



Regional Guidelines on Cold Chain Management of Fish and Fishery Products in ASEAN Region

**Marine Aquaculture Centre
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SOUTHEAST ASIAN FISHERIES DEVELOPMENT CENTER

The Southeast Asian Fisheries Development Center (SEAFDEC) is a technical organization devoted to the accelerated development of fisheries in the region. The member countries of SEAFDEC are Brunei Darussalam, Cambodia, Indonesia, Japan, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam. SEAFDEC has five departments, namely, the Marine Fisheries Research Department (MFRD) in Singapore, the Training Department (TD) in Thailand, the Aquaculture Department (AQD) in Philippines, the Marine Fishery Resources Development and Management Development (MFRDMD) in Malaysia, and the Inland Fishery Resources Development and Management Department (IFRDMD) in Indonesia.

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ISBN 978-981-14-4153-0

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Background

The Codex Alimentarius Commission (2008) defines Cold Chain as “A term embracing the continuity of successively employed means to maintain the temperatures of foods, and appropriate, from receiving through processing, transport, storage, and retailing”. As affluence in the region continues to grow, demands for high quality food, and particularly seafood, also grows. Furthermore, as countries seek to facilitate and encourage more bilateral trade, it is not uncommon for goods to travel thousands of miles before reaching a market. However, fish and seafood are temperature sensitive and highly perishable commodities, with deterioration occurring almost immediately following catch or harvest. Fish and seafood deterioration can occur through microbiological metabolism, oxidative reactions, and enzymatic activity, which are processes that can be accelerated through poor temperature control. Cold chain management is an essential tool in maintaining and ensuring the quality and safety of fish and seafood, as well as its economic value.

Throughout the supply chain, the fisheries industry heavily relies on proper cold chain management practices to ensure the quality, safety and commercial viability of its products. From aquaculture production or wild catch, post-harvest handling, receiving, processing, packing, transport, to retail, it is essential to ensure there is no breakage in the cold chain to maintain high quality and safety of the seafood. Practices such as the application of ice, use of refrigerated seawater, storage in refrigerated facilities, and chilling or freezing, are used to ensure that the fish and seafood is kept under cold chain throughout the supply chain. However, these low temperature conditions must also be supported by good and hygienic handling practices, to effectively delay spoilage of the fish and seafood.

In the ASEAN region, fisheries industry players face many challenges in the implementation of a cold chain system. Firstly, many players in the fisheries industry are small-medium enterprises, with limited access to technologies and appropriate facilities, and lack knowledge of cold chain management practices. Furthermore, many fisheries supply chain systems in this region involve individual players who operate as single entities. Thus, even if businesses are able to procure facilities and technologies to apply cold chain management in the handling of fish and seafood, problems arise

in maintaining the system throughout the supply chain. Finally, cold chain management practices are still largely voluntary in many ASEAN Member Countries, and are not enforced as a requirement

In view of this, the Southeast Asian Fisheries Development Centre (SEAFDEC), under its Marine Fisheries Research Department (MFRD) Programmes, has initiated and implemented a project on the Cold Chain Management of Seafood from 2015-2018, of which this set of guidelines were developed in close consultation with the ASEAN-SEAFDEC member countries. The project is in line with the ASEAN-SEAFDEC Resolution (20) and Plan of Action (D58 and D63), as endorsed at the ASEAN-SEAFDEC Conference 2011. The goals of the project were to create a platform for the ASEAN region to share knowledge, experiences, and cost-effective technologies on the cold chain management of seafood, and to develop a set of guidelines for cold chain management of fish and fishery products to serve as a benchmark for ASEAN Member Countries when developing their own national guidelines.

1. Scope and Objective

Scope

The Guidelines cover the application and observation of time and temperature controls for the cold chain management of raw and minimally processed chilled and frozen fish and fishery products, along the stages of post-harvest handling, chilling, receiving, processing, freezing, glazing, packing, cold storage, transport and distribution, retail and wholesale.

Objective

The Guidelines aim to serve as a reference for best practices in cold chain management for raw and minimally processed chilled and frozen fish and fishery products to ensure safety, quality, and wholesomeness of such products.

2. Definitions

As used in the Guidelines, the following terms are defined as follows:

Chilling

The process of cooling fish and fishery products such that the core temperature is between 0 to 5°C.

Note: As per CAC Code of Practice for Fish and Fishery Products, chilling was defined as the process of cooling fish and shellfish to a temperature approaching that of melting ice. That is 0°C. Therefore we suggest putting a range of between 0 to 5°C. This is also to differentiate it from superchilling.

Clean Water

Water from any source where harmful microbiological contamination, substances and/or toxic plankton are not present at such levels that may adversely affect the safety of fish and fishery products intended for human consumption.

Cold Chain

Consists of a series of operations involved in time and temperature controls in post-harvest handling, receiving, processing, freezing, glazing, packing, storing, transporting, and retail and wholesale of fresh, chilled and frozen fish and fishery products to ensure that food safety and quality is maintained.

Fish

Any of the cold blooded aquatic vertebrates and invertebrates intended for human consumption.

Fishery products

Any edible human food product in which fish is the characterising ingredient.

Fish and fishery products business

A business, enterprise or activity that involves the production and processing of fish and fishery products, intended for human consumption.

Fish and fishery products handler

A person who engages in the production and processing of fish and fishery products, intended for human consumption.

Glazing

Application of a protective layer of ice formed at the surface of a frozen product by spraying or dipping it into chilled potable water, or chilled potable water with approved additives, as appropriate.

Note: To be consistent with the statement in section 4(f)

Harvesting

The process which involves taking the fish out from water for human consumption.

Minimally Processed Products

Products derived from primary processing (e.g. washing, gutting, deboning, filleting, freezing, glazing, chilling and packaging), that does not fundamentally alter the raw fish or that only separate the whole, intact fish into components.

Post-Harvest Handling

Handling of fish that begins after fish is taken out from water for human consumption, prior to processing.

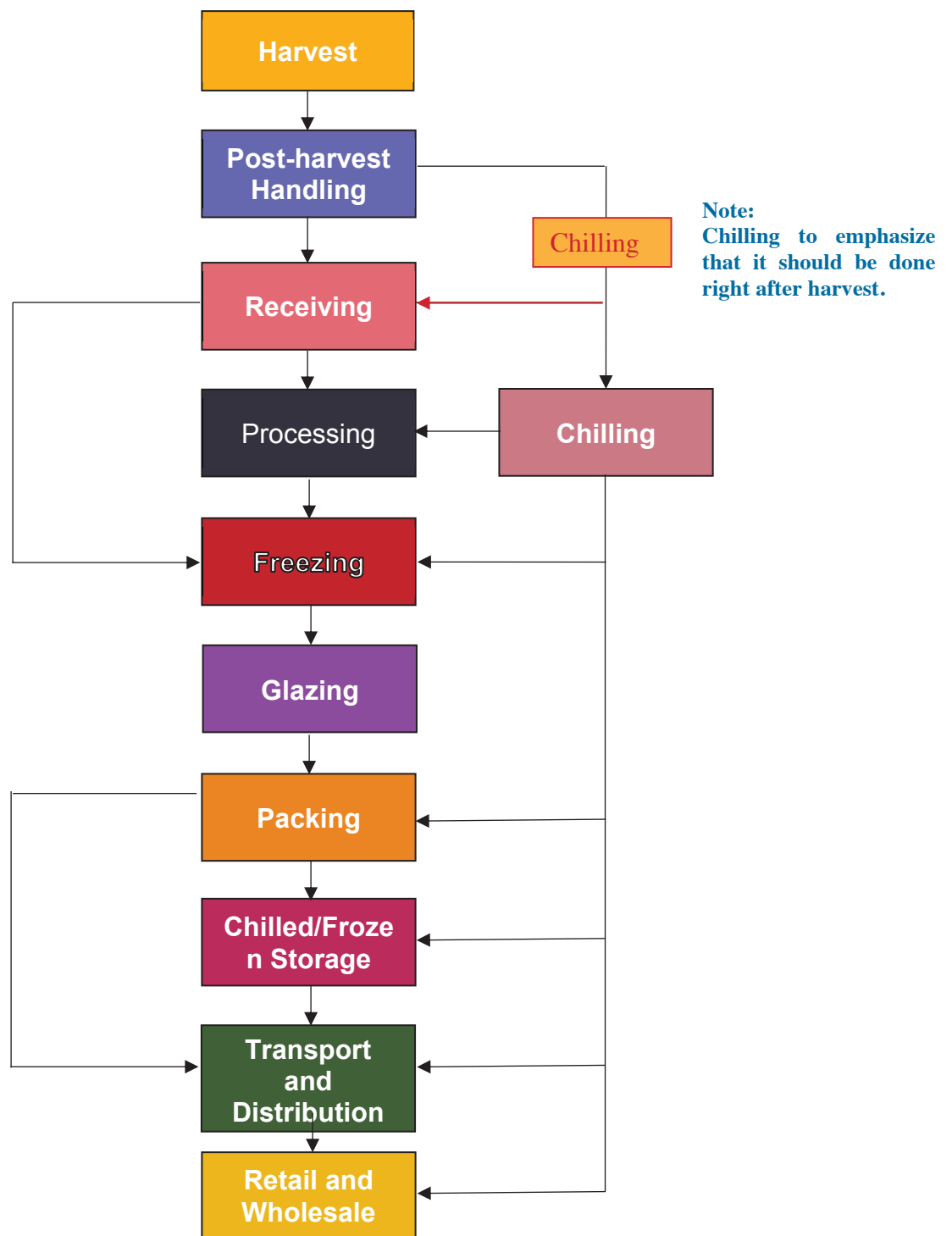
Potable Water

Fresh water fit for human consumption. Standard of potable water should not be lower than those contained in the latest edition of The International Standards for Drinking-Water issued by the World Health Organisation (WHO).

Time and Temperature controls

The monitoring and maintaining of time and temperature of fish and the fishery products through the supply chain, to ensure safety and quality of products is maintained.

3. Generic Flow Chart on Cold Chain for Fish and Fishery Products



4. Production

Chilled fish and fishery products should be maintained between 0 to 5°C. During processing for short periods, temperature of fish and fishery products should not exceed 10°C, subject to national regulations.

The core temperature of frozen fish and fishery products should be maintained at a temperature of -18°C or below.

Monitoring, controlling and recording of time and temperature should be done regularly. All temperature monitoring devices should be calibrated as appropriate.

a) Post-harvest

(include on-board handling and harvest from aquaculture facilities)

The post-harvest operations should ensure that all measures are taken to maintain adequate time and temperature control for the fish and fishery products.

b) Chilling

Fish and fishery products should be chilled and maintained between 0 to 5°C. Ice used in the process should be made from clean water.

c) Receiving

Collecting

Fish and fishery product businesses should take all monitoring and recording measures to ensure it only accepts fish and fishery products that is under adequate time and temperature control at the point of receiving.

Fish and fishery product handlers should be competent in product safety and quality evaluation techniques, including time and temperature monitoring, to ensure raw fish and fishery products meet essential safety and quality provisions of the appropriate standard.

Sorting and grading

The facility for sorting and grading should be capable of maintaining time and temperature control of the fish. To minimise handling damage, fish and fishery products should be handled with care, particularly during sorting and grading in order to avoid physical damage such as puncture and mutilation. Where containers are used for sorting and grading of fish and fishery products, they should be cleaned and not overfilled. Sorting and grading should be carried out with minimal delay.

Holding

Fish and fishery products before and after processing need to be maintained under adequate time and temperature control. It should be stored using appropriate fish containers.

d) Processing

Adequate time and temperature control should be maintained and recorded during processing.

Washing and gutting

An adequate supply of chilled clean water should be available for washing. Gutted fish should be drained and well iced, or appropriately chilled and stored in clean containers, in specially designated and appropriate areas which maintain the fish and fishery products under time and temperature control.

Filleting/deboning

Fish and fishery products should be appropriately iced or chilled in clean containers, protected from dehydration, and stored in appropriate areas. The temperature of the fish and fishery products should be maintained at not more than 10°C during filleting and deboning, and between 0 to 5°C during storing.

Thawing

Thawing can be done under clean air or potable water. Temperature used during thawing should be controlled such that core temperature of product is maintained between 0 to 5°C.

e) Freezing

The fish and fishery products should be subjected to freezing process as quickly as possible. A time and temperature regime should be established and should take into consideration the freezing equipment and capacity as well as the nature of the fish and fishery products. The size, shape and temperature of fish and fishery products entering the freezing process should be as uniform as possible. Frozen products should be moved to the cold storage facility as quickly as possible. The core temperature of the frozen fish and fishery products should be monitored regularly for completeness of the freezing process, at a minimum of -18°C.

f) Glazing

Glazing is considered complete when the entire surface of the frozen fish product is covered with suitable protective coating of ice and should be free of exposed areas where dehydration can occur. Chilled potable water should be used for glazing.

g) Packing

Packing should be conducted in the shortest time possible, to ensure product is maintained within required temperatures. Packaging material should be clean, good, durable, and sufficient for its intended use and of food grade material.

h) Storing

Fish and fishery products should be stored under time and temperature control, where there is an adequate means of monitoring and recording its time and temperature. Chilled fish and fishery products should be maintained between 0 to 5°C. The core temperature of frozen fish and fishery products should be maintained at -18°C or below.

i) Transport and Distribution

A fish and fishery product business operator should ensure fish and fishery products are kept chilled or frozen, and exercise means of monitoring time and temperature of the products during transport and distribution.

Before and after loading, the cleanliness, suitability and sanitation of the transport vehicle should be verified.

The transport vehicle should be capable of maintaining adequate time and temperature control of fish and fishery products. The products should be packed with protection against contamination, exposure to extreme temperatures and the drying effects of the sun or wind. Arrangement of the packages within the transport vehicle should optimise time and temperature control, and should ensure that any possible damage to fish and fishery products is avoided.

j) Retailer and Wholesaler

During receiving, fish and fishery products should not be accepted if required temperatures are not met, and non-conformances are present in packaging or product. Delivery should be scheduled in a manner to ensure that fish and fishery products can be transferred properly and stored in the shortest possible time.

Adequate time and temperature control should be maintained in display shelves. It is recommended to retain records of temperature monitoring. Chilled fish and fishery products should be maintained between 0 to 5°C. Frozen products should be maintained at -18°C or below.

The display should be situated away from sources of heat and direct sunlight, and not overloaded. Wet market operators should ensure quick and proper unloading of fish and fishery products upon receipt. Equipment used in wet markets should be clean, and display cabinets should protect fish and fishery products from external factors such as sunlight and pests. Products should be maintained under ice to ensure temperature control, and stored in clean containers.

Handlers should implement “first in first out” practice.

5. Skills and Knowledge

A fish and fishery product business operator should ensure that fish and fishery product handlers have skills and knowledge in food safety, quality and personal hygiene.

6. Annexes

Chilling Methods

Some examples of chilling methods are as listed below.

Note: Icing is replaced by chilling because the mechanism for refrigerated seawater cannot be qualified as icing.

- Ice slurry: One-part water to one-part ice
- Direct Icing: cooling is effected by the direct contact between the melted ice and the fish; alternating layers of fish and ice
- Chilled seawater: Seawater is chilled at 0°C, with the addition of ice. Ideal for vessels fitted with holding water
- Refrigerated seawater: Seawater chilled using mechanical cooling system. Used in vessels with holding water

It is essential to ensure that clean water is used to make ice used in icing. Fish should also be stored in shallow layers, and surrounded with finely divided ice, or ice slurry before processing. Avoid over stacking and over filling storage boxes or containers, to minimise risk of damaging and contaminating fish and fishery products.

In direct icing, storage boxes and containers should have drainage outlets to remove melted ice. Bottom and top of storage boxes or containers should be covered with sufficient layers of ice. Ice should be added when necessary.

Different forms of ice to use

- Flake ice: Allows for an easier, more uniform and gentle distribution of ice around fish and in storage container. It will cause very little or no mechanical damage to fish, and will chill fish more quickly than the other types of ice.
- Crushed ice: Large and sharp pieces of ice in this ice form may damage fish physically. However, finely crushed ice melt quickly on the fish surface and large pieces of ice that tend to last longer and compensate for thermal losses.
- Block ice: Requires less stowage volume for transport, and melts slowly. It also contains less water at the time it is crushed than flake ice
- Tube ice: Very durable, and has large surface area. More suitable for use in chilled Seawater systems if ice is wet, as it normally is under tropical conditions, as less water exists on its surface
- Slush ice: Fine ice crystal that allows flow-ability through pumping systems, allowing it to fill small spaces without the use of water.

Microbiological quality of ice

The microbiological quality of ice made from potable water is as shown below.

Parameters	Limits
<i>E. coli</i>	N.D. in 100ml
Coliform bacteria	N.D. in 100ml

(Where N.D. denotes Not Detected)

Adapted from the World Health Organisation (2002)

a) Temperature Monitoring Methods

- Data Loggers: A range of temperature data-logger devices are available. Such devices are flexible in their operation, recording and some providing information direct to an alarm management system.
- Digital Thermometers: A flat blade or needle probe is sometimes the selected temperature measuring device
- Bi-metal Thermometers: A bi-metal dial thermometer may be suitable.
- Glass Thermometers: Mercury-in-glass or alcohol-in-glass thermometers pose a potential hazard due to possibility of cross- contamination.
- Infra-red (non-contact) Surface Temperature Thermometers: This can be a fast way to take product surface temperatures without having to open the case or damage product. Be aware that measuring the temperature of outer packaging is indicative only of the temperature of the product inside, and may be inaccurate due to abuse and calibration issues.
- Data devices from new technologies: Emerging technologies include active or passive RFID tags to monitor product temperature fluctuation history. Higher end, robust and reliable, wireless sensor network based, online monitoring solutions embracing product traceability, are available.
- Time Temperature Indicators (TTIs): TTIs provide 'indication' rather than quantitative measurement, which can be helpful, particularly at package monitoring level. Typically, these are based on heat sensitive film on packaging that highlight cumulative temperature abuse.

b) Checklist on Temperature Monitoring

Checklists should include details in accordance to national and international regulatory requirements, such as:

- Name and address of supplier
- Date and time of recording
- Name of product/equipment to be monitored
- Recorded temperature
- Name of monitoring personnel
- Signature/initials of verifying personnel

c) Different types of Freezing Techniques

- Continuous stream of cold air: Continuous streams of cold air is blown onto the fish and fishery products, freezing the products to the desired temperature. Such equipment includes Air Blast Freezers.
- Direct contact: Direct contact between the fish and fishery products, and a refrigerated surface, to allowing freezing through conduction. Such equipment includes Contact Freezers.
- Immersion or spraying: Fish and fishery products are sprayed with refrigeration liquids within freezing units to bring products to desired temperature.

d) Thawing Methods

- Air Thawing: Fish and fishery products are left at ambient or chilled temperatures until thawing has completed. This method is recommended for small and individually frozen products, as waterlogging can occur. Good drainage should also be ensured.
- Water Thawing: Products are placed in running water to aid controlled thawing. This means that the product can be thawed quickly, producing a better quality product. Factors that can be controlled include water temperature, flow rate and product separation.

7. References

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