



Issue	Histamine in Fish (Scombroid Poisoning)
Background	<p>The Philippines is the world's eighth-largest fish producer in 2018. According to the Food and Agriculture Organization (FAO), the Philippines produced 4.37 million metric tons of total fisheries production, accounting for around 2% of global production [1]. In 2020, the fisheries sector contributed to the national Gross Domestic Product (GDP) by 1.4% at current and constant 2018 prices [2].</p> <p>Fish consumption, on the other hand, is constantly expanding worldwide due to its high nutritional value. The Philippines' average daily consumption of fish and fishery products from 2018 to 2019 was 93.9 grams per capita [3].</p> <p>While fish consumption is increasing and many types of cuisines include fish as an important part, the consumption of fish that contain a high level of histamine poses a significant food safety concern. Fish exposed to high storage temperatures for an extended period produce biogenic amines, such as histamine, which have toxicological effects in humans [4]. A high histamine level may cause scombrototoxin fish poisoning (SFP), also called histamine poisoning.</p> <p>In 2015, histamine poisoning was reported in Naguilian, Isabela. Over 50 residents were hospitalized after consuming dishes made from <i>tulingan</i> or frigate tuna. The investigation showed that the tuna had already gone stale by the time it was sold to the residents [5]. Similarly, in Hong Kong, the Centre of Health Protection of the Department of Health reported 26 local SFP from 2009 to 2018, affecting 45 persons. These reported cases underline the importance of educating key players in the food supply chain, such as fisherfolks, traders, processors, vendors, and consumers, about the best practices for maintaining the quality of fresh fish and guaranteeing food safety [6].</p> <p>Histamine levels are set by regulatory authorities to ensure quality and safety of fresh fish. Australia, New Zealand, and the European Union (EU) have adopted a maximum histamine limit at 200 mg/k (200 ppm) of raw fish [7]. Locally, the Fisheries Administrative Order No. 210 Series of 2001 issued by the Bureau of Fisheries and Aquatic Resources (BFAR) established the same regulatory limit [8]. Whereas, the US Food and Drug Administration follows stricter limits at 50 ppm and is proposing to lower the value to 35 ppm [9].</p> <p>This Technical Bulletin aims to provide information on the food safety issue of high levels of histamine content in fish and fish products. It also lists the recommended practices from catch until it reaches the consumer to prevent histamine formation.</p>

<p>General Description</p>	<p>Fish and fish products play an important part in the human diet because they are good sources of nutrients such as proteins, vitamins, minerals, and polyunsaturated fatty acids. However, these products are highly perishable commodities due to postmortem changes and subsequent formation of spoilage compounds [7].</p> <p>During the metabolism of different microorganisms in fish, nitrogenous compounds called biogenic amines (BAs) are formed from the decarboxylation of free amino acids, or the amination of carbonyl-containing organic compounds. This makes the accumulation of BAs in fish a good indicator of earlier fish spoilage and the hygiene level of handling and processing procedures [10, 11]. Among the BAs, histamine is considered the most biologically active and toxic as it causes scombroid fish poisoning (SFP) [4].</p> <p>Scombroid fish poisoning, also known as histamine poisoning, results from ingesting fresh, canned, or smoked fish that were improperly handled after capture or during subsequent storage activities. Histamine is formed when bacteria decompose free histidine, a naturally occurring amino acid found in the muscular tissue of tropical and temperate marine fish [12].</p> <p>The term "scombroid" comes from the <i>Scombridae</i> family of fish (e.g., tuna and mackerel), which are mostly associated with histamine poisoning [13]. Fish with dark muscles have more histidine than those with white muscles. Therefore when mishandled, these types of fish accumulate more histamine [7]. Other dark-fleshed fish implicated include sardines, anchovies, and marlin [14].</p>
<p>For Food Safety: Hazard Presence in Food</p> <p>For Quality: Quality Issues in Food</p>	<p>Histamine (Scombrototoxin)</p> <p>Gram-negative bacteria commonly found on fish skin, gills, and guts (e.g., <i>Morganella morganii</i>, <i>Escherichia coli</i>, <i>Klebsiella</i> species, and <i>Pseudomonas aeruginosa</i>), produce enzymes called histidine decarboxylase. These enzymes react with free histidine naturally present in fish muscle forming histamine (or scombrototoxin) [12, 15].</p> <p>Fresh-caught fish has relatively low histamine levels. Histamine levels rise during handling, processing, and storage due to several factors. Histamine-forming bacteria thrive at a wide range of temperatures (20-37°C). However, fast growth is observed at temperatures above 32.2°C. Histamine production in fish can happen quite quickly. After only three to four hours at room temperature, histamine levels can reach threshold levels. As a result, the higher the temperature abuse, the more histamine is likely to be produced. This is why it is critical to maintain the cold chain after fish harvesting to avoid histamine formation by limiting bacterial growth and enzyme activity. Time and temperature abuse should be avoided at the onset of fresh fish handling [7, 12].</p>

	<p>Although cooking can inactivate the enzymes, once histamine is formed, no preparation method can remove the toxins, including freezing, canning, or smoking. The toxicity will remain unchanged due to its stability [14, 15].</p>
<p>Adverse Health Effect in Human</p>	<p>Although it has similar symptoms to fish allergy, scombroid poisoning causes more severe symptoms. Allergic reactions typically affect one person who has a history of allergy to the implicated food item. However, with scombroid poisoning, more than one person may be affected, often with no history of allergies [16].</p> <p>Scombroid poisoning symptoms appear quickly, usually between ten minutes to four hours after swallowing contaminated fish. Pseudo-allergic reactions such as facial flushing and perspiration, peppery or metallic taste, burning feeling in the mouth and throat, dizziness, palpitations, nausea, and headache are all possible early signs. This may advance to facial rash, hives, edema, nausea, vomiting, short-term diarrhea, and stomach cramps [7].</p> <p>Severe cases reported symptoms such as blurred vision, respiratory stress, tongue swelling, and vasodilatory shock are possible symptoms in severe cases. The scombroid poisoning symptoms normally last four to six hours and rarely last more than one or two days [13].</p>
<p>Mitigating Measures</p>	<p>Time and temperature are the critical points when preventing histamine production in fish. Every step of the food supply chain should be carried out promptly, and fish should be stored in maintained cold temperatures. To achieve this, the following practices are recommended:</p> <div data-bbox="502 1254 1452 1489" style="text-align: center;"> </div> <p>A. For Fisherfolks [17, 18, 19]:</p> <p>A.1 Catching and handling fish</p> <ul style="list-style-type: none"> • Remove fish from nets and hooks as quickly as possible to prevent death or shorten the period from death until chilling of the fish. • Do not keep any dead fish showing signs of decomposition on board the vessel. Should this be observed, these should be segregated and labeled to allow proper disposal upon off-loading. • Avoid rough handling, overcrowding, and over-stacking of fish to prevent crushing, bruising, and skin lacerations. • Clean and sanitize the deck area and equipment before landing fish, and prepare the chilling medium with the desired temperature.

A.2 Gutting and gilling (for fish that requires gutting)

- Observe hygienic practices during gutting and gilling.
- Remove guts and gills rapidly and efficiently, and rinse the visceral cavity to delay histamine formation in the muscle.
- Avoid rupturing the guts as histamine can also spread more rapidly to muscle tissues if gastric contents are spilled due to improper butchering or gutting.

A.3 Chilling and/or freezing

- Define temperature limits and monitoring frequencies in the onboard chilling and freezing process.
- Set the maximum loading volumes and rates, as well as maximum starting temperatures for refrigerated seawater (RSW) and/or brine tank, to guarantee suitable chilling environment for each harvested batch of fish.
- Surround the fish with sufficient ice or ice/seawater slurries or RSW to bring the internal temperature of fish to below 4°C as quickly as possible after death.
- Secure enough ice for the volume of caught fish and length of the fishing trip.
- Pack the belly cavity of larger eviscerated fish with ice or other cooling media.
- Freeze fish to -18 °C to prevent the growth of histamine-producing bacteria and inactivate the enzymes from producing additional histamine.
- Manage the chilling of dead fish to ensure that none are inadvertently exposed on deck past the time limit established for the temperature conditions.
- Refrigeration and other chilling equipment should be in good working condition and can chill fish rapidly and safely.
- Fish should be packed loosely in ice slurries and brine tanks to allow good circulation and rapid cooling.

A.4 Refrigerated and/or frozen storage

- Keep fish refrigerated at a temperature as near 0°C as possible.
- Keep storage temperature below 4°C until off-loading.
- Surround the stored fish with ice, monitor and replenish as needed.
- Regularly monitor and control RSW and/or brine temperature throughout the trip.
- Use continuous temperature recording devices, or thermometers, in refrigerated and frozen storage compartments to identify possible inadequate holding conditions, and take appropriate actions.
- Install the recording thermometer in the warmest area of the cold storage.

A.5 Receiving establishment operations (fish reception)

- Measure internal fish temperatures at reception to ensure reception temperature limits are met.

- Check the adequacy of ice surrounding the fish and document the interior temperature data during offloading of the fishing vessel.
- Take samples randomly throughout the fishing vessel delivery lot. The number of fish temperatures checked, and the results reported should be enough to offer reasonable assurance that the crew properly maintained the temperatures. The different kinds, morphologies, and sizes of fish should be considered when taking samples.
- Store fish on the vessel at 4°C or below. If an internal temperature in a sample fish exceeds 4°C (or the established temperature limit based on elapsed time from death), this indicates a lapse in histamine control. The cause of the deviation should be determined and corrected, histamine testing of the entire vessel delivery lot performed, or the delivery rejected.

B. For Receiving establishment operators (fish reception) [17]:

- Measure internal fish temperatures at reception to ensure reception temperature limits are met.
- Check the adequacy of ice surrounding the fish and document the interior temperature data during offloading of the fishing vessel.
- Take samples randomly throughout the fishing vessel delivery lot. The number of fish temperatures checked, and the results reported should be enough to offer reasonable assurance that the crew properly maintained the temperatures. The different kinds, morphologies, and sizes of fish should be considered when taking samples.
- Store fish on the vessel at 4°C or below. If an internal temperature in a sample fish exceeds 4°C (or the established temperature limit based on elapsed time from death), this indicates a lapse in histamine control. The cause of the deviation should be determined and corrected, histamine testing.

C. For Transporters [17]:

- Keep fish cold through mechanical refrigeration or by surrounding the fish with ice or other cooling media.
- Pre-chill the vehicles or vessels before loading fish.
- Use continuous temperature recording devices to monitor the temperatures of refrigerated compartments or cooling media such as ice slurries during transport between different locations (e.g. receiving establishments, processing establishments, distributors, and markets). The receiving establishment should then check the device's temperature record. For accuracy, devices should be calibrated regularly.
- Monitor the internal temperatures of a representative sample of fish and adequacy of ice or other cooling media when applicable during delivery.
- Identify and correct the cause of the problem should the vehicle compartment temperature is beyond the control limits

D. For Processors/processing establishments [17, 19]:**C.1 Reception**

- If fish are delivered directly from the fishing vessel, same practices in Subsection A.5 should be done.
- If fish are delivered through a transport vehicle, same practices in Subsection A.6 should be done.
- If the processing establishment is a secondary processor receiving product from a primary processor (e.g. receiving establishment or factory vessel), verify that the primary processor has a HACCP system in place to control histamine levels.
- Conduct histamine control activities. *i.e.* temperature monitoring, sensory evaluation, vessel records review, and/or histamine testing.

C.2 Refrigerated and frozen storage

- Same practices in Subsection A.4 should be done.
- Develop and maintain a systematic stock rotation plan, e.g. first in, first out (FIFO).
- For chilled storage, keep the fish in shallow layers with enough finely crushed ice made from clean/potable water or a mixture of ice and clean/potable water.
- Avoid overstacking or overfilling of boxes to prevent damage in fish.

C.3 Processing

- When fish are processed (e.g., thawing, cutting, re-chilling, salting, drying, pickling, boiling, smoking, canning), avoid exposing the fish to time-temperature conditions that favor the growth of histamine-producing bacteria and subsequent histamine formation.
- During processing activities, keep the processing room temperature cool as possible. Product exposure time should be kept to a minimum.
- During production interruptions or slowdowns, ice the fish or return it to chilled storage.
- Prior to defrosting, remove the outer and inner packaging.
- Air thaw the raw material at refrigerated temperature to avoid excessive warming of the fish's surface. Shorten thawing time by immersing in circulating cold water or spraying with cold water.

E. For Retailers/vendors [20, 21]:

- Purchase from reputable suppliers, such as those that have a food safety program or quality assurance system.
- Receive fresh fish at refrigerated temperatures (< 5°C).
- Place the fish under refrigeration as soon as received and continue to store fish at refrigerated temperatures.
- Keep clean cold storage rooms and freezers and make sure that it is free from objectionable odor, and in good condition.
- Maintain the chilling temperature for fish and fishery products at 0° C to 4°C while freezing temperature shall be -18°C or below.

- Provide cold storage facilities/freezers with a thermometer and ensure adequate capacity to maintain the desired temperature.
- Maintain the temperature of chilled fish at 0°C to 4 °C (preferably at a ratio of one (1) part of ice to one (1) part fish) through proper icing.
- Maintain stock rotation and sell product well in advance of its shelf life.
- When displaying fish for sale, always ensure there is enough ice on the product and refrigeration units are set to maintain product temperatures at less than 5°C.

F. For Consumers [21, 22, 23]:

- Purchase from reputable suppliers who store the fish on ice or under refrigeration
- Receive product at refrigerated temperatures (<5°C)
- Buy and consume fresh fish products. Fresh fish should smell fresh and mild, not fishy, sour, or ammonia-like. Eyes are crystal clear, plump, and moist. Gills are clean, red in color, and with no odor. Fins are wet and whole. The flesh is firm and intact. Lastly, there should not be any protruding internal organs or flesh wounds.
- Place the fish under refrigeration as soon as it is received.
- Refrigerate fish to 4°C (40°F) at all times.
- Keep fresh fish refrigerated for up to two days, or for longer periods store it in a freezer.
- Fresh fish should be cooked and consumed within 48 hours at refrigerated temperatures.
- If the fish is frozen, thaw the fish under refrigeration, or cook from frozen state or according to any package directions.
- Use packaged fish before its use-by or best-before dates.

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