Virginia Cooperative Extension
Virginia Tech • Virginia State University

Publication FST-276P

Fish Slaughter

David D. Kuhn, Assistant Professor and Extension Specialist, Department of Food Science and Technology, Virginia Tech
Stephen A. Smith, Professor, Virginia-Maryland Regional College of Veterinary Medicine, Virginia Tech

Summary

Slaughter is the term used when animals are killed for food. The methods used to slaughter fish depend on many factors, including fish species and size, fish numbers, type of aquaculture production system (e.g. ponds, cages, tanks), animal welfare concerns, regulatory compliance, economics, market preferences and effects on product quality. Some methods may not be approved in some countries, such as the use of certain anesthetics and other methods to kill fish.

Several organizations have prepared guidelines for humane treatment prior to and during slaughter, and slaughter methods may soon be specified in the purchase requirements of major seafood buyers. All methods of slaughter have issues where animal welfare concerns should be addressed. Approaches such as bleeding without stunning have been cited as less acceptable. Meanwhile, electrical stunning followed by an acceptable killing method, a combination that minimizes physical and biological effects, may have less animal welfare issues.

Selecting a Slaughter Method

Prior to slaughter, feed is withdrawn from cultured fish to allow their digestive systems to empty their contents. This reduces the chance of fish tissues being contaminated by gut contents during processing and helps to maintain the quality and hygiene of the final products.

Fish should not be crowded. Crowding exposes fish to a rapidly increasing density, and as a result, oxygen availability and water quality can decrease rapidly. Overly crowded fish may show vigorous agitation, gasping and splashing. There is also an increased risk of damage from abrasion through contact with other fish, nets or holding tanks. The adverse effects of crowding can be lessened by reducing densities slowly and providing additional oxygen. Fish should be crowded for as short a period of time as possible.

Harvesting fish for slaughter usually requires some handling and concentration of fish, which creates stress for the fish. Harvesting can cause elevated levels of cortisol, which is the primary stress hormone in fish, as well as lactic acid and glucose. Stress can also cause reduced glycogen levels, decreased muscle pH and rapid onset of rigor mortis. Thus, undesirable pre-harvest physiological changes that stress the fish can result in lower product quality and reduced processing yields. This can have a significant effect on profitability.

Slaughter Methods

A variety of slaughter methods are currently used for fish, depending on the species, desired product quality and market demand. Some fish are killed and processed individually, while others are killed and processed collectively. Slaughter is generally a two-stage process. First, the fish are stunned so they cannot sense pain. Then the fish are killed by one of a variety of methods. It is important that the stun-to-kill time is brief so that fish do not regain consciousness before they are killed.

When choosing methods for slaughter, it is important to evaluate how each method will impact the fish, personnel, and resulting product. For each slaughter situation, be sure the method:

- Induces rapid loss of consciousness and death in fish.
- Creates a minimal amount of pain and distress.
- Produces irreversible loss of consciousness.
- Works with intended fish use and purpose.
- Provides reliable slaughter methodology.
- Works with species, size and age of fish.

Produced by Communications and Marketing, College of Agriculture and Life Sciences, Virginia Tech, 2017

VT/0617/FST-276P

- Is appropriate for the subsequent evaluation or use of fish tissues.
- Causes minimal environmental impact of fish carcass disposition.
- Is safe for predators or scavengers should carcasses be consumed.
- Produces minimal or no drug residue.
- Is safe for personnel who use methodology.
- Minimizes emotional effect on observers or operators.
- Causes no damage to equipment.
- Meets regulatory requirements.

Fish Welfare and Common Slaughter Methods

Acceptable slaughter methods must render the animals insensible immediately and should be performed without causing undue pain or suffering. Rapid slaughter methods are preferred over slower methods, since they lead to improved fish welfare and fish quality.

A summary of current recommended methods of slaughter (American Veterinary Medical Association 2016) for fish follows:

Fish Slaughter Methods

Carbon Dioxide

Carbon dioxide saturated water causes narcosis and loss of consciousness in the fish. Only carbon dioxide from a source that allows for careful regulation of the concentration, such as from a gas cylinder, is acceptable.

The gas is dissolved in the water prior to fish being introduced to the water. Fish placed in this water often react violently while their blood absorbs the gas rapidly. The fish may get bruised from hitting other fish or the sides of the holding container. The time required for fish to be killed can vary from a few minutes to 10+ minutes. Thus, carbon dioxide is often used as the first step in a two-step process. First, fish are anesthetized by the carbon dioxide . Then, fish are killed rapidly by a secondary method. Some countries do not allow the use of carbon dioxide due to welfare concerns.

Captive Bolt

With the captive bolt method, fish are oriented into a machine individually that uses a pneumatic non-penetrating captive bolt to stun the fish. This technique is accurate and delivers the required concussion velocity to stun the fish quickly. Fish are then killed manually or mechanically by exsanguination using an acceptable bleeding technique, such as cutting or removing the gills.

Gunshot

This ballistic technique is used with large wild-caught fish species such as halibut and tuna. The bullet penetrates the brain, where it causes extensive damage and immediate death of the fish. Inaccuracy and human safety are major concerns of this technique.

Spiking

In spiking, pithing, coring or “ikejime”, a spike or probe is inserted through the skull of the fish directly into the brain. The fish are stunned and killed at the same time. This procedure can be applied more accurately in large fish due to the larger size of the brain. In smaller fish, the brain may be difficult to locate and destroy. If the brain is not adequately destroyed, the fish can undergo distress, and undesirable tissue quality changes may result.

Other Manual Techniques

These methods include manual blunt force trauma, decapitation and cervical transection. With blunt force trauma, fish are removed from the water individually and given a sharp blow to the head. If the blow is accurate and strong enough, the animal is killed instantly. However, if the blow is weaker, the animal is only stunned and a second step of killing is required. Both decapitation and transection of the cervical spine also require a secondary kill method such as pithing.

Electrical Stunning

Stunning by use of electricity is known as electronarcosis. Killing by electricity is known as electrocution. Electrocution completely destroys brain function and renders the animal unconscious while stopping the breathing reflex, so the fish is stunned and killed simultaneously. Electric stunning is reversible, as normal brain function is disrupted for only a

short period of time. Hence, electronarcosis must be followed immediately by a secondary kill method. Electric stunning immobilizes the fish and prevents distress and struggling prior to slaughter, which are detrimental to tissue quality. Recent advances in electrical equipment design have made substantial improvements in preventing or minimizing undesirable physical and biological effects in electric stunned fish. For electrical stunning to be effective, proper current and stun duration must be maintained. Also, water factors such as conductivity and temperature must be properly managed.

Bleeding

Killing a fish by bleeding can be accomplished by any of three major processes: cutting the gills, removing the gills or severing the caudal vessels of the tail. Fish should be stunned prior to bleeding. Fish die of anoxia and proper stunning should prevent any distress or struggling of the fish. Bleeding prevents fish muscles from turning an undesirable red color or acquiring a blood odor, which can prevent fish from being sold for sushi or surimi.

Rapid Chilling

Placing fish in iced water can be used to immobilize fish so they can be more easily handled for a secondary killing method. Fish can also be placed in an ice bath for a longer time until death occurs, but this technique is only appropriate for warm water fish species and not recommended for temperate, cool or cold water species, or for medium to large-bodied fish where the time to death may be significantly prolonged. Even though fish usually struggle prior to loss of consciousness, live chilling is considered by many in the aquaculture industry to offer benefits to carcass quality, because reducing muscle temperature close to zero degrees Celsius helps delay enzymatic and microbial spoilage processes. The process also increases the time for onset of rigor mortis and the resolution of rigor. Another advantage of this slaughter method is that the water can be drained and the fish placed in an iced container with the fish's temperature already lowered.

Asphyxiation

Asphyxiation by removal from water, or "dewatering", has been commonly used by the aquaculture industry for many years. Basically, fish are removed from the water and allowed to die via asphyxiation. The fish struggles as oxygen is depleted and respiration ceases. The rate at which oxygen depletion occurs depends upon ambient temperature and the rate of fish activity (e.g. reducing the temperature of fish typically prolongs the time to anoxia and, therefore, the time to insensibility, thereby lengthening the period of distress). This method is less acceptable compared to the aforementioned methods and is not considered acceptable by American Veterinary Medical Association (2016).

Anesthesia

With the exception of carbon dioxide, the use of anesthetics is not an acceptable method for slaughter (AVMA 2016) as there are regulatory and human consumption concerns over potential anesthetic residues in the fish tissues.

References

American Veterinary Medical Association. 2016 Schaumburg, IL: AVMA. Guidelines for the Slaughter of Animals. https://www.avma.org/KB/Resources/Reference/AnimalWelfare/Documents/Humane-Slaughter-Guidelines.pdf

Farm Animal Welfare Committee. 2014. Opinion on the Welfare of Farmed Fish at the Time of Killing. London: Department for Environment, Food and Rural Affairs. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/319331/Opinion_on_the_welfare_of_farmed_fish_at_the_time_of_killing.pdf

World Organization for Animal Health. 2010. Aquatic Animal Health Code: Welfare aspects of stunning and killing of farmed fish for human consumption. 13th ed. Paris, France: OIE World Organization for Animal Health. http://web.oie.int/eng/normes/fcode/en_chapitre_1.7.3.pdf

Yue, S. 2008. An HSUS Report: The Welfare of Farmed Fish at Slaughter. Humane Society of the United States. http://www.humanesociety.org/assets/pdfs/farm/hsus-the-welfare-of-farmed-fish-at-slaughter.pdf