the fisherman. The fisherman has no control over intrinsic qualities, which are part of the fish regardless of what is done to them. Extrinsic qualities, however, can be controlled by handling fish properly and by cleaning and chilling them as soon as possible. Fish that are fresh and have been handled properly look better, smell and taste better, are safer to eat, and are more valuable than poorly handled fish.

Intrinsic qualities	Extrinsic qualities
Species	No damage from gaffing or handling
Size	No scale loss, skin shiny and firm
Sex	No bruising or gaping
Market appeal	No blood in flesh
Flavour	No burned flesh
Fat content	Gills red, eyes clear
Diseases present or not	Fresh seaweed smell
Parasites present or not	Core temperature between -1.0°C and 4.0°C

In addition to food safety, you should also be concerned with safety in the workplace. Fishermen can be injured from the tools they use to catch fish, but can also be injured by the fish that they catch. From the time a fish is caught until it is delivered to the first customer it can be a hazard because fish have sharp teeth, have spines that are often poisonous, are coated with bacteria, can contain toxic substances, and can give off poisonous gases if allowed to rot. Fish can cause serious injury, disease, or even death during handling if care is not taken.

Fish handling and quality

How to tell if fish is fresh and was properly handled:

- High quality fish have a seaweed-like smell and not a fishy odour
- Gills, if present, should be red, not brown or grey
- Skin should be shiny and firm to the touch with no bruising
- Scales should not fall off
- Eyes should be clear and bright
- Core temperature should be between -1 °C and 4°C

Fish quality is lost because of:

- Bacterial spoilage
- Enzyme activity
- Chemical changes
- Physical damage
- Dehydration
- Contamination

Bacterial spoilage

Bacterial spoilage is the most important factor affecting fish quality. Bacteria are present on the skin and gills, and in the guts of fish, but not in the flesh of living fish. A fish's immune system protects the flesh from bacteria but only while the fish is alive. Once a fish is dead, bacteria can invade the flesh and reduce quality. Bacteria can enter the flesh through cuts and other damage to the flesh. Bacterial growth on fish is slowed by proper cleaning, dressing and chilling. One type of food poisoning that people can get from eating poorly handled fish is called histamine, or scombroid, poisoning. Histamine poisoning occurs when bacteria convert histadine, a naturally occurring amino acid, into histamine. Histamine poisoning is most common in tuna (*Scombridae* spp.) and mahi mahi (*Coryphaena hippurus*) that were not chilled properly.



Clear eyes, shiny skin, properly iced... these mahi mahi will certainly attract top prices at the United Fish Agency longline auction, Honolulu, Hawaii.
Image: Naomi Blinick/Marine Photobank.

Enzymes

Enzymes are naturally occurring chemicals that fish use for digestion and for muscle movement. After a fish dies, enzymes begin to digest the flesh causing the flesh to burn or become soft and mushy. One way this happens is that the natural sugars in the flesh are converted to lactic acid. This happens when the sugars are digested without any oxygen, or under anaerobic conditions.

The flesh does not receive any oxygen after the heart stops beating but does continue trying to convert sugar to energy. The result is the formation of lactic acid, which causes a condition called burned flesh syndrome, where the flesh turns brown and has an off-flavour. This can be avoided by properly stunning and then spiking the fish so that all muscle activity stops. Enzyme activity is also slowed by chilling.

Chemical changes

Chemical changes, including oxidation, causes a fish to have a fishy odour. Chemical changes can be slowed if the fish is kept out of sunlight, is kept covered and moist, and is chilled properly. One particular chemical change causes the fish to become stiff (called rigor mortis). This is normal and the fish may stay stiff for several hours. It is important not to handle fish too much during rigor mortis, and they should not be processed or moved around. Mishandling during rigor mortis can cause gaping.

Physical damage

Physical damage includes bruising, gaping, and mushy flesh. Fish muscle tissue is fragile compared with muscle tissue of other animals (e.g. cow and pig), and is easily damaged. Bruising occurs when blood seeps into the flesh and clots, and the flesh then becomes soft and discoloured. Gaping occurs when layers of muscle tissue separate. Tossing fish, slamming them onto the deck, or throwing them into a fish box will cause bruising and gaping. Over-filling a fish box so that fish on the bottom are squashed will also cause bruising, gaping, and mushy flesh. Bending a fish can cause gaping. Bruising and gaping can occur several days after the fish is caught so it is important to always handle the fish gently from catching to off-loading. Bruising, gaping, and mushy flesh can all be reduced if fish are handled gently and chilled quickly.

Dehydration

Dehydration, or drying out, can occur if fish are left uncovered or in the sun. Dehydration can be avoided if fish are chilled quickly and kept covered with ice or chilled seawater. Chilling the air inside a fish hold or fish box is not a good way to cool a fish because it takes longer to get the temperature down to 0°C and because the fish will dehydrate.

Contamination

Contamination can be caused by fuel and oil, chemicals, bird and rat droppings, and cockroaches and flies. Oil and chemical contaminants can ruin the smell and flavour of a fish. Contamination from pests can introduce bacteria that cause spoilage. Contamination can also be caused by using dirty ice. Sometimes contaminated fish are considered spoiled and must be destroyed. This results in a total loss for the fisherman.

Contaminants should be kept away from fish and from surfaces that come in contact with fish. Fuel, oil, paint, cleaners, and other such chemicals should never be stored in a fish hold. Oil spills should be cleaned up immediately, and animal and insect pests should be eliminated. Only clean ice made from potable water should be used to chill fish.

1. A cold chain is a temperature-controlled supply chain. An unbroken cold chain is an uninterrupted series of storage and distribution activities that maintain a given temperature range. (Source: Wikipedia http://en.wikipedia.org/wiki/Cold_chain).

Three keys to fish quality

- Always handle fish properly
- Chill fish quickly and maintain the cold chain¹
- Practice good sanitation

Proper handling — general

Proper fish handling has a significant impact on quality. Fish are handled three or four times between the time they are caught and the time they reach the first customer. With each handling they become more fragile; therefore, handling should be minimised. Good handling practices reduce physical damage, which in turn reduces bacterial spoilage.

Only minimal handling is needed for smaller fish such as mackerel, skipjack tuna, and small bottom fish. These fish should be chilled immediately after landing with no further handling. Medium sized fish such as groupers and snappers can be spiked and bled right after landing, and then chilled. Larger fish, such as wahoo, billfish, and yellowfin and bigeye tunas should be gaffed and then landed on a foam pad or carpet and not directly on a hard deck. Fish that are gaffed should be gaffed in the head only. They should then be stunned immediately with a fish bat if they are thrashing, and then spiked and bled and dressed as soon as possible.

Care should be taken not to cut into the flesh when dressing the fish. Throughout this process, all fish should always be treated gently. Fish should not be thrown or slammed onto the deck or into a fish box or fish hold. Small fish should be lifted by the head, not the tail. Larger fish should be lifted by the tail and throat, avoiding bending the fish or breaking the isthmus (the connection between the jaw and throat) as this will cause gaping. Fish should never be stepped on. Fish holds and fish boxes should not be overloaded. All fish should be chilled as quickly as possible. Spiking, bleeding, and dressing vary according to customer requirements and the size of the fish. Some customers prefer gilled and gutted (G&G) or headed and gutted (H&G) fish, others prefer whole, undressed fish. Some customers ask that fish be spiked and bled but not gilled and gutted. Spiking and bleeding improve fish quality, including bottom fish and troll-caught fish, but are probably more important for larger fish such as sashimi-grade tunas.

Proper handling — spiking

Spiking kills the brain and reduces enzyme activity. Fish such as snappers, can be spiked by inserting the spike under the gill cover and penetrating the brain from the bottom of the skull. Fish with thick, hard skulls, such as mahi mahi and opah, can be spiked by inserting the spike into the back of the eye socket and piercing the bottom of the skull by shoving the spike up and back at a 45-degree angle. Larger fish, such as tuna, can be spiked by piercing the skull from the top between the eyes and shoving the spike back at a 45-degree angle.

Proper handling — bleeding

Bleeding improves fish quality by reducing enzyme activity and by preventing blood clots from forming in the flesh. Bleeding is best done on most fish by making a cut in the throat just in front of the heart, severing the blood vessels that supply blood to the gills. It is important to rinse away all blood immediately with clean sea water. Bleeding on tunas is sometimes done by cutting the blood vessels on both sides of the fish that lie just under the skin on the pectoral fin recess just behind the pectoral fins. A seawater hose is then inserted into a cut in the gill cavity to rinse away all blood.

Proper handling — dressing

Dressing can include gilling and gutting (removing the gills and guts) but can also include heading (removing the head) and finning (removing the fins). Gilling and gutting improve fish quality by reducing the amount of bacteria present in the fish. Heading and finning are usually done at the buyer's preference to reduce freight costs. Sometimes dressing is done on shore before fish are shipped or delivered to a buyer. Before chilling dressed fish on a boat, all blood, slime, and bits of flesh should be rinsed away with clean seawater. If fish are dressed after they are unloaded from the boat they should be rinsed with chilled potable water, not ambient temperature water and never with seawater from a harbour.

Chilling

Chilling and maintaining the cold chain slows bacterial growth, slows enzyme activity, keeps fish moist, and helps to reduce physical damage. The ideal temperature for fresh fish is 0°C. Fresh fish should not be kept at a temperature below -2°C or above 4°C. Maintaining the cold chain means that the fish stay within this temperature range from the time they are caught until they reach the first customer. There are three ways to chill fresh fish on a boat – icing, refrigerated seawater (RSW), and chilled seawater (CSW).

Icing

For icing fish, flake ice or tube ice made from potable water are best. Crushed ice may damage fish if the chunks of ice are large. Seawater ice is too cold in most cases, and may cause fish to freeze. It is important to start with a bed of ice deep enough so that as the ice melts the fish will not come in contact with the bottom of the fish hold or fish box. Fish should be placed in rows, back up and belly down, side-by-side but not touching each other, and should be covered completely with ice. It takes about 2 kg of ice to properly chill 1 kg of fish. Only clean ice should be used. Dirty ice should be discarded. Fish are chilled when the surrounding ice melts and heat is removed. Melting freshwater ice always stays at 0°C so it is not necessary to monitor the temperature of an ice

hold. It is important, however, to have proper drainage in the fish hold or fish box so that meltwater does not stay in contact with the fish. It is also important to have a cap layer of ice over the top of the fish so that they do not dehydrate. About 1 m³ of fish hold will be enough for about 300 kg of fish on ice, depending on the size of the fish.

Refrigerated seawater

RSW requires a refrigeration compressor to chill the seawater in a fish hold. Usually fresh water is added to the seawater to raise the temperature and keep the fish from freezing. It is important to keep the temperature of the refrigerated seawater at about -2 to 0°C. Therefore, it is critical to monitor and regulate the temperature. It is also important to have good circulation so that the water temperature is uniform. Baffles may be needed to prevent fish from moving around in the RSW hold. Some fishermen like to hang fish vertically in an RSW hold to prevent them from moving. Larger fish such as tuna can be put in cloth or plastic body bags to prevent damage. Each cubic metre of an RSW fish hold can chill about 500 kg of fish.

Chilled seawater

CSW is made by mixing two parts of clean ice to one part of seawater. The resulting slurry will stay at about -2 to 0°C. It is not important to monitor the temperature of a CSW hold as it will always stay within this range as long as there is sufficient ice. As more fish are added more ice may be needed to maintain this temperature range. The slurry should be thick enough so that fish cannot move around. The slurry should have the consistency of wet cement. Each cubic metre of a slurry hold can chill about 500 kg of fish.

Sanitation

Sanitation is important to reduce bacterial spoilage. The working deck of the boat should be rinsed clean after each catch. Blood, slime and scales should be rinsed away with clean seawater regularly while fishing. Gills and guts should be thrown overboard. The deck and fish hold and fish boxes should be cleaned and sanitised after every fishing trip. Good sanitation protects against bacterial spoilage and prevents contamination. All surfaces that come in contact with fish should be rinsed to remove blood, slime, scales and offal. They should then be scrubbed with a mixture of seawater and detergent, using a stiff nylon bristle brush. All detergent should be rinsed away with clean seawater. Then all surfaces should be sanitised with a mixture of seawater and household bleach in a ratio of about 20 to 1. This should be allowed to stand for about five to ten minutes before being rinsed away with clean seawater. All tools used for catching and processing fish should also be cleaned and sanitised, including gaffs, spikes, saws and knives. Gloves should be washed and sanitised as well. Household products containing phenols should never be used for sanitising.

Fish handling and safety

Be aware of hazards when fishing:

- Make sure that all crew members know the specific dangers of each fish species that you may catch, and the specific dangers of each piece of equipment and fishing gear on the boat.
- Make sure that all gaffs, spikes, meat hooks, saws and knives are clean and sharp.



- Always have a bolt cutter onboard so that if a fisherman becomes impaled by a hook, the tip and barb can be cut off. The hook is then removed by pulling it out the way it went in. If the tip has not pierced the skin it must be shoved through until it is exposed so it can be cut off. Never pull a hook out without first cutting off the tip and barb.
- Never wrap a leader line around your hand when pulling in a large fish.
- When pulling up a multiple hook-line with a fish still in the water, always remove empty hooks as they come up. Otherwise the fish could run and impale the fisherman with a hook.
- When standing by to gaff a fish, always hold the gaff so that the hook is up and not on the deck, otherwise someone could step on the gaff hook when the boat rolls and become seriously injured.
- When gaffing marlin or other billfish, always grab the bill when hauling the fish onboard so nobody gets injured.
- Always wear gloves when handling fish. This prevents injuries to your hands and fingers. Fish are coated with slime that contains millions of bacteria. Small cuts and scrapes on your hands can become infected easily.
- Wear protective clothing and gumboots when handling larger fish.
- Remove hooks by striking with a fish bat or by gripping the leader and turning the hook the opposite way that it went in. Avoid putting your hands in the fish's mouth as the sharp teeth and gill rakers can cut your fingers.
- Stun and then kill larger fish immediately before they have time to injure someone when they flop around on deck. Smaller fish can be stunned by immersing them directly into RSW or CSW.
- When lifting heavy fish, bend your knees and keep your back straight. Lift with the knees. You may need help from someone else to lift or move very large fish.
- Always rinse blood and slime from your hands and gloves after cleaning and handling a fish.
- Treat any cuts or scrapes on hands immediately by cleaning and disinfecting them.
- Never enter a fish hold that contains rancid fish or if it smells like rotten eggs.



The bluespine unicornfish (Naso unicornis) has two razor-like spines on each side of its caudal peduncle.

Artwork: Les Hata.

Be aware of hazards from handling fish:

- Dorsal and anal fin spines
- Opercular spines
- Caudal spines
- Tail scutes
- Sharp teeth of wahoo, barracuda, moray eels and sharks
- Sharp beaks of needlefish and garfish
- Bills of marlin and swordfish
- Poisonous spines of scorpionfish
- Poisonous tail barbs of stingrays
- Poisonous barbs of some sharks
- Stinging tentacles of Portuguese-man-o-war and some jellyfish (often encountered while fishing)
- Poisonous gas given off by decomposing fish

Be aware of fish that are unsafe to eat

Finally, there are some fish that are not safe to eat even if they are handled properly. These include fish that have accumulated ciguatera toxins in their flesh, fish that have accumulated high levels of mercury in their flesh, and some species of pufferfish that are naturally toxic. Ciguatera and mercury can both occur in fish that are normally safe to eat. Generally, larger fish in a group are more likely than smaller fish of the same species of being ciguatoxic. Larger fish are also more likely to have higher levels of mercury. Consult your local fisheries officer to find out what the ciguatera and mercury risks are in your area. It is best, however, to always avoid eating puffer fish, as a mistake could be fatal if the wrong species is consumed.