codex alimentarius commission

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

WORLD HEALTH ORGANIZATION

JOINT OFFICE: Viale delle Terme di Caracalla 00100 ROME Tel.: 57051 Telex: 625825-625853 FAO I Facsimile: 39.06.570.54593 Email:codex@fao.org

Agenda Item 4 **CX/FFP 00/4**

JOINT FAO/WHO FOOD STANDARDS PROGRAMME

CODEX COMMITTEE ON FISH AND FISHERY PRODUCTS
Twenty-fourth Session
Ålesund, Norway, 5-9 June 2000

PROPOSED DRAFT CODE OF PRACTICE FOR FISH AND FISHERY PRODUCTS

The 23rd Session of the Committee considered the revision of the current codes of practice for fish and fishery products and agreed that all existing codes and the codes under development would be incorporated into a single code of practice, and that specific sections would be developed as follows: Frozen, Fresh and Minced Fish (United Kingdom/Canada); Canned Fish (France); Molluscan Shellfish (Netherlands); Frozen Surimi (Japan/USA); Salted Fish (Norway); Smoked Fish (Denmark); Shrimps and Prawns (Mexico); Lobsters and Crabs (Brazil); Cephalopods (New Zealand); Frozen Coated Products (Germany/USA); Aquaculture (FAO/WHO).

The Committee agreed on the general approach to the revision and the structure of the code, which should integrate the HACCP system for food safety provisions and a similar system for non-safety aspects. The Committee returned the Proposed Draft to Step 3 for comments and further redrafting. For this purpose, it was agreed that the Working Group including all lead countries would meet between the sessions to coordinate the revision of the Code, with the understanding that the United Kingdom, Canada and France were responsible for overall coordination and drafting of the final text (ALINORM 99/18, paragraph 65).

The revised version of the Proposed Draft Code is hereby circulated for comments at Step 3 of the Procedure. Governments and international organizations wishing to submit comments should do so in writing to the Secretary, Joint FAO/WHO Food Standards Programme, FAO, via delle Terme di Caracalla, 00100 Rome, Italy, with a copy to the Chairman of the Committee, Dr. John Race, Norwegian Food Control Authority, P.O. Box 8187, Dep. N-0034, Oslo, Norway (Fax. +47.22.24.66.99) **before 30 April 2000.**

NOTE: The background to the revision and the changes proposed by the co-ordinating countries and incorporated in the Code are described in the following text, provided by Dr. Kevin Hargin (United Kingdom) on behalf of the Drafting Group (United Kingdom, France and Canada).

Background to the Revision of the Code (Working Group, April 1999, London)

Representatives from the majority of the co-ordinating countries met in London in April 1999 to discuss all major issues of principle and the specific sections of the code. There was not total agreement on all points, and many of these issues will have to be re-visited in the wider forum of the CCFFP, but there did appear to be consensus on the general way forward and in what we were ultimately trying to achieve. As a consequence, the drafting group has had to exercise a certain degree of editorial privilege where complete agreement could not be reached. Outlined below are some of the main changes that have been made to the draft document that was considered at the 23rd Session.

Issues of Principle

A significant change that was agreed at the aforementioned London meeting was the rearrangement of Sections. At a prior meeting in Paris, the Drafting Group proposed that the 'handling of fresh fish prior to processing' part from Section 5 of Alinorm 99/18 would be more appropriate as a stand-alone section. It was viewed that the general nature of the recommendations would be applicable for the processing of other fishery products and some of the issues concerning temperature control and incoming material requirements were closely aligned with those outlined in the General Principles of Food Hygiene. It was also suggested that the 'potential hazards and defects' part of Section 4 would be better placed in an appendix. The Co-ordinating Group, however, felt that the 'handling of raw fish and shellfish' would be better placed prior to the HACCP and DAP Section, and that the hazards and defects should not be relegated to an Appendix. Thus a new Section 4 has been created entitled 'General Considerations for the Handling of Fresh Fish and Shellfish', which includes the hazards and defects associated with fresh fish and shellfish.

One of the main principles that generated much discussion was the portrayal in the Processing Sections of *'potential hazards'* and *'potential defects'* and the intention behind listing these for each of the processing steps. In 'purest HACCP terms' a 'hazard' exists if there is the potential to cause harm. Thus one pathogenic micro-organism has the potential to cause harm even though, as a single organism, it may be considered safe. Therefore, strictly speaking, any one particular hazard should be considered at each processing step from when it is introduced until it is eliminated or reduced to an acceptable level. However, it was agreed that in the interests of 'user-friendliness' the hazards and defects would only be listed at the steps where they could be introduced into a product or where they are controlled. It was also considered necessary only to list the 'significant' hazards or defects at these steps otherwise, taking into account the myriad of products and processes available, the lists would be not only excessively long, but misleading for many operators.

In accordance with the wishes of the CCFFP the 'control boxes' have been removed from the processing sections. Further, the highlighting of specific CCPs and DAPs on the flow diagrams has been discontinued as it was felt to retain them would be incongruous with the removal of the 'control boxes'. The reasoning behind these decisions was to address the concerns of the CCFFP that the 'examples' would be taken as the 'solution' and proper HACCP assessment of a processing operation would not be undertaken. The user can now use Section 5 with the worked example, in conjunction with the relevant Processing Section, to establish a unique HACCP/DAP plan. This will encourage a fuller consideration of the most appropriate hazards and defects associated within a particular situation.

The 'How to Use This Code' section has been expanded to explain the principles and changes agreed by the co-ordinating countries and helps make the Code more 'user-friendly'.

Other Changes

Section 3

Section 3 has been re-drafted to reflect the essential elements required prior to initiating hazard and defect analyses, with some items being removed from the previous Section 5 to this more appropriate location. There was lengthy discussion concerning the content and Section order of both the Pre-requisite Programme and the Principles of HACCP Sections. It was concluded that while a pre-requisite programme may contain CCPs, these will only be required in relation to a particular process and that it is necessary to have certain global procedures in place before developing a HACCP or a DAP plan. It was also decided to delete Table 1, which listed a summary of the elements of a pre-requisite programme, since this was HACCP-based and the style and content would be more fully and appropriately dealt with in Section 4.

It has been recommended that the Pre-requisite Programme Section should identify those GHP technical guidelines that are specific to fish and shellfish. This would rationalise the need to elaborate on the General Principles of Food Hygiene, for example, fishing and harvesting vessels. The introduction to the Section emphasises the need to reference the General Principles of Food Hygiene. Further editorial changes removed GHP recommendations from the subsequent sections dealing with minimising damage during the harvesting of farmed fish.

Section 4

Section 4 has become the new Section 5 on the application of HACCP and DAP. The introductory paragraphs have been re-drafted in order to better differentiate the safety aspects from the defects, and emphasise that DAPs are determined on a voluntary basis. Although not unanimous, the co-ordinating countries agreed that duplication should be kept to a minimum to help reduce potential confusion to the user. It was decided that the current text should be retained for discussion at the next session of the CCFFP.

Additionally, the request for this to be a more user-friendly section has been addressed by the inclusion of a worked example (a canned tuna process) relating to the various sub-sections. There was discussion concerning the complexity of the example of the flow diagram for canned tuna. Opinion was divided as to whether it would be better to have an illustration which highlighted CCPs and DAPs (i.e. the canned tuna as presented) or to have a much simplified, more generic, example. The drafting group decided on the majority decision to retain the more detailed example, but this issue will need to be discussed during the 24th Session.

This Section was further strengthened to ensure that it was more practical and provides sufficient guidance to users in applying all the 7 principles of HACCP. It has been highlighted that for defects the application of principles similar to HACCP is one approach which could be considered in facilitating compliance to essential quality, labelling and composition provisions of Codex Standards and other non-safety requirements of national legislation or commercial specification.

Processing Sections

The presentation of the Processing Sections was discussed at great length. It was decided that, for any given step in a process, as many of the bullet points were a combination of control measures, corrective actions and technical guidelines they should come under a general sub-heading of “Technical Guidance”. It was generally agreed that unnecessarily prescriptive guidance should not be given in the Code

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PROPOSED DRAFT RECOMMENDED INTERNATIONAL CODE OF PRACTICE FOR FISH AND FISHERY PRODUCTS (At Step 3 of the Procedure)

INTRODUCTION

This Code of Practice for Fish and Fishery Products has been developed by the Codex Committee on Fish and Fishery Products from the merging of the individual codes of listed in Appendix XII plus a section on aquaculture and a section on frozen surimi. These codes were primarily of a technological nature offering general advice on the production, storage and handling of fish and fishery products on board fishing vessels and on shore. It also deals with the distribution and retail display of fish and fishery products.

This combined Code of practice has been further modified to incorporate the Hazard Analysis Critical Control Point (HACCP) approach described in the *International Recommended Code of Practice – General Principles of Food Hygiene* (CAC/RCP 1-1969, Rev.3 1997), Annex:*HACCP System and Guidelines for its Application* (Supplement to CodexVolume 1B). A pre-requisite programme is described in the Code covering technological guidelines and the essential requirements of hygiene in the production of fish and fishery products, which are safe for human consumption, and otherwise meets the requirements of the appropriate Codex product standards. The Code also contains guidance on the use of HACCP, which is recommended to ensure the hygienic production of fish and fishery products to meet health and safety requirements.

Within this Code a similar systematic approach has been applied to essential quality, composition and labelling provisions of the appropriate Codex product standards. Throughout the code this is referred to as “Defect Action Point (DAP) Analysis”.

The Codex Committee on Fish and Fishery Products recommended at its Twentieth Session that defects of a commercial nature, i.e. workmanship defects, which had been removed from Codex fish product standards, be transferred to the appropriate Codex Code of practice for optional use between buyers and sellers during commercial transactions. The Committee further recommended that this detail should be described in a section on Final Product Specifications, which now appear as Appendices II - XI of this document. A similar approach to HACCP has been incorporated into the Code as guidelines for the control of defects (DAP Analysis).

This Code will assist all those who are engaged in the handling and production of fish and/or fishery products, or are concerned with their storage, distribution, export, import and sale in attaining safe and wholesome products which can be sold on national or international markets and meet the requirements of the Codex Standards (see Appendix XII).

HOW TO USE THIS CODE

The aim of this Code is to provide a user-friendly document as background information and guidance for the elaboration of fish and shellfish process management systems which would incorporate Good Management Practice (GMP) as well as the application of HACCP in countries where these, as yet, have not been developed. In addition, it could be used for training of fishermen and employees of the fish processing industry.

The practical application of this *international* Code, with regard to *national* fisheries, would therefore require some modifications and amendments, taking into account local conditions and specific consumer requirements. This Code, therefore, is not intended to replace the advice or guidance of trained and experienced technologists regarding the complex technological and hygienic problems which might be unique to a specific geographical area or specific fishery and, in fact, is intended to be used as a supplement in such instances.

This Code is divided into separate, though interrelated, Sections. It is intended that in order to set up a HACCP or DAP programme these should be consulted as appropriate:

(a) *Section 2 - Definitions* – Being acquainted with the definitions is important and will aid the overall understanding of the Code.

(b) *Section 3 - Pre-requisite Programme* - Before HACCP or a similar approach can properly be applied to a process it is important that a solid foundation of good hygienic practice exists. This Sections covers the groundwork which should be regarded as the minimum requirements for a processing facility prior to the application of hazard and defect analyses.

(c) *Section 4 – General Considerations for the Handling of Fresh Fish and Shellfish* – This Section provides an overall view of the potential hazards and defects which may have to be considered when building up a HACCP or DAP plan. This is not intended to be an exhaustive list but is designed to help a HACCP or DAP team to think about what hazards or defects should be considered in the fresh fish or shellfish, and then it is up to the team to determine the significance of the hazard or defect in relation to the process.

(d) *Section 5 – Hazard Analysis Critical Control Point (HACCP) and Defect Action Point (DAP) Analysis* - Only when the groundwork in Section 3 has been satisfactorily achieved should the application of the principles outlined in *Section 5* be considered. This Section uses an example of the processing of a canned tuna product to help illustrate how the principles of HACCP should be applied to a process.

(e) *Section 6 - Processing of Fresh, Frozen and Minced Fish* – This Section forms the foundation for most of the subsequent fish and shellfish processing Sections. It deals with the major process steps in the handling of raw fish through to cold storage and gives guidance and examples on the sort of hazards and defects to expect at the various steps. This Section should be used as the basis for all the other fish processing operations (Sections 7-14) which give <u>additional</u> guidance specific to the appropriate product sector.

Although potential hazards and potential defects are listed for most steps in the Processing Sections, it should be noted that this is only for guidance and the consideration of other hazards and/or defects may be appropriate. Also, the format in these Processing Sections has been designed for maximum 'ease of use' and therefore <u>the **'potential hazards'** or **'potential defects'** are listed only where they may be introduced into a product or where they are controlled, rather than repeating them at all the intervening processing steps</u>.

Additionally, it must be stressed that hazards and defects, and their subsequent control or action points, are product and line specific and <u>therefore a full critical analysis based on *Section* 5 must be completed for each individual operation</u>.

(f) *Sections 7 to 15 – Specific Fish and Shellfish Processing Sections* – Processors operating in particular sectors will need to consult the appropriate Section to find additional information specific to that sector.

(g) *Section 16 – Aquaculture Production* deals with aquaculture production.

(h) *Sections 17 and 18 – Transportation and Retail* cover general transportation and retail issues.

(i) Additional information will be found in the *Appendices.*

SECTION 1 SCOPE

This Code of practice applies to the growing, harvesting, handling, production and storage of fresh and processed fish and fishery products from marine and freshwater sources, which are intended for human consumption.

SECTION 2 DEFINITIONS

For the purpose of this Code:

2.1 GENERAL DEFINITIONS

Chilled Sea Water	is clean sea water in which the temperature is maintained at 0°C (32°F) or slightly colder by the addition of ice;
Chilling	is the process of cooling fish to a temperature approaching that of melting ice;
Clean Sea Water	means sea water or brackish water which is free from microbiological contamination, harmful substances and/or toxic marine plankton in such quantities as may affect the health quality of fishery products. For the purpose of this Code clean sea water also includes water sources from fresh water lakes;
Cleaning	means the removal of soil, food residues, dirt, grease or other objectionable matter from surfaces;
Contaminant	means any biological or chemical agent, foreign matter, or other substances not intentionally added to food which may compromise food safety suitability;
Contamination	the occurrence of a contaminant in fish due to microbial pathogens, chemicals, foreign bodies, spoilage, objectionable taints, unwanted or diseased matter, which may compromise fish safety or suitability;
Control Measure	means any action and activity that can be used to eliminate a food safety hazard or reduce it to an acceptable level. For the purposes of this Code a control measure is also applied to a defect.
Corrective Action	means any action to be taken when the results of monitoring at the CCP indicate a loss of control. For the purposes of this Code this also applies to a DAP.
Critical Control Point (CCP)	a step at which control can be applied and is essential to prevent or eliminate a food safety hazard or reduce it to an acceptable level.
Critical Limit	is a criterion, which separates acceptability from unacceptability. For the purpose of this Code this also applies to a DAP;
Decision Tree	a sequence of questions applied to each process step with an identified hazard to identify which process steps are CCPs. For the purpose of this Code this also applies to a DAP;
Decomposition	is a persistent and distinct objectionable odour or flavour including texture breakdown caused by the deterioration of fish;
Defect	means a condition found in a product which fails to meet essential quality, composition and/or labelling provisions of the appropriate Codex product standards;
Defect Action Point (DAP)	a point, step or procedure at which control can be applied and a defect can be prevented, eliminated or reduced to acceptable level, or a fraud risk eliminated;
Disinfection	means the application of hygienically satisfactory chemical or physical agents and processes to clean surfaces with the intention of eliminating micro-organisms;
Dressed	means that portion of fish remaining after heading and gutting;

Fish	means any of the cold-blooded aquatic vertebrates and aquatic invertebrates. Aquatic mammals and amphibians are not included;
Hazard	a biological, chemical or physical agent in, or condition of, food with the potential to cause an adverse health effect;
Hazard Analysis Critical Control Point (HACCP)	a system which identifies, evaluates, and controls hazards which are significant for food safety;
Marine Biotoxins	means poisonous substances accumulated by fish and shellfish feeding on toxin producing algae, or in (sea)water containing toxins produced by such organisms;
Monitor	the act of conducting a planned sequence of observations or measurements of control parameters to assess whether a CCP is under control. For the purpose of this Code this also applies to a DAP;
Potable Water	is fresh water fit for human consumption. Standards of potability should not be lower than those contained in the latest edition of the "International Standards for Drinking Water", World Health Organisation;
Pre-Requisite Programme	is a programme that is required prior to the application of the HACCP system to ensure that a fish processing facility is operating according to the Codex Principles of Food Hygiene, the appropriate Code of Practice and appropriate food safety legislation;
Processing Facility	means any premises where fishery products are prepared, processed, chilled, frozen, packaged or stored. For the purposes of this Code, premises also includes vessels;
Raw Material	are fresh and frozen fish and/or parts of fish which may be utilised to produce fish and fishery products intended for human consumption;
Refrigerated Sea Water	is clean sea water cooled by a suitable refrigeration system;
Shelf-Life	the period during which the product maintains its microbiological safety and sensory qualities at a specific storage temperature. It is based on identified hazards for the product, heat or other preservation treatments, packaging method and other hurdles or inhibiting factors that may be used;
Shellfish	means those species of molluscs and crustaceans including cephalopods that are usually used for food;
Step	is a point, procedure, operation or stage in the food chain including raw materials, from primary production to final consumption;
Verification	the application of methods, procedures, tests and other evaluations, in addition to monitoring to determine compliance with the HACCP plan. For the purposes of this Code this also applies to a DAP;
Whole Fish	are fish as captured, ungutted.

2.2 FRESH, FROZEN AND MINCED FISH

Candling	is passing fish over a translucent table illuminated from below to detect parasites and other defects
Dehydration	is the loss of moisture from frozen products through evaporation. This may occur if the products are not properly glazed, packaged or stored. Deep dehydration adversely affects the appearance and surface texture of the product and is commonly known as "freezer burn";
Fillet	is a slice of fish of irregular size and shape removed from the carcase by cuts made parallel to the backbone;

Freezer	is equipment designed for freezing fish and other food products, by quickly lowering the temperature so that after thermal stabilisation the temperature in the thermal centre of the product is the same as the storage temperature;
Freezing Process	is a process which is carried out in appropriate equipment in such a way that the range of temperature of maximum crystallisation is passed quickly. The quick freezing process shall not be regarded as complete unless and until the product temperature has reached -18°C (0°F) or lower at the thermal centre after thermal stabilisation;
Fresh Fish	are fish or preparations thereof which, in their final form, have received no preserving treatment other than chilling;
Frozen Fish	are fish which have been subjected to a freezing process sufficient to reduce the temperature of the whole product to a level low enough to preserve the inherent quality of the fish and which have been maintained at this low temperature during transportation, storage and distribution up to and including the time of final sale. For the purpose of this Code the terms "frozen", "deep frozen", "quick frozen", unless otherwise stated, shall be regarded as synonymous;
Glazing	The application of a protective layer of ice formed at the surface of a frozen product by spraying it with, or dipping it into, clean sea water, potable water, or potable water with approved additives, as appropriate;
Minced Fish	is comminuted flesh produced by separation from skin and bones;
Modified Atmosphere Packaging (MAP)	means packaging in which the atmosphere surrounding the fish is different from the normal composition of air;
Separation	is a mechanical process for producing minced fish whereby the skin and bone is substantially removed from the flesh;
Separator	is a mechanical device used for separation;
Steak	is a section of fish, removed by cutting approximately at right angle to the backbone.

2.3 MOLLUSCAN SHELLFISH

Accepted / Acceptable / Approved	means accepted by the official agency having jurisdiction;
Conditioning	means placing live molluscan shellfish in tanks, floats or natural sites to remove sand, mud or slime and improve product acceptability;
Distribution Centre	means any approved on-shore or off-shore installation or establishment for the reception, conditioning, washing, cleaning, grading and packaging of live molluscan shellfish fit for human consumption;
Growing Areas	means all brackish and marine areas approved for the production or harvesting of molluscan shellfish either by natural growth or by aquaculture, destined for human consumption;
Heat Shocking	means the process of subjecting molluscan shellfish in the shell to any form of heat treatment, such as steam, hot water, or dry heat for a short period of time, to facilitate rapid removal of meat from the shell. Such treatment should not be considered as any part of a cooking process;
Purification	(depuration) means the removal of microorganisms from molluscan shellfish by the process of holding live molluscan shellfish for a period of time under approved, controlled conditions in natural or artificial sea water suitable for the process, which may be treated or untreated, in tanks, floats or rafts;

Relaying means the removal of molluscan shellfish from a polluted growing area to an acceptable growing or holding area under the supervision of the agency having jurisdiction and holding them there for the time necessary for the reduction of pollutants to an acceptable level.

2.4 LOBSTERS AND CRABS

Autolysis is the breakdown or deterioration of crustacean[1] meat or viscera by means of indigenous enzymes;

Batch systems are those processing methods where crabs are processed as bulk units;

Black spot is the appearance of dark pigments at the joints and injured parts of lobster segments, caused by oxidative enzyme reaction;

Butchering is the process of removing crab back shell, viscera and gills. In some fisheries it may also include the removal of walking legs and claws. Butchering may take place either before or after cooking;

Butt end of the tail is that part of the tail muscle of lobsters which extends into the cephalothorax;

Cephalothorax is the body region of lobsters which is formed anatomically by the fusion of head and thorax;

Claw means the "thigh", merus or the first large leg segment from the crab shell;

Cocktail claw is a crab claw product where the shell is partially removed to expose the meat portion of the claw;

Cooking means boiling of crustaceans in potable water, clean sea water or brine or heating in steam for a period of time sufficient for the thermal centre to reach a temperature adequate to coagulate the protein;

Crab means the commercially important species of the Decapoda order in the Brachyura and Anomura sections;

Deterioration means those natural processes of quality reduction that occur after harvesting and that are quite independent of man's deliberate intervention;

Devein is to remove the intestine/vein from the lobster tail;

Droptail is a condition observed in cooked lobsters which have died or deteriorated before processing. The tail does not curl under the lobster and there is a gap between the tail and cephalothorax;

Enzymatic activity is the catalytic action of enzymes on biochemical reactions;

Insensible is the state of unresponsiveness as a result of thermal, electrical, or physical process imposed on lobsters and crabs prior to cooking;

2.5 SHRIMPS AND PRAWNS [TO BE COMPLETED]

2.6 CEPHALOPODS

Splitting means cutting cephalopods along the mantle to produce a single fillet.

2.7 SALTED FISH

Brine solution of salt in water;

Brine Injection is the process for directly injecting brine into the fish flesh;

Brining means the process of placing fish in brine for a period of sufficient length for the fish tissue to absorb a significant quantity of salt;

Dry-Salting is the process of mixing fish with suitable salt and stacking the fish in such a manner that the resulting brine drains away;

Fatty Fish	refers to those fish that contain more than 2% fat or oil in the flesh;
Gibbing	the process of removing the gills, long gut and stomach from a fish such as herring, by inserting a knife at the gills; the milt or roe and some of the pyloric caeca are left in the fish;
Heavy Salted Fish	the salt content of the fish muscle is above 20 g/100 g water phase;
Medium Salted Fish	the salt content of the fish muscle is above 10 g/100 g water phase or is lower or equal to 20 g salt/100 g water phase;
Light Salted Fish	the salt content of the fish muscle is above 4 g/100 g water phase or is lower or equal to 10 g salt/100 g water phase;
Maturing	the process from salting until the fish is salt-matured
Nobbing	removing gut from fatty fish, such as herring by partially severing the head and pulling the gills away together with attached gut;
Pickle	brine which may contain vinegar and spices;
Salt	is a crystalline product consisting predominantly of sodium chloride. It is obtained from the sea, from underground rock salt deposits or from natural brine
Salt Cured Fish	means fish that is preserved with salt;
Salt-Matured Fish	means salted fish that has an appearance, consistency and flavour characteristic of the final product;
Salted Fish /Salted Fillet	fish /fillets which have been treated by either brining, dry-salting, pickle curing or a combination of these;
Split Fish	fish that have been cut open from throat or nape to the tail, with gills, guts and roe removed. Whole or part of backbone may be left in or removed;
Wet Salting (Pickling)	is the process whereby fish is mixed with suitable salt and stored in watertight containers under the resultant brine (pickle) which forms by solution of salt in the water extracted from the fish tissue. Brine may be added to the container. The fish is subsequently removed from the container and stacked so that the brine drains away;

2.8 SMOKED FISH

Cold Smoking	means smoking at a temperature of the smoked product lower than the temperature where the fish flesh shows sign of heat denaturation;
Hot Smoking	means smoking at a temperature of the smoked product until the fish flesh is denatured throughout;
Mechanical Smoking	means a smoking process where the smoke is generated outside the smoking chamber and by artificial ventilation forced to flow around the fish;
Smoke	means the aerosol of particles and droplets in the combustion gases from the combustion of wood. The smoke might be submit to separation of tar before it enters the smoking chamber;
Traditional Smoking Kiln	means an enclosed space such as a chamber or chimney where smoke is generated beneath the fish and allowed to flow around the fish by draught to a chimney;
Wood	means wood including sawdust, shavings and chips, and woody plants in their natural or dried state. Painted, impregnated or otherwise treated wood or woody plants must not be used for the generation of smoke.

2.9 CANNED FISH

For the purpose of this Code, only the definitions of the main terms related to canning industry and used in section 13 are given. For an overall set of definitions; please refer to the Recommended International Code of Hygienic Practice for Low-Acid and Acidified Low-Acid Canned Food (CAC/PRC 23-1979, Rev. 2 (1993)).

Canned Food	means commercially sterile food in hermetically sealed containers ;

Commercial sterility of thermally processed food	means the condition achieved by application of heat, sufficient, alone or in combination with other appropriate treatments, to render the food free from micro-organisms capable of growing in the food at normal non-refrigerated conditions at which the food is likely to be held during distribution and storage ;
Hermetically Sealed Containers	are containers which are sealed to protect the content against the entry of micro-organisms during and after heat processing ;
Retort	means a pressure vessel designed for thermal processing of food packed in hermetically sealed containers ;
Scheduled Process (or Sterilisation schedule)	means the thermal process chosen by the processor for a given product and container size to achieve at least commercial sterility ;
Sterilisation Temperature	means the temperature maintained throughout the thermal process as specified in the scheduled process;
Sterilisation time	means the time between the moment sterilisation temperature is achieved and the moment cooling started ;
Thermal Process	means the heat treatment to achieve commercial sterility and is quantified in terms of time and temperature ;
Venting	means thorough removal of the air from steam retorts by steam prior to a scheduled process ;

2.10 FROZEN SURIMI

De-Watering	means removal of excessive wash water from the minced fish flesh;
Frozen Surimi	means the fish protein product for further processing, which has been processed by heading, gutting, cleaning fresh fish, and mechanically separating the edible muscle from the skin and bone. The minced fish muscle is then washed, refined, de-watered, mixed with cryoprotective food ingredients and frozen;
Gel Forming Ability	means the ability of surimi to form an elastic gel when fish meat is comminuted with the addition of salt and then formed and heated. This elasticity is a function possessed by myosin as the primary component of myofibrillar protein;
Myofibrillar Protein	is a generic term of skeletal muscle proteins such as myosin and actin;
Refining	means a process of removing from washed meat by used of a strainer small bones, sinews, scales and bloody flesh of such sizes as may not be mixed in a final product, thereby concentrating myofibrillar protein;
Surimi-Based Products	means a variety of products produced from surimi with addition of ingredients and flavour such as “surimi gel” and shellfish analogues;
Water-Soluble Components	means any water-soluble proteins, organic substances and inorganic salts contained in fish meat;
Washing	means a process of washing away blood and water soluble components from minced fish with cold water by the use of a rotary filter, thus increasing the level of myofibrillar proteins thereof;
Washed meat	means fish meat that is washed and then drained of water.

2.11 AQUACULTURE

Adequate	means sufficient to accomplish the intended purpose of this Code;
Aquaculture	means the farming of aquatic organisms, including fish, molluscs, crustaceans and aquatic plants;

Aquaculture Establishment	is any premises for the production of live finfish or crustaceans (fish) intended for human consumption, including the supporting inner infrastructure and surroundings under the control of the same management;
Chemicals	includes any substance either natural or synthetic which can affect the live fish, its pathogens, the water, equipment used for production or the land within the aquaculture establishment; such substances include pesticides, therapeutic chemicals, disinfectants, anaesthetics, hormones, dyes, detergents, antifoulants, and fertilisers;
Colouring	means obtaining specifically coloured fish flesh by incorporating into the fish food a natural or artificial substance or additive approved for this purpose by the agency having jurisdiction;
Conditioning	means transferring harvested fish which are fit for human consumption into other ponds, tanks or cages of the same aquaculture establishment , in order to clean the gut, recover from stress or acclimatise to different conditions before transport of the live product;
Corrosion-resistant Material	means impervious material, which is free from pits, crevices, and scale, is non-toxic and unaffected by water (or seawater), ice, slime or any other corrosive substance with which it is likely to come into contact. Its surfaces must be smooth and it must be capable of withstanding exposure to repeated cleaning, including the use of detergents and disinfectants;
Diseased Fish	means a fish on or in which pathological changes or other abnormalities are apparent;
Establishment	see aquaculture establishment;
Equipment	means utensils such as nets, conveyers, sorting tables or machines, buckets, dip nets, pumps, transportation tanks, vehicles, etc., used during fishing out, sorting, loading and transportation of fish to market;
Feed Additives	means chemicals other than nutrients for fish, which are approved for addition to fish feed;
Fish	means any of the cold-blooded aquatic vertebrate animals commonly known as such. For the purpose of this Code, the term covers finfish (teleosts) and crustaceans. Molluscs, other invertebrates, elasmobranchs, cyclostomes, aquatic mammals, amphibians and reptiles are not included;
Fish Feed	means fodder intended for fish in aquaculture establishments, in any form and of any composition;
Fishing Out	means collecting or harvesting of fish out of rearing units for their transfer to another rearing unit;
Good Aquaculture (or Good Fish Farming) Practices	are defined as those practices of the aquaculture sector that are necessary to produce quality food products conforming to food laws and regulations as well as those related to animal welfare;
Growing Area	means freshwater, estuarine, brackish and marine areas used for aquaculture establishments, including surroundings under the control of the same management;
Harvesting	means those operations which start with taking the fish from the water and end with the transport of live or fresh fish for human consumption to the market;
Manager	in relation to an establishment includes any person for the time being responsible for the management of the establishment;
Official Agency Having Jurisdiction	means the official authority or authorities charged by the government with the control of food hygiene (sometimes referred to as the competent authority) as well as/or with sanitation in aquaculture;

Pesticide means any substance intended for preventing, destroying, attracting, repelling or controlling any pest including unwanted species of plants or animals during the production, storage, transport, distribution and processing of food, agricultural commodities, or animal feeds or which may be administered to animals for the control of ectoparasites. The term normally excludes fertilisers, plant and animal nutrients, food additives, and veterinary drugs;

Pesticide Residue means any specified substance in food, agricultural commodities, or animal feed resulting from the use of a pesticide. The term includes any derivatives of a pesticide, such as conversion products, metabolites, reaction products, and impurities;

Pollutants means substances originating from human activities and not from natural causes, which can contaminate the fish or impair the quality of the water in which they are grown;

Purification see entry in molluscan shellfish section;

Rearing Environment is the water space in which fish are confined for the purpose of aquaculture by any construction material;

Rearing Unit **in an aquaculture establishment** means an adequate aqueous confinement space for a certain biomass; this term includes a pond, storage pond, tank, raceway, or cage;

Residues means any foreign substances including their metabolites, which remain in fish prior to harvesting as a result of either application or accidental exposure. Examples of such substances are antibiotics, anthelminthics, chemotherapeutics, disinfectants, fish food additives, growth promoters, hormones, hormone-like substances, heavy metals, pesticides, tranquillisers and radioactive materials. Maximum residue limits (MRLs) are specified for many substances by the Codex Alimentarius or national regulations;

Tolerance refers to residue levels of a chemical that are permitted by the official agency having jurisdiction in food for human consumption;

Unit see "rearing unit";

Veterinary Drug means any substance applied or administered to any food-producing animal, such as meat or milk-producing animals, poultry, fish or bees, whether used for therapeutic, prophylactic or diagnostic purposes or for modification of physiological functions or behaviour;

Wastewater refers to liquid waste discharged from homes, commercial premises and similar sources to individual disposal systems or to municipal sewers, and consists mainly of excreta and used water;

Withdrawal Time is the period of time between the administration of a veterinary drug to fish, or exposure of fish to a chemical, and harvesting of the fish to ensure that the concentration of the drug or chemical in the edible flesh of the fish complies with the maximum permitted concentration of the drug or chemical in fish for human consumption.

2.12 FROZEN COATED PRODUCTS

Batter liquid preparation from ground cereals, spices, salt, sugar and other ingredients and/or additives for coating. Typical batter types are: non-leavened batter and leavened batter.

Breading dry breadcrumbs or other dry preparations mainly from cereals with colorants and other ingredients used for the final coating of fishery products. Typical breading types are: free-flowing breading, coarse breading, flour-type breading.

Coating covering the surface of a fishery product with batter and/or breading.

Pre-frying frying of breaded and battered fishery products in an oil bath in a way so that the core remains frozen.

Sawing sawing (by hand or fully merchandised) of regular shapes QF fish blocks into pieces suitable for later coating.

SECTION 3 PRE-REQUISITE PROGRAMME

Prior to the application of HACCP to any segment of the fish processing chain, that segment must be supported by pre-requisite programmes based on good hygienic practice or as required by the competent authority.

The establishment of pre-requisite programmes will allow the HACCP team to focus on the HACCP application to food safety hazards which are directly applicable to the product and the process selected, without undue consideration and repetition of hazards from the surrounding environment. The pre-requisite programmes would be specific within an individual establishment or for an individual vessel and will require monitoring and evaluation to ensure their continued effectiveness.

Reference should be made to the *International Recommended Code of Practice – General Principles of Food Hygiene* (CAC/RCP 1-1969, Rev.3 1997), Annex: *HACCP System and Guidelines for its Application* for further information to assist with the design of the pre-requisite programmes for a processing facility or vessel.

It should be noted that some of the issues listed below, e.g. those related to damage, are designed to maintain quality rather than safety and are not always essential to a pre-requisite programme for a safety oriented HACCP system.

3.1 FISHING AND HARVESTING VESSEL DESIGN AND CONSTRUCTION

There are many different types of fishing vessel used throughout the world which have evolved in particular regions to take account of the prevailing economics, environment and types of fish caught or harvested. This Section attempts to highlight the basic requirements for cleanability, minimising damage, contamination and decomposition to which all vessels should have regard to the extent possible in order to ensure hygienic, high quality handling of fresh fish intended for further processing and freezing.

The design and construction of a fishing vessel and vessels used to harvest farmed fish should take into consideration the following:

3.1.1 For Ease of Cleaning and Disinfection

- vessels should be designed and constructed to minimise sharp inside corners and projections to avoid dirt traps;
- construction should facilitate ample drainage;
- a good supply of clean sea water or potable water[1] at adequate pressure.

3.1.2 To Minimise Contamination

- all surfaces in fish handling areas should be non-toxic, smooth impervious and in sound condition, to minimise the build-up of fish slime, blood, scales and guts and to reduce the risk of physical contamination;
- where appropriate, adequate facilities should be provided for the handling and washing of fish and should have an adequate supply of cold potable water or clean sea water for that purpose;
- adequate facilities should be provided for washing and disinfecting equipment, where appropriate;
- the intake for clean sea water should be located to avoid contamination;
- all plumbing and waste lines should be capable of coping with peak demand;
- non-potable water lines should be clearly identified and separated from potable water to avoid contamination;
- objectionable substances, which could include bilge water, smoke, fuel oil, grease, drainage and other solid or semi-solid wastes should not contaminate the fish;
- where appropriate, containers for offal and waste material should be clearly identified, suitably constructed with a fitted lid and made of impervious material;

[1] WHO Guidelines for Drinking Water Quality , 2nd edition, Geneva, 1993

- separate and adequate facilities should be provided to prevent the contamination of fish and dry materials, such as packaging, by:
  - poisonous or harmful substances;
  - dry storage of materials, packaging etc.;
  - offal and waste materials;
- adequate hand washing and toilet facilities should be available;
- prevent the entry of birds, insects, or other pests, animals and vermin, where appropriate.

3.1.3 To Minimise Damage to the Fish

- in fish handling areas, surfaces should have a minimum of sharp corners and projections;
- in boxing and shelving fish storage areas, the design should preclude excessive pressure being exerted on the fish;
- chutes and conveyors should be designed to prevent physical damage caused by long drops or crushing;
- the fishing gear and its usage should minimise damage and deterioration to the fish.

3.1.4 To Minimise Damage during Harvesting of Farmed Fish

Farmed fish are usually harvested using seines or nets and may be transported live to processing facilities.

- seines, nets and traps should be carefully selected to ensure minimum damage during harvesting;
- harvesting areas and all equipment for harvesting, catching, sorting, grading, conveying and transporting of live fish should be designed for rapid and efficient handling of live fish without causing mechanical damage;
- conveying equipment for live and slaughtered fish should be constructed of suitable corrosion-resistant material which does not transmit toxic substances and should not cause mechanical injuries to fish;
- where fish are transported live, care should be taken to avoid overcrowding and to minimise bruising.

3.2 PROCESSING FACILITY DESIGN AND CONSTRUCTION

The processing facility should include a product flow-through pattern that is designed to prevent potential sources of contamination, minimise process delays which could result in further reduction in fish quality, and prevent cross-contamination of finished product from raw materials. Fish are highly perishable foods and should be handled carefully and chilled without undue delay. The fish processing facility, therefore, should be designed for the rapid processing and storage of fish and fishery products.

The design and construction of a fish processing facility should take into consideration the following:

3.2.1 For Ease of Cleaning and Disinfection

- the surfaces of walls, partitions and floors should be made of impervious, non-toxic materials;
- all surfaces with which fish might come in contact should be of corrosion resistant, impervious material which is light-coloured, smooth and easily cleanable;
- walls and partitions should have a smooth surface up to a height appropriate to the operation;
- floors should be constructed to allow adequate drainage;
- ceilings and overhead fixtures should be constructed and finished to minimise the build-up of dirt and condensation, and the shedding of particles;
- windows should be constructed to minimise the build-up of dirt and, where necessary, be fitted with removable and cleanable insect-proof screens. Where necessary, windows should be fixed;
- doors should have smooth, non-absorbent surfaces;
- joints between floors and walls should be constructed for ease of cleaning.

3.2.2 To Minimise Contamination

- processing facility layout should be designed to minimise cross-contamination and may be accomplished by physical or time separation;
- all surfaces in fish handling areas should be non-toxic, smooth impervious and in sound condition, to minimise the build-up of fish slime, blood, scales and guts and to reduce the risk of physical contamination;
- working surfaces that come into direct contact with fish should be in sound condition, durable and easy to maintain. They should be made of smooth, non-absorbent and non-toxic materials, and inert to fish, detergents and disinfectants under normal operating conditions;
- adequate facilities should be provided for the handling and washing of fish and should have an adequate supply of cold potable water for that purpose;
- suitable and adequate facilities should be provided for storage and/or production of ice;
- ceiling lights should be covered or otherwise suitably protected to prevent contamination by glass or other material;
- ventilation should be sufficient to remove excess steam, smoke and objectionable odours;
- adequate facilities should be provided for washing and disinfecting equipment, where appropriate;
- a suitable water treatment system should be installed, where appropriate;
- non-potable water lines should be clearly identified and separated from potable water to avoid contamination;
- drainage should be suitably sized and designed to prevent contamination of fish;
- all plumbing and waste lines should be capable of coping with peak demands;
- accumulation of solid, semi-solid or liquid wastes should be minimised to prevent contamination of fish;
- where appropriate, containers for offal and waste material should be clearly identified, suitably constructed with a fitted lid and made of impervious material;
- separate and adequate facilities should be provided to prevent the contamination of fish by:
  - poisonous or harmful substances;
  - dry storage of materials, packaging etc.;
  - offal and waste materials;
- adequate hand washing and toilet facilities should be available;
- prevent the entry of birds, insects, or other pests, animals and vermin.

3.2.3 To Provide Adequate Lighting

- on all work surfaces.

3.3 DESIGN AND CONSTRUCTION OF EQUIPMENT AND UTENSILS

The equipment and utensils used on a vessel or in a processing facility will vary greatly depending on the nature and type of operation involved. During use, they are constantly in contact with the fish. The condition of the equipment and utensils should be such that it minimises the build-up of proteinaceous residues and prevents them becoming a source of contamination.

The design and construction equipment and utensils should take into consideration the following:

3.3.1 For Ease of Cleaning and Disinfection

- equipment should be durable and movable and/or capable of being disassembled to allow for maintenance, cleaning, disinfection and monitoring;
- equipment, containers and utensils coming into contact with fish should be designed to provide for adequate drainage and constructed to ensure that they can be adequately cleaned, disinfected and maintained to avoid contamination;
- equipment and utensils should be designed and constructed to minimise sharp inside corners and projections and tiny crevices or gaps to avoid dirt traps;

- a suitable and adequate supply of cleaning utensils and cleaning agents, approved by the official agency having jurisdiction, should be provided.

3.3.2 To Minimise Contamination

- all surfaces of equipment in fish handling areas should be non-toxic, smooth, impervious and in sound condition, to minimise the build-up of fish slime, blood, scales and guts and to reduce the risk of physical contamination;
- accumulation of solid, semi-solid or liquid wastes should be minimised to prevent contamination of fish;
- adequate drainage should be provided in storage containers and equipment;
- drainage should not be permitted to contaminate fish.

3.3.3 To Minimise Damage

- surfaces should have a minimum of sharp corners and projections;
- chutes and conveyors should be designed to prevent physical damage caused by long drops or crushing;
- fish storage equipment should be fit for the purpose and not lead to crushing of the fish.

3.4 HYGIENE CONTROL PROGRAMME

The potential effects of harvesting and handling of farmed products, on-board vessel handling or in-plant production activities on the safety and suitability of fish should be considered at all times. In particular this includes all points where contamination may exist and taking specific measures to ensure the production of a safe and wholesome product. The type of control and supervision needed will depend on the size of the operation and the nature of its activities.

The hygiene control programme should take into consideration the following :

3.4.1 A Permanent Cleaning and Disinfection Schedule

A permanent cleaning and disinfection schedule should be drawn up to ensure that all parts of the vessel, processing facility and equipment therein are cleaned appropriately and regularly. The schedule should be reassessed whenever changes occur to the vessel, processing facility and/or equipment. Part of this schedule should include a 'clean as you go' policy.

A typical cleaning and disinfecting process may involve as many as seven separate steps:

Pre-cleaning Preparation of area and equipment for cleaning. Involves steps such as removal of all fish or fish products from area, protection of sensitive components and packaging materials from water, removal by hand or squeegee of fish scraps, etc.

Pre-rinse A rinsing with water to remove remaining large pieces of loose soil.

Cleaning Treatment of surfaces with an appropriate detergent to loosen and remove any remaining soil.

Rinse A rinsing with potable water or clean sea water, as appropriate, to remove all soil and detergent residues.

Disinfection Application of chemicals, approved by the official agency having jurisdiction and/or heat to destroy most microorganisms on surface.

Post-rinse As appropriate a final rinse with potable water or clean sea water to remove all soil and disinfectant residues.

Storage Cleaned and disinfected equipment, container and utensils should be stored in a fashion which would prevent its contamination.

Fish handlers or cleaning personnel as appropriate should be well trained in the use of special cleaning tools and chemicals, methods of dismantling equipment for cleaning and should be knowledgeable in the significance of contamination and the hazards involved.

3.4.2 Designation of Personnel for Cleaning

In each processing plant or vessel a trained individual should be designated to be responsible for the sanitation of the processing facility or vessel and the equipment within. Schedules should be implemented to:

- prevent the build up of waste and debris;
- protect the fish from contamination;
- dispose of any rejected material in a hygienic manner;
- monitor personal hygiene and health standards;
- monitor the pest control programme;
- monitor cleaning and disinfecting programmes;
- monitor the quality and safety of water and ice supplies.

3.4.3 Maintenance of Premises, Equipment and Utensils

- buildings, materials, utensils and all equipment in the establishment - including drainage systems - should be maintained in a good state and order;
- equipment, utensils and other physical facilities of the plant or vessel should be kept clean and in good repair;
- procedures for the maintenance, repair, adjustment and calibration, as appropriate, of apparatus should be established. These procedures should specify for each equipment, the methods used, the persons in charge of their application, and their frequency.

3.4.4 Pest Control Systems

- good hygienic practices should be employed to avoid creating an environment conducive to pests;
- pest control programmes could include preventing access, eliminating harbourage and infestations, and establishing monitoring detection and eradication systems;
- physical, chemical and biological agents should be properly applied by appropriately qualified personnel.

3.4.5 Supply of Water, Ice and Steam

3.4.5.1 Water

- an ample supply of cold and hot potable water[2] and/or clean sea water under adequate pressure should be provided;27
- potable water should be used wherever necessary to avoid contamination to the fish and shellfish.

3.4.5.2 Ice

- ice should be manufactured using potable water[3] or clean sea water;
- ice should be protected form contamination.

3.4.5.3 Steam

- for operations which require steam, an adequate supply at sufficient pressure should be maintained;
- steam used in direct contact with fish or shellfish or food contact surfaces should not constitute a threat to the safety or suitability of the food.

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[2] WHO Guidelines for Drinking Water Quality, 2nd edition, Geneva, 1993

3.4.6 Waste Management

- offal and other waste materials should be removed from the premises of a processing facility or vessel on a regular basis;
- facilities for the containment of offal and waste material should be properly maintained;
- vessel waste discharge should not contaminate vessel water intake system or incoming product.

3.5 PERSONAL HYGIENE AND HEALTH

Personal hygiene and facilities should be such to ensure that an appropriate degree of personal hygiene can be maintained to avoid contaminating fish

3.5.1 Facilities and Equipment:

Facilities and equipment should include:

- adequate means of hygienically washing and drying hands;
- adequate toilet and changing facilities for personnel should be suitably located and designated.

3.5.2 Personnel Hygiene

- no person who is known to be suffering from, or who is a carrier of any communicable disease or has an infected wound or open lesion should be engaged in the preparation, handling or transporting of fish or fishery products;
- where necessary, adequate and appropriate protective clothing, headcovering and footwear should be worn;
- all persons working in a processing facility should maintain a high degree of personal cleanliness and should take all necessary precautions to prevent the contamination of the fish or their products or ingredients;
- the following should not be permitted in fish handling and processing areas:
  - smoking
  - spitting
  - chewing or eating
  - sneezing or coughing over unprotected food
  - the adornment of personal effects such as jewellery, watches, pins or other items that, if dislodged, may pose a threat to the safety and suitability of the fish.
  - hand-washing should be carried out by all personnel:
  - at the start of fish handling activities and upon re-entering a processing area;
  - immediately after using the toilet;
  - after handling raw fish and shellfish or any questionable material which could result in the contamination of fish in the process or in the finished product.

3.6 TRANSPORTATION

Vehicles should be designed and constructed:

- such that walls, floors and roofs, where appropriate, are made of a suitable corrosion-resistant material with smooth non-absorbent surfaces. Floors should be adequately drained;
- where appropriate with chilling equipment to maintain chilled fish during transport to a temperature as close as possible to 0°C or, for frozen fish and fishery products, to maintain a temperature of -18°C or colder;
- to provide the fish with protection against contamination from dust, exposure to higher temperatures and the drying effects of the sun or wind;
- to permit the free flow of chilled air around the load when fitted with mechanical refrigeration means.

3.7 TRACEABILITY AND RECALL PROCEDURES

Experience has demonstrated that a system for recall of product is a necessary component of a pre-requisite programme because no process is fail-safe. Traceability, which includes lot identification, is essential to an effective recall procedure.

- managers should ensure effective procedures are in place to effect the complete traceability and rapid recall of any lot of fishery product from the market;
- appropriate records of processing, production and distribution should be kept and retained for a period that exceeds the shelf-life of the product;
- each container of fish or fishery product should be clearly marked to identify the producer/processor and lot;
- where there is an immediate health hazard, products produced under similar conditions, and likely to present a similar hazard to public health, may be withdrawn. The need for public warnings should be considered;
- recalled products should be held under supervision until they are destroyed, used for purposes other than human consumption, or reprocessed in a manner to ensure their safety.

3.8 TRAINING

Fish hygiene training is fundamentally important. All personnel should be aware of their role and responsibility in protecting fish from contamination and deterioration. Fish handlers should have the necessary knowledge and skill to enable them to handle fish hygienically. Those who handle strong cleaning chemicals or other potentially hazardous chemicals should be instructed in safe handling techniques.

Each fish processing facility should ensure that individuals have received adequate and appropriate training in the design and proper application of a HACCP system and process control. Training of personnel in the use of HACCP is fundamental to the successful implementation and delivery of the programme in fish processing establishments. The practical application of such systems will be enhanced when the individual responsible for HACCP has successfully completed a course given by or certified by a competent authority. Managers should also arrange for adequate and periodic training of every employee in the establishment so that they understand the principles involved in HACCP.

SECTION 4 - GENERAL CONSIDERATIONS FOR THE HANDLING OF FRESH FISH AND SHELLFISH

Unless they can be reduced to an acceptable level by normal sorting and/or processing, no fish should be accepted if it is known to contain parasites, undesirable microorganisms, pesticides, veterinary drugs or toxic, decomposed or extraneous substances. When fish and shellfish determined as unfit for human consumption are found they should be removed and stored separately from the catch, and disposed of in a proper manner. Potential hazards, which have been known to be associated with fresh fish and shellfish, are described in Section 4.1. All fish and shellfish deemed fit for human consumption should be handled properly with particular attention being paid to time and temperature control.

4.1 POTENTIAL HAZARDS ASSOCIATED WITH FRESH FISH AND SHELLFISH

4.1.1 Biological Hazards

4.1.1.1 Parasites

The parasites known to cause disease in humans and transmitted by fish or crustaceans are broadly classified as helminths or parasitic worms. These are commonly referred to as Nematodes, Cestodes and Trematodes. Fish can be parasitised by protozoans, but there are no records of fish protozoan disease being transmitted to man. Parasites have complex life cycles, involving one or more intermediate hosts and are generally passed to man through the consumption of raw, minimally processed or inadequately cooked products that contain the parasite infectious stage, causing foodborne disease. Freezing at [-20°C or below for 7 days or -35°C for about 20 hours] for fish intended for raw consumption will kill parasites. Processes such as brining or pickling may reduce the parasite hazard but will not eliminate it. Candling, trimming belly flaps and physically removing the parasite cysts will also reduce the hazards but will not guarantee elimination.

Nematodes

Many species of nematodes are known to occur worldwide and some species of marine fish act as secondary hosts. Among the nematodes of most concern are *Anisakis* spp., *Capillaria* spp., *Gnathostoma*

spp., and *Pseudoteranova* spp., which can be found in the liver, belly cavity and flesh of marine fish. An example of a nematode causing disease in man is *Anisakis simplex;* its occurrence is rare as the infective stage of the parasite is killed by heating ([60°C] for 1 minute) and by freezing ([-20°C] for 24 hours) in the fish core.

Cestodes

Cestodes are tapeworms and the species of most concern associated with the consumption of fish is *Diphyllobotrium latum*. This parasite occurs worldwide and marine fish are intermediate hosts. Similar to other parasitic infections, the foodborne disease occurs through the consumption of raw or under-processed fish. Similar freezing and cooking temperatures as applied to nematodes will inactivate the infective stages of this parasite.

Trematodes

Fish-borne trematode (flatworm) infections are major public health problems that occur endemically in about 20 countries around the world, particularly in Southeast Asia. The most important species with respect to the numbers of people infected belong to the genera *Clonorchis* and *Ophisthorchis* (liver flukes), *Paragonimus* (lung flukes), and to a lesser extent *Heterophyes* and *Echinochasmus* (intestinal flukes). The most important definitive host of these trematodes is man or other mammals. Freshwater fish are the second intermediate host in the life cycles of *Clonorchis* and *Ophistorchis*, and freshwater crustaceans in the case of *Paragonimius*. Foodborne infections take place through the consumption of raw, undercooked or otherwise under-processed products containing the infective stages of these parasites. Freezing fish at -20°C for 7 days or at -35°C for 24 hours will kill the infective stages of these parasites.

4.1.1.2 Bacteria

The level of contamination of fish at the time of capture will depend on the environment and the bacteriological quality of the water in which fish are harvested. Many factors will influence the microflora of finfish, the more important being water temperature, salt content, proximity of harvesting areas to human habitations, quantity and origin of food consumed by fish, and method of harvesting. The edible muscle tissue of finfish is normally sterile at the time of capture and bacteria are usually present on the skin, gills and in the intestinal tract.

There are two broad groups of bacteria of public health importance that may contaminate products at the time of capture - those that are normally present in the aquatic environment, referred to as the indigenous microflora, and those introduced through environmental contamination by domestic and /or industrial wastes. Examples of indigenous bacteria, which may pose a health hazard, are *Aeromonas hydrophyla*, *Clostridium botulinum*, *Vibrio parahaemolyticus*, *Vibrio cholerae*, *Vibrio vulnificus*, and *Listeria monocytogenes*. Non-indigenous bacteria of public health significance include members of the Enterobacteriaceae, such as *Salmonella* spp., *Shigella* spp., and *Escherichia coli*. Other species that cause foodborne illness and which have been isolated occasionally from fish are *Edwardsiella tarda*, *Pleisomonas shigeloides* and *Yersinia enterocolitica*.

Indigenous pathogenic bacteria, when present on fresh fish, are usually found in fairly low numbers, and where products are adequately cooked prior to consumption, food safety hazards are insignificant. During storage, indigenous spoilage bacteria will outgrow indigenous pathogenic bacteria, thus fish will spoil before becoming toxic and will be rejected by consumers. Hazards from these pathogens can be controlled by heating seafood sufficiently to kill the bacteria, holding fish at chilled temperatures and avoiding post-process cross-contamination.

Vibrio species are common in coastal and estuarine environments and populations can depend on water depth and tidal levels. They are particularly prevalent in warm tropical waters and can be found in temperate zones during summer months. *Vibrio* species are also natural contaminants of brackish water tropical environments and will be present on farmed fish from these zones. Hazards from *Vibrio* spp. associated with finfish can be controlled by thorough cooking and preventing cross-contamination of cooked products. Health risks can also be reduced by rapidly chilling products after harvest, thus reducing the possibility of proliferation of these organisms.

4.1.1.3 Scombrotoxin

Scombroid intoxication, sometimes referred to as histamine poisoning, results from eating fish that have been incorrectly chilled after harvesting. Scombrotoxin is attributed to *Enterobacteriaceae* which produce high levels of histamine in the fish muscle when products are not immediately chilled after catching. The main susceptible fish are the scombroids such as tuna, mackerel, and bonito, although it can be found in other species. The intoxication is rarely fatal and symptoms are usually mild. Rapid refrigeration after catching and a high standard of handling during processing should prevent the development of the toxin. The toxin is not inactivated by normal cooking temperatures or by canning. In addition, fish may contain toxic levels of histamine without exhibiting any of the usual sensory parameters characteristic of spoilage.

4.1.1.4 Viral Contamination

Molluscan shellfish harvested from inshore waters that are contaminated by human or animal faeces may harbour viruses that are pathogenic to man. Enteric viruses that have been implicated in seafood-associated illness are the hepatitis A virus, caliciviruses, astroviruses and the Norwalk virus. The latter three are often referred to as small round structured viruses. All of the seafood-borne viruses causing illness are transmitted by the faecal-oral cycle and most viral gastro-enteritis outbreaks have been associated with eating contaminated shellfish, particularly raw oysters.

Viruses are species specific and will not grow or multiply in foods or anywhere outside the host cell. There is no reliable marker for indicating presence of the virus in shellfish harvesting waters. Seafood-borne viruses are difficult to detect, requiring relatively sophisticated molecular methods to identify the virus.

Viral gastro-enteritis can be prevented by controlling sewage contamination of shellfish farming areas and pre-harvest monitoring of shellfish and growing waters. Depuration or relaying are alternative strategies but longer periods are required for shellfish to purge themselves clean of viral contamination than for bacteria. Thermal processing (85-90°C for 1.5 min.) will destroy viruses in shellfish.

4.1.2 Chemical hazards

Fish may be harvested from coastal zones and inland habitats that are exposed to varying amounts of environmental contaminants. Of greatest concern are fish harvested from coastal and estuarine areas rather than fish harvested from the open seas. Agro-chemicals and heavy metals may accumulate in products that can cause public health problems. Antibiotic residues can occur in aquaculture products when correct withdrawal times are not followed or when the sale and use of these compounds are not controlled. Fresh fish can also be contaminated with chemicals such as diesel oil, when incorrectly handled.

4.1.2.1 Biotoxins

There are a number of important biotoxins to consider. Around 400 poisonous fish species exist and, by definition, the substances responsible for the toxicity of these species are biotoxins. The poison is usually limited to some organs, or is restricted to some periods during the year.

For some fish, the toxins are present in the blood; these are ichtyohaemotoxin. The involved species are eels from the Adriatic, the moray eels, and the lampreys. In other species, the toxins are spread all over the tissues (flesh, viscera, skin); these are ichtyosarcotoxins. It concerns tetrodotoxic species responsible for several poisonings, often lethal.

Biotoxins are often heat-stable and the only possible control measure is to check the identity of the used species.

4.1.2.2 Ciguatoxin

The other important toxin to consider is ciguatoxin, which can be found in a wide variety of mainly carnivorous fish inhabiting shallow waters in or near tropical and subtropical coral reefs. The source of this toxin is dinoflagellates and over 400 species of tropical fish have been implicated in intoxication. The toxin is known to be heat stable. There is still much to be learnt about this toxin and the only control measure that can reasonably be taken is to avoid marketing fish that have a known consistent record of toxicity.

4.1.2.3 Phycotoxins

These toxins concern especially the bivalve shellfish; the toxicity is due to the ingestion by the shellfish of phytoplanktonic species, which are able to synthesise toxic substances. The shellfish concentrates the toxin to a level such as it becomes potentially toxic. The principal toxins are the Paralytic Shellfish Poison (PSP) produced by dinoflagellates genus *Alexandrium*, the Diarrheic Shellfish Poison (DSP) produced by other dinoflagellates genus *Dinophysis*, or domoic acid produced by a diatom *Nitzschia pungens*.

All these toxins are known to keep in general their toxicity through processing, even in canned fish products, so the knowledge of the species identity and/or origin of fish or shellfish intended for processing is important.

4.1.3 Physical Hazards

These can include material such as metal or glass fragments, shell, bones, etc.

4.2 TIME AND TEMPERATURE CONTROL

Temperature is the single most important factor affecting the rate of fish deterioration and multiplication of micro-organisms. For species prone to scombroid toxin production, time and temperature control may be the most effective method in controlling food safety. It is therefore essential that fresh fish, fillets and other and shellfish and their products which are to be chilled should be held at a temperature as close as possible to 0ºC.

4.2.1 Minimise the Deterioration of Fish - Time

To minimise the deterioration of fish, it is important that:

- chilling of fish should commence as soon as possible;
- fresh fish should be kept chilled, processed and distributed with care and minimum delay.

4.2.2 Minimise the Deterioration of Fish - Temperature Control

Where temperature control is concerned:

- sufficient and adequate icing, or chilled or refrigerated sea water systems where appropriate, should be employed to ensure that fish are kept chilled at a temperature as close as possible to 0ºC;
- fish should be stored in shallow layers and surrounded by finely divided ice;
- chilled or refrigerated sea water systems and/or cold storage systems should be designed and maintained to provide adequate cooling and/or freezing capacities during peak loads;
- fish should not be stored in refrigerated sea water systems to a density which impairs its working efficiency;
- monitoring and controlling the time and temperature and homogeneity of chilling should be performed regularly.

4.3 MINIMISE THE DETERIORATION OF FISH - HANDLING

Poor handling practices can lead to damage of fresh fish which can accelerate the rate of decomposition and increase unnecessary post-harvest losses. Handling damage can be minimised by:

- fish should be handled and conveyed with care particularly during transfer and sorting in order to avoid physical damage such as puncture, mutilation, etc.;
- where fish are held or transported live, care should be taken to maintain factors that can influence fish health (e.g. CO_2, O_2, temperature, nitrogenous wastes, etc.);
- fish should not be trampled or stood upon;
- where boxes are used for storage of fish they should not be overfilled or stacked too deeply;
- while fish are on deck, exposure to the adverse effects of the elements should be kept to a minimum in order to prevent unnecessary dehydration;
- finely divided ice should be used where possible, which can help minimise damage to fish and maximise cooling capacity;

- in refrigerated sea water storage areas, the density of the fish should be controlled to prevent damage.

[dn: reference to the section on molluscan shellfish and on aquaculture for the specific requirements on growing and harvesting required?].

SECTION 5 HAZARD ANALYSIS CRITICAL CONTROL POINT (HACCP) AND DEFECT ACTION POINT (DAP) ANALYSIS

The Hazard Analysis Critical Control Point (HACCP) is a science-based system which is aimed to prevent food safety problems from occurring rather than reacting to non-compliance of the finished product. The HACCP system accomplishes this by the identification of specific hazards and the implementation of control measures. An effective HACCP system should reduce the reliance on traditional end-product testing. Section 5 explains the principles of HACCP as it applies to the handling and processing of fish and fishery products, but the Code can only provide guidance on how to use these principles and offer suggestions as to the type of hazards which may occur in the various fish and fishery products. The HACCP plan, which should be incorporated into the food management plan should be well documented and be as simple as possible. This section will demonstrate one format, which may be considered in the development of the HACCP plan.

Section 5 also explains how a similar approach involving many of the principles can apply to the broader application covering the essential quality, composition and labelling provisions of Codex standards or other non-safety requirements which in this case are referred to as **Defect Action Point Analysis**. This approach for defect analysis is optional and other techniques, which achieve the same objective, may be considered.

Figure 5.1 summarises how to develop a HACCP and Defect Analysis system.

5.1 HACCP PRINCIPLES

The HACCP system consists of seven principles[3], which are:

- Hazard Analysis,
- Determination of CCP,
- Establish Critical Limits,
- Establish Monitoring Procedures,
- Establish Corrective Action,
- Establish Verification Procedures, and
- Establish Record Keeping Procedures.

These principles have to be followed in any consideration of HACCP.

[3] *International Recommended Code of Practice – General Principles of Food Hygiene* (CAC/RCP 1-1969, Rev.3 - 1997), Annex: *HACCP System and Guidelines for its Application*.

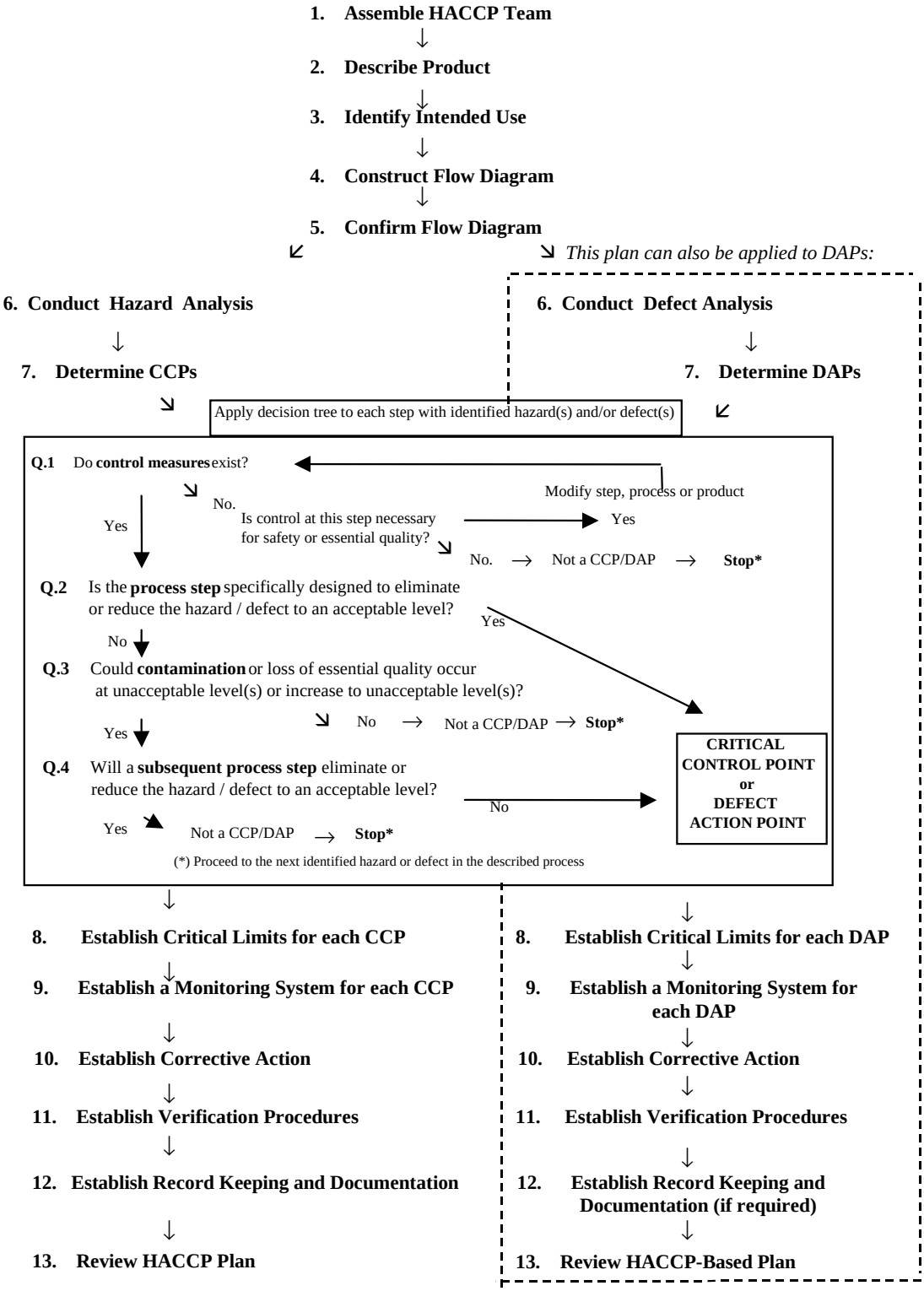

Figure 5.1 Summary of how to develop a HACCP and Defect Analysis system

HACCP is an important management tool, which can be used by operators for ensuring safe, efficient processing. It must also be recognised that personnel training is essential in order that HACCP will be effective. In following HACCP principles, users are requested to list all of the hazards that may be reasonably expected to occur for each product type at each step or procedure in the process from point of harvest, during unloading, transport, storage or during processing, as appropriate to the process defined.

It is important that HACCP principles be considered on a specific basis to reflect the risks of the operation.

5.2 DEFECT ACTION POINT ANALYSIS

Since the Code is intended to cover not only those hazards associated with safety but to include other aspects of production including the essential product quality, composition and labelling provisions as described in product standards developed by the Codex Alimentarius Commission, not only are critical control points (CCP) described but also defect action points (DAP) are included in the Code. The HACCP principles may be applied to the determination of a DAP, with quality instead of safety parameters being considered at the various steps.

5.3 APPLICATION

Each aquaculture, molluscan shellfish, and fish processing facility should ensure that the provisions of the appropriate Codex standards are met. To accomplish this, each facility should implement a food safety management system based on HACCP principles and should at least consider a similar approach to defects, both of which are described in this code. Prior to the application of HACCP to any segment of the growing, handling and processing chain of fish and fishery products, that segment must be supported by a pre-requisite programme based on good hygienic practice (see Section 3). It should be noted that parts of the pre-requisite programme may be classified as a CCP or DAP within a particular process.

The food management system developed should indicate responsibility, authority and the interrelationships of all personnel who manage, perform and verify work affecting the performance of such systems. It is important that the collection, collation and evaluation of scientific and technical data should be carried out by a multi-disciplinary team. Ideally, a team should consist of people with the appropriate level of expertise together with those having a detailed knowledge of the process and product under review. Examples of the type of personnel to include on the team are the processing facility manager, a microbiologist, a quality assurance/quality control specialist, and others such as buyers, operators, etc., as necessary. For small-scale operations, it may not be possible to establish such a team and therefore external advice should be sought.

The design of this programme should identify critical control points in the operation where the processing facility or product will be inspected, the specification or standard to be met, the monitoring frequency and sampling plan used at the critical control point, the monitoring system used to record the results of these inspections and any corrective action when required. A record for each critical control point that demonstrates that the monitoring procedures and corrective actions are being followed should be provided. The records should be maintained as verification and evidence of the plant's quality assurance programme. Similar records and procedures may be applied to DAPs with the necessary degree of record keeping. A method to identify, describe, and locate the records associated with HACCP programmes should be established as part of the HACCP programme.

Verification activities include the application of methods; procedures (review/audit) and tests in addition to those used in monitoring to determine:

- the effectiveness of the HACCP or DAP plan in delivering expected outcomes i.e. validation;
- compliance with the HACCP or DAP plan, e.g. audit/review;
- whether the HACCP or DAP plan or its method of application need modification or revalidation."

Table 5.1 A product description for Canned Tuna in Salted Water

	Objective	Example
Product name(s)	Identify the species and method of processing.	Canned tuna in salted water
Source of raw material	Describe the origin of the fish	Yellowfin tuna caught by purse seine in the Gulf of Guinea Whole brine frozen
Important final product characteristics	List characteristics that affect product safety and essential quality, especially those that influence microbial flora.	Compliance with Codex Standard Canned Tuna and Bonito; 'low-acid' food; can seal integrity.
Ingredients	List every substance added during processing. Only ingredients approved by the official agency having jurisdiction may be used.	water, salt
Packaging	List all packaging materials. Only materials approved by the official agency having jurisdiction may be used.	Container in coated chromium steel, capacity : 212 ml, total net weight : 185 g, fish weight : 150 g Traditional opening
How the end product is to be used	State how the final product is to be prepared for serving, especially whether it is ready to eat.	Ready to eat
Shelf life (if applicable)	State the date when the product can be expected to begin to deteriorate if stored according to instructions.	3 years
Where the product will be sold	Indicate the intended market. This information will facilitate compliance with target market regulations and standards.	Domestic retail market.
Special labelling instructions	List all instructions for safe storage and preparation	"Best before the date shown on label."
Special distribution control	List all instructions for safe product distribution.	None

The implementation of HACCP principles is better identified in the Logic Sequence for implementation of HACCP (Figure 5.1).

This flow chart is for illustrative purposes only. For in-factory HACCP implementation a complete and comprehensive flow chart has to be drawn up for each process.

References correspond to relevant Sections of the Code.

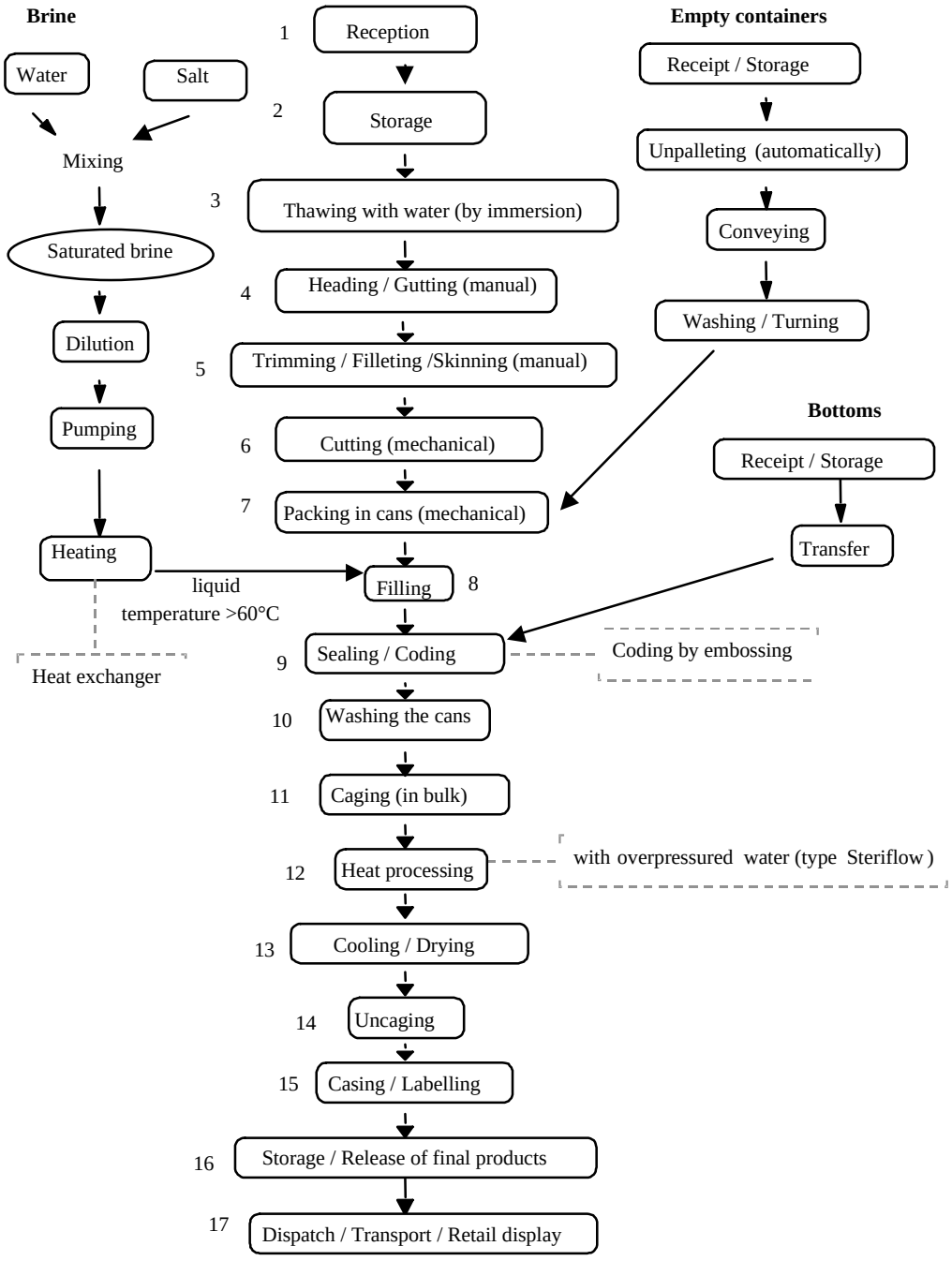

Figure 5.2 Example of a flow diagram for a canned tuna fish processing line

5.3.1 Describe Product

In order to gain a greater understanding and knowledge of the product under review, a thorough product description evaluation should be carried out. This exercise will facilitate in the identification of potential hazards or defects. An example of the type of information used in describing a product is given in Table 5.1.

5.3.2 Flow Diagram

For Hazard and Defect Analysis, it is necessary to carefully examine both the product and the process and produce a flow diagram(s). Any flow diagram should be as simple as possible. Each step in the process, including process delays from the selection of raw materials through to the processing, distribution, sale and customer handling, should be clearly outlined in sequence with sufficient technical data to avoid ambiguity. If a process is too complex to be easily represented by a single flow diagram, then it can be sub-divided into constituent parts, provided the relationship between each of the parts is clearly defined. It is helpful to number and label each processing step for ease of reference. An accurate and properly constructed flow diagram will provide the multi-disciplinary team with a clear vision of the process sequence. Once CCPs and DAPs have been identified they can be incorporated into the flow diagram specific for each processing facility. Figure 5.2 represents an example of a flow diagram for a canned tuna fish processing line. For examples of different processes see Figures 6.X to 15.Y in the individual processing sections of the code.

5.3.3 Identification of Hazards and Defects

It cannot be stressed enough that each individual facility should gather sound scientific and technical data for each step, from primary production, processing, manufacture, storage and distribution until the point of consumption. The assembly and nature of this information should be such to ensure that the multi-disciplinary team is able to identify and list, at each step of the process, all potential hazards and defects that, in the absence of control measure(s), may likely result in the production of an unacceptable food. Table 5.2 summarises possible pre-harvest and harvest safety hazards in incoming fish & molluscan shellfish and Table 5.3 summarises possible safety hazards introduced in the post harvest and further processing of fish & molluscan shellfish.

It is important to identify potential hazards and defects in the operation from the point of view of plant construction, equipment used in the plant and hygienic practices, including those which may be associated with the use of ice and water. This is covered by the pre-requisite programme and is used to denote hazards that are common to almost any point in the process.

Table 5.2 Possible Pre-harvest and Harvest Hazards in Incoming Fish & Shellfish

Biological		Chemical		Physical	
Parasites:	Parasites of public health significance: Trematodes, Nematodes, Cestodes	**Agro-chemicals:**	Pesticides, herbicides, algicides, fungicides, anti-oxidants (added in feeds);	**Critical Foreign Matter**	fish hooks
Pathogenic bacteria:	Salmonella, *E. coli* O157, Shigella, Vibrio cholerae, Vibrio parahaemolyticus, Vibrio vulnificus,	**Veterinary drug residues:**	Antibiotics, growth promoters (hormones), other feed additives from animal manures.		
Enteric Viruses:	Norwalk virus	**Heavy metals:**	Metals leached from marine sediments and soil, from industrial wastes, from sewage or animal manures		
		Biological toxins:	Tetrodotoxin; Ciguatoxin, [Paralytic Shellfish Poisoning (PSP), Diarrheic Shellfish Poisoning (DSP), Neurotoxic Shellfish Poisoning (NSP), Amnesic Shellfish Poisoning (ASP)]		
		Miscellaneous:	Petroleum		

Table 5.3 Possible Hazards Introduced in the Post Harvest and Further Processing of Fish & Shellfish*.

Biological		Chemical		Physical	
Pathogenic bacteria:	Listeria monocytogenes, Clostridium botulinum, Staphylococcus aureus	**Agro-chemicals:**	Disinfectants, Sanitizers or Lubricants (Misapplication)	**Critical Foreign Matter**	Metal fragments; hard or sharp objects
Enteric Viruses:	Hepatitis A, Rotovirus		Disinfectants, Sanitizers or Lubricants (non-approved)		
		Biological toxins:	Scombrotoxin, Staph. Enterotoxin, botulinum toxin		
		Ingredients and Additives:	Misapplication and non-approved		

Note: For biological hazards, environmental factors (for example: temperature, oxygen availability, pH and A_w) play a major role in their activity and growth, therefore the type of processing the fish will undergo, and the its subsequent storage, will determine their risk and inclusion in a food safety management plan. In addition, some hazards may show a certain degree of overlap between the two levels of operation through their existence and manifestation into the water supply.

* For hazards relating to specific products see the relevant processing section.

For the example on canned tuna developed in this section, the following essential potential hazards can be identified:

Table 5.4: An example of essential potential hazards for canned tuna

	In raw materials (frozen tuna)	During processing or storage or transportation
Biological	Presence of *Cl. botulinum*, Presence of histamine	Contamination by *Cl. botulinum,* Growth of *Cl. Botulinum,* Survival of spores of *Cl. botulinum*, Contamination and growth of *Staphylococcus aureus* Microbial recontamination after heat processing Production of histamine during processing, Production of staphylotoxin
Chemical	Presence of heavy metals	Recontamination by metals coming from the cans Recontamination by cleaning agents, by the brine, by mechanical grease, …
Physical	Unlikely	Recontamination during processing (pieces of knives, by the cans, …)

For the example on canned tuna developed in this section, the following essential potential defects can be identified:

Table 5.5 An example of essential potential defects of canned tuna

	In raw materials (frozen tuna)	During processing or storage or transportation of cans
Biological	decomposition	decomposition, survival of micro-organisms responsible of decomposition, …
Chemical		oxidation during storage, …
Physical		objectionable matters (viscera, scales, skin, …), formation of struvite crystals, container defects (panelled container, …), …
Others	species substitution	abnormal flavours, incorrect weight, incorrect coding, incorrect labelling

5.3.3.1 Hazards

It is equally important to consider, naturally occurring safety hazards in the environment from which fish are harvested. In general, risks to consumer health from seafoods captured in unpolluted marine environments are low, provided these products are handled in line with principles of Good Manufacturing Practice. However, as with all foods, there are some health risks associated with the consumption of certain products, which may be increased when the catch is mishandled after harvest. Fish from some marine environments, such as tropical reef fish, can pose a consumer risk from natural marine toxins, such as ciguatera. The risk of adverse health effects from certain hazards might be increased under certain circumstances in products from aquaculture when compared with fish from the marine environment. The risks of foodborne disease associated with products from aquaculture are related to inland and coastal ecosystems, where the potential of environmental contamination is greater when compared to capture fisheries. In some parts of the world, where fish are consumed either raw or partially cooked, there is an increased risk of foodborne parasitic or bacterial disease. In order to perform a hazard analysis as part of the process of developing a HACCP plan, fish processors must have scientific information on potential hazards associated with raw material and products for further processing.

5.3.3.2 Defects

Potential defects are outlined in the essential quality, labelling and composition requirements described in the Codex Standards listed in Appendix XII. Where no Codex Standard exists regard should be made to national regulations and/or commercial specifications.

End product specifications outlined in Appendices II - XI, describe optional requirements which are intended to assist buyers and sellers in describing those provisions which are often used in commercial transactions or in designing specifications for final products. These requirements are intended for voluntary application by commercial partners and not for application by governments.

5.3.4 Significance of Hazards and Defects

One of the most important activities, which must be performed in a processing facility as a part of the food safety management system, is to determine if an identified hazard(s) or defect(s) at each step is significant. The judgement of significance should at least consider the source of introduction or

manifestation of the hazard or defect, the risk (likelihood of occurrence) and the severity of their effect. Where significant hazard(s) and/or defects have been identified, control measures to reduce or eliminate their potential occurrence must be considered. It is possible to control a hazard or a defect with more than one control measure.

In the example on canned tuna developed in this section, *Cl. botulinum* is a significant hazard at the processing step n° 12 « heat processing »:

Table 5.6 An example of the significant hazard survival of *Cl. Butulinum* at the step of heat processing for canned tuna

Processing step	Potential hazard	Is the potential hazard significant?	Justification	Control measures
12. Heat processing	Survival of spores of Cl. botulinum	Yes	A non-efficient heat processing may result in survival of C. botulinum spores and therefore, possibility of toxin production.	Training and qualification of personnel Working procedures and instructions establishing all parameters (product initial t°, t° levels, back-pressure, …) Maintenance procedures and instructions of retorts, control and recording equipment ; calibration, verification and standardisation of measurement equipment [Cleaning and disinfecting procedures and instructions (sprinkling openings, water circuit …)]

In the example on canned tuna developed in this section, rancidity is a significant defect at the processing step n° 2 « Storage of frozen tuna »:

Table 5.7: An example of the significant defect rancidity during the storage of frozen tuna for canned tuna.

Processing step	Potential defect	Is the potential defect significant?	Justification	Control measures
2. Storage of frozen tuna	Persistent and distinct objectionable odours or flavours indicative of rancidity	Yes	An inadequate storage (too long or with temperature fluctuations) of frozen tuna may result in oxidation of the flesh. This defect cannot be eliminated by further processing steps.	Controlled temperature in the storage premises Stock management procedure Maintenance procedure of the refrigeration system Personnel training and qualification

Table 5.8 A schematic example of a hazard analysis with corresponding control measures and the application of the Codex decision tree for the determination of a critical control point at processing step 12 of the example process as set out in Figure 5.2.

Processing Step N° 12 **Heat processing**		**Application of Codex Decision Tree**			
Potential Hazards	Control Measures				
Survival of spores of *Clostridium botulinum*	Training and qualification of personnel Working procedures and instructions establishing all parameters (product initial t°, t° levels, back-pressure, …) Maintenance procedures and instructions of retorts, control and recording equipment ; calibration, verification and standardisation of measurement equipment Cleaning and disinfecting procedures and instructions (sprinkling openings, water circuit …)	**Q1**: Do control measures exist? **If yes** – go to Q2. **If no** – consider whether control measures are available or necessary within the process. Proceed to next identified hazard.	**Q2**: Is the step specifically designed to eliminate or reduce the likely occurrence of *Cl. botulinum* to an acceptable level? **If yes** – this step is a CCP. **If no** – go to Q3.	**Q3**: Could contamination occur in excess of acceptable levels or could these increase to unacceptable levels? **If yes** – go to Q4. **If no** – not a CCP.	**Q4**: Will a subsequent step eliminate or reduce the hazard to an acceptable level? **If yes** – not a CCP. **If no** – CCP. *What about consideration of a previous step?*
		A: Yes: a heat processing procedure (schedule, method) is clearly defined.	**A**: Yes, this step was specifically designed to eliminate spores.		
		Decision: Processing step N°12 « Heat processing » is a **Critical Control Point**			

5.3.5 Determine Critical Control Points and Defect Action Points

A thorough and concise determination of Critical Control Points and Defect Action Points in a process is important in ensuring food safety and compliance with elements related to essential quality, composition and labelling provisions of the appropriate Codex standard. The Codex decision tree (Figure 5.1, step 7) is a tool , which can be applied, to the determination of CCPs and a similar approach may be used for DAPs. Using this decision tree, a significant hazard or defect at a step can be assessed through a logical sequence of questions. Where CCPs and DAPs have been identified at a step, that point in the process must be

controlled to prevent, reduce or eliminate the likely occurrence of the hazard or defect to an acceptable level. For illustrative purposes, an example of the application of the Codex decision tree to a hazard and defect using the canned tuna fish processing line, are shown in Tables 5.4 & 5.5, respectively.

Table 5.9 A schematic example of a defect analysis with corresponding control measures and the application of the Codex decision tree for the determination of a defect action point at processing step 2 of the example process as set out in Figure 5.2.

Processing Steps N°2 **Storage of frozen tuna**		**Application of Codex Decision Tree**			
Potential Defects	Control Measures				
Persistent and distinct objectionable odours or flavours indicative of rancidity	Controlled temperature in the storage premises Stock management procedure Maintenance procedure of the refrigeration system Personnel training and qualification	**Q1**: Do control measures exist? **If yes** – go to Q2. **If no** – consider whether control measures are available or necessary within the process. Proceed to next identified hazard.	**Q2**: Is the step specifically designed to eliminate or reduce the likely occurrence of rancidity to an acceptable level? **If yes** – this step is a DAP. **If no** – go to Q3.	**Q3**: Could rancidity occur in excess of acceptable levels or could it increase to unacceptable levels? **If yes** – go to Q4. **If no** – not a DAP.	**Q4**: Will a subsequent step eliminate rancidity or reduce its likely occurrence to acceptable level? **If yes** – not a DAP. **If no** – DAP. *What about consideration of a previous step?*
		A: Yes, the storage temperature is controlled, procedures exist	**A**: No	**A** : Yes, if the storage time is too long and/or the storage temperature is too high	**A** : No
		Decision: Processing Step N°2 « Storage of frozen tuna » is a **Defect Action Point**			

5.3.6 Establish Critical Limits

For each CCP and DAP, critical limits for the control of the hazard or defect must be specified. For any given hazard or defect, it may be necessary to have more than one critical limit designated for each control measure. The establishment of critical limits should be based on scientific evidence and validated by appropriate technical experts to ensure its effectiveness in controlling the hazard or defect. Table 5.10 illustrates critical limits for a CCP and a DAP using a canned tuna fish processing line as an example.

5.3.7 Establish Monitoring Procedures

Any monitoring system developed by the multi-disciplinary team should be designed to detect loss of control at a CCP or DAP relative to its critical limit. The monitoring activity of a CCP or DAP should be documented in a concise fashion providing details regarding the individual responsible for the observation or measurement, the methodology used, the parameter(s) being monitored and the frequency of the inspections. The complexity of the monitoring procedure should also be carefully considered. Considerations include optimising the number of individuals performing the measurement and selection of appropriate methods, which will produce rapid results (for example: time, temperature, pH). For CCPs, records of monitoring should be acknowledged and dated by a responsible person for verification.

Because each process is unique for each fish product, it is possible only to present, for illustrative purposes, an example of a monitoring approach for a CCP and DAP using the canned tuna fish processing line. This example is shown in Table 5.10.

5.3.8 Establish Corrective Action

An effective HACCP or DAP plan is anticipatory by nature and it is recognised that corrective action may be necessary from time to time. A documented corrective action program should be established to deal with instances where the critical limit has been exceeded and loss of control has occurred at a CCP or DAP. The goal of this plan is to ensure that comprehensive and specific controls are in place and can be implemented to prevent the affected lot(s) from reaching the consumer. Of equal importance, is an assessment by plant management and other appropriate personnel to determine the underlying reason(s) why control was lost. For the latter, a modification to HACCP and DAP plans may be necessary. A record of investigation results and actions taken should be documented by a responsible person for each instance where loss of control occurred at a CCP or DAP. The record should demonstrate that control of the process has been re-established. An example of a corrective action approach for a CCP and DAP using a canned tuna fish processing line is illustrated in Table 5.10.

5.3.9 Establish Verification Procedures

A processing facility should establish a verification procedure to periodically assess if the HACCP and DAP plans are complete, implemented and working properly. This step will help determine if CCPs and DAPs are under control. Examples of verification activities include: a paper review of HACCP system, its procedures and records; review of corrective actions and product disposition actions when critical limits are not met and validation of established critical limits. The latter is particularly important when an unexplained system failure has occurred, when a significant change to the process, product or packaging is planned or when new hazards or defects have been identified. Observation, measurement and inspection activities within the processing facility should also be incorporated as a part of the verification procedure, where applicable. Verification activities may be carried out by qualified individuals within the company, third party experts or officials of regulatory agencies. The verification frequency of the HACCP and DAP plans should be sufficient to provide assurance that their design and implementation will prevent food safety problems as well as issues associated with essential quality, composition and labelling provisions of the appropriate Codex standard to enable problems to be detected and dealt with in a timely manner. For illustration purposes, an example of a verification procedure approach for a CCP and DAP using the canned tuna fish processing line is shown in Table 5.10.

5.3.10 Establish Record Keeping Procedures

A current, accurate and concise record keeping system will greatly enhance the effectiveness of a HACCP program and facilitate in the verification process. Examples of the elements of a HACCP plan that should be documented have been provided in this section for illustrative purposes. Inspection and corrective action records should be practical and collect all the appropriate data necessary to demonstrate "real-time" control or deviation control of a CCP. Records are recommended but not required for a DAP except where a loss of control occurred. For illustration purposes, an example of a record keeping approach for a CCP and DAP using the canned tuna fish processing line is shown in Table 5.10.

Table 5.10 An example of the results of the application of HACCP principles to the two specific steps in the canned tuna process (Tables 4.4 & 4.5), for a CCP & a DAP, respectively.

CCP				
Processing Step No. 12 : Heat Processing Hazard: Survival of spores of *Clostridium botulinum*				
Critical Limit	Monitoring Procedure	Corrective Action	Records	Verification
The time-temperature profile indicated in the validated sterilisation schedule appropriate for the particular product and can size.	**Who**: Qualified person assigned to heat processing **How**: Checks of sterilisation schedule and other factors [Stability tests] **What**: Heat and time processing parameters **Frequency**: every batch	What: Personnel retraining New heat processing or batch destruction Corrective maintenance of equipment Hold product until safety can be evaluated. Who: Appropriate trained personnel	Records of heat processing parameters (schedule, temperature diagrams, …) Stability tests results Maintenance records	On-site audit Review of monitoring and corrective action reports [Microbiological testing]

DAP				
Processing Step No. 2 : Storage of frozen tuna Defect: Persistent and distinct objectionable odours or flavours indicative of rancidity				
Critical Limit:	Monitoring Procedure	Corrective Action	Records	Verification
Number of rancid sample units cannot exceed acceptance number of established sampling plan. Storage temperature and time.	**Who**: Appropriate trained personnel **How** : Organoleptic examination Chemical tests Checking of the storage premise temperature Checking of stock forms **What**: fish quality and acceptability based on product Codex standard. **Frequency**: as required	What: Application of an intensified monitoring According to the results of this intensified inspection, immediate processing, sorting or reject of frozen tuna exceeding the critical limits. Adjust storage temperature. Personnel retraining Who: Appropriate trained personnel	Analysis results Stock forms Temperature records	On-site audit Review of monitoring and corrective action reports

Conclusion

Section 5 has demonstrated the principles of HACCP and how they should be applied to a process to ensure safe product. The same principles can be used to determine the points in a process where it is necessary to control defects. Since every processing facility and each processing line is different it is possible within this Code only to demonstrate the types of potential hazards and defects that must be considered. Furthermore, because of the nature of the significance of hazards and defects it is not possible to categorically determine which steps in a process will be CCPs and/or DAPs without actually assessing the process and its environment. The example of the canned tuna fish processing line is intended to illustrate how to apply the principles and why a HACCP and DAP plan will be unique to each operation.

The remaining Sections in the Code concentrate on fish and fishery product processing and attempt to illustrate the potential hazards and defects at the various stages in a wide range of processes. In developing a HACCP or DAP plan it will be necessary to consult Sections 3 & 5 before turning to the appropriate processing section for specific advice. It should also be noted that Section 6 refers to processing of fresh, frozen and minced fish and will provide useful guidance for most fish processing operations.

SECTION 6 PROCESSING OF FRESH, FROZEN AND MINCED FISH

In the context of recognising controls at individual processing steps, this section provides examples of potential hazards and defects and describes technological guidelines, which can be used to develop control measures and corrective action. At a particular step only the hazards and defects, which are likely to be introduced or controlled at that step, are listed. It should be recognised that in preparing a HACCP and/or DAP plan it is essential to consult Section 5 which provides guidance for the application of the principles of HACCP and DAP analysis. However, within the scope of this Code of Practice it is not possible to give details of critical limits, monitoring, record keeping and verification for each of the steps since these are specific to particular hazards and defects.

In general, the processing of fresh, frozen fish and minced fish, will range in sophistication. In its simplest form, the processing of fresh and frozen fish may be presented in a raw state such as dressed, fillets, and

minced to be distributed in markets and institutions or used in processing facilities. For the latter, the processing of fresh, frozen and minced fish is often an intermediate step to the production of value added products (for example, smoked fish as described in section 12, canned fish as described in section 13, frozen breaded or battered fish as described in section 15). Traditional methods often prevail in the design of a process. However, modern scientific food technology is having an increasingly important role in enhancing the preservation and shelf-stability of a product. Regardless of the complexity of a particular process, the fabrication of the desired product relies on the consecutive execution of individual steps. As stressed by this Code, the application of appropriate elements of the pre-requisite program (Section 3) and HACCP principles (Section 5) at these steps will provide the processor with reasonable assurance that the essential quality, composition and labelling provisions of the appropriate Codex standard will be maintained and food safety issues controlled.

The example of the flow diagram (Figure 6.1) will provide guidance to some of the common steps involved in a fish fillet preparation line, and three examples of final product types: modified atmosphere packaging (MAP), minced and frozen fish. As in the further processing of fresh fish in a MAP product, or minced or frozen fish, the section labelled “Fish Preparation” is used as the basis for all the other fish processing operations (Sections 7-15), where appropriate.

This flow chart is for illustrative purposes only. For in-factory HACCP implementation a complete and comprehensive flow chart has to be drawn up for each process.

References correspond to relevant Sections of the Code.

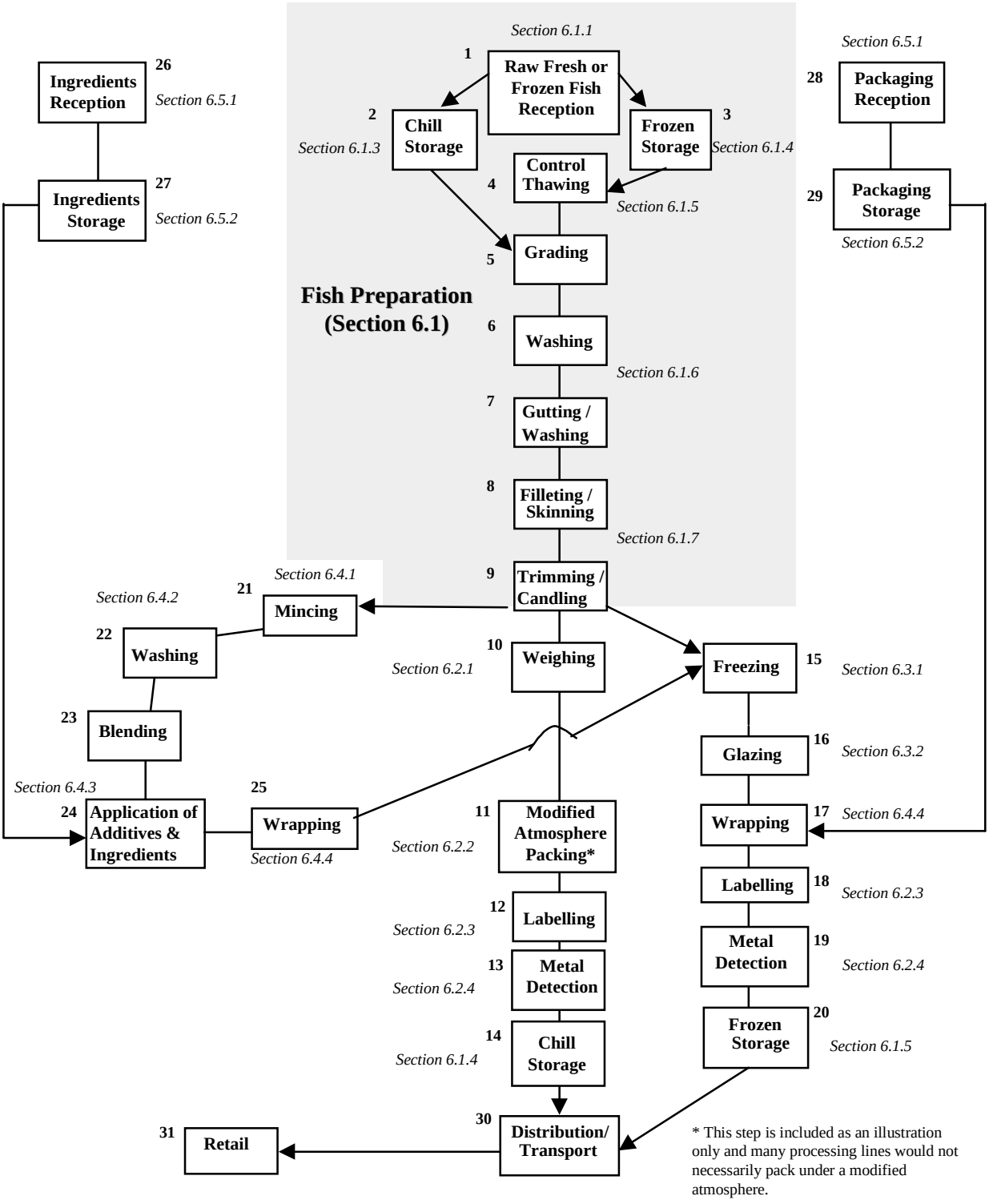

Figure 6.1 Example of a flow chart of a fish fillet preparation line, including MAP, mincing and freezing operations

6.1 FINFISH PREPARATION

The hygienic conditions and technical manner in which fish are prepared is similar and is not influenced greatly by its intended purpose (for direct distribution or for further processing). However, variations will exist in the form in which the fresh fish flesh is to be utilised. The forms may include, but not limited to, dressed, fillets or steaks.

6.1.1 Raw, Fresh or Frozen Fish Reception (Processing Steps 1)

Potential Hazards: *Microbiological pathogens and biochemical toxins, chemical (including veterinary drug residues) and physical contamination, toxic species, viable parasites.*

Potential Defects: *Decomposition, parasites, physical contamination*

Technical Guidance:

- for raw fish material, product specifications could include the following characteristics:
  - organoleptic characteristics such as appearance, odour, texture, etc;
  - chemical indicators of decomposition and/or contamination, for example, TVBN, histamine, heavy metals, pesticide residues, nitrates etc;
  - microbiological criteria, in particular for intermediate raw materials, to prevent the processing of raw material containing microbial toxins;
  - foreign matter;
  - physical characteristics such as size of fish;
  - species homogeneity.
- training in species identification and communication in product specification should be provided to fish handlers and appropriate personnel to ensure a safe source of incoming fish where written protocols exist. Of special consideration, are the reception and sorting of fish species that poses a risk of biotoxins such as ciguatoxin in large carnivorous tropical and sub-tropical reef fish or scombrotoxin in scombroid species or parasites;
- skills should be acquired by fish handlers and appropriate personnel in sensory evaluation techniques to ensure raw fish meet essential quality provisions of the appropriate Codex standard;
- fish requiring gutting on arrival at the processing facility should be gutted efficiently, without undue delay and with care to avoid contamination (see Section 6.1.5 - Washing & Gutting);
- fish should be rejected if it is known to contain harmful, decomposed or extraneous substances, which will not be reduced or eliminated to an acceptable level by normal procedures of sorting or preparation.

6.1.1.1 Sensory Evaluation of Fish

The best method of assessing the freshness or spoilage of fish is by sensory evaluation techniques. It is recommended that appropriate sensory evaluation charts be used to verify the acceptability of fish and to eliminate fish showing loss of essential quality provisions of the appropriate Codex standards. As an example, fresh white fish species are considered unacceptable when showing the following characteristics:

Skin / Slime:	dull, gritty colours with yellow brown dotting slime.
Eyes:	Concave, opaque, sunken discoloured.
Gills:	grey – brown or bleached, slime opaque yellow, thick or clotting.
Odour:	flesh odour amines, ammonia, milky lactic, sulphide, faecal, putrid, rancid.

6.1.2 Chilled Storage (Processing Steps 2 & 14)

Potential Hazards: *Microbiological pathogens and biochemical toxins.*

Potential Defects: *Decomposition, physical damage.*

Technical Guidance:

- fish should be moved to the chill storage facility without undue delay;
- the facility should be capable of maintaining the temperature of the fish between [0ºC - +4ºC];
- the chill room should be equipped with a calibrated indicating thermometer. Fitting of a recording thermometer is strongly recommended;
- stock rotation plans should ensure proper utilisation of the fish;

- the fish should be stored in shallow layers and surrounded by sufficient finely divided ice;
- fish should be stored such that damage will be prevented from over-stacking or over-filling of boxes;
- fish should be rejected if known to contain harmful, decomposed or extraneous substances, which will not be eliminated or reduced to an acceptable level by normal procedures of sorting or preparation. An appropriate assessment should be carried out to determine the reason(s) for loss of control and the HACCP or DAP plan should be modified where necessary;
- where appropriate replenish ice supply on the fish or alter temperature of the room.

6.1.3 Frozen Storage (Processing Steps 3 & 20)

Potential Hazards: *Unlikely.*

Potential Defects: *Dehydration, rancidity, loss of nutritional quality*

Technical Guidance:

- the facility should be capable of maintaining the temperature of the fish at or colder than -18ºC, and with minimal temperature fluctuations;
- the store should be equipped with a calibrated indicating thermometer. Fitting of a recording thermometer is strongly recommended;
- a systematic stock rotation plan should be developed and maintained;
- product should be glazed and/or wrapped to protect it from dehydration;
- fish should be rejected if known to contain defects, which subsequently cannot be reduced or eliminated to an acceptable level by re-working. An appropriate assessment should be carried out to determine the reason(s) for loss of control and the DAP plan modified where necessary.

6.1.4 Control Thawing (Processing Step 4)

Potential Hazards: *Microbiological pathogens and biochemical toxins*

Potential Defects: *Decomposition*

Technical Guidance:

- the thawing method should be clearly defined and should address the time and temperature of thawing, temperature measuring instrument used and placement of device for measurement. The thawing schedule (time and temperature parameters) should be carefully monitored. Selection of the thawing method should take into account in particular the thickness and uniformity of size of the products to be thawed;
- thawing time and temperature and fish temperature critical limits should be selected so as to control the development of micro-organisms, histamine, where high risk species are concerned or persistent and distinctive objectionable odours or flavours indicative of decomposition or rancidity;
- where water is used as the thawing medium, it should be of potable quality;
- where recycling of water is used, care should be taken to avoid the build up of microorganisms;
- where water is used, circulation should be sufficient to produce even thawing;
- during thawing, according to the method used, products should not be exposed to excessively high temperatures;
- particular attention should be paid to controlling condensation and drip from the fish. An effective drainage should be made;
- after thawing, fish should be immediately processed or refrigerated and kept at the adequate temperature (temperature of melting ice);
- fish should be rejected if known to contain harmful, decomposed or extraneous substances, which will not be eliminated or reduced to an acceptable level by normal procedures of sorting or preparation. An appropriate assessment should be carried out to determine the reason(s) for loss of control and the HACCP or DAP plan should be modified where necessary;
- the thawing schedule should be reviewed as appropriate and amended where necessary.

6.1.5 Washing and Gutting (Processing Steps 6 & 7)

Potential Hazards: *Microbiological pathogens and biochemical toxins*

Potential Defects: *Presence of viscera, bruising, off-flavours, cutting faults.*

Technical Guidance:

- gutting is considered complete when the intestinal tract and internal organs have been removed;
- an adequate supply of clean sea water or potable water should be available for washing of:
  - whole fish to remove foreign debris and reduce bacterial load prior to gutting;
  - gutted fish to remove blood and viscera from the belly cavity;
  - surface of fish to remove any loose scales;
  - gutting equipment and utensils to minimise build-up of slime and blood and offal;
- depending on the vessel or processing facility product flow pattern and where a prescribed critical limit for staging time and temperature regime has been established for the control of histamine or a defect, the gutted fish should be drained and well iced or appropriately chilled in clean containers and stored in specially designated and appropriate areas within the processing facility;
- separate and adequate storage facilities should be provided for the fish roe, milt and livers, if these are saved for later utilisation.

6.1.6 Filleting, Skinning, Trimming and Candling (Processing Steps 8 & 9)

Potential Hazards: *Viable parasites, microbiological pathogens and biochemical toxins, presence of bones.*

Potential Defects: *Parasites, presence of bones, objectionable matter (e.g. skin, scales, etc.), decomposition.*

Technical Guidance:

- to minimise time delays, the design of the filleting line and candling line, where applicable, should be continuous and sequential to permit the uniform flow without stoppages or slow-downs and removal of waste;
- an adequate supply of clean sea water or potable water should be available for washing of:
  - fish prior to filleting or cutting especially fish that have been scaled;
  - fillets after filleting or skinning or trimming to remove any signs of blood, scales or viscera;
  - filleting equipment and utensils to minimise build-up of slime and blood and offal;
  - for fillets to be marketed and designated as boneless, fish handlers should employ appropriate inspection techniques and use the necessary tools to remove bones not meeting Codex standards[4,5] or commercial specifications;
- The candling of skinless fillets by skilled personnel, in a suitable location which optimises the illuminating effect, is an effective technique in controlling parasites (in fresh fish) and should be employed when implicated fish species are being used;
- the candling table should be frequently cleaned during operation in order to minimise the microbial activity of contact surfaces and the drying of fish residue due to heat generated from the lamp;
- where a prescribed critical limit for staging time and temperature regime has been established for the control of histamine or a defect, the fish fillets should be well iced or appropriately chilled in clean containers, protected from dehydration and stored in appropriate areas within the processing facility.

6.2 PROCESSING OF MODIFIED ATMOSPHERE PACKED FISH

This section is designed to augment the processing of fresh fish section with additional operation steps pertaining specifically to the modified atmosphere packing of fish (see also Appendix I).

[4] Codex Standard for Quick Frozen Blocks of Fish Fillet, Minced Fish Flesh and Mixtures of Fillets and Minced Fish Flesh (Codex Stan. 165-1989, Rev.1-1995)

[5] Codex Standard for Quick Frozen Fish Fillets (Codex Stan. 190-1995)

6.2.1 Weighing (Processing Step 10)

Potential Hazards: *Unlikely*

Potential Defects: *Incorrect net weight*

Technical Guidance:

- weigh scales should be periodically calibrated with a standardised mass to ensure accuracy.

6.2.2 Modified Atmosphere Packaging (Processing Step 11)

Potential Hazards: *Subsequent microbiological pathogens and biochemical toxins, physical contamination (metal).*

Potential Defects: *Subsequent decomposition*

Technical Guidance:

The extent to which the shelf-life of the product can be extended by MAP will depend on the species, fat content, initial bacterial load, gas mixture, type of packaging material and, especially important, the temperature of storage. Refer to Appendix I for process control issues in modified atmosphere packaging.

- modified atmosphere packaging should be strictly controlled by:
  - monitoring the gas to product ratio;
  - types and ratio of gas mixtures used;
  - type of film used;
  - type and integrity of the seal;
  - temperature control of product during storage;
- fish flesh should be clear of the seam area;
- packaging material should be inspected prior to use to ensure that it is not damaged or contaminated;
- packaging integrity of the finished product should be inspected at regular intervals by an appropriately trained personnel to verify the effectiveness of the seal and the proper operation of the packaging machine;
- following sealing, MAP products should be transferred carefully and without undue delay to chilled storage.

6.2.3 Labelling (Processing Steps 12 & 18)

Potential Hazards: *Unlikely*

Potential Defects: *Incorrect labelling*

Technical Guidance:

- prior to their application, labels should be verified to ensure that all information declared meet, where applicable, the Codex General Standard for the Labelling of Pre-packaged Foods[6], labelling provisions of the appropriate Codex Standard for products and/or other relevant national legislative requirements;
- in many cases it will be possible to re-label incorrectly labelled products. An appropriate assessment should be carried out to determine the reason(s) for incorrect labelling and the DAP plan should be modified where necessary;

6.2.4 Metal Detection (Processing Steps 13 & 19)

Potential Hazards: *Metal contamination*

Potential Defects: *Unlikely*

Technical Guidance:

- it is important that line speeds are adjusted to allow for the proper functioning of a metal detector;
- routine procedures should be initiated to ensure product rejected by the detector is investigated as to the cause of the rejection;

[6] Codex General Standard for the Labelling of Pre-packaged Foods (Codex Stan 1-1985, Rev. 2-1999)

- metal detectors, if used, should be periodically calibrated with a known standard to ensure proper operation;

6.3 PROCESSING OF FROZEN FISH

This section is designed to augment the processing of fresh fish section with additional operation steps pertaining specifically to the processing of frozen fish.

6.3.1 Freezing Process (Processing Step 15)

Potential Hazards: *Viable parasites.*

Potential Defects: *Texture deterioration, development of rancid odours*

Technical Guidance:

The fish product should be subjected to a freezing process as quickly as possible since unnecessary delays before freezing will cause temperature of the fish products to rise, increasing the rate of quality deterioration and reducing shelf-life due to the action of micro-organisms and undesirable chemical reactions.

- a time and temperature regime for freezing should be established and should take into consideration the freezing equipment and capacity; the nature of the fish product including thermal conductivity, thickness, shape and temperature and the volume of production, to ensure that the range of temperature of maximum crystallisation is passed through as quickly as possible;
- the thickness, shape and temperature of fish product entering the freezing process should be as uniform as possible;
- processing facility production should be geared to the capacity of freezers;
- frozen product should be moved to the cold storage facility as quickly as possible;
- the core temperature of the frozen fish should be monitored regularly for completeness of the freezing process;
- frequent checks should be made to ensure correct operation of freezing;
- fish should be rejected if known to contain harmful substances or defects, which subsequently cannot be reduced or eliminated to an acceptable level by re-working. An appropriate assessment should be carried out to determine the reason(s) for loss of control and the HACCP and/or DAP plan should be modified where necessary;
- accurate records of all freezing operations should be kept.

6.3.2 Glazing (Processing Step 16)

Potential Hazards: *Microbiological pathogens and biochemical toxins*

Potential Defects: *Subsequent dehydration, incorrect net weight*

Technical Guidance:

- glazing is considered complete when the entire surface of the frozen fish product is covered with a suitable protective coating of ice and should be free of exposed areas where dehydration (freezer-burn) can occur;
- if additives are used in the water for glazing, care should be taken to ensure its proper proportion and application with product specifications;
- where the labelling of a product is concerned, information on the amount or proportion of glaze applied to a product or a production run should be kept and used in the determination of the net weight which is exclusive of the glaze;
- where appropriate monitoring should ensure that spray nozzles do not become blocked;
- where dips are used for glazing it is important to replace the glazing solution periodically to minimise the bacterial load and build-up of fish protein, which can hamper freezing performance;
- fish should be rejected if known to contain harmful substances or defects, which subsequently cannot be reduced or eliminated to an acceptable level by re-working. An appropriate assessment should be carried out to determine the reason(s) for loss of control and the HACCP and/or DAP plan should be modified where necessary.

6.4 PROCESSING OF MINCED FISH

This section is designed to augment the processing of fresh fish section (prior to mincing) and processing of frozen fish section (after mincing) with additional operation steps pertaining specifically to the processing of minced fish.

6.4.1 Mincing Fish Using Mechanical Separation Process (Processing Step 21)

Potential Hazards: *Microbiological pathogens and biochemical toxins, physical contamination (metal, bones, rubber from separator belt, etc).*

Potential Defects: *Incorrect separation (i.e. objectionable matter), decomposition, presence of bones, parasites.*

Technical Guidance:

- the separator should be fed continuously but not excessively;
- candling is recommended for fish suspected of high infestation with parasites;
- split fish or fillets should be fed to the separator so that the cut surface contacts the perforated surface;
- fish should be fed to the separator in a size that it is able to handle;
- in order to avoid time-consuming adjustments of the machinery and variations in quality of the finished product, raw materials of different species and types should be segregated and processing of separate batches should be carefully planned;
- the perforation sizes of the separator surface as well as the pressure on the raw material should be adjusted to the characteristics desired in the final product;
- the separated residual material should be carefully removed on a continuous or near-continuous basis to the next processing stage;
- temperature monitoring should ensure undue temperature rises of the product are avoided.

6.4.2 Washing of Minced Fish (Processing Step 22)

Potential Hazards: *Microbiological pathogens and biochemical toxins.*

Potential Defects: *Poor colour, poor texture*

Technical Guidance:

- if necessary the mince should be washed and should be adequate for the type of product desired;
- stirring during washing should be carried out with care, but it should be kept as gentle as possible in order to avoid excessive disintegration of the minced flesh which will reduce the yield due to the formation of fines;
- the washed minced fish flesh may be partially de-watered by rotary sieves or centrifugal equipment and the process completed by pressing to appropriate moisture content;
- if necessary, and depending on eventual end-use, the de-watered mince should be either strained or emulsified;
- special attention should be taken to ensure mince being strained is kept cool;
- the resulting waste water should be disposed of in a suitable manner.

6.4.3 Blending and Application of Additives and Ingredients to Minced Fish (Processing Steps 23 & 24)

Potential Hazards: *Physical contamination, non-approved additives and/or ingredients.*

Potential Defects: *Physical contamination, incorrect addition of additives.*

Technical Guidance:

- if fish, ingredients and /or additives are to be added, they should be blended in the proper proportions to achieve the desired sensory quality;
- additives should comply with the requirements of the Codex General Standard for Food Additives;
- the minced fish product should be packaged and frozen immediately after preparation; if it is not frozen or used immediately after preparation it should be chilled.

6.4.4 Wrapping and Packing (Processing Steps 17 & 25)

Potential Hazards: *Unlikely.*

Potential Defects: *Subsequent dehydration, decomposition*

Technical Guidance:

- packaging material should be clean, sound, durable, sufficient for its intended use and of food grade material;

- the packaging operation should be conducted to minimise the risk of contamination and decomposition;
- products should meet appropriate standards for labelling and weights.

6.5 PACKAGING, LABELS & INGREDIENTS

6.5.1 Raw Material Reception – Packaging, Labels & Ingredients (Processing Steps 26 & 28)

Potential Hazards: *Microbiological pathogens biochemical toxins, chemical and physical contamination*

Potential Defects: *Misdescription*

Technical Guidance:

- only ingredients, packaging material and labels complying with the processors' specification should be accepted into the processing facility;
- labels which are to be used in direct contact with the fish should be fabricated of a non-absorbent material and the ink or dye used on that label should be approved by the official agency having jurisdiction;
- ingredients and packaging material not approved by the official agency having jurisdiction should be investigated and refused at reception;

6.5.2 Raw Material Storage - Packaging, Labels & Ingredients (Processing Steps 27 & 29)

Potential Hazards: *Microbiological pathogens, biochemical toxins, chemical and physical contamination.*

Potential Defects: *Loss of quality characteristics of packaging materials or ingredients.*

Technical Guidance:

- ingredients and packaging should be stored appropriately in terms of temperature and humidity;
- a systematic stock rotation plan should be developed and maintained to avoid out of date materials;
- ingredients and packaging should be properly protected and segregated to prevent cross-contamination;
- defective ingredients and packaging should not be used.

[section 7 PROCESSING OF MOLLUSCAN SHELLFISH [to be revised]

7.1 IDENTIFICATION OF HAZARDS

Molluscan shellfish species like oysters, mussels, manilla and hard shell clams can survive for extended periods out of water and can be traded for human consumption as live animals. Other species like cockles can be traded live if carefully handled, but are normally processed. Species not adapted to drying conditions soon die when out of water and are best handled as chilled or processed products.
When spawning it becomes undesirable and in many instances impracticable to trade them as live animals. Stress can induce spawning.

The main hazards known from the production of molluscan shellfish are from sewage contamination of their growing waters, especially when the molluscan shellfish are intended to be eaten raw. Since molluscs are filter feeders they can concentrate pollution until a much higher concentration than the surrounding seawater. The pollution in the growing area is therefore critical for the end product specification and determines the process requirements for further processing. Gastro-enteritis and other serious diseases such as hepatitis can occur as result from sewage contamination like enteric bacterial and/or viral pathogens (Norwalk like viruses, viruses causing hepatitis) or from natural occurring bacterial pathogens (Vibrio spp.) Biotoxins coming from certain toxic algae can cause various forms of serious poisoning like diarrhetic shellfish poisoning (DSP), paralytic shellfish poisoning (PSP), neurotoxic shellfish poisoning (NSP) or amnesic shellfish poisoning (ASP).

To control the hazards coming from the growing area identification and monitoring is very important for molluscan shellfish safety. The identification, classification and monitoring of growing waters is a responsibility for competent authorities. *E.coli*/faecal coliforms are used as an indicator for the possibility of bacterial and viral pathogens although it is known that for especially viruses and for natural occurring bacterial pathogens the indicator is not working effectively. If the biotoxins are found in the shellfish flesh in an hazardous amounts the production area must be closed until toxicological investigation has made clear

that the shellfish meat is free from hazardous amount of biotoxins. Chemical toxins should not be present in amounts so that the calculated dietary intake exceeds the permissible daily intake, or so that the taste of the molluscs may be impaired

Molluscan shellfish from waters subject to relatively low levels of sewage contamination can be made safe by relaying in a suitable growing area or a purification process to reduce the level of bacteria and of viruses if the process is continued long enough, or by a heat treatment to destroy the pathogens. Purification is a short-term process commonly used to reduce low levels of bacterial contamination, but much longer term relaying is required if there is a greater risk of viral contamination.

Especially when the molluscan shellfish need to undergo relaying, purification and /or are meant to be eaten raw (temperature) stress and excessive shocks of the molluscan shellfish are a hazard and must be avoided. This is very important because these molluscan shellfish should be able to function again during purification, relaying or conditioning.
When molluscan shellfish are meant to be processed avoiding stress and excessive shocks is less important.

Mussels, oyster, manila and hard shell clams are considered suitable for purification, cockles can be purified provided they are carefully handled and there is only a short delay between harvesting and purification, but scallops may not be suitable for purification.

Recontamination has to be avoided. Therefore hygienic handling and the use of clean sea water and a good working cleaning and disinfection program is important when handling and/or processing of molluscan shellfish. When out of the water live molluscan shellfish should be kept cool to slow their metabolism and prevent them form drying out. Storage temperature as low as 0°C can cause thermal shock. Blue mussels are an exception and can be kept directly iced. Dead molluscan shellfish held as fresh fishery products, such as scallops are best well iced or otherwise chilled.

This flow chart is for illustrative purposes only. For in-factory HACCP implementation a complete and comprehensive flow chart has to be drawn up for each process.

References to be added to correspond to relevant Sections of the Code.

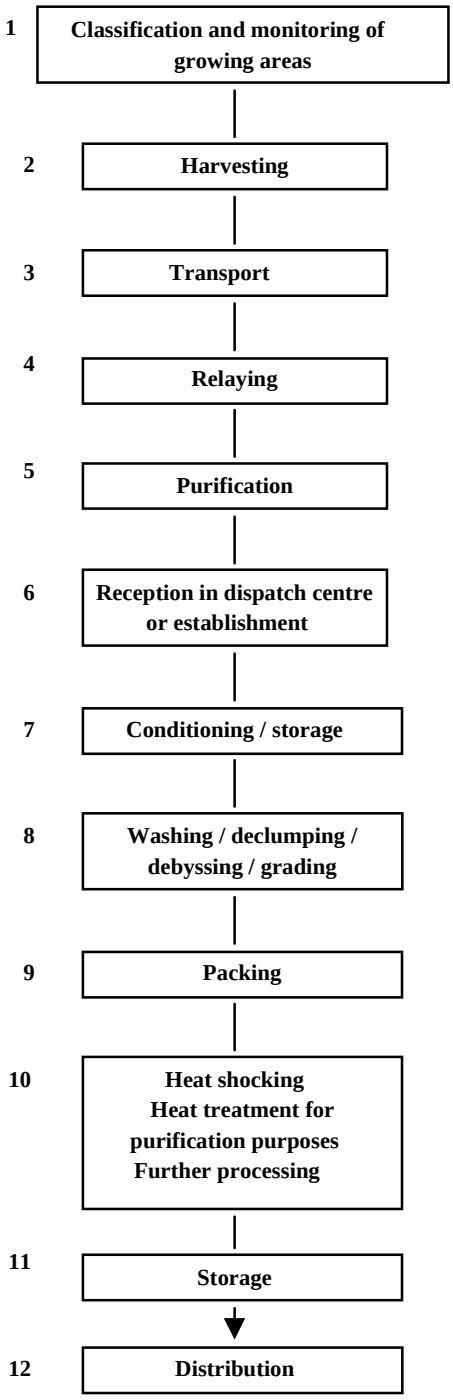

Figure 7.1 Example of a simplified flow diagram for the production of live molluscan shellfish

7.2 GROWING AREA REQUIREMENTS

As already stated, identification of hazards, sewage contamination of the growing waters is critical for the end product specification and determines the process requirements for further processing. To control the hazards coming from the growing area identification and monitoring is very important for molluscan shellfish

safety. The identification, classification and monitoring of growing waters is a responsibility for competent authorities.

There are 5 different types of important hazards coming from the shellfish growing environment:

- enteric bacterial pathogens;
- enteric viral pathogens (Norwalk like viruses, viruses causing hepatitis);
- natural occurring bacterial pathogens (Vibrio species);
- biotoxins (DSP, PSP, NSP, ASP);
- chemical contaminants.

E.coli/faecal coliforms are used as an indicator for the possibility of the first 3 types of hazards, although it is known that for especially viruses and for natural occurring bacterial pathogens the indicator is not working effectively. The contamination with *E.coli*/faecal coliforms in sea water or molluscan shellfish is used in defining a growing area. The present monitoring programs of the US and the EU are examples of good monitoring programs. Both monitoring programs are presented in [ ].

Biotoxins in molluscan shellfish are caused by plankton containing toxins. If the biotoxins are found in the shellfish flesh in an amount higher than the limit in the end product specification the production area must be closed until toxicological investigation has made clear that the shellfish meat is free from hazardous amount of biotoxins.

Chemical toxins should not be present in amounts so that the calculated dietary intake exceeds the permissible daily intake, or so that the taste of the molluscs may be impaired.

Deep water stocks of wild scallops of the type trawled commercially are not considered prone to sewage contamination but can be subject to algal toxins and chemical/toxic substance contamination.

Growing areas should be clearly defined by the competent authority as suitable for harvesting for either:

- direct human consumption;
- relaying in acceptable water or purification in an approved purification centre or other forms of treatment e.g. heat treatment, radiation;
- non-suitable for growing or harvesting molluscan shellfish.

Growing areas providing molluscan shellfish for direct human consumption meet the following requirements at time of harvest:

- the area is not subject to contamination that may present an actual or potential hazard to human health;
- the molluscan shellfish harvested meet the end product specification in the Codex Standard and the requirements outlined in Appendix III.

Production areas providing molluscan shellfish for indirect human consumption should be defined in relation to the further procedure of the lot.

In determining the public health suitability of molluscan shellfish growing areas the official agency having jurisdiction should take the following actions:

- classification/reclassification of growing areas by frequent monitoring of E.coli/faecal coliforms;
- closure/reopening of growing waters by frequent monitoring of algae in sea water and biotoxins in shellfish;
- control of chemical contaminants.

7.2.1 Classification of growing areas

Surveys of the growing area, shoreline and land catchment should be conducted to determine sources of both domestic and industrial pollution, which may affect the quality of the growing area water and molluscan shellfish. Sources may include municipal sewage outputs, industrial outputs, mine wastes, geophysical contaminants, domestic animal holding pens, pastoral farming activities, nuclear power plants, refineries or other sources. The need to reschedule hygiene surveys will be determined by population shifts and changes in agricultural and industrial activities in the coastal area. Resurveys should be conducted at an acceptable frequency

When pollution sources have been identified and evaluated, sampling stations for water, molluscan shellfish and/or sediments should be established and studies conducted to determine the effects of the

pollutants on water and molluscan shellfish quality. The data should be evaluated by the official agency having jurisdiction and growing areas should be classified according to official standards and criteria.

When interpreting growing area data, the official agency having jurisdiction should take into account variations which may affect the level of pollution during the most unfavourable hydrographic and climatic conditions as influenced by rainfall, tides, winds, methods of sewage treatment, population variations and other local factors, since shellfish respond rapidly to an increase in the number of bacteria or viruses in their environment by accumulating these agents. The agency should also consider that shellfish have the ability to accumulate toxic chemicals in their tissue in concentrations greater than the levels found in the surrounding water. FAO, WHO, or other international or national food standards may be used as a guide to acceptable levels.

Classified growing areas should be routinely monitored for changes in water quality and/or molluscan shellfish quality, and sub-standard areas patrolled to prevent harvesting for purposes other than that established by the official agency. Tests for suitable indicator bacteria such as faecal coliforms or *Escherichia coli* should be used to determine the degree of faecal contamination. The effectiveness of indicator bacteria used should be kept under constant review for their reliability as measures for the degree of faecal contamination If faecal contamination exceeds a certain threshold-level, to be set by the official agency, only relaying in a suitable area for a time approved by the competent authority is allowed.

When routine monitoring programs or resurvays show that the growing area no longer meets the classification criteria, the area should be reclassified or closed for harvesting immediately by the official agency having jurisdiction.

The official agency having jurisdiction should immediately announce these decisions to the affected producers and purification and distribution centres.

7.2.2. Marine biotoxin control

All growing areas should be routinely monitored for the presence of marine biotoxins such as paralytic shellfish poison. The risk of blooms of toxic algae may show seasonal variability and areas may also be affected by toxic algae earlier unknown in the surrounding sea or coastal waters. These risks should be recognised when drawing up monitoring schedules.

The official agency having jurisdiction should close immediately and effectively patrol affected areas when acceptable levels are exceeded in edible portions of shellfish meats. These areas should not be opened before toxicological investigation has made clear that the shellfish meat is free from hazardous amounts of biotoxins.

The official agency having jurisdiction should immediately announce these decisions to the affected producers and purification and distribution centres.

7.2.3 Chemical contaminants

Growing areas should be monitored on regular basis on chemical contaminants

7.3 HYGIENIC HARVESTING, TRANSPORTATION AND STORAGE TECHNIQUES OF LIVE MOLLUSCAN SHELLFISH

Especially when the molluscan shellfish need to undergo relaying, purification and /or are meant to be eaten raw (temperature) stress and excessive shocks of the molluscan shellfish are a hazard and must be avoided. This is very important because these molluscan shellfish should be able to function again during purification, relaying or conditioning. The shellfish need to stay alive until they are cooked or eaten raw by the consumer. When molluscan shellfish are meant to be processed avoiding stress and excessive shocks is less important but still advisable.

7.3.1 Hygiene requirements for vessels/conveyances harvesting or transporting live molluscan shellfish from growing area to relaying area, purification tank, raft or float or distribution centre or establishment

- equipment and product containers should not constitute a hazard to health. Containers, which are re-used, should be of such material and construction as will facilitate thorough cleaning, and should be so cleaned and maintained as not to constitute a source of contamination to the product;

- dredges and other harvesting equipment, decks, holds and containers, which come into contact with molluscan shellfish, should be capable of being well drained and easily cleaned. These equipment and containers should be corrosion resistant;
- dredges and other harvesting equipment, decks, holds and containers which are contaminated from use in a polluted area should be cleaned and if applicable disinfected (sanitised) before being used for shellfish from an unpolluted area;
- holds in which molluscan shellfish are held or containers should be so constructed that the molluscan shellfish are held above the floor level and drained so that the molluscan shellfish is not in contact with wash-down or bilge water, or shell fluid. Where necessary a bilge pumping system must be provided.

7.3.2 Protection of product from contamination

- suitable precautions should be taken to protect molluscan shellfish and those parts of the harvesting boat, harvesting equipment, containers and other equipment likely to come into contact with molluscan shellfish from being contaminated by polluted water, droppings from sea birds, footwear which may have been in contact with faecal matter or by other polluted material;
- no animals should be permitted to live on any harvesting boats;
- fuel, lubricating oils, chemicals used for the control of pests and other noxious chemicals should not be stored near molluscan shellfish or containers and equipment likely to come into contact with molluscan shellfish;
- wash-down pumps should draw water only from non-contaminated sea water and should not be connected directly or indirectly to the bilge or the toilet facilities;
- effective measures should be taken to protect against the entrance of rodents and other vermin into harvesting boats.

7.3.3 Harvesting, transporting and storage of live molluscan shellfish

Appropriate handling procedures depend on different species, growing area and season:

- Molluscan shellfish should be harvested from and stored in an growing area or relaying area acceptable to the official agency having jurisdiction;
- excessive shocks during harvesting should be avoided using appropriate harvesting techniques and by carefully handling the molluscan shellfish;
- on removal from water or during handling and transportation, molluscan shellfish should not be subjected to extremes of heat or cold or sudden variations in temperature. This is particularly important for those molluscan shellfish, which are to be subjected to purification. Temperature control is critical in handling live molluscan shellfish. The temperature should be advised to each species separately. Special equipment, such as insulated containers and refrigeration equipment, should be used if prevailing temperatures and the time involved so require. Molluscan shellfish should not be exposed to full sun or surfaces heated by the sun or come into direct contact with ice and other freezing surfaces, nor should it be held in closed containers with solid carbon dioxide. In most cases storage above 10 ^{o} C (50^{o} F) or below 2^{o} C(35^{o} F) should be avoided;
- molluscan shellfish should be freed from excessive mud and weed soon after being harvested by washing it with clean sea water or approved fresh water under suitable pressure. Wash water should not be allowed to flow over shellfish already cleaned. The water should not be re-circulated;
- Molluscan shellfish held on boats should not come into contact with accumulated wash-down water, bilge water of shell fluid;
- during handling and transportation, molluscan shellfish should be held under hygienic conditions and should not come into contact with substances, which may render the meats unfit for human consumption. Shell washings should be drained from the molluscan shellfish containers;
- at all times shellfish should be handled and transported carefully to avoid damage to the shells and under conditions which will prevent death of the shellfish. Containers should not be dropped or subjected to excessive weights where there is a danger of damage occurring to the shells in the course of normal handling. The use of shallow rigid boxes, trays or baskets will minimise damage. The handling of molluscan shellfish in large bulk containers should be avoided;
- the interval between harvesting and immersion in water for relaying, storage, conditioning or purification should be kept as short as possible. This also applies to the interval between final harvesting and handling in a distribution centre;

- if molluscan shellfish is to be re-immersed after harvest it should be re-immersed in clean sea water.

7.4 RELAYING

For relaying areas most requirements for growing areas do also apply. Relaying is intended to reduce the level of contaminants that may be present in shellfish which have been harvested from contaminated areas to such levels that the shellfish will be acceptable for human consumption without further processing. Shellfish harvested for relaying should only be harvested from areas that are so designated/classified by the official agency .

For natural functioning and therefore relaying to occur it is essential that the molluscs have not been over-stressed or damaged during harvesting or handling prior to purification and are not in a seasonally weak or spawning condition.

Some species such as the soft shell clam *Mya arenaria* cannot be relayed.

- when biologically feasible molluscan shellfish may be relayed from contaminated growing areas to areas approved for harvesting. Relaying operations should be strictly supervised by the official agency having jurisdiction to prevent contaminated molluscan shellfish from being diverted directly to the consumer market or form cross contamination of other molluscan shellfish. Boundaries of relaying areas should be clearly identified by buoys, poles or other fixed means;
- holding time and minimum temperature in the accepted area prior to harvest will be determined by the official agency having jurisdiction according to the degree of contamination before relaying, the temperature of the water, the shellfish species involved and local geographic or hydrographic conditions;
- Molluscan shellfish should be laid out at a density, which will permit them to open and undergo natural purification**;**
- for harvesting of molluscan shellfish from relaying areas, see the recommendations Section 7.3.2;
- after relaying the molluscan shellfish should meet the end product specification in Appendix III.

7.5 PURIFICATION OF MOLLUSCAN SHELLFISH IN TANKS, FLOATS AND RAFTS

Purification is intended to reduce the number of pathogenic bacteria that may be present in shellfish which have been harvested from moderately polluted areas to such levels that the shellfish will be acceptable for human consumption without further processing. Purification alone is not suitable for cleansing molluscs from more heavily contaminated areas or areas subject to contamination by hydro-carbons, heavy metals, pesticides or by biotoxins. Shellfish harvested for purification should only be harvested from areas that that so designated/classified by the official agency .

The required conditions vary according to the species of mollusc and the design of the purification system.

For natural functioning and therefore purification to occur it is essential that the molluscs have not been over-stressed or damaged during harvesting or handling prior to purification and are not in a seasonally weak or spawning condition.

Mussels, oysters, manila and hard shell clams are considered suitable for purification, cockles can be purified provided they are carefully handled and there is only a short delay between harvesting and purification, but scallops may not be suitable for purification.

Purification centres, rafts, tanks and floats must be approved by the competent authority.

- Molluscan shellfish subjected to the purification process should not contain metallic ions, pesticides, industrial wastes or marine biotoxins in such quantities that it presents a health hazard to the consumer. A low rate of removal of these substances makes purification impracticable;
- the process and the equipment, tanks, float, rafts used for purification should be acceptable to the official agency having jurisdiction;
- sea water for the tanks, or sea water where floats or rafts are used in purification should be clean and of a salinity to permit the shellfish to function normally. When sea water has a microbiological quality not acceptable to the official agency having jurisdiction, a method of disinfecting (sanitising) the water, which should be approved by the official agency having jurisdiction, should be employed. Water used in purification tanks should be changed continuously or at suitable intervals or if recirculated be treated properly. The flow of water per hour should be sufficient to the amount of shellfish treated and should be depend on the degree of contamination of the shellfish;

- dead or damaged shellfish should be removed before the purification process, when practicable. Surfaces of shells should be free from mud and soft commensal organisms. If necessary the molluscan shellfish should be washed with clean sea water or potable water before the purification process;
- Molluscan shellfish should be laid out at a density, which will permit them to open and undergo natural purification;
- there should be no toxic substances, for example chlorine, in the water at levels that will prevent the shellfish from functioning properly;
- the oxygen content of the water should be maintained at an adequate level by aeration, or by intermittent or continuous replacement;
- the length of the period of purification should be adapted to the water temperature, the degree of contamination before purification and the shellfish species. Microbiological investigation of process water and of shellfish meat should be used to assess purification parameters. It should be taken into account that viruses and Vibrio spp. are more persistent during purification than the indicator bacteria mostly used for microbiological monitoring (*E. coli* and faecal coliforms);
- during the process of purification, the water temperature should not be allowed to fall below the minimum at which shellfish remain physiologically active; high water temperatures which adversely affect the pumping rate and the purification process should be avoided; tanks should be protected from the direct rays of the sun when necessary;
- equipment in contact with water, i.e. tanks, pumps, pipes or piping, and other equipment should be constructed of non-porous, non-toxic materials. Copper, zinc, lead and their alloys should preferably not be used in tanks, pumps or piping systems used in purification processing;
- to avoid recontamination of molluscan shellfish undergoing purification, unpurified molluscan shellfish should not be placed in the same tank as molluscan shellfish, which are already undergoing purification;
- Molluscan shellfish undergoing purification should remain immersed in approved, clean sea water until it satisfies the sanitary requirements of the official agency having jurisdiction;
- on removal from the purification system, molluscan shellfish should be washed with running potable water or clean sea water, and handled in the same manner as living molluscan shellfish taken directly from a non-polluted area. Dead, with broken shells or otherwise unwholesome shellfish should be removed;
- before removing the shellfish form the tanks drain the water from the system to avoid resuspension and reingestion. The tanks should be cleaned after each use and disinfected at suitable intervals;
- after purification the molluscan shellfish should meet the end product specification in Appendix III.

7.6 DISPATCH OF MOLLUSCAN SHELLFISH IN A DISTRIBUTION CENTRE

7.6.1 Reception

- Molluscan shellfish dispatched by a distribution centre must leave the distribution centre alive. Therefore stress and excessive shocks of the molluscan shellfish must be avoided;
- distribution centres should only accept molluscan shellfish, which meet the end product specification in appendix I from approved growing areas or after relaying in an approved relaying area or after purification in an approved purification centre, raft, float, or tank.

7.6.2 Conditioning and storage of molluscan shellfish in sea water tanks, basins etc.

Conditioning means storage of molluscan shellfish in sea water tanks, basins, floats, rafts or natural sites which the intention to remove mud, sand and slime.

- the process of storing molluscan shellfish in sea water tanks, basins, floats, natural sites or rafts can be used if it is acceptable to the official agency having jurisdiction;
- only clean sea water should be used in the tanks, floats, natural sites or rafts and should be of an adequate salinity to permit the shellfish to function normally. Optimum salinity will vary with shellfish species and with the harvesting area. Water condition has to be satisfactory adequate for the process;

- equipment in contact with water, i.e. tanks, pumps, pipes or piping, and other equipment should be constructed of non-porous, non-toxic materials. Copper, zinc, lead and their alloys should preferably not be used in tanks, pumps or piping systems;
- before conditioning or storage molluscan shellfish should be washed to remove mud and soft commensal organisms and dead or damaged shellfish should be removed when practicable;
- during storage molluscan shellfish should be laid out at a density and under such conditions that will permit them to open and function normally;
- the oxygen content in the sea water should be maintained at an adequate level at all times;
- the temperature of the water in storage tanks should not be allowed to rise to such levels as to cause weakness of the molluscan shellfish. If ambient temperatures are excessively high, tanks should be placed in a well-ventilated building or away from the direct rays of the sun. The length of the period of conditioning should be adapted to the water temperature;
- shellfish should be stored in clean sea water only for such time as they remain sound and active;
- tanks should be drained, cleaned and disinfected at suitable intervals;
- recirculating wet storage systems must contain approved water treatment systems**.**

7.6.3 Washing, declumping, debyssing and grading

- All steps in the process, including packaging, should be performed without unnecessary delay and under conditions which will prevent the possibility of contamination, deterioration and the growth of pathogenic and spoilage micro-organisms;
- damage to shells and stress will shorten the shelf life of shellfish and increase the risk of contamination and deterioration. So shellfish have to be handled carefully:
    - The number of handlings with shellfish should be minimised;
    - Excessive shocks should be avoided;
- the different process steps should be supervised by technically competent personnel;
- the outsides of the shells should be washed free of mud, and all soft adhering organisms should be removed. Hard adhering organisms should also be removed when possible, care being taken not to chip lips of shells by vigorous washing. Washing should be carried out using pressurised clean sea water or potable water;
- Molluscan shellfish having formed clumps, should be declumped and debyssed as appropriate. The equipment used should be designed and adjusted to minimise the risk of damage to the shells.

7.6.4 Packing

- before packing shellfish should undergo visual inspection. Shellfish, which are dead, with broken shells, with adhering soil or otherwise unwholesome, should not be passed for human consumption;
- the packaging material should be appropriate for the product to be packed and for the expected conditions of storage and should not transmit to the product harmful or other objectionable substances or odours and tastes. The packaging material should be sound and should provide appropriate protection from damage and contamination;
- the packaging material should avoid contamination and should be drained;
- labels should be clearly printed and must comply with the labelling laws of the country where the product is marketed. The packaging material may be used to bear an indication as to how the shellfish should be kept from the time they were bought at the retailer. It is recommended to mention the date of packaging or a shelf life date;
- all packaging material should be stored in a clean and sanitary manner. Product containers should not have been used for any purpose, which may lead to contamination of the product. Packaging material should be inspected immediately before use to ensure that they are in a satisfactory condition and where necessary disposed of or cleaned and/or disinfected; when washed they should be well drained before filling. Only packaging material required for immediate use should be kept in the packing or filling area;
- packing should be done under conditions that preclude the introduction of contamination into the product.

7.6.5 Storage

- the end product should be stored under such conditions as will preclude the contamination with and/or proliferation of micro-organisms. If prevailing temperatures are high it is recommended to cool the shellfish before distribution. The packaging material of the end product should not have direct contact with the floor but should be placed on a clean, raised surface;
- periodic inspection of the end product should take place to ensure that only food, which is fit for human consumption, is dispatched and that end product specifications should be complied with when they exist;
- storage periods should be kept as short as possible;
- reimmersion in or spraying with water of live bivalve molluscs must not take place after they have been packed and have left the distribution centre except in the case of retail sale at the distribution centre.

7.6.6 Distribution

- The product should be dispatched in the sequence of the lot numbers;
- Molluscan shellfish intended for human consumption should only leave the distribution centre in closed packaging;
- the means of transport should provide sufficient protection of the shellfish against extremes of hot and cold, contamination with dirt or dust and damage to the shells from shocks. The shellfish should not be transported with other products, which might contaminate them;
- during distribution the product should be maintained at a temperature which does **not** adversely affect their quality and viability.

7.7 HEAT TREATMENT / HEAT SHOCKING OF MOLLUSCAN SHELLFISH IN ESTABLISHMENT

In this section only heat treatment/ heat shocking of molluscan shellfish is covered which is specific for this code of hygienic practice.Most requirements for reception of molluscan shellfish, conditioning, storage, washing/ declumping/ debyssing/ grading, packaging, storage and distribution would also apply for molluscan shellfish intended for heat treatment or heat shocking.
Stress and excessive shocks of the molluscan shellfish to be heat treated are somewhat less critical than molluscan shellfish, which are intended to be distributed.

7.7.1 Heat treatment for purification purposes

In stead of relaying/ purification it is possible in certain circumstances to eliminate microbiological contamination with a heat treatment. This can be either a sterilisation or pasteurisation process.

The time/ temperature control is very important ($F \geq 15$). The heat treatment is very critical and must be approved by the competent authority.

The establishments must carry out frequent own checks to ensure that the heat treatment is satisfying.

Also very import is documentation of the lots of molluscan shellfish. Polluted shellfish should not come in contact/ be mixed with molluscan shellfish, which meet the end product specification.

After the heat treatment the molluscan shellfish must meet the end product specification in Appendix III.

- The molluscan shellfish must come from approved growing areas;
- each establishment which purifies molluscan shellfish with a heat treatment must develop a heat treatment process schedule, acceptable to the official agency, which addresses such critical factors as the species and size of shellfish, time of exposure to heat, internal shellfish temperature, type of heat process used, water/steam to shellfish ratios, nature of heat equipment, measurement devices and their calibration, post heating chilling operations, cleaning and sanitising of heat process equipment;
- the heat treatment process must be approved by the competent authority;
- all molluscan shellfish should be washed with pressurised potable water or clean sea water and culled for damaged and dead molluscan shellfish prior to heat treatment;
- polluted shellfish should not come in contact with molluscan shellfish, which meet the end product specification;

- after the heat treatment the molluscan shellfish must meet the end product specification in Appendix III.

7.7.2 Heat shocking of molluscan shellfish followed by packing

Heat shocking is a method to remove shells from the molluscan shellfish.

- The molluscan shellfish must come from approved growing areas and/or after relaying in an approved relaying area or purification in an approved purification centre, raft, float or tank. Each establishment which heat shucks shellfish should develop a heat shuck process schedule, acceptable to the official agency, which addresses such critical factors as the species and size of shellfish, time of exposure to heat, internal shellfish temperature, type of heat process used, water/steam to shellfish ratios, nature of heat equipment, measurement devices and their calibration, post heating chilling operations, cleaning and sanitising of heat process equipment;
- all molluscan shellfish should be washed with pressurised potable water or clean sea water and culled for damaged and dead molluscan shellfish prior to heat treatment;
- before heat shocking the molluscan shellfish should be inspected if the shellfish are alive and not badly damaged;
- the heat shocking process should not result in an increase in microbiological levels in the shellfish;
- heat shocked shellfish should be cooled to 7°C or less within two hours of being heat treated (this time includes the shucking process) and should be further cooled to 4°C or less within 4 hours of heat treatment. This temperature should be maintained during transport, storage and distribution;
- the heat shocked shellfish should be packed as soon as possible. Before packing the shellfish should be examined for objectionable matter such as shell pieces;
- after heat shocking the shellfish must meet the end product specification in Appendix III.

7.8 DOCUMENTATION

- the transport of live bivalve molluscs from a growing area to a distribution centre, purification centre, relaying area or establishment must be accompanied by documentation for the identification of lots of live bivalve molluscs;
- permanent, legible and dated records of relaying and purification should be kept concerning each lot. These records should be retained for a period of minimal two years;
- purification centres, tanks, floats and rafts and distribution centres and establishments should only accept lots of live molluscan shellfish with documentation issued by or accepted by the official agency having jurisdiction. This document should contain the following information
  - the gatherer's identity and signature;
  - the date of harvesting;
  - the location of the growing area;
- complete records of harvest area and date of harvest and length of time of relaying or purification of each lot should be maintained by the distribution centre or establishment for a period designated by the official agency having jurisdiction.

7.9 LOT IDENTIFICATION AND RECALL PROCEDURES

- Each product leaving the distribution centre or establishment should have an easy identifiable lot number. This lot number must include an identification code number of the distribution centre or establishment the country of origin and day and month of packing in order to facilitate the traceback of the product. The distribution centres should establish a record-keeping system based on these lot numbers so that individual lots of shellfish can be traced from the growing area to the end user;
- if a recall must be carried out its success depends on whether the management of the distribution centre has taken certain preparatory steps in advance;
- some important aspects are:
  - the affected product must be easy identifiable by lot numbers;
  - destination and customers of the affected product must be identifiable;
  - competencies and responsibilities of management and personnel must be clear;
  - names and telephone numbers of affected personnel, organisations and customers must be present.**]**

SECTION 8 PROCESSING OF LOBSTERS AND CRABS

In the context of recognising controls at individual processing steps, this section provides examples of potential hazards and defects and describes technological guidelines, which can be used to develop control measures and corrective actions. At a particular step only the hazards and defects, which are likely to be introduced or controlled at the step, are listed. It should be recognised that in preparing a HACCP and/or DAP plan it is essential to consult Section 5 which provides guidance for the application of the principles of HACCP and DAP analysis. However, within the scope of this Code of Practice it is not possible to give details of critical limits, monitoring, record keeping and verification for each of the steps since these are specific to particular hazards and defects.
This section applies to lobsters, rock lobsters, spiny lobsters, and slipper lobsters from the genus *Homarus* of the family Nephropidae and from the families Palinuridae and Scyllaridae and other similar species but does not apply to Nephrops.
This also applies, generally, to commercial crabs of the *Cancer* species, king crab related species (*Lithodes* and *Paralithodes*), swimming crabs (Portunidae), *Geryon* species and snow crab species (*Chionoectes*) as well as other species of crabs which are similar in physical structure to the above mentioned.

8.1 GENERAL – ADDITION TO PRE-REQUISITE PROGRAM

In addition to the pre-requisite program outlined in Section 3 of this document, the processing facility is encouraged to evaluate the design and construction of their facility and the maintenance and sanitation of their operation, specific to the processing of lobsters and crabs. Consideration should be given to the following:

8.1.1 - Design and Construction of Equipment and Utensils

- in batch systems the inactivation tank, cooker and cooling tank should be located adjacent to each other and may be provided with an overhead hoist or gantry provided to transfer baskets from one to the other;
- cookers should be designed to provide constant and adequate supply of heat so that all crustaceans could be given the same time/temperature exposure during the cooking operation;
- a chamber of adequate length, through which an open link conveyor passes and which is equipped with spray nozzles so that the crabs are sprayed from all sides, may be used for the purpose.

8.1.2 - Hygiene Control Programme

- [when in-factory chlorination of water is used, the residual content of free chlorine should be maintained at no more than the minimum effective level for the use intended];
- [chlorinating system should not be relied upon to solve all hygiene problems].
- water, which has been in contact with crustaceans, should not be re-used to avoid taint problems;
- if it is unavoidable for the same workers to handle the raw as well as the cooked, stringent precautions should be taken to prevent contamination of the cooked product by micro-organisms from raw material;

8.2 GENERAL CONSIDERATIONS FOR THE HANDLING OF "LOBSTERS AND CRABS"

Refer to Section 4 – General Considerations for the Handling of Fresh Fish and Shellfish.

8.2.1. Potential Hazards and Defects Associated with Lobsters and Crabs

Refer also to Section 4.1 Potential Hazards Associated with Fresh Fish and Shellfish and Section 5.3.3 Identification of Hazards and Defects.

8.2.1.1 Biological Hazards:

Parasites
Trematodes or flukes *(Chlonorchis sinensis, Opisthorchis* spp., *Heterophyses* spp.*,* and *Metagonimus* spp.) are of most concern in seafood. Some products that have been implicated in human infection are: civiche or cibichi (fish and spices marinated in lime juice); lomi lomi (salmon marinated in lemon juice, onion and tomato); poisson cru (fish marinated in citrus juice, onions, tomatoes and coconut milk); salmon roe; sashimi (chunks of raw fish); sushi (pieces of raw fish with rice and other ingredients); green herring (lightly brined herring); drunken crabs (crabs marinated in wine and peppers); cold-smoked fish and undercooked grilled fish.

A trematode belonging to the genus *Paragonimus* is the very common oriental lung fluke. Eating raw or inadequately cooked crabs or crayfish infects humans. The adult parasite lives in cysts in the lungs, but it also has a tendency to migrate to other sites such as liver, spleen and brain. A chronic pulmonary disease ensues when the worms develop in the lungs.

Bacteria
Staphylococcus aureus in an aerobic or facultatively anaerobic Gram-positive spherical micro-organism. It is coagulase-positive and ferments glucose. Some strains can produce enterotoxins.
Staphylococcus is not found in the normal microflora on fish. The natural habitat for this organism is the skin and mucous membranes of animal and man; the carrier rate among normal healthy individuals is about 50 percent or more. The presence of *Staphylococcus* on fish is an indication of post-harvest contamination due to poor personal hygiene. The organism is a poor competitor and will not multiply in fish. However, in fish or shellfish products, where the normal flora is reduced or eliminated (i.e. cooked peeled shrimp or crabmeat), the presence of staphylococci indicates a potential for food poisoning. ICMSF (1974) suggests a microbiological limit of 10^3 *S. aureus/g.*
Pathogens, such as *Listeria monocytogenes* (*L.m*.) that may be present in low numbers at the time that molluscan shellfish are harvested, may increase to more hazardous levels if they are exposed to time/temperature abuse.

Although the data are limited, recent surveys suggest that cooked fish and other seafood may also be contaminated with *L.m.* From 4-8% of cooked crabmeat and 3-4% of shrimp may yield *L.m.* on analysis. One enumeration study on frozen, butterfly shrimp conducted using a genetic probe suggested 200 *L.m.* per gram might be present.

8.2.1.2 Chemical Hazards

Biotoxins
Paralytic shellfish poisoning (PSP) in the U.S. is generally associated with the consumption of molluscan shellfish from the Northeast and Northwest coastal regions of the U.S. PSP in other parts of the world has been associated with molluscan shellfish from environments ranging from tropical to temperate waters. In addition, in the U.S., PSP toxin has been reported from the viscera of mackerel, lobster *(Homarus* spp.*),* Dungeness crabs, tanner crabs and red rock crabs.

Amnesic shellfish poisoning (ASP) is generally associated with the consumption of molluscan shellfish from the Northeast and Northwest coasts of North America. It has not yet been a problem in the Gulf of Mexico, although the algae that produces the toxin has been found there. ASP toxin has recently been identified as a problem in the viscera of Dungeness crab, tanner crab, red rock crab, and anchovies along the West Coast of the United States.

8.2.1.3 Defects

Blue discoloration
The problem of the blue discoloration in canned crabmeat has caused trouble until recent times. The blue meat often appears not only on the surface of crabmeat in the cans, but also, though, on crabmeat several hours after boiling and cooling of the carcasses. The blue meat appears more often on the surface of joint of shoulder meat, claw meat and other leg joints. It appears in canned horsehair crabmeat ("kegani") more often than in king crab. The appearance of the blue meat is undoubtedly due to the cooper contained in haemocyanin, which is a component of the blood of molluscs or arthropods.

Inoue and Motohiro have investigated on a cause and mechanism of blue discoloration. Cooper contents in blue and normal meats of king crabs were 2.80mg/100g and 0.49mg/100g (wet weight) in average, respectively. Higher copper contents were found in the shoulder meat, surface of first leg and meats nearer a joint and claw meat than those in other parts. The limit of copper above which blueing occurs appears to be about 2.0mg/100g. The haemocyanin contained in crab haemolymph can react with hydrogen sulphide to produce a blue coloured pigment by heating (100ºC, 15 minutes). Heat coagulated haemocyanin may also react hydrogen sulphide to give a blue colour by heating. Reflectance spectrum of

haemocyanin-sulphide complex closely resembles that of the blue meat. The chemical composition of a blue substance that the blue meat of canned crab was digested by protease was in accord with that of king crab haemocyanin-sulphide complex, apart from the sulphide content. And they concluded that the causative substance of the blue discoloration of canned crabmeat is haemocyanin-sulphide complex.

Osakabe has succeeded in preventing the appearance of the blue meat of the canned crab by "Low-temperature and fractional heating" of the carcasses from which shell had been removed. According to his experiments, the coagulating temperature of blood protein of crabs is from 69ºC to 70ºC, and that of meat protein of crabs is from 59ºC to 60ºC. Thus, if the carcasses are heated at 59ºC~60ºC the meat coagulates, but the uncoagulated blood will run out. After removing the meat from the shell in a half-heated condition, the blood will run out leaving the meat alone. When the meat from which the blood has been removed is boiled for a few minutes and packed in can as the usual manner, the blue meat will not appear in the finished product. In addition, when the "low-temperature and fractional heating" method is used, canned tendonless (boneless) crabmeat be prepared. In Japan the introduction of Osakabe's method made an epoch in the procedure of canning crabmeat.

Black discoloration

Black discoloration (melanosis) is caused by melanin formation in the ventral tail segments of lobsters owing to oxidative enzymatic reaction (polyphenol oxidase), followed by auto-oxidation and polymerisation. It is thought that live individuals have an underlying defence mechanism that sets off enzymatic processes which develop melanosis, depending only on certain abnormal conditions such as the degree of injuries and probably stress under agonising circumstances.

Histochemical enzymatic tests done with lobster specimens subjected to two different treatments showed negative test results for those which were anaesthetised in ice-cold water for 30 min, while those which were injured showed positive results. This suggests that the even distribution of enzymes and substrates is changed in the integumentary tissues, and that the accumulation of fluids (haemolymph) in affected parts results in greater concentrations of these substances. Thus, the phenomenon, which occurs, is probably a host defence mechanism similar to that in insects, where humoral and/or cellular defence reactions help them recover from injuries.

The growth of lobster is cyclical, periods of comparative rest alternate with periods of metabolic changes in the epidermis, subepidermal tissues and heapatopancreas. Blackening appears more frequently when lobsters go through stage C (intermoult) and stage D (pre-moult). After ecdysis, in stage A and early B, live lobsters would harden their carapace (sclerotisation) than form melanin, as this gives them more protection against predators, and so being rarely appeared black spots.

Melanosis was found to be inevitable for lobsters once traumatised alive during the process of storing and thawing, while lobsters which suffered no injuries before dying showed no signs of blackening whatsoever.

Since traumatism occurs in lobsters normally due to unavoidable circumstances, they should be submitted to quick-freezing as soon as possible and stored at as low a temperature as possible so as not to advance the melanisation. Quick thawing using running water is recommended to wash out the water-soluble melanin forming substances. However, affected lobsters are not always of low quality, but because of rough handling, losses in quality will take place in a short time. Blackening develops only in the integumentary tissues and muscle surfaces, not reaching the internal muscles.

8.2.2 Minimise the Deterioration of Crustaceans - Handling

Refer also to Section 4.3 – Minimise the Deterioration of Fish – Handling.

- it is generally known that under similar conditions, the quality of crustaceans deteriorate more rapidly than fish and therefore care in maintaining the crustaceans live prior to processing is strongly recommended;
- since crustacean legs and other appendages can be easily broken and the damage can cause the risk of infection and weakening of the crustacean, care should be taken to handle live crustaceans at all times;
- tanks and wells for pounding live crustaceans should be so placed and constructed as to ensure survival of the crustaceans;
- time is one of the most effective method in controlling crab product processing. It is strongly recommended that all operations in crab product processing be achieved as rapidly as possible;
- [good quality of crab butchered sections can be maintained by immediate cooking and chilling or freezing;]

- live crustaceans should be carefully packed in clean tanks, wells, crates, open-weave bag, or in boxes covered with wet sacking and held at as low a temperature as practicable, as required of varying species;
- holding tanks are regarded as a better method of storage for long-term handling than well storage;
- the use of clean hessian or jute bags, for transport, is preferred. Bags made of woven synthetic material should not be used;
- where bags open weave are used for transport, precautions should be taken to avoid suffocation of crustaceans due to slime or mud;
- care also should be taken to maintain the necessary humidity in holding the crustaceans live in bags for transport;
- species, which mutilate each other, should have the claws banded as soon as possible after catching;
- if it is not possible to keep crustaceans alive until the time of processing, lobsters should be killed and crabs butchered. Tails and sections, respectively, should be carefully separated and cleaned before freezing or cooling down to the temperature of melting ice, which should be done as rapidly as possible.

8.3 PROCESSING OPERATIONS – LOBSTERS AND CRABS

Once a processing facility has establish a pre-requisite program (section 3) the principles of HACCP (Section 5) can be applied to each individual process within that facility.
This section provides three examples of products derived from lobsters and crabs. Special consideration was given to elaborate on products, which involve heat treatment because of their potential impact on food safety (such as post processing handling). The products and their respective flow diagrams are as follows: Frozen Raw Lobster Tails (Fig. 8.1), Chilled Cooked Whole Lobster/Chilled Cooked Lobster Meat (Fig. 8.2) and Chilled Pasteurised CrabMeat (Fig. 8.3). To provide an appreciation for other products of lobsters and crabs, a reference has been included in Appendix A and B.

8.3.1 Frozen Raw Lobster Tail

8.3.1.1 Live Lobster Reception (Processing Step 1)

Potential Hazards: *Phycotoxins (PSP).*

Potential Defect *Reception of weak or injured lobsters, lobster mortality.*

Technical Guidance:

- live lobsters should be inspected upon receipt to ensure that they are alive, which can be demonstrated by active leg movement and the tail of lobsters being curled light by underneath the body when the lobster is picked up;
- lobsters which are dead or may pose a hazard to human should not be processed, should be rejected and disposed of in a proper manner;
- weak lobsters should be processed immediately;
- since lobster legs and other appendages can be easily broken and the damage can cause to risk of infection and weakening of the lobsters, care in handling should be applied to live lobsters at all times. The necessary shills should be acquired by lobster handlers;
- training in species identification and communication in product specification should be provided to lobster handlers and appropriate personnel to ensure a safe source of incoming lobsters. Of special consideration are the reception and sorting of lobster species that poses a risk of PSP toxin;
- lobsters should be rejected if they are known to contain harmful or extraneous substances and/or defects, which will not be eliminated or reduced to an acceptable level by normal procedures of sorting or preparation. An appropriate assessment should be carried out to determine the reason(s) for loss of control and the HACCP or DAP plan should be modified where necessary.

8.3.1.2 – Live Lobster Holding (Processing Step 2)

Refer also to Section 8.2.2 – Minimise the Deterioration of Crustaceans – Handling and **[**Section 16.8- Water Quality**]**

Potential Hazards: *Unlikely*
Potential Defects: *Lobster mortality*
Technical Guidance:

- all live lobsters should be processed as soon as possible;
- storage time should be monitored where appropriate and should be as short as practical;
- to minimise damage and mortality losses during captivity, especially for the moulting stage of lobsters, over-crowding should be avoided and this can be achieved by controlling the stocking density;
- for short-term storage, live lobsters should be held in suitable containers and in land-based tanks and wells should be supplied with running sea water;
- dead lobsters should not be processed and should be rejected and disposed in a proper manner. An appropriate assessment should be carried out to determine the reason(s) for loss of control and the DAP plan should be modified where necessary.

8.3.1.3 Tailing (Processing Step 3)

Potential Hazards: *Unlikely*

Potential Defects *Unlikely*

Technical Guidance:

- when lobsters are not landed alive, the tail and cephalothorax should be separated immediately after catching. This practice is strongly recommended as they are brought on board. Tails should be carefully separated and cleaned before freezing or cooling down to the temperature of melting ice, which should be done as rapidly as possible;
- tailing should be carried out as rapidly as possible.

This flow chart is for illustrative purposes only. For in-factory HACCP implementation a complete and comprehensive flow chart has to be drawn up for each process.

References correspond to relevant Sections of the Code.

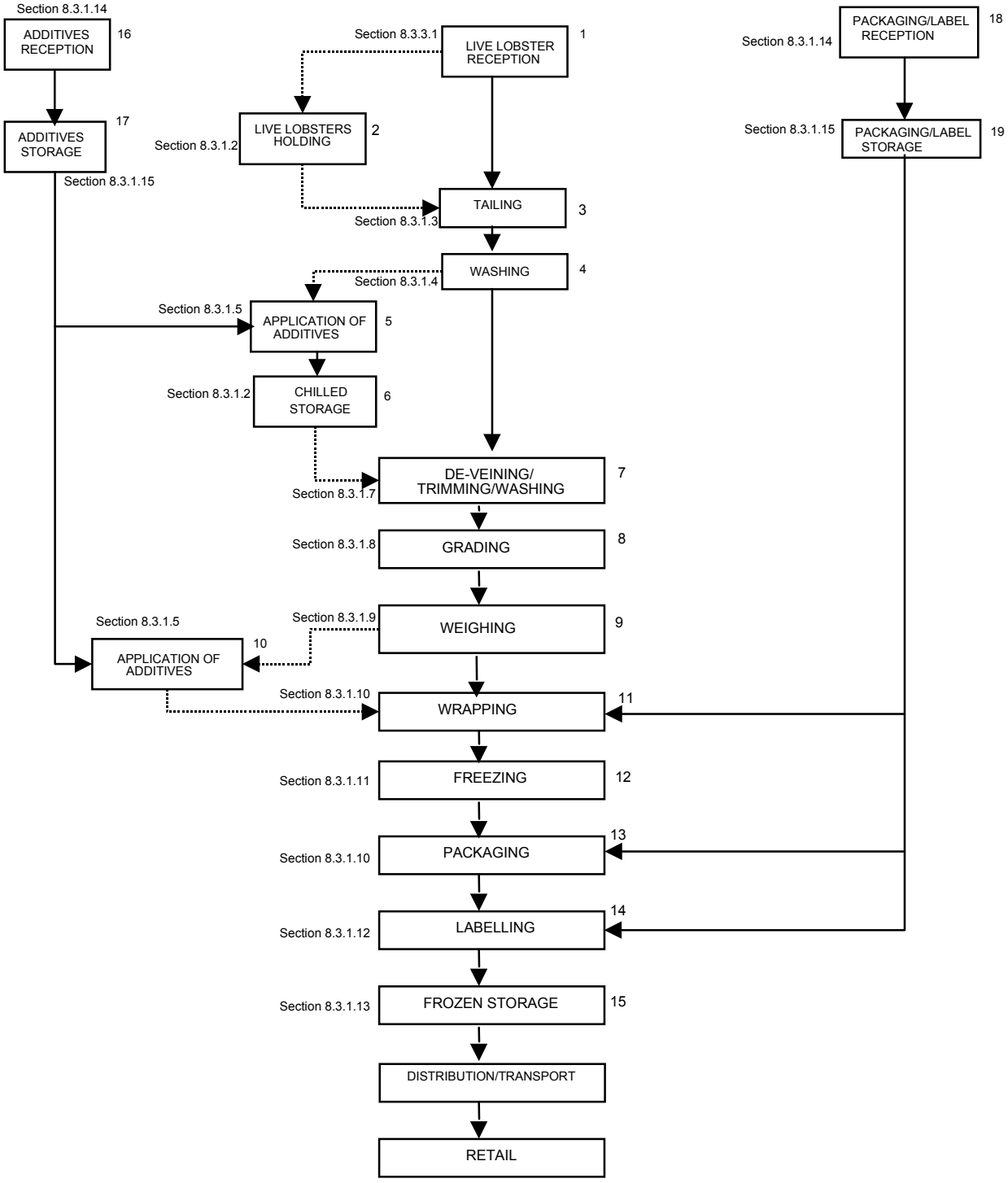

Figure 8.1 Example of a flow chart for frozen raw lobster tail line

8.3.1.4 Washing (Processing Step 4)

Refer also to section 6.1.5 – Washing and Gutting of the Revised Draft Codex Fish Code – May 1999.

Potential Hazards: *Unlikely*

Potential Defects: *Unlikely*

Technical Guidance:

- **[**lobster tails should be washed in plenty of running potable water, or clean sea water, **[**or chlorinated water**]**, to remove all impurities**]**

8.3.1.5 Application of Additives to Lobster Tails (Processing Steps 5 & 10)

Potential Hazards: *Physical contamination, the use of non-approved additives; incorrect application of sulphites*[7]*.*

Potential Defects: *Physical contamination, black spots due to inadequate application of sulphites*[1]*, incorrect application of phosphates*[1]*.*

Technical Guidance:

- additives should comply with the requirements of the Codex General Standard for Food Additives;
- skilled should be acquired for the mixing and application of appropriate additives;
- lobster tails should be rejected if known to contain harmful or extraneous substances and defects, which will not be eliminated or reduced to an acceptable level by normal procedures of sorting or preparation. An appropriate assessment should be carried out to determine the reason(s) for loss of control and the HACCP or DAP plan should be modified where necessary;

8.3.1.6 Chilled Storage (Processing Step 6)

Refer to sections 4.2 – Time and Temperature Control and 6.1.2 - Chilled Storage.

Potential Hazards: *Unlikely.*

Potential Defects: *Unlikely*

Technical Guidance:

- for lobster tails, storage in refrigerated seawater is not recommended because excessive salt penetration into the muscle will take place rapidly. However, refrigerated sea water systems can be used for rapid pre-cooling before freezing or storage in ice;
- lobster tails should be rejected if known to contain defects, which will not be eliminated or reduced to an acceptable level by normal procedures of sorting or preparation. An appropriate assessment should be carried out to determine the reason(s) for loss of control and the DAP plan should be modified where necessary.

8.3.1.7 De-veining/Trimming/Washing (Processing Step 7)

Refer to Section 6.1.5 – Washing and Gutting.

Potential Hazards: *Unlikely*

Potential Defects: *Incomplete de-veining, decomposition, dark membrane attached to the shell, physical contamination*

Technical Guidance:

- the intestine should be removed immediately and consideration should be given to use methods such as ejection by water pressure, vacuum, or physical removal by appropriate utensils (such as scissors, knives or extractors);
  - skills should be acquired by lobster handlers with particular attention being given to the removal of membrane and blood from the butt end of the tail;
  - an adequate supply of clean sea water or potable water **[**or chlorinated water**]** should be available for the washing of de-veined and trimmed lobster tails to ensure that no remnants of the gut or its contents remain;
  - depending on the vessel or processing facility product flow pattern and where a prescribed critical limit for staging time and temperature regime has been established for the control of the development persistent and distinct objectionable odours or flavours indicative of decomposition,

[7] List of additive names for “sulphites” and “phosphates” can be found in the Codex Standard for Quick Frozen Lobsters (Codex Stan. 95-1981, Rev. 1-1995)

the de-veined or trimmed lobster tails should be washed and well iced or appropriately chilled in clean containers and stored in specially designated and appropriate areas within the processing facility;

- lobster tails should be rejected if known to contain defects, which will not be eliminated or reduced to an acceptable level by normal procedures of sorting or preparation. An appropriate assessment should be carried out to determine the reason(s) for loss of control and the DAP plan should be modified where necessary.

8.3.1.8 Grading (Processing Step 8)

Potential Hazards: *Unlikely*

Potential Defects: *Incorrect grading*

Technical Guidance:

- lobster tails should be graded into species, sizes and weights for the relevant market, to assure the economic integrity of the final product;
- calibrated balances should be provided for accurate grading;
- if lobster tails known to contain defects, an appropriate assessment should be carried out to determine the reason(s) for loss of control. Lobster tails should be regraded and the DAP plan should be modified where necessary.

8.3.1.9 Weighing (Processing Step 9)

Potential Hazards: *Unlikely*

Potential Defects: *Incorrect net weight*

Technical Guidance:

- balances should be calibrated periodically with a standardised mass to ensure accuracy;
- if lobster tails known to contain defects, an appropriate assessment should be carried out to determine the reason(s) for loss of control. Lobster tails should be re-weighed and the DAP plan should be modified where necessary.

8.3.1.10 Wrapping and Packaging (Processing Steps 11 & 13)

Potential Hazards: *Unlikely*

Potential Defects: *Subsequent dehydration*

Technical Guidance:

- packaging material should be clean, sound, durable, sufficient for its intended use and of food grade material;
- care should be taken to ensure that the butt end of tail is completely wrapped to protect against dehydration;
- if lobster tails known to contain defects, an appropriate assessment should be carried out to determine the reason(s) for loss of control. Lobster tails should be re-processed (to take the superficial dehydration out) if known to contain defects which will not be eliminated or reduced to an acceptable level by normal procedures of sorting or preparation and the DAP plan should be modified where necessary.

8.3.1.11. Freezing (Processing Step 12)

Refer to section 6.3.1 – Freezing Process.

Potential Hazards: *Unlikely*

Potential Defects: *Unlikely*

Technical Guidance:

- air blast and liquid nitrogen freezing should be used to produce high quality tails;
- the freezing and storage of whole-uncooked lobsters is not recommended.

8.3.1.12 Labelling (Processing Steps 14)

Potential Hazards: *Absence of labelling of allergenic additives*

Potential Defects: **Incorrect labelling**

Technical Guidance:

- where sulphites were used in the process, care should be taken to ensure that this additive is properly declared on the label;
- prior to their application, labels should be verified to ensure that all information declared meet, where applicable, the Codex General Standard for the Labelling of Pre-packaged Foods[8], labelling provisions of the appropriate Codex Standard for products and/or other relevant national legislative requirements;
- if lobster tails are known to contain hazards and/or defects, an appropriate assessment should be carried out to determine the reason(s) for loss of control. Lobster tails should be re-labelled and the HACCP or DAP plan should be modified where necessary.

8.3.1.13 Frozen Storage (Processing Step 15)

Refer to Section 6.1.3 – Frozen Storage.

Potential Hazards: *Unlikely*

Potential Defects: *Unlikely*

Technical Guidance:

- the products should stacked in the freezer store so that there is always a space for cold air to circulate along the walls, floor and stacks.

8.3.1.14 Additives, Packaging and Label Reception (Processing Steps 16 & 18)

Refer to section 6.5.1 – Raw Material Reception – Packaging, Labels & Ingredients

Potential Hazards: ***Biological, chemical and physical contamination, absence of labelling of allergenic additives***

Potential Defects: *Misdescription*

Technical Guidance:

- only additives, packaging material and labels complying with the processors specification should be accepted into the processing facility;
- additives and packaging material not approved by the official agency having jurisdiction should be investigated and refused at reception.

[8] Codex General Standard for the Labelling of Pre-packaged Foods (Codex Stan 1-1985, Rev. 2-1999)

This flow chart is for illustrative purposes only. For in-factory HACCP implementation a complete and comprehensive flow chart has to be drawn up for each process.

References correspond to relevant Sections of the Code.

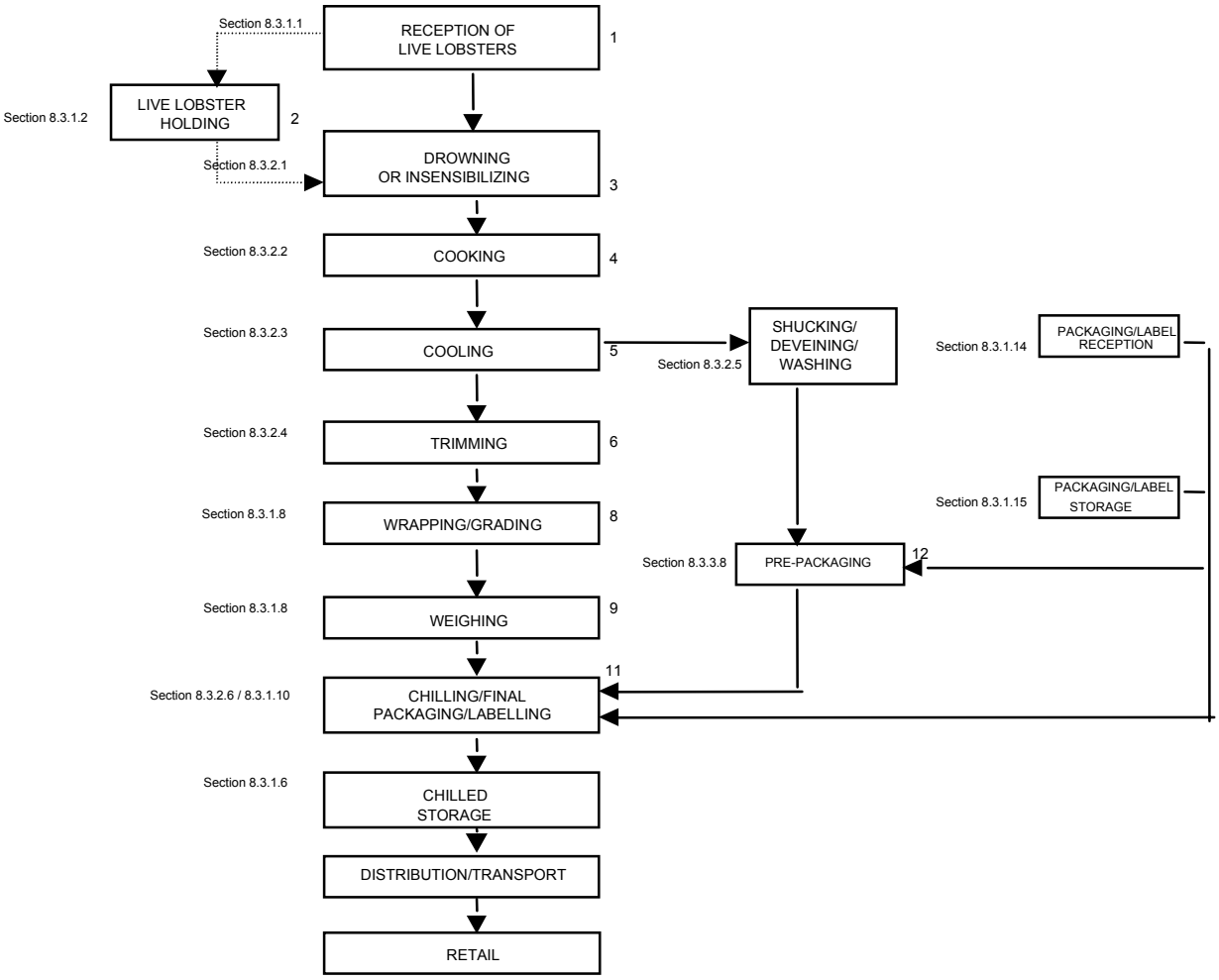

Figure 8.2 Example of a flow chart for chilled cooked whole lobster and chilled cooked lobster meat processing lines

Processing steps 9 and 10 are concerned with chilled cooked lobster meat product

8.3.1.15 Additives, Packaging and Label Storage (Processing Steps 17 & 19)

Refer to section 6.5.2 – Raw Material Storage – Packaging, Labels & Ingredients.

Potential Hazards: ***Biological, chemical and physical contamination***

Potential Defects: *Unlikely*

Technical Guidance:

- additives and packaging should be properly protected and segregated to prevent cross-contamination;
- contaminated additives and packaging should not be used and should be rejected;

8.3.2 Chilled Cooked Whole Lobster and Chilled Cooked Lobster Meat

This section is designed with additional operation steps pertaining specifically to Chilled Cooked Whole Lobster and Chilled Cooked Lobster Meat.

8.3.2.1 Drowning or Insensibilising (Processing Step 3)

Potential Hazards: ***Unlikely***

Potential Defects: *Unlikely*

Technical Guidance:

some species (not Homarus) are prepared for cooking by drowning suffocation in water with a low oxygen content or by immersing in chilled water;
another possible process is an electric shock (pulse) in potable water or seawater.

8.3.2.2 Cooking (Processing Step 4)

Potential Hazards: ***Survival of pathogenic micro-organisms due to insufficient cook***

Potential Defects: *Over / undercooking*

Technical Guidance:

- a cooking schedule for boiling or steaming should be designed which takes into consideration the appropriate parameters which can affect the cook such as time/temperature and size of the lobster;
- cooking should be carried out by appropriately trained personnel who has acquired the necessary skills to monitor and ensure that all lobsters are given the same time/temperature exposure and adequate heat penetration during the operation;
- each cooker should be equipped with a suitable thermometer to show the cooking operation temperature. Fitting of a recording thermometer is strongly recommended. A simple device to indicate time of cooking should be supplied.
- lobsters should be cooked according to size until the shell is uniformly orange-red in colour, and depending on the product, until the meat can be easily removed from the shell. Overcooking causes the meat to shrink excessively, lower yields and undercooking makes it difficult to remove the meat from the shell;
- lobsters should be rejected if they are known to contain harmful substances or defects, which will not be eliminated or reduced to an acceptable level by normal procedures of sorting or preparation. An appropriate assessment should be carried out to determine the reason(s) for loss of control and the HACCP or DAP plan should be modified where necessary.

8.3.2.3 Cooling (Processing Step 5)

Potential Hazards: ***Microbiological contamination***

Potential Defects: *Unlikely*

Technical Guidance:

- cooling times should be kept as short as possible and every effort should be made to avoid contamination of the product during this period;
- cooling should be done in a proper manner, immediately after cooking, to end it uniformly throughout the batch and to avoid holding at temperatures which would encourage the growth of bacteria;
- lobsters should be rejected if they are known to contain harmful substances, which will not be eliminated or reduced to an acceptable level by normal procedures of sorting or preparation. An

appropriate assessment should be carried out to determine the reason(s) for loss of control and the HACCP plan should be modified where necessary.

8.3.2.4 Trimming (Processing Step 6)

Potential Hazards: ***Microbiological contamination***

Potential Defects: *Unlikely*

Technical Guidance:

- an adequate supply of clean sea water, potable water or **[**chlorinated water**]** should be available to remove adhering coagulate protein. Spray washing on a conveyor is sometimes sufficient but it may be necessary to brush by hand. These methods can be combined;
- all surfaces and brushes should be frequently cleaned during operation in order to minimise the microbial activity of contact surface and utensils;
- lobsters should be rejected if they are known to contain harmful substances, which will not be eliminated or reduced to an acceptable level by normal procedures of sorting or preparation. An appropriate assessment should be carried out to determine the reason(s) for loss of control and the HACCP plan should be modified where necessary.

8.3.2.5 Shucking, De-veining and Washing (Processing Step 10)

Potential Hazards: *Microbiological recontamination during shucking and de-veining, microbial proliferation, microbial toxin development*

Potential Defects: *Presence of shell fragments*

Technical Guidance:

- the shucking and de-veining of cooked lobsters should be done quickly and carefully, in order to provide an attractive product and prevent cross-contamination of cooked product with raw crustacean or any questionable material;
- depending on the vessel or processing facility product flow pattern and where a prescribed critical limit for staging time and temperature regime has been established for the control of hazards, the shucked or de-veined cooked lobster should be washed and appropriately chilled in clean containers and stored in specially designated and appropriate areas within the processing facility;
- lobster meat should be thoroughly washed on all surfaces in cold potable water, clean sea water or **[**chlorinated water**]**;
- lobsters should be rejected if they are known to contain harmful substances or defects, which will not be eliminated or reduced to an acceptable level by normal procedures of sorting or preparation. An appropriate assessment should be carried out to determine the reason(s) for loss of control and the HACCP or DAP plan should be modified where necessary.

8.3.2.6 Chilling, Final Packaging, Labelling (Processing Step 11)

Potential Hazards: *Unlikely*

Potential Defects: *Incorrect labelling*

Technical Guidance:

- packaging material should be clean, sound, durable, sufficient for its intended use and of food grade material;
- for sale in the fresh cooked form, whole lobsters or lobster meat should be immediately chilled and maintained at melting ice temperature;
- where ice is used for chilling, it should be manufactured using potable water, clean sea water or [chlorinated water];
- prior to their application, labels should be verified to ensure that all information declared meet, where applicable, the Codex General Standard for the Labelling of Pre-packaged Foods[9], labelling provisions of the appropriate Codex Standard for products and/or other relevant national legislative requirements;
- if lobsters are known to contain defects, an appropriate assessment should be carried out to determine the reason(s) for loss of control. Lobster should be re-labelled and the DAP plan should be modified where necessary.

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9 Codex General Standard for the Labelling of Pre-packaged Foods (Codex Stan 1-1985, Rev. 2-1999)

8.3.3 Chilled Pasteurised Crab Meat

8.3.3.1 Live Crab Reception (Processing Step 1)

Refer also to section 8.3.1.1 of this document.

Potential Hazards: *Phycotoxins (PSP and ASP), parasite (Paragonimus westermani).*

Potential Defects: *Reception of weak or injured crab, crab mortality.*

Technical Guidance:

- live crabs should be inspected upon receipt to ensure that they are alive, which can be demonstrated by active leg movement;
- training in species identification and communication in product specification should be provided to crab handlers and appropriate personnel to ensure a safe source of incoming crabs. Of special consideration are the reception and sorting crabs species at poses a risk of PSP and ASP toxins and parasites;
- in factories which process crabs, any dead crabs should be discarded. Where sections are processed, any defective or deteriorated parts should be removed from the lot and disposed off in a proper manner;
- weak crabs should be processed immediately;
- crab should be rejected if they are known to contain harmful, decomposed or extraneous substances, which will not be eliminated or reduced to an acceptable level by normal procedures of sorting or preparation. An appropriate assessment should be carried out to determine the reason(s) for loss of control and the HACCP or DAP plan should be modified where necessary.

This flow chart is for illustrative purposes only. For in-factory HACCP implementation a complete and comprehensive flow chart has to be drawn up for each process.

References correspond to relevant Sections of the Code.

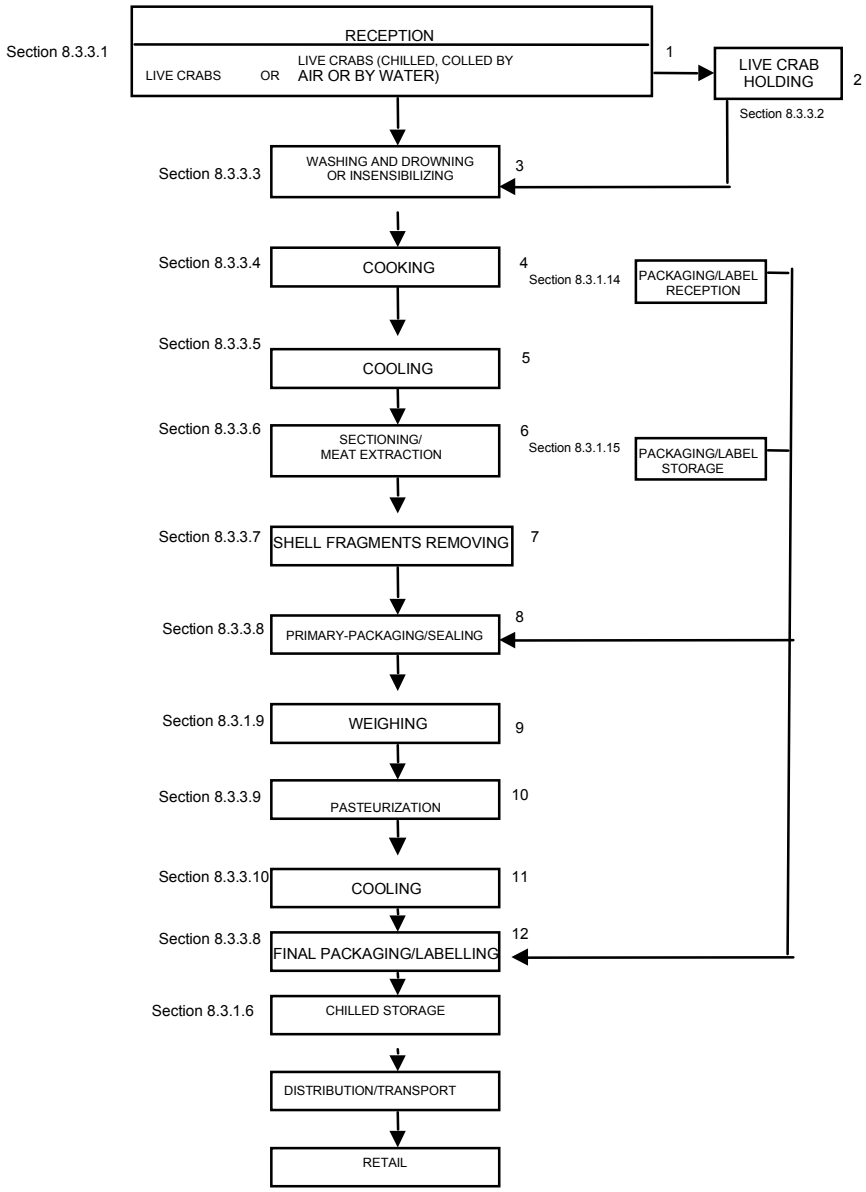

Figure 8.3 Example of a flow chart for chilled pasteurised crab meat processing line

2 - The operation descriptions already mentioned in this document will not be repeated.

8.3.3.2 – Live Crab Holding (Processing Step 2)

Refer also to [Section 16.8 – Water Quality] and Section 8.3.1.2 – Live Lobster Holding.

Potential Hazards: *Unlikely*

Potential Defects: *Crab Mortality*

Technical Guidance:

- live crabs should be stored in circulated sea water, at temperatures of their natural environment or slightly lower, depending on the species;
- dead crabs should not be processed and should be rejected and disposed in a proper manner. An appropriate assessment should be carried out to determine the reason(s) for loss of control and the DAP plan should be modified where necessary.

8.3.3.3 Washing and Drowning or Insensibilising (Processing Step 3)

Potential Hazards: *Unlikely*

Potential Defects: *Loss of Legs and claws, deterioration*

Technical Guidance:

- crabs should be washed in plenty of running potable water, or clean seawater, **[**or chlorinated water**]**, to remove all impurities. For some species, scrubbing by brush may be necessary. These methods can be combined;
- crabs that are to be processed whole for fresh and frozen products should be rendered insensible or killed just prior to cooking to prevent legs and claws loss. This may be accomplished by the following methods:
- cooling the crabs for [twenty minutes or until two hours] at 0ºC or lower, depending of the specie;
- immersion of the crabs in potable water or clean sea water which is approximately 10-15ºC warmer than the natural environment of the species;
- piercing of the two nerve centres by means of a stainless steel skewer or rod. A rod is inserted through one of the eyes and through the vent;
- stunning the crabs by passing a weak electric current through seawater or freshwater in which the crabs are immersed;
- since spoilage in dead crabs takes place very rapidly and any delay prior to cooking may reduce the meat quality, crabs that are rendered insensible or killed should be cooked immediately;
- if crabs are known to contain defects, an appropriate assessment should be carried out to determine the reason(s) for loss of control. Crabs should be rejected if known to contain defects which will not be eliminated or reduced to an acceptable level by normal procedures of sorting or preparation and the DAP plan should be modified where necessary.

8.3.3.4 Cooking (Processing Step 4)

Potential Hazards: *Survival of pathogenic micro-organisms due to insufficient cooking.*

Potential Defects: *over/undercooking.*

Technical Guidance:

- where the final product is to be marketed as cooked crabs in the shell or the shucked meat should be chilled to a temperature approaching that of melting ice and either passed into the distribution chain or processed within 18 hours;
- in most cases the cooking of crabs in boiling water is preferred to steaming. Steaming has a tendency to dry the meat, resulting in the flesh adhering to the shell. Continuous conveyorised cooking is recommended;
- cooking should be carried out by appropriately trained personnel who has acquired the necessary skills to monitor and ensure that all crabs are given the same time/temperature exposure during the operation;
- adequate uniform cooking is essential because too much cooking causes excessive meat shrinkage, moisture loss and lower yields, and too little cooking makes it difficult to remove the meat from the shell;
- it is difficult to specify cooking times and temperatures generally due to differences in size, structure and physiology of the different species of crabs. Considering these reasons, time and temperature should be previously determined for cooking operation to assure the

accomplishment of the microbiological levels of pathogenic bacteria. In general, a minimum meat temperature of 82 to 93ºC (180 to 200ºF) should be achieved.

- [The following represents some general practices presently used in the industry for various crab species:

– Blue crab (whole crab):
  1. steam retorted for 10 min after reaching 121ºC retort temperature and
  2. boiling or steaming for a minimum of 15 min at 100ºC.

– King crab section:
  3. one-stage cook - 22-25 min in seawater at 100ºC;
  4. two-stage cook - 10 min at 71-75ºC followed by meat removal and a second cook for about 10 min at 100ºC in brine and
  5. "green cook or partial cook" for canning where sections are blanched for 10-15 min at 100ºC.

– Snow crab and Geryon sections:
  6. one-stage cook - 7-15 min at 100ºC depending on the size of the crab and
  7. two-stage cook - 4 -5 min in water at 71-82ºC followed by meat removal and a second cook of 3-5 min in steam (100ºC).

– Cancer species:
  8. butchered sections - 10-15 min in water or steam at 100ºC and
  9. whole crabs - inactivation followed by boiling or steaming 100ºC for 15 - 25 min depending on size.]

- crabs should be rejected if they are known to contain harmful substances or defects, which will not be eliminated or reduced to an acceptable level by normal procedures of sorting or preparation. An appropriate assessment should be carried out to determine the reason(s) for loss of control and the HACCP or DAP plan should be modified where necessary.

8.3.3.5 Cooling (Processing Step 5)

Potential Hazards: *Microbiological contamination*

Potential Defects: *unlikely*

Technical Guidance:

- cooling should be done in cold circulated air, running potable water or clean sea water;
- where crabs are cooked on a continuous basis, cooling is also best done on a continuous basis;
- cooling should be completed as quickly as possible and every effort should be made to avoid contamination of the product during this period;
- the same water should not be used for cooling more than one batch;
- in some species, the body cavity contains a considerable amount of water, so that adequate drainage, in an area set aside for the purpose, is desirable;
- crabs should be rejected if they are known to contain harmful substances, which will not be eliminated or reduced to an acceptable level by normal procedures of sorting or preparation. An appropriate assessment should be carried out to determine the reason(s) for loss of control and the HACCP plan should be modified where necessary.

8.3.3.6 Sectioning/Meat Extraction (Processing Step 6)

Potential Hazards: *Recontamination during meat extraction, microbiological growth, microbial toxin development, presence of shell fragments.*

Potential Defects: *Unlikely*

Technical Guidance:

- after butchering, any remaining viscera and gills should be removed by brushing and washing. Proper cleaning at this stage is strongly recommended since it eliminates the risk of foreign material being included in the finished product;
- it is recommended that different staff be involved in operations with cooked and uncooked crabs, to avoid cross-contamination;
- picking or shaking operations should be carefully controlled to prevent contamination from bacteria and/or foreign materials;

- it is recommended that all types of meat are picked, packaged and either chilled [(internal temperature of 4.5ºC/40ºF or less) or frozen within two hours];
- depending on the vessel or processing facility product flow pattern and where a prescribed critical limit for staging time and temperature regime has been established for the control of hazards, the crab meat should be appropriately chilled in clean containers and stored in specially designated and appropriate areas within the processing facility;
- because of the possibilities of microbiological contamination, continuous mechanical processing is preferable to hand picking or shaking of white meat by batch processing;
- claws, leg tips and shell parts containing recoverable meat should be continuously separated, rapidly and efficiently, from waste material during the picking operation and should be kept chilled and free from contamination;
- meat recovery operation materials should be carried out continuously;
- crabs should be rejected if they are known to contain harmful substances or and defects, which will not be eliminated or reduced to an acceptable level by normal procedures of sorting or preparation. An appropriate assessment should be carried out to determine the reason(s) for loss of control and the HACCP or DAP plan should be modified where necessary.

8.3.3.7 Shell Fragments Removing (Processing Step 7)

Potential Hazards: *Presence of shell fragments, microbial toxin development*

Potential Defects: *Unlikely*

Technical Guidance:

- particular care should be taken to ensure that shell fragments are removed from crab meat since they are very objectionable to consumers and in some circumstances they may be dangerous;
- to minimise time delays, the design of the meat extraction and shell fragment removal line should be continuous to permit a uniform flow without stoppages or slow-downs and removal of waste;
- depending on the vessel or processing facility product flow pattern and where a prescribed critical limit for staging time and temperature regime has been established for the control of hazards, the crab meat should be appropriately chilled in clean containers and stored in specially designated and appropriate areas within the processing facility;
- the use of an ultraviolet light could improve the detection of shell fragments in crabmeat. If the ultraviolet light is used it should be in compliance with the requirements of the official authorities having jurisdiction;
- crabmeat should be rejected if they are known to contain harmful substances, which will not be eliminated or reduced to an acceptable level by normal procedures of sorting or preparation. An appropriate assessment should be carried out to determine the reason(s) for loss of control and the HACCP plan should be modified where necessary.

8.3.3.8 Primary-Packaging/Sealing/Final Packaging/Labelling (Processing Steps 8 and 12)

Refer to section 13.4 – Packing in Containers (Filling, Sealing and Cooling).

Potential Hazards: *Subsequent microbiological contamination due to a bad sealing*

Potential Defects: *Incorrect labelling*

Technical Guidance:

- packaging material should be clean, sound, durable, sufficient for its intended use and of food grade material;
- prior to their application, labels should be verified to ensure that all information declared meet, where applicable, the Codex General Standard for the Labelling of Pre-packaged Foods[10], labelling provisions of the appropriate Codex Standard for products and/or other relevant national legislative requirements;
- the operation, maintenance, regular inspection and adjustment of sealing machines should received particular care;
- the sealing operation should be conducted by qualified personnel specially trained;
- packaging integrity of the finished product should be inspected at regular intervals by an appropriately trained personnel to verify the effectiveness of the seal and the proper operation of the packaging machine;

10 Codex General Standard for the Labelling of Pre-packaged Foods (Codex Stan 1-1985, Rev. 2-1999)

- crab meat should be rejected if they are known to contain harmful substances and or defects, which will not be eliminated or reduced to an acceptable level by normal procedures of sorting or preparation. An appropriate assessment should be carried out to determine the reason(s) for loss of control and the HACCP or DAP plan should be modified where necessary.

8.3.3.9 Pasteurisation (Processing Step 10)

Potential Hazards: *Surveillance of pathogens.*

Potential Defects: *Deterioration*

Technical Guidance:

- pasteurising of product should be carried out by appropriately trained personnel who has acquired the necessary skills to monitor and ensure that all packages are given the same time/temperature exposure during the operation;
- pasteurisation should be carried out in hermetically sealed containers;
- crab meat should be pasteurised immediately after picking and packaging;
- to prevent any possible deterioration of the product the crabmeat should be pasteurised immediately. It is preferable that the meat be at a temperature of
- approximately 18ºC (64.4ºF) when the container are hermetically sealed to provide a slight vacuum after chilled storage temperatures;
- a time and temperature regime for the pasteurisation of different crab products should be established and should take into consideration the pasteurisation equipment and capacity, the physical properties of the crab and packaging container including their thermal conductivity, thickness, shape and temperature, to ensure that adequate heat penetration has been achieved for all containers in the lot;
- each container of crab meat should be exposed to a minimum processing temperature of 85ºC (185ºF) of at least 1 min at the geometric centre of the container;
- the water bath should be preheated to a temperature of 90ºC (194ºF) before the loaded basket is put into it. Special concern should be given to proper water circulation within the bath and around each individual container being pasteurised. Hot water bath temperature should remain constant until processing is completed;
- [proper pasteurisation procedures for blue crab usually require a cooking time of 110 to 115 min when 401 flat cans are used;]
- once proper times and temperatures are established, they must be adhered to closely and pasteurisation processes should be standardised by accurate thermocouple measuring equipment. It is recommended that new equipment be standardised after installation and re-standardise on an annual basis or when difficulties are experienced;
- calibration and appropriate maintenance of temperature recording equipment should be performed on a regular basis to ensure accuracy;
- crab meat should be rejected if they are known to contain harmful substances and or defects, which will not be eliminated or reduced to an acceptable level by normal procedures of sorting or preparation. An appropriate assessment should be carried out to determine the reason(s) for loss of control and the HACCP or DAP plan should be modified where necessary.

8.3.3.10 Cooling (Processing Step 11)

Potential Hazards: *Microbiological recontamination due to a bad sealing, poor/rough handling and contaminated water, formation of Clostridium botulinum toxin.*

Potential Defects: *Unlikely*

Technical Guidance:

- the pasteurised container of meat should be immediately cooled after processing;
- cooling is best accomplished in an ice water bath. The size of the cooling bath should exceed the size of the pasteurising water bath to allow for an excess of ice, which is needed if the water is to be kept below 8ºC (46.4ºF) and a maximum cooling rate is to be realised. No water agitation is required since adequate convection currents are created by differences between bath and product temperatures;
- the water used at the cooling operation should be [chlorinated] in order to avoid recontamination of the product;
- the product should be removed from the ice bath when the temperature has been reduced to below 3.0ºC (38ºF) with subsequent transfer to chilled storage as quickly as possible;

- crates used to hold container in chilled storage should allow free passage of air currents in order to complete the cooling cycle;
- crab meat should be rejected if they are known to contain harmful substances, which will not be eliminated or reduced to an acceptable level by normal procedures of sorting or preparation. An appropriate assessment should be carried out to determine the reason(s) for loss of control and the HACCP plan should be modified where necessary;
- the processing facility should implement a traffic control system that will ensure that the unpasteurised product cannot be mixed with any pasteurised product.

Potential Hazards: *Formation of* Clostridium botulinium *toxin*

Potential Defects: *Unlikely*

Technical Guidance:

- the pasteurised crab meat should be moved to the chilled storage facility without undue delay;
- the pasteurised product is perishable and unless it is kept chilled at a minimum temperature of below 3.0ºC (38ºF), there is a possibility that Clostridium botulinum may grow and produce toxins;
- the chill room should be equipped with a calibrated indicating thermometer. Fitting of a recording thermometer is strongly recommended;
- crab meat should be rejected if they are known to contain harmful substances, which will not be eliminated or reduced to an acceptable level by normal procedures of sorting or preparation. An appropriate assessment should be carried out to determine the reason(s) for loss of control and the HACCP plan should be modified where necessary.

SECTION 9 PROCESSING OF SHRIMPS AND PRAWNS

9.1 FROZEN SHRIMPS AND PRAWNS - GENERAL

- fresh shrimps from an estuary, bay or aquaculture should be processed quickly;
- frozen shrimps for plant processing should be thawed in accordance with the procedures defined in section 9.2.6 and inspected for suitability;
- if the shrimps cannot be processed immediately, they should be placed in clean containers with an ample quantity of ice and stored in specially designated and appropriate areas in the plan.

9.2 PROCESSING OPERATIONS

Refer to figure 9.1 for a flow diagram of processing shrimps and prawns.

9.2.1 Reception (in behead area)

Potential Hazards: *microbiological contamination.*

Potential Defects: *unlikely*

Technical Guidance:

- raw materials should be monitored to verify sanitary quality;
- organoleptic characteristic such as appearance, odour, texture, etc.;
- chemical indicators of decomposition and/or contamination, for example TVBN, heavy metals, pesticides residues, antibiotics or drugs, etc.;
- microbiological criteria;
- foreign matter;
- all personnel should be trained in operations and handling;
- delays and exposure of the shrimps to the environment and a temperature above 4°C should be avoided;
- it is necessary to use approved suppliers or verify specifications in drugs or pesticide use, especially in bay, estuary and aquaculture origin;

The type of containers should meet the following requirements for transport and handling of the fresh or frozen product:

- the containers should protect the contents from contamination by micro-organisms or any other substance;

- their inner surfaces should not react with the contents in any way that would adversely affect the product or the containers;
- their outer surfaces should be resistant to corrosion under any likely conditions storage;
- they should be easy to open and easy to empty to avoid physical damage to the product.

9.2.2 Washing

Potential Hazards: *microbiological contamination.*

Potential Defects: *microbiological contamination.*

Technical Guidance:

To replace ice or drain warm water and replace for cold water:

- immediately after shrimps have been beheaded, the container should be washed in potable water to remove shrimp debris, dirt and other undesirable materials;
- replace ice or drain warm water and replace for cold water;
- remove waste products and maintain the water temperature below 4°C (39.2°F).

This flow chart is for illustrative purposes only. For in-factory HACCP implementation a complete and comprehensive flow chart has to be drawn up for each process.

References correspond to relevant Sections of the Code.

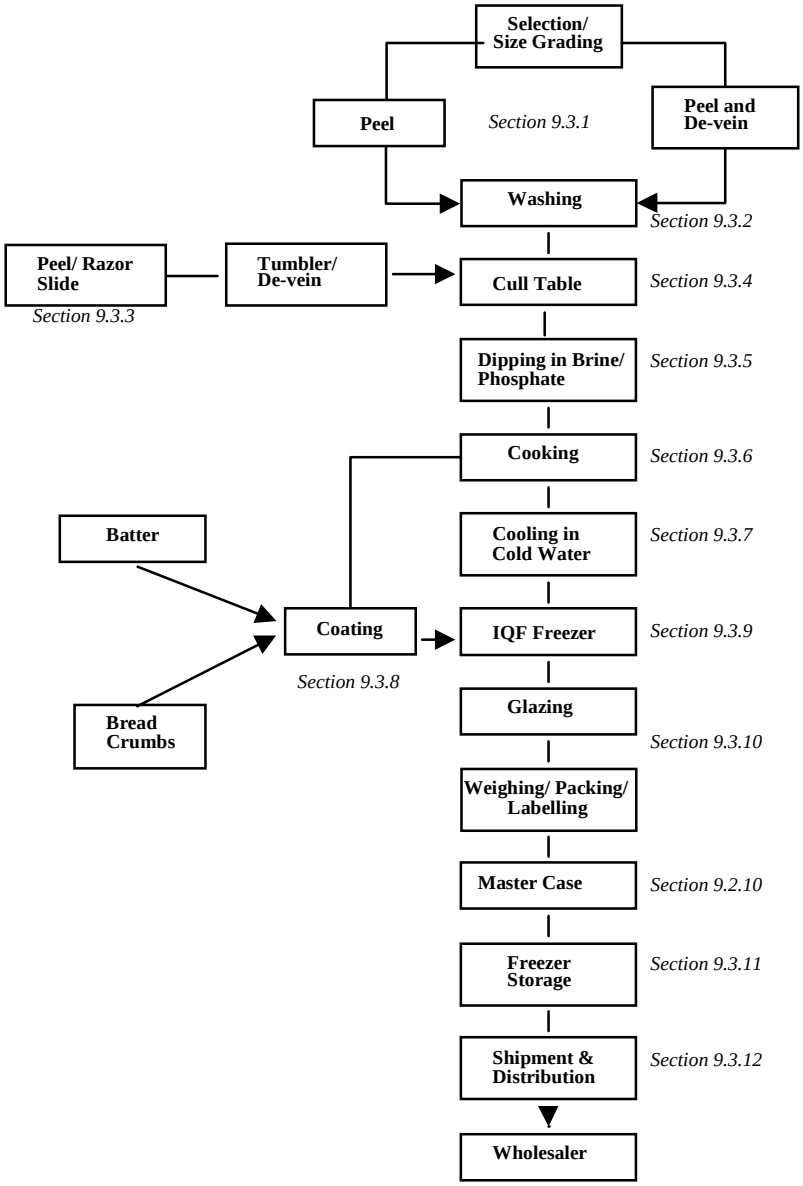

Figure 9.2 Example of a flow chart of I.Q.F. peel, peel and de-vein, cooked or breaded shrimp

9.2.3 Behead / Washing (process on board)

Potential Hazards: *microbiological and chemical (combustible) contamination.*

Potential Defects: *contamination by micro-organisms and extraneous material.*

Technical Guidance:

- it is necessary to cover the product to avoid contamination by bird faeces;
- all surfaces with which the shrimps might come into contact should be of suitable corrosive-resistant material;
- deck pounds or pens, stanchions, dividing boards and holding tanks should be constructed of suitable corrosive-resistant material. They should be adequate in quantity and height to prevent crushing of the catch due to excess weight or to the vessel's motion, and to hold the estimated catch;
- in practise wood is still used in many fisheries for deck pound boards and steel for stations and other fixtures. Where this is the case, the wood should be treated to prevent the entry of moisture and should be coated with a durable, non-toxic light coloured paint or other non-toxic surface coating that is smooth and easy to clean. Steelworks should be coated with anti-corrosion and non-toxic paint. Whenever possible, suitable corrosion-resistant materials should be used;
- after the product has been beheaded it should be washed with fresh or seawater of potable quality;
- the temperature of the product should be appropriate for the operation.

9.2.4 Freezing (process on board)

Potential Hazards: *microbiological contamination.*

Potential Defects: *unlikely*

Technical Guidance:

- for freezing in brine, it is necessary to avoid the use of copper serpentine (pipe coils). For freezing in horizontal or vertical plate freezers it is necessary to have a maintenance schedule to avoid any contamination with refrigeration;
- for freezing in brine it is necessary to remove the brine, and maintain a schedule. It is important to inspect the salt to be used for the brine;
- for freezing in brine it is necessary to avoid excess salt and calibrate salinity instruments;
- brine systems for freezing should be properly designed to give adequate cooling capacity;
- the freezing area should be covered and maintained to avoid contamination;
- all the tanks, heat exchangers, pumps and associated piping should be constricted of, or coated with, suitable corrosion-resistant material, and designed that they could be easily cleaned and disinfected.

9.2.5 Reception (in the processing area)

Consider all the points in Section [DN: 6.3?]

9.2.6 Controlled Thawing

Potential Hazards: *microbiological contamination.*

Potential Defects: *unlikely*

Technical Guidance:

- for thawing in water, the water used should be either fresh water or sea water of potable quality, or use approved ice suppliers;
- shrimps and prawns should be thawed rapidly in properly designed equipment. The water temperature should be maintained no higher than 20ºC (68ºF) and the water should not be reused;
- it is necessary to implement thawing procedures;
- if thawing tanks are used, a constant supply of potable or clean sea water at a temperature maintained no higher than 20ºC (68ºF) should be provided and it should not be reused;
- prior to thawing, the packaging material, such as wax cartons, should be removed so that they will not come into contact with the thawing water;

- it is desirable for the exit conveyor, leading from the thawing tank, to be equipped with a series of low velocity sprays to wash the shrimps as they leave the tank. The water used for this purpose should be cold so that the shrimps are being chilled whilst being washed;
- immediately after thawing the shrimps or prawns should remain chilled whilst processing to avoid abuse of temperature.

9.2.7 Inspection / Pre-selection

Potential Hazards: *physical contamination.*

Potential Defects: *unlikely*

Technical Guidance:

- shrimps carried out of the tank by a conveyor should be inspected to detect any foreign matter or odour by chemical decomposition;
- shrimps or prawns should be sorted into species and trade quality categories for the relevant market;
- it is necessary to avoid delays, which increase temperature and the likelihood of black spots in shrimps or prawns;
- personnel should be trained to identify any change of quality.

9.2.8 Packaging / Labelling

Potential Hazards: *physical contamination.*

Potential Defects: *incorrect labelling.*

Technical Guidance:

- packaging material should be visually checked and be within specifications. It should also be clean, durable, sufficient for its intended use and of food grade material to avoid damage or contamination of the product;
- approved packaging material suppliers should be used;
- the packaging operations should be conducted in a manner to minimise the risk of contamination and decomposition;
- it is necessary to check packaging materials before use to avoid incorrect labelling.

9.2.9 Freezing

Potential Hazards: *microbiological contamination.*

Potential Defects: *unlikely.*

Technical Guidance:

Products for freezing should be frozen as quickly as possible since unnecessary delays before freezing will cause temperature of the shrimp to rise, increasing the rate of quality deterioration and reducing shelf-life due to the action of micro-organisms and undesirable chemical reactions.

- plant production shall be geared to the capacity of freezing, avoid overload;
- a schedule of checks should be made to ensure the operation of freezing is correct;
- accurate records of all freezing operations should be kept;
- temperature in the freezer should be -35ºC to -40ºC [and the product temperature should not rise above -18°C?]

9.2.10 Glaze and Master Case

Potential Hazards: *microbiological and physical contamination.*

Potential Defects: *unlikely*

Technical Guidance:

- during the glazing operation delays or exposure of the product to a high temperature should be avoided;
- the glaze temperature should be maintained between 0°C and 2°C;
- potable cold water should be used to glaze the product;
- master material should be of food grade material and appropriate for labelling and weighing and provide good protection for the product;

- it is necessary to use approved packaging material suppliers.

9.2.11 Freezer Storage

Potential Hazards: *microbiological contamination.*

Potential Defects: *unlikely*

Technical Guidance:

- frozen products should be immediately transferred to the freezer for storage;
- temperature should be monitored and recorded.
- temperature in the freezer should be -20ºC to -25ºC and the product temperature should be below -18°C;
- schedule for checks should be made to ensure correct operation of freezer storage ;
- plant production shall be geared to the capacity of freezer to avoid overload.

9.3 I.Q.F. PEEL, PEEL AND DE-VEIN, COOKED OR BREADED SHRIMPS OR PRAWNS

9.3.1 Peel or Peel and De-vein

This step peel or peel and de-vein, is considered a manual operation. Figure 9.2 is an example flow chart for I.Q.F. peel, peel and de-vein, cooked or breaded shrimps.

- the design of the peel and de-vein line should be continuous and sequential to permit the uniform flow without stoppages or slow-downs and removal of waste;
- any damaged, contaminated or otherwise unacceptable shrimps or prawns should be discarded;
- all the surfaces and utensils should be cleaned, before, during and after process;
- piling large quantities of shrimps or prawns over the table should be avoided;
- care should be taken to avoid contamination and damage to shrimps or prawns

9.3.2 Washing

Potential Hazards: *microbiological contamination.*

Potential Defects: *contamination by micro-organisms and extraneous material.*

Technical Guidance:

- immediately after peel or peel and de-vein, the shrimps or prawn should be washed with cold potable water to remove all impurities, vein, or shell ;
- for washing by immersion warm water should be drained and replaced for cold water below 4°C;
- the resulting wastewater should be disposed of in a suitable manner.

9.3.3 Peel / Razor Slide

This step is considered a mechanical operation.

- the equipment should have a maintenance schedule in order to keep in good condition;
- any damaged, contaminated or otherwise unacceptable shrimps or prawns should be discarded;
- all the surfaces and utensils should be cleaned, before, during and after process;
- piling large quantities of shrimps or prawns over the table should be avoided;
- care should be taken to avoid contamination and damage to shrimps or prawns;
- the equipment should be dismantled and each piece cleaned by trained personnel.

9.3.4 Cull Table

- avoid delays in the removal of defective product (i.e. broken shrimps or prawns, pieces, unpeeled and de-veined shrimps or prawns, black spots, etc.);
- all the surfaces and utensils should be cleaned, before, during and after the process;
- care should be taken to avoid contamination and damage to shrimps or prawns;
- shells left by the machine should also be checked for incomplete removal of meat and the presence of unshelled or broken pieces of shrimps;

- peeled and de-veined shrimps or prawn should be thoroughly washed, preferably by a spray of cold potable water or a weak brine solution.

9.3.5 Dip in brine or polyphosphate solution

- immediately after removal of shell, defective product or black spot it is necessary to dip the product in cold brine or polyphosphate solution;
- only fresh brine or polyphosphate solution should be used;
- the ratio and concentration of brine or polyphosphate solution to shrimp should be adjusted according to the desired product;
- it is necessary to calibrate brine measurement apparatus;
- the time of immersion and the temperature should be controlled to obtain the desired product;
- salt and polyphosphate are ingredients which do not meet the specifications and should be controlled to avoid the risk that they might be processed;
- the brine or polyphosphate solution should be replaced and dip tanks and other dipping equipment should be thoroughly cleaned at frequent intervals.

9.3.6 Cooking

- cooking procedure, in particular, time and temperature, should be clearly defined;
- the cooking schedule should be reviewed before each process;
- shrimp cooked together in batches should be similar in size to ensure they are cooked at an even temperature and avoid temperature differentials;
- potable water should be used for steam;
- it is necessary to have a cooker maintenance schedule.

9.3.7 Cool in Water

- cooked shrimp should be cooled as quickly as possible to bring the product to a temperature range limiting bacteria proliferation or toxin production;
- the cooling schedule should enable control of the temperature and time;
- use approved ice suppliers;
- enough cool potable water should be supplied. The same water should not be used for cooling more than one batch.
- avoid contamination with raw materials.

9.3.8 Breading and coating

- the breading and coating schedule should sufficiently mix the ingredients and use the correct quantities;
- ingredients used should be controlled to meet specifications;
- ingredients should be covered and kept in cool storage to avoid the risk of contamination;
- mix ingredients should be replaced and the equipment should be thoroughly cleaned. Avoid the contact of dry mix and product;
- potable water should be used to mix ingredients;
- ensure ingredients are within buyer specifications.

9.3.9 I.Q.F Freezer

- shrimp in batches should be similar in size to control freezing time and avoid burns;
- freezer schedule should be followed to ensure correct operation of freezing.

9.3.10 Glazing/Weight/Pack/Label

Potential Hazards: *microbiological and physical contamination.*

Potential Defects: *incorrect label*

Technical Guidance:

- frozen shrimp should be glazed to protect quality during storage and distribution. Glazing should be adjusted according to similar;

- glazed shrimp should be immediately weighed, packed and labelled to avoid risk of contamination and protect quality during storage and distribution;
- frozen and packed shrimp should be immediately transferred to the freezer storage;
- temperature should be monitored and recorded;
- all wrappings, adhesives and printing material likely to come into contact with the product should be odourless. The packaging should ensure that the original product flavour and odour are retained. Furthermore there should be no risk that substances likely to be harmful to health will be transferred from the packaging material to the food.

9.3.11 Freezer Storage

Potential Hazards: *microbiological contamination.*
Potential Defects: *unlikely*
Technical Guidance:

- storage temperature should be between -20ºC to -25ºC;
- the product temperature should be below -18°;
- the product should be handled carefully and not over-stacked.

9.3.12 Shipment and Distribution

Potential Hazards: *microbiological contamination.*
Potential Defects: *unlikely*
Technical Guidance:

- before loading the cleanliness and sanitation of the truck containers should be verified;
- before loading the containers should be pre-cooled;
- avoid delays during the loading and unnecessary exposure to elevated temperatures;
- monitor temperatures during transport;
- vehicles should be designed and made with walls, floors and roofs of a suitable corrosion-resistant material with smooth non-absorbent surfaces. Floors should be adequately drained;
- ensure the temperature of frozen shrimps or prawns is maintained at -18ºC or below;
- protect the frozen shrimps or prawns against contamination from dust, exposure to higher temperatures and the drying effects of the sun or wind;
- permit the free flow of chilled air around the load;
- load for good air flow and avoid physical damage.

SECTION 10: PROCESSING of CEPHALOPODS

10.1 SCOPE

This code of practice applies to fresh and processed cephalopods including commercially imported cuttlefish (*Sepia* and *Sepiella*), squid (*Ilex, Loligo, Loliolus*, *Sepioteutis, Symplectoteuthis* and *Todarodes*) and octopuses (*Octopus, Polypus* and *Eledone*) intended for human consumption.

10.2 PROCESSING OPERATIONS - CEPHALOPODS

This code shows an example of a cephalopod process. Figure 10.1 lists the steps associated with receiving and processing fresh squid. It should be noted that there is a variety of processing operations for cephalopods and this process is being used for illustrative purposes only. The principles of HACCP should be applied to each process.

Fresh Cephalopods are extremely perishable and should be handled at all times with great care and in such a way as to prevent contamination and inhibit the growth of micro-organisms.

Cephalopods should not be exposed to direct sunlight or to the drying effects of winds, or any other harmful effects of the elements, but should be carefully cleaned and cooled down to the temperature of melting ice, 0°C (32°F), as quickly as possible.

10.2.1 Reception of Cephalopods (Processing Step 1)

Potential hazards: *microbiological, physical contamination, parasites.*
Potential defects: *damaged products.*

Technological Guidance:

The processing facility should have in place a programme for inspecting cephalopods on catching or arrival at the factory. Only sound product should be accepted for processing.

Personnel inspecting product should be trained and experienced with the relevant species in order to recognise any defects and potential hazards.

The presence of lacerations, breakages and discoloration of the skin, or a yellowish tinge spreading from the liver and digestive organs inside the mantle, are the first indication of product deterioration.

10.2.2 Storage of Cephalopods (Processing Step 2)

Refer to the general fish guideline in section 3.

10.2.3 Splitting and Gutting (Processing Step 3)

Potential hazards: *Unlikely.*

Potential defects: *presence of gut contents, parasites, shells, discoloration.*

Technological Guidance:

Gutting should remove all intestinal material and the cephalopod shell if present.

Any by-product of this process, which is, intended for human consumption e.g. tentacles, mantle; should be handled in a timely and hygienic manner.

This flow chart is for illustrative purposes only. For in-factory HACCP implementation a complete and comprehensive flow chart has to be drawn up for each process.

References correspond to relevant Sections of the Code.

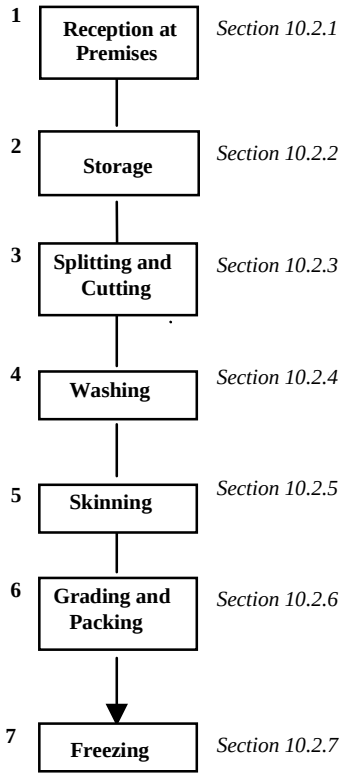

Figure 10.1 Flow diagram of processing fresh cephalopods to frozen product

10.2.4 Washing (Processing Step 4)

Potential hazards: *Unlikely.*

Potential defects: *presence of ink, gut material.*

Technological Guidance:

Cephalopods should be washed in clean seawater or potable water immediately after gutting to remove any remaining material from the tube cavity and to reduce the level of micro-organisms present on the product.

10.2.5 Skinning (Processing Step 5)

Potential hazards: *unlikely*

Potential defects: *presence of objectionable matter, bite damage, skin damage*

Technological Guidance:

The method of skinning should not contaminate the product nor should it allow the growth of micro-organisms e.g. enzymatic skinning or hot water techniques should have defined time/temperature parameters to prevent the growth of micro-organisms.

10.2.6 Grading/Packing (Processing Step 6)

See also section 3.

Potential hazards: *microbiological, chemical or physical contamination from packaging.*

Potential defects: *incorrect labelling, incorrect weight*

10.2.7 Freezing (Processing Step 7)

Potential hazards: *parasites e.g. Anasakis.*

Potential defects: *freezer burn, decomposition, loss of quality due to slow freezing.*

Technological Guidance:

If freezing is used as a control point for parasites, then the time/temperature parameters need to ensure that the parasites are no longer viable need to be established.

SECTION 11 PROCESSING OF SALTED FISH

Salted fish and fish products should be sound and wholesome, well prepared and packaged so that they will be protected from contamination and remain attractive and safe to eat. In order to maintain the quality of fish it is important to adopt quick, careful and efficient handling procedures.

11.1 GENERAL

Refer also to Section 6.1 for general handling prior to processing and figure 11.1 for and example flow chart of a salted fish processing line.

- fresh fish intended for processing salted fish should be checked for nematodes;
- frozen fish should not be salted before it is thoroughly thawed and inspected for suitability;

This flow chart is for illustrative purposes only. For in-factory HACCP implementation a complete and comprehensive flow chart has to be drawn up for each process.

References correspond to relevant Sections of the Code.

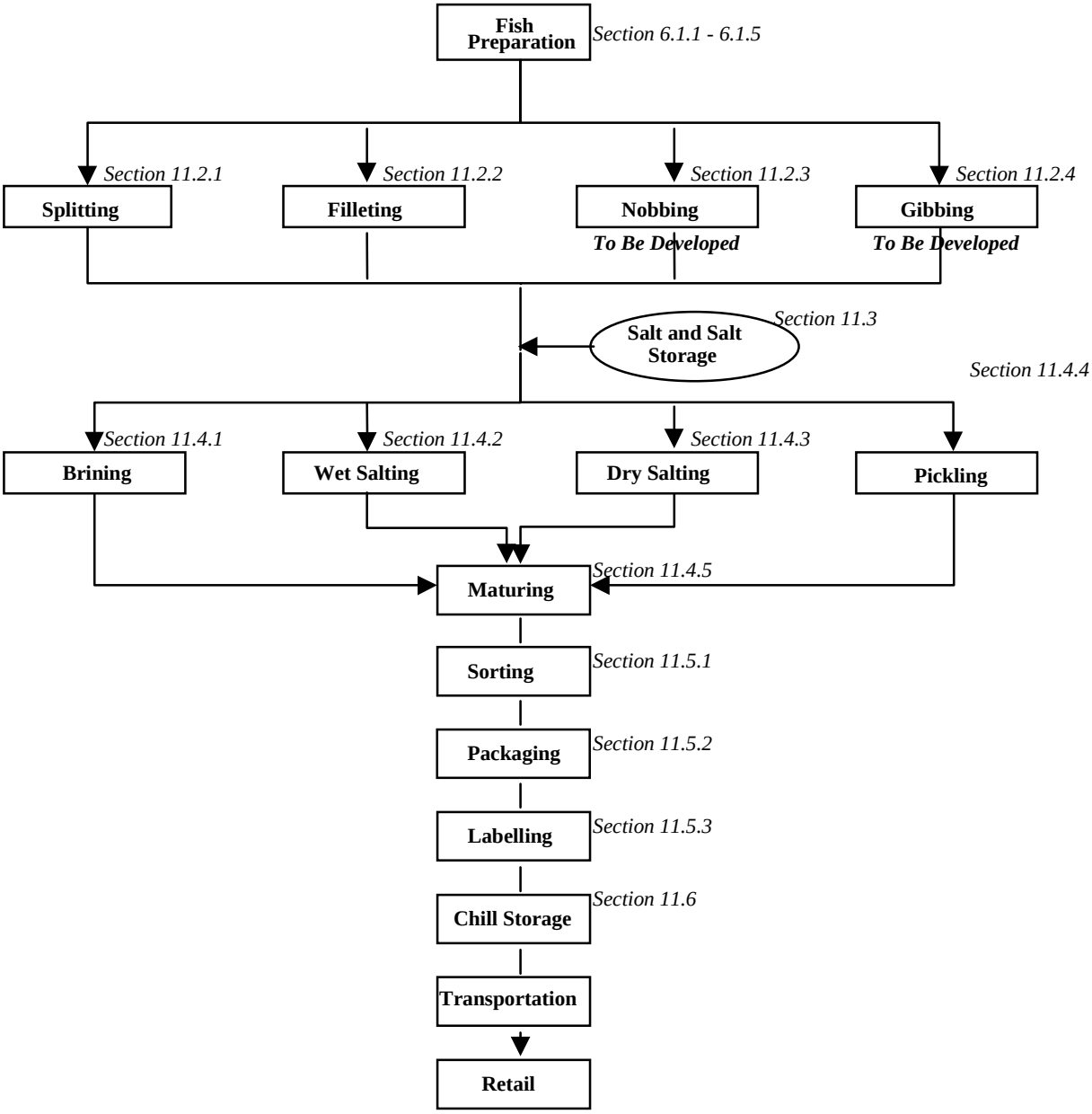

Figure 11.1 Example of a flow chart of a salted fish processing line.

11.2 PREPARING FOR SALTING

11.2.1 Splitting, Washing and Rinsing

Potential Hazards: *Parasites, microbiological contamination*

Potential Defects: *Parasites, decomposition*

Technical Guidance:

- the design of the splitting line should be continuous and sequential to permit the uniform flow without stops or slow-downs. The waste should be continuously removed from the line;
- any damaged, contaminated or otherwise unacceptable fish should be discarded before splitting;
- fish should be split by a cut made parallel to the backbone straight down from the nape to the tail and in such a way as to prevent uneven and ragged edges or a loss in recovery. If the backbone is to be removed, the fish should be split so deeply that the remains of the backbone (the tail-bone) lie free. It is important to cut the bone rather than to break it from the flesh;
- splitting of fish should be carried out expertly so that blood in nape and blood clots are removed;
- immediately after splitting, fish should be washed in plenty of running potable water or clean sea water, to remove all blood from the fish;
- all impurities, blood and slivers should be removed;
- if the black membrane has to be removed than it should be done after the splitting step.

11.2.2 Filleting, Skinning and Trimming

Refer to Section 6.1.6

11.2.3 Nobbing (Herring)

(To be developed)

11.2.4 Gibbing (Herring)

(To be developed)

11.3 SALT HANDLING AND SALT REQUIREMENTS

11.3.1 Handling

Potential Hazards: *Contamination (biological, chemical, physical)*

Potential Defects: *Contamination (biological, chemical, physical)*

Technical Guidance:

- Salt for salting of fish should be transported and stored dry and hygienically covered in salt bins, storerooms, containers or in plastic sacks;
- In order to minimise infections of salted fish the re-use of salt should be avoided.

11.3.2 Salt Requirements

Potential Hazards: *Incorrect composition, microbiological growth*

Potential Defects: *Incorrect composition, contamination (biological, chemical, physical)*

Technical Guidance:

- The quality of salt used in salting of fish should possess an appropriate composition for the product;
- The composition of salt differs according to the origin. Mine salt is usually almost pure sodium chloride but solar salt of marine origin contains several other salts like calcium sulphate, magnesium sulphate and chloride as impurities;
- A relatively pure salt is needed for the dry-salting of fatty fish but for some products the presence of small quantities of calcium salts will give the product a somewhat superior appearance. Too much calcium may reduce the rate of salt penetration to an extent that spoilage may occur;

- Magnesium salts if present at too high a concentration will give rise to unpleasant bitter flavours and may cause spoilage during the salting operation;
- Salt produced from marine sources may contain halophilic bacteria which continue to live in the salt and dry salted fish;
- Salt used to salt fish should be clean, free from foreign matter and foreign crystals, show no visible sign of contamination with dirt, oil, bilge or other extraneous materials. Salt used for heavy salted fish should meet the following requirements:
  - levels of calcium salts between 0.15% and 0.35% have been found satisfactorily;
  - levels of magnesium salts if present, not more than 0.15%;
  - content of copper not more than 0.1 mg/kg ;
  - content of iron not more than 10 mg/kg;
  - small crystals for dry-salting of fatty fish and large crystals for lean fish;
  - free from micro-organisms, which adversely affect the quality of final products.

11.4 SALTING AND MATURING

Salted fish should be salt-matured, sound and wholesome. The fish should be free of remains of the guts, liver and other entrails.

Salting of fish either by brining, wet salting, dry salting or pickling should be carried out with full understanding of their effects on the quality of the final product and should be done under strict hygienic condition.

Two particular conditions that can adversely affect the quality of dry salted fish are the occurrence of "*pink*", a discoloration caused by red halophilic bacteria; and "*dun*", a development of the mould *Sporendonema epizoum*. Both defects can be combated by maintaining a temperature lower than 10^{o}C (50^{o}F). Salt produced from marine sources may contain halophilic bacteria, which continue to live in the salt and salted fish. In order to minimise infections of salted fish, previously used and/or contaminated salt should be removed from the plant.

11.4.1 Brining

Potential Hazards: *contamination, decomposition (histamine, fatty fish)*

Potential Defects: *contamination, decomposition (histamine, fatty fish)*

Technical Guidance:

- only fresh stabilised brine should be used for the salting operations;
- the ratio of brine to fish and the concentration of the brine should be adjusted to desired product;

11.4.2 Wet Salting

Potential Hazards: *contamination, decomposition (histamine, fatty fish)*

Potential Defects: *contamination, decomposition (histamine, fatty fish)*

Technical Guidance:

- fish for wet salting should be carefully salted and properly packed into the curing container;
- amount of salt, time and temperature should be carefully controlled to obtain the desired product;
- when salting the fish, the salt concentration of the brine should be checked periodically with a salinometer according to specifications;
- after salting the containers of fish could be stacked. This should not be done before the proper salt/water balance is obtained. In case of stacking, adequate amounts of salt should be added and evenly distributed over the whole surface of the fish;
- salted fish should be stored or maintained for a sufficient period under controlled temperatures, to ensure proper curing and to prevent deterioration of the product;

11.4.3 Dry Salting

Potential Hazards: *contamination, decomposition (histamine, fatty fish)*

Potential Defects: *contamination, decomposition (histamine, fatty fish)*

Technical Guidance:

- fish for dry salting should be properly arranged to ensure uniform conditions and proper drainage;
- fish piles should never be placed directly on the floor;
- amount of salt, time and temperature should be carefully controlled to obtain the desired product;
- fish should be restacked periodically with the top of the pile going to the bottom of the new pile, and with the addition of fresh salt to ensure that sufficient salt will be present to complete the cure;
- if the fish is restacked on pallets, the pallet should be clean;
- under certain conditions dry salting of small fatty fish, such as anchovy and small herring, may be used. For large fish, pickling or brining should be used in preference;
- fish should not be exposed to freezing temperatures or to high temperatures;

11.4.4 Pickling

Potential Hazards: *contamination, decomposition (histamine, fatty fish)*

Potential Defects: *contamination, decomposition (histamine, fatty fish)*

Technical Guidance:

- the amount of salt must be adjusted to the quality of the fatty fish (fat content). Salt, sugar and spices should be weighed/measured and be evenly distributed;
- during the pickling operation all fish should be well immersed in the resulting pickle;
- fish should be allowed to settle in containers and then salt or pickle added before the container is closed;
- cured fatty fish should be kept in brine or pickle;
- fatty fish should always be covered with pickle during curing;
- when salting fish of Scombridae and Clupeidae families, regular checks should be made of histamine content.

11.4.5 Maturing

Potential Hazards: *Decomposition (histamine, fatty fish)*

Potential Defects: *Decomposition*

Technical Guidance:

- maturing time depends on the fish (species, size and quality), temperature and the amount of salt absorbed by the fish tissues;
- wet salted split fish of the Gadidae family is regarded as mature after 10 to 12 days in the brine, and for dry salted split fish after 20 to 28 days, with temperature between 5°C to 8°C;
- fatty fish such as herring may be kept for up to three weeks in a temperature range of 5°C to 10°C. If the containers are to be held at lower temperatures, the maturing period will increase;
- the first part of curing period for fish of the Clupeidae and Scombridae families should be done at temperatures between 0°C and 5°C to prevent development of histamine;

11.5 SORTING, PACKAGING, WRAPPING AND LABELLING

Refer also to Sections 6.4.4 and 6.5.

11.5.1 Sorting

Potential Hazards: *unlikely*

Potential Defects: *incorrect sorting*

Technical Guidance:

- salted fish should be sorted into species, sizes and trade quality categories for the relevant market;
- loose salt should be removed from the fish before sorting and new salt should be added before packaging.

11.5.2 Packaging/Wrapping

Potential Hazards: *unlikely*

Potential Defects: *contamination, decomposition*

Technical Guidance:

Refer also to Section 6.4.4 and Section 6.5

- packaging material should be clean, sound, durable, sufficient for its intended use and of food grade material;
- the packaging operation should be conducted to minimise the risk of contamination and decomposition;
- products should meet appropriate standards for labelling and weights;
- barrels in which fatty fish are to be marketed should be clean, whole and hygienic.

11.5.3 Labelling

Refer to Section 6.2.3

11.6 CHILL STORAGE

Potential Hazards: *contamination, decomposition (histamine, fatty fish)*

Potential Defects: *contamination, decomposition (histamine, fatty fish), development of "pink" and "dun"*

Technical Guidance:

- salt matured fish should be stored in chill storage. The storage should be well ventilated and the products protected from dust, rodents and other contamination;
- the temperature in the chill storage should be between 1^{o}C to 5^{o}C;
- temperature and storage time should be monitored and recorded at regular intervals;
- the products should be handled carefully and not be over-stacked.

SECTION 12 PROCESSING OF SMOKED FISH

Smoking of fish has a long tradition as a preservation method for fish. As such experience regarding the potential hazards has been gained over the time.

Modern ways of smoking and keeping the smoked products refrigerated however has changed the traditional barriers to growth of bacteria and substituted them in essence by refrigeration resulting in an extended storage time. As a result the historic knowledge of product safety is no longer sufficient but has to be extended with new knowledge.

[Whether the use of liquid smoke is a process under this code or it is to be seen as use of flavouring substances is to be discussed.]

Nevertheless the potential hazards and potential defects for the different types of raw materials used for the production of smoked fish are known (cf. Section 12) and mutatis mutandis should be carried over to the production, packaging and storage of the smoked products.

In general the pre-requisite programme described in Section 3 applies as well as the general considerations for the handling of fresh fish in Section 4, and the description of HACCP and DAP analysis in Section 5. The recommendations made for the production of fresh fishery products in Section 6 are valid for the preparation of fish used as raw material for the production of smoked fish. If fresh fish of species likely to harbour viable [and hazardous] parasites are to be used as raw material for a smoked product and is not during later processing steps treated in a way that will kill parasites, the fresh fish should be frozen [for at least 24 hours at -20°C] as a step in the fish preparation. As an example this may be necessary when using wild salmon from certain waters as raw material for cold smoked salmon, if the smoked salmon is not frozen prior to sale.

Cold smoked fish should meet the requirements set out in the Codex Standard for Pre-Packed Cold Smoked Fish[11].

The objects to be dealt with in this chapter will be those covering the special features of the smoked products and the handling of these products.

Where the process, packaging or storage conditions of the product are not as described in this code, the operator should endeavour to scientifically validate the safety of such a process, packaging or storage of the product so as to eliminate further hazards to the consumer.

12.1 PRE-SALTING (Processing Step 1)

Potential Hazards: *Microbiological, chemical and physical contamination, microbiological growth, biochemical development*

Potential Defects: *Decomposition, physical contamination*

Technical Guidance:

Usually fish for hot smoking are pre-salted only a short time to gain taste, i.e. 0-2 hours, by floating in medium strength salt brine.

Usually fish for cold smoking are dry salted or salted by pickle injection of a medium strength salt brine to gain taste. The salted fish is left to equilibrate for about 24 hours under refrigeration.

Histamine formation may take place in fish of the susceptible species, if the fish is kept at a too high temperature for a prolonged time.

- new brine should be prepared each day of production from food grade salt;
- salt content in the brine should be monitored; for fish for cold smoking the salt content in the fish should be more than [3%][3.5%] salt in the water phase to avoid growth of Clostridium botulinum;
- the brine should be kept cooled and the temperature should be monitored, in particular if the brine is recycled for pickle injection;
- if the brine is recycled a decontamination step should be instated
- the flow of products should be maintained in such a way as to avoid undue accumulation.

12.2 THE SMOKING (Processing Steps 2 & 3)

Potential Hazards: *Microbiological, chemical and physical contamination, microbiological growth, biochemical development*

Potential Defects: *Decomposition, physical contamination*

Technical Guidance:

The smoking process usually is initiated by a drying phase. This phase should be kept short, as prolonged exposure to ambient temperature may lead to formation of histamine in susceptible species.

In the hot smoking process the temperature in the centre of the product will normally reach [63°C][72°C] for about ½ hour (time and temperature to be managed), which leads to a pasteurisation like condition.

In the cold smoking process the temperature of the products is kept below the coagulation temperature for the fish, usually under 30°C.

To avoid cross contamination with wood dust and spores from moulds and to reduce chemical contamination the smoke should be generated in a separate room. Only wood that has not been treated with any chemicals such as paint or impregnating remedies should be used for smoke generation. Where smoke generators are

[11] Codex Standard for Pre-Packed Cold Smoked Fish (under elaboration)

part of units, special care should be exercised not to contaminate the smoke room with wood shavings and smoke emitted from generators.

- wood for generating smoke should not have been treated with any chemicals;
- store wood in a dry place separated from the production rooms
- avoid cross contamination from wood to products by placing the smoke generator in a separate room from the production rooms;
- keep drying time of fish before smoking as short as possible;
- monitor time and temperature of the smoking process.

12.3 SLICING OF COLD SMOKED PRODUCTS (Processing Steps 5 & 6)

Potential Hazards: *Microbiological cross contamination, microbiological growth*

Potential Defects: *Unlikely*

Technical Guidance:

Most cold smoked fish products are sold as whole filets or sliced. Before slicing the smoked filets may be frozen to about -5°C to stabilise the fish to be sliced. The slicing process is critical to the hygienic condition of the product. Special care should be taken to control the presence of Listeria monocytogenes and avoid growth of this bacterium by keeping the slicer clean and avoid possibilities of growth.

- maintain a flow of products to avoid undue accumulation of products along the processing line;
- keep the slicer clean by frequent and planned cleaning during the process.

12.4 COOLING (Processing Steps 4 & 9)

Potential Hazards: *Microbiological contamination, microbiological growth*

Potential Defects: *Decomposition, physical contamination*

Technical Guidance:

Cooling after smoking (process step 4) is important and should be carried out with care.
Cooling after packing (process step 9) is equally important.

- cool hot smoked products adequately[, i.e. products should be cooled to below 10°C within 2 hours and to below 3°C within 6 hours];
- cool cold smoked products adequately[, i.e. products should be cooled to 0°C-+2°C within 2 hours].

12.5 PACKING OF HOT SMOKED PRODUCTS (Processing Step 7)

Potential Hazards: *Microbiological, chemical and physical contamination, microbiological growth, dilution of preservatives from smoke by condensing water*

Potential Defects: *Decomposition, cross contamination, physical contamination*

Technical Guidance:

Hot smoked fish are presented to the market in many forms but mostly in boxes or pre-packaged in plastic bags, possibly evacuated or in modified atmosphere (MAP).

If the products after cooling are packed in a room at ambient temperature condensation might occur on the surface of the smoked products leading to a dilution of [salt and] the preservatives deposited by the smoking process.

- avoid condensation of water on the surface of the smoked product;
- maintain a flow of products to avoid undue accumulation of products along the processing line;
- packaging material should be clean, sound, durable, and sufficient for its intended use and of food grade material.

12.6 LABELLING (Processing Step 8)

Potential Hazards: *Unlikely*

Potential Defects: *Incorrect labelling*

Technical Guidance:

Cold smoked fish are presented to the market mainly as whole filets, packed or unpacked, or as sliced pre-packaged products. Before the slicing process the products are often frozen to facilitate the slicing process, cf. Section 6.3.

Hot as well as cold smoked products are seasonal products, which are produced over a period of time and may be kept in storage as frozen products, but thawn and sold as chilled products. It should be clear from the labelling that the products have been stored as frozen and thawn prior to sale.

- labelling should comply to the general recommendations, cf. Section 6.2.3;
- it should be clearly stated on the labelling if the product has been kept in storage in frozen condition and then thawn prior to sale.

12.7 STORAGE, DISTRIBUTION AND RETAIL (Processing Steps 10, 11 & 12)

Potential Hazards: *Microbial growth*

Potential Defects: *Loss of quality characteristics of product*

Technical Guidance:

- Definition of storage temperature and shelf life for cold smoked products should take into account the risk of microbiological growth, in particular growth of Listeria monocytogenes.

12.8 THAWING (Processing Steps 13 & 14)

Potential Hazards: *Microbiological growth, biochemical development and microbiological contamination*

Potential Defects: *Decomposition*

Technical Guidance:

- the thawing process should follow the relevant recommendations in Section 6.1.4.

SECTION 13 PROCESSING OF CANNED FISH AND SHELLFISH

In the context of recognising controls at individual processing steps, this section provides examples of potential hazards and defects and describes technological guidelines, which can be used to develop control measures and corrective action. At a particular step only the hazards and defects, which are likely to be introduced or controlled at that step, are listed. It should be recognised that in preparing a HACCP and/or DAP plan it is essential to consult Section 5 (Hazard Analysis Critical Control Point (HACCP) and Defect Action Point (DAP) Analysis) which provides guidance for the application of the principles of HACCP and DAP analysis. However, within the scope of this Code of Practice it is not possible to give details of critical limits, monitoring, record keeping and verification for each of the steps since these are specific to particular hazards and defects.

This section concerns the processing of heat processed sterilised canned fish and shellfish products which have been packed in hermetically sealed rigid or semi-rigid containers[12] and intended for human consumption.

As stressed by this Code, the application of appropriate elements of the pre-requisite program (Section 3) and HACCP principles (Section 5) at these steps will provide the processor with reasonable assurance that the essential quality, composition and labelling provisions of the appropriate Codex standard will be maintained and food safety issues controlled. The example of the flow diagram (Figure 13.1) will provide guidance to some of the common steps involved in a canned fish or shellfish preparation line.

[12] Aseptic filling is not covered by this Code. Reference of the relevant code is made in Appendix XI.

This flow chart is for illustrative purpose only. For in-factory implementation of HACCP principles, a complete and comprehensive flow chart has to be drawn up for each product.

References correspond to relevant Sections of the Code.

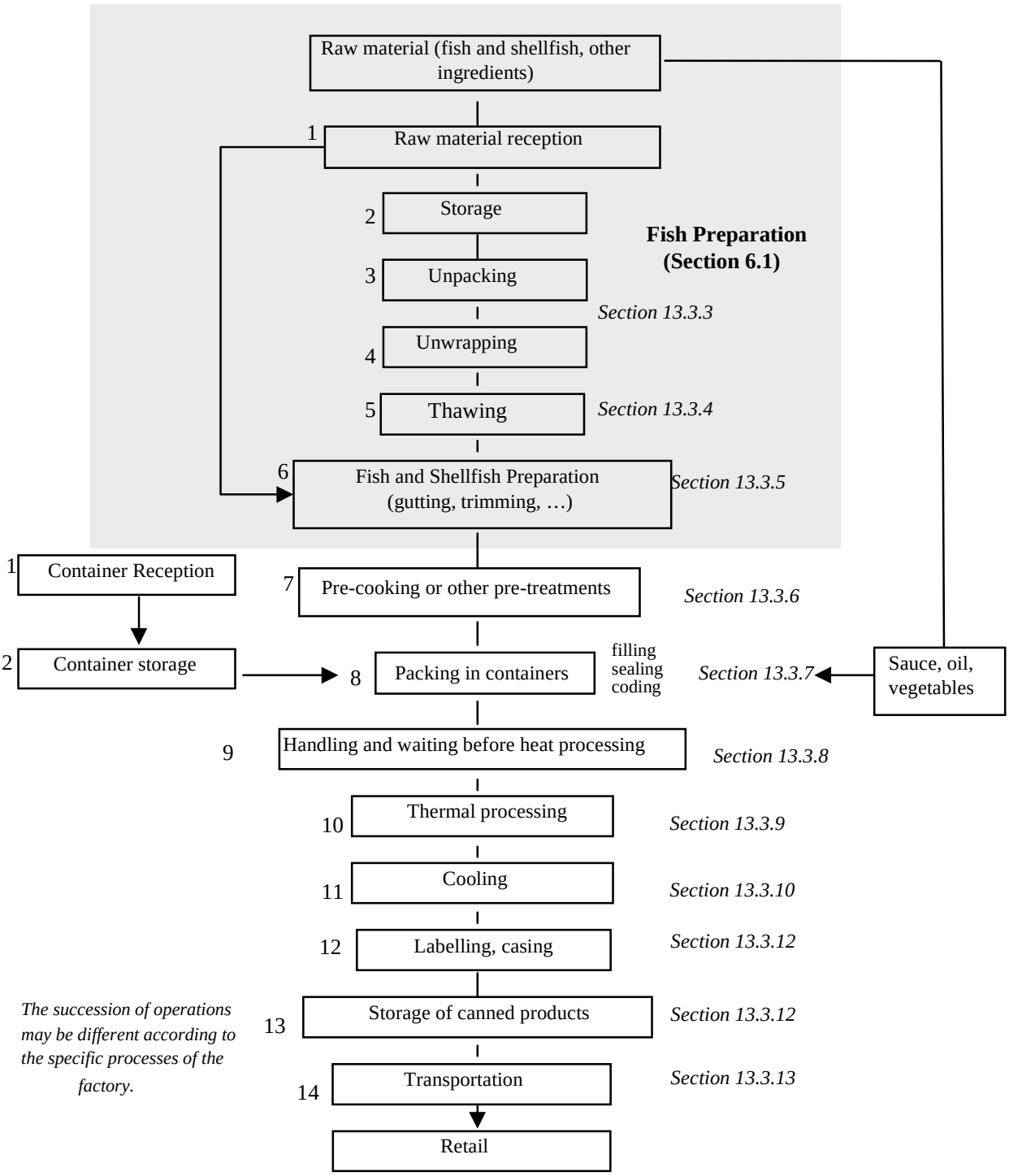

Figure 13.1 Example of a flow chart for the processing of canned fish and shellfish

13.1 GENERAL - ADDITION TO PRE-REQUISITE PROGRAMME

Section 3 (Pre-requisite programme) gives the minimum requirements for good hygienic practices for a processing facility prior to the application of hazard and defect analyses.

For fish and shellfish canneries, additional requirements to the guidelines described in Section 3 are necessary due to the specific technology involved. Some of them are listed below, but reference should also be made to the Recommended International Code of Hygienic Practice for Low-Acid and Acidified Low-Acid Canned Food (CAC/PRC 23-1979, Rev. 2 (1993)) for further information.

- equipment and baskets used for handling containers before and after retorting should be properly designed, constructed and maintained to prevent contamination and damage of those containers;
- an adequate number of efficient sealing machines should be available to avoid undue delay in processing;
- design, working and maintenance of handling devices for containers and loading devices for the baskets aimed at retorting should be appropriate for the kind of containers and materials used. These devices should prevent any excessive abuse to the containers.
- retorts should have a suitable supply of energy, vapour, water and/or air so as to maintain in it sufficient pressure during the heat treatment of sterilisation ; their dimensions should be adapted to the production to avoid undue delays;
- every retort should be equipped with an indicating thermometer, a pressure gauge and a time and temperature recorder,
- an accurate clearly visible clock should be installed in the retorting room;
- canneries using steam retorts should consider installing automatic retort controls;
- Instruments used to control and to monitor in particular the thermal process should be kept in good condition and should be regularly verified or calibrated. Calibration of instruments used to measure temperature should be made in comparison with a reference thermometer. This thermometer should be regularly calibrated. Records concerning the calibration of instruments should be established and kept.

13.2 IDENTIFICATION OF HAZARDS AND DEFECTS

Refer also to Section 4.1 (Potential Hazards Associated with Fresh Fish and Shellfish)
This section describes the main potential hazards and defects specific to canned fish and shellfish.

13.2.1 Hazards

A - Naturally occurring marine toxins

Biotoxins such as tetrodotoxines or ciguatoxines are known to be generally heat-stable, so the knowledge of the identity of the species and/or the origin of fish intended for processing is important.

Phycotoxins such as DSP, PSP or ASP are also heat stable, so it important to know the origin and the status of the area of origin of molluscan shellfish or other affected species intended for processing.

B - Microbiological toxins

Histamine
Histamine is heat-stable, and so its toxicity remains practically intact in containers. Good practices for the conservation and handling from capture to heat processing are essential to prevent the histamine production. The Codex Commission adopted in its standards for some fish species maximum levels tolerated for histamine.

Clostridium botulinum
The botulism risk usually appears only after an inadequate heat processing. The toxin is heat-sensitive, on the other hand, the destruction of *Clostridium botulinum* spores, in particular from proteolytic strains, requires high sterilisation values. The heat processing effectiveness depends on the contamination level at the time of the treatment. Therefore, it is advisable to limit proliferation and the contamination risks during processing.

Staphylococcus aureus

Toxins from *Staphylococcus aureus* can be present in a highly contaminated raw material or can be produced by bacterial proliferation during processing. These toxins are heat-resistant, so they have to be taken into account in the hazard analysis.

C - Hazards linked to the containers

Care should be taken to avoid contamination of the product from components of the containers (ex. lead…).

13.2.2 Defects

Potential defects are outlined in the essential quality, labelling and composition requirements described in the relevant Codex Standards listed in Appendix XII. Where no Codex Standard exists regard should be made to national regulations and/or commercial specifications.

End product specifications outlined in Appendix IX describe optional requirements specific to canned products.

13.3 PROCESSING OPERATIONS

Canners can also refer to the Recommended International Code of Hygienic Practice for Low-Acid and Acidified Low-Acid Canned Foods (CAC/RCP 23-1979, Rev. 2 (1993)) in order to obtain detailed advice on canning operations.

13.3.1 Raw Materials reception

13.3.1.1 Fish and shellfish (Processing step 1)

Potential Hazards: *Chemical and biochemical contamination (DSP, PSP, histamine, heavy metals...)*

Potential Defects: *Species substitution, decomposition, parasites*

Technical Guidance:

Refer to section 6.1.1 (Raw Fresh or Frozen Fish Reception); and also:

- When live shellfish (crustaceans) are received for canning processing, inspection should be carried out in order to discard dead or badly damaged animals.

13.3.1.2 Container and packaging materials (Processing step 1)

Potential Hazards: *Subsequent microbiological contamination*

Potential Defects: *Tainting of the product*

Technical Guidance:

Refer to section 6.5.1 (Raw Material Reception – Packaging, Labels & Ingredients); and also:

- containers and packaging materials should be suitable for the type of product, the conditions provided for storage, the filling, sealing and packaging equipment and the transportation conditions;
- the containers in which fish and shellfish products are canned should be made from suitable material and constructed so that they can be easily closed and sealed to prevent the entry of any contaminating substance;
- containers for canned fish and shellfish should meet the following requirements:

– they should protect the contents from contamination by micro-organisms or any other substance;

– their inner surfaces should not react with the contents in any way that would adversely affect the product or the containers ;

– their outer surfaces should be resistant to corrosion under any likely conditions of storage;

– they should be sufficiently durable to withstand the mechanical and thermal stresses encountered during the canning process and to resist physical damage during distribution;

- when necessary, some characteristics of containers or materials from which containers are made should be checked. It concerns in particular their resistance to mechanical, chemical and thermal stress encountered during the product life. This can be carried out by visual examinations and/or physical testing.

13.3.1.3 Other ingredients (Processing step 1)

Refer to section 6.5.1 (Raw Material Reception – Packaging, Labels & Ingredients).

13.3.2 Storage of raw material, containers and packaging materials

13.3.2.1 Fish and shellfish (Processing step 2)

Refer to sections 6.1.2 (Chilled storage), 6.1.3 (Frozen storage and 7.6.2 Conditioning and storage of molluscan shellfish in sea water tanks, basins, etc.)

13.3.2.2 Containers and packaging (Processing step 2)

Potential Hazards: *Unlikely*

Potential Defects: *Foreign matters*

Technical Guidance:

Refer to section 6.5.2 (Raw Material Storage - Packaging, Labels & Ingredients); and also:

- all materials for containers or packages should be stored in satisfactory clean and hygienic conditions;
- during storage, empty containers and covers should be protected from dirt, moisture and temperature fluctuations, in order to avoid condensations on containers and in the case of tin cans, the development of corrosion;
- during loading, stowing, transportation and unloading of empty containers, any shock should be avoided. Containers shouldn't be stepped on. These precautions become more imperative when containers are put in bags or on pallets. Shocks can deform the containers (can body or flange), that can compromise tightness (shocks on the seam, deformed flange) or be prejudicial to appearance.

13.3.2.3 Other ingredients (Processing step 2)

Refer to section 6.5.2 (Raw Material Storage - Packaging, Labels & Ingredients).

13.3.3 [Unwrapping, unpacking (Processing steps 3 and 4)

Potential Hazards: *[Contamination and proliferation] ?*

Potential Defects: *Foreign matters*

Technical Guidance:

- During unwrapping and unpacking operations, precautions should be taken in order to limit product contamination and foreign matters introduction into the product. To avoid microbial proliferation, waiting periods before further processing should be minimised.]

13.3.4 Thawing (Processing step 5)

Refer to section 6.1.4 (Control Thawing)

13.3.5 Fish and shellfish preparatory processes (Processing step 6)

13.3.5.1 Fish preparation (gutting, trimming...)

Potential Hazards: *[Microbiological growth] ?, microbiological contamination [(Clostridium botulinum)], biochemical development (histamine)*

Potential Defects: *Objectionable matters (viscera, skin, scales, ... in certain products), off flavours, presence of bones, parasites...*

Technical Guidance:

Refer to sections 6.1.5 (Washing and Gutting) and 6.1.6 (Filleting, Skinning, Trimming and Candling); and also:

- when skinning of fish is operated by soaking in soda solution, a particular care should be taken to carry out an appropriate neutralisation.

13.3.5.2 Preparation of molluscs and crustaceans

Potential Hazards: *[Toxin development in dead animals], shell fragments*

Potential Defects: *Objectionable matters*

Technical Guidance:

Refer to sections 7.7 (Heat Treatment/Heat Shocking of Molluscan Shellfish in Establishment), **[**8 ? ? and 9 ? ?**]**; and also:

- [when live shellfish are used, inspection should be carried out in order to discard dead or badly damaged animals;
- particular care should be taken to ensure that shell fragments are removed from shellfish meat. Inspection methods and appropriate techniques for the removal of shell fragments from the meat, should be used.]

13.4 PRE-COOKING AND OTHER TREATMENTS

13.4.6 Pre-Cooking

Potential hazards : *chemical contamination (polar components of oxidised oils), microbiological or biochemical (scombrotoxin) growth.*

Potential defects : *water release in the final product (for products canned in oil), abnormal flavours.*

Technical guidance:

13.4.6.1 General Considerations

- methods used to pre-cook fish or shellfish for canning should be designed to bring about the desired effect with a minimum delay and a minimum amount of handling; the choice of method is usually strongly influenced by the nature of the treated material. For products canned in oil such as sardines or tunas, pre-cooking should be sufficient in order to avoid excessive release of water during heat processing;
- means should be found to reduce the amount of handling subsequent to pre-cooking, wherever practical;
- if eviscerated fish is used, then the fish should be arranged in the belly down position for pre-cooking to allow for the drainage of fish oils and juices which may accumulate and affect product quality during the heating process;
- where appropriate, molluscan shellfish, lobsters and crabs, shrimps and prawns and cephalopods should be pre- cooked according to technical guidance laid down in sections 7 (Processing of Molluscan Shellfish), 8 (Processing of Lobsters and Crabs), 9 (Processing of Shrimps and Prawns) and 10 (Processing of Cephalopods).

13.4.6.1.2 Pre-cooking Schedule

- the pre-cooking method, in particular, in terms of time and temperature, should be clearly defined. The pre-cooking schedule should be checked;
- fish pre-cooked together in batches should be very similar in size. It also follows that they should all be at the same temperature when they enter the cooker.

13.4.6.1.3 Control of Quality of Pre-cooking Oils and Other Fluids

- only good quality vegetable oils should be used in pre-cooking fish or shellfish for canning;
- cooking oils should be changed frequently in order to avoid the formation of polar compounds. Water used for pre-cooking should also be changed frequently in order to avoid contaminants;
- care must be taken that the oil or the other fluids used such as vapour or water do not impart an undesirable flavour to the product.

13.4.6.1.4 Cooling

- except for products, which are packed when still hot, cooling of pre-cooked fish or shellfish should be done as quickly as possible to bring the product temperatures in a range limiting proliferation or toxin production, and under conditions where contamination of the product can be avoided;
- where water is used to cool crustacea for immediate shucking, it should be potable water or clean seawater. The same water should not be used for cooling more than one batch.

13.4.6.2 Smoking

- refer to section 12 (Processing of smoked fish)

13.4.6.3 Use of Brine and Other Dips

Potential hazards : *microbiological and chemical contamination by the dip solution*

Potential defects : *adulteration (additives), abnormal flavours.*

Technical guidance:

- Where fish or shellfish are dipped or soaked in brine or in solutions of other conditioning or flavouring agents or additives in preparation for canning, solution strength and time of immersion should both be carefully controlled to bring about the optimum effect;
- dip solutions should be replaced and dip tanks and other dipping apparatus should be thoroughly cleaned at frequent intervals;
- care should be taken to ascertain whether or not the ingredients or additives used in dips would be permitted in canned fish and shellfish by the related Codex Standards and in the countries where the product will be marketed.

13.4.7 Packing in Containers (Filling, Sealing and Coding) (Processing Step 8)

13.4.7.1 Filling

Potential hazards : *[microbiological growth (waiting period)], microbiological growth and recontamination after heat processing due to incorrect filling or faulty containers.*

Potential defects : *incorrect weight, foreign matter.*

Technical guidance

- containers and covers should be inspected immediately before delivery to the filling machines or packing tables to ensure that they are clean, undamaged and without visible flaws;
- if necessary, empty containers should be cleaned. It is also a wise precaution to have all containers turned upside down to make certain that they do not contain any foreign material before they are used;
- care should also be taken to remove faulty containers, because they can jam a filling or sealing machine, or cause trouble during heat processing (bad sterilisation, leaks);
- empty containers should not be left on the packing tables or in conveyor systems during clean up of premises to avoid contamination or splashes;

- where appropriate, to prevent microbial proliferation, containers should be filled with hot fish and shellfish (> 63°C, for example for fish soups) or should be filled quickly (the shortest possible waiting period) after the end of the pre-treatments;
- if the fish and shellfish must be held for a long time before packing into containers, they should be chilled;
- containers of canned fish and shellfish should be filled as directed in the scheduled process;
- mechanical or manual filling of containers should be checked in order to comply with the filling rate and the headspace specified in the adopted sterilisation schedule. A regular filling is important not only for economical reasons, but also because the heat penetration and the container integrity can be affected by excessive filling changes;
- the necessary amount of headspace will depend partly on the nature of the contents. The filling should also take into account the heat processing method. Headspace should be allowed as specified by the container manufacturer;
- furthermore, containers should be filled such as the end product meets the regulatory provisions or the accepted standards concerning weight of contents;
- where canned fish and shellfish is packed by hand, there should be a steady supply of fish, shellfish and eventually other ingredients. Build-up of fish and shellfish, as well as filled containers at the packing table should be avoided;
- the operation, maintenance, regular inspection and adjustment of filling machines should received particular care. The machine manufacturers' instructions should be carefully followed;
- the quality and the amount of other ingredients such as oil, sauce, vinegar...should be carefully controlled to bring about the optimum desired effect;
- if fish has been brine-frozen or stored in refrigerated brine, the amount of salt absorbed should be taken into consideration when salt is added to the product for flavouring;
- filled containers should be inspected:
- to ensure that they have been properly filled and will meet accepted standards for weight of contents
- and to verify product quality and workmanship just before they are closed;
- manual filled products such as small pelagic fish should be carefully checked by the operators to verify that container flanges or closure surface have not any product residues, which could impede the formation of a hermetic seal. For automatic filled products, a sampling plan should be implemented.

13.4.7.2 Sealing

Sealing the container is one of the most essential processes in canning.

Potential hazards : *subsequent contamination due to a bad seam*

Potential defects : *Unlikely*

Technical guidance

- the operation, maintenance, regular inspection and adjustment of sealing machines should received particular care. The sealing machines should be adapted and adjusted for each type of container and each closing method which are used. Whatever the type of sealing equipment, the manufacturers or equipment supplier's instructions should be followed meticulously;
- seams and other closures should be well formed with dimensions within the accepted tolerances for the particular container;
- qualified personnel should conduct this operation;
- if vacuum is used during packing, it should be sufficient to prevent the containers from bulging under any condition (high temperature or low atmospheric pressure) likely to be encountered during the distribution of the product. This is useful for deep containers or glass containers. It is difficult and hardly necessary to create a vacuum in shallow containers that have relatively large flexible covers;
- excessive vacuum may cause the container to panel, particularly if the headspace is large, and may also cause contaminants to be sucked into the container if there is a slight imperfection in the seam;
- to find the best methods to create vacuum, competent technologists should be consulted;
- regular inspections should be made during production to detect potential external defects on containers. At intervals sufficiently close to each other in order to guarantee a closure in

accordance with specifications, the operator, the supervisor of the closure or any other competent person should examine the seams or the closure system for the other types of containers, which are used. Inspections should consider for example vacuum measurements and seam teardown. A sampling plan should be used for the checks;

- in particular, at each start of the production line and at each change in container dimensions, after a jamming, a new adjustment or a restarting after a prolonged stop of the sealing machine, a check should be carried out;
- all appropriate observations should be recorded.

13.4.7.3 Coding

Potential hazards: *subsequent contamination due to damaged containers*

Potential defects: *loss of traceability due to an incorrect coding.*

Technical guidance

- each container of canned fish and shellfish should bear indelible code markings from which all-important details concerning its manufacture (type of product, cannery where the canned fish or shellfish was produced, production date, etc.) can be determined.
- coding equipment must be carefully adjusted so that the containers are not damaged and the code remains legible.

13.4.8 Handling of Containers After Closure - Staging Before Heat Processing (Processing Step 9)

Potential hazards: *[microbiological growth (waiting period)], subsequent contamination due to damaged containers.*

Potential defects: *Unlikely*

Technical guidance

- containers after closure should always be handled carefully in such a way as to prevent every damage capable to cause defects and microbiological recontamination;
- if necessary, filled and sealed metal containers should be thoroughly washed before heat processing to remove grease, dirt and fish or shellfish stains on their outside walls;
- to avoid microbial proliferation, the waiting period should be as short as possible;
- if the filled and sealed containers must be held for a long time before heat processing, refrigeration or heat holding (> 63°C) for fish soups, for example, are necessary;
- every cannery should develop a system, which will prevent non heat-processed canned fish and shellfish from being accidentally taken past the retorts into the storage area.

13.4.9 Thermal Processing (Processing Step 10)

Heat processing is one of the most essential operations in canning.
Canners can refer to the Recommended International Code of Hygienic Practice for Low-Acid and Acidified Low-Acid Canned Foods (CAC/RCP 23-1979, rev. 2 in 1993) in order to obtain detailed advice on heat processing. In this Section, only some essential elements are pointed out.

Potential hazards: *Survival of spores of Clostridium botulinum.*

Potential defects: *Survival of micro-organisms responsible of decomposition*

Technical guidance

13.4.9.1 Sterilisation Schedule

- to determine the sterilisation schedule, at first, the heat process required to obtain the commercial sterility should be established taking into account some factors (microbial flora, dimensions and nature of the container, product formulation, etc.). A sterilisation schedule is established for a certain product in a container of a given size;
- then, competent canning technologist to take into account the sterilisation equipment at disposal and the product quality, which is desired, should carry out heat penetration tests. This heat penetration in the product must be established in the most unfavourable conditions likely to occur during processing. Standard heat processing procedures and experimentally established sterilisation schedules should be checked and validated by an expert to confirm that the values are appropriate for each product and retort;
- if any changes in operations (initial temperature of filling, product composition, size of containers, fullness of the retort, etc.) are made, competent technologists should be consulted as to the need for re-evaluation of the process.

13.4.9.2 Heat Processing Operation

- only qualified and properly trained personnel should operate retorts. Therefore it is necessary that retort operators control the processing operations and ensure the sterilisation schedule is closely followed, including meticulous care in timing, monitoring temperatures and pressures, and in maintaining records;
- it is essential to comply with the initial temperature described in the schedule process to avoid under-processing. If the filled containers were held at refrigerated temperatures because of a too long waiting period before heat processing, the sterilisation schedule should take into account these temperatures;
- it is essential to flush all the air out of steam retorts in order to attain the controlled processing temperature. This is done by venting. Air pockets should not remain in the retort;
- in order that the heat processing is effective and process temperature is controlled, air must be evacuated from the retort through a venting procedure that is deemed efficient by a competent technologist. Container size and type, retort installation and loading equipment and procedures should be considered;
- the timing of the heat processing should not commenced until the specified heat processing temperature has been reached, and the conditions to maintain uniform temperature throughout the retort achieved, in particular, until the minimum safe venting time has elapsed;
- for other types of retorts (water, steam/air, flame, etc.) refer to the Recommended International Code of Hygienic Practice for Low-Acid and Acidified Low-Acid Canned Foods (CAC/RCP 23-1979, rev. 2 in 1993);
- canned fish and shellfish in different size containers should not be processed together in the same retort load;
- when processing fish and shellfish in glass containers, care must be taken to ensure that the initial temperature of the water in the retort is slightly lower than that of the product being loaded. The air pressure should be applied before the water temperature is raised.

13.4.9.3 Monitoring of Heat Processing Operation

- during the application of heat processing, it is important to ensure that the sterilisation process and factors such as container filling, minimal internal depression at closing, retort loading, initial product temperature, etc. are in accordance with the sterilisation schedule;
- retort temperatures should always be determined from the indicating thermometer, never from the temperature recorder;
- permanent records of the time, temperature and other pertinent details should be kept concerning each retort load;
- the thermometers should be tested regularly to ensure that they are accurate. Calibration records should be maintained;
- inspections should be made periodically to ensure that retorts are equipped and operated in a manner that will provide thorough and efficient heat processing, that each retort is properly equipped, filled and used, so that the whole load is brought up to processing temperature quickly and can be maintained at that temperature throughout the whole of the processing period;

- the inspections should be made under the guidance of a canning technologist.

13.4.10 Cooling (Processing Step 11)

Potential hazards : *recontamination due to a bad seam and contaminated water*

Potential defects : *formation of struvite crystals, buckled containers, scorch.*

Technical guidance:

- after heat processing, canned fish and shellfish should, wherever practical, be water cooled under pressure to prevent deformations, which could result in a loss of tightness. In case of recycling, only potable chlorinated water should be used for this purpose. The residual chlorine level during cooling should be monitored in order to minimise the risk of post-processing contamination from cooling water;
- in order to avoid organoleptic defects of the canned fish and shellfish, such as scorch or overcooking, the internal temperature of containers should be lowered as quickly as possible;
- for glass containers, the temperature of the coolant in the retort should be, at the beginning, lowered slowly in order to reduce the risks of breaking due to thermal shock;
- where canned fish and shellfish products are not cooled in water after heat processing, they should be stacked in such a way that they will cool rapidly in air. They should not be labelled, cased or handled unnecessarily until they are quite cool;
- [rapid cooling of canned fish and shellfish avoids the formation of struvite crystals (quality defect).]
-

13.4.11 Monitoring After Heat Processing and Cooling

- canned fish and shellfish should be inspected for faults and for quality assessment soon after it is produced and before labelling;
- representative samples from each code lot should be examined to ensure that the containers do not exhibit external defects and the product meets the standards for weight of contents, vacuum, workmanship and wholesomeness. Texture, colour, odour, flavour and condition of the packing medium should be assessed;
- stability tests should be made in order to verify in particular the heat processing;
- this examination should be made as soon as practical after the canned fish and shellfish have been produced, so that if there are any faults due to failings on the part of cannery workers or canning equipment, these failings can be corrected without delay. Segregating and properly disposing of all defective units or lots that are unfit for human consumption should be ensured.

13.4.12 Labelling, Casing and Storage of Finished Products (Processing steps 12 and 13)

Potential hazards : *subsequent recontamination due to the damage of containers or to an exposition to extreme conditions*

Potential defects : *incorrect labelling*

Technical guidance

- heat processed canned fish and shellfish should not be touched by hand or articles of clothing unnecessarily before they are cooled and thoroughly dry. They should never be handled roughly or in such a way that their surfaces, and in particular their seams, are exposed to contamination;
- the materials used for labelling and casing canned fish and shellfish should not be conducive to corrosion of the container. Cases should have an adequate size in order that the containers fit them and are not damaged by any move inside. Cases and boxes should be the correct size and strong enough to protect the canned fish and shellfish during distribution;

- code marks appearing on containers of canned fish and shellfish should also be shown on the cases in which they are packed;
- the labelling should be made as referred in 6.2.3;
- storage of canned fish and shellfish should be made in order not to damage the containers. In particular, pallets of finished products should not be stacked excessively high and the forklift trucks used for the storage should be used in a proper manner;
- canned fish and shellfish should be so stored that they will be kept dry and not exposed to extremes of temperature.

13.4.13 Transportation of Finished Products (Processing step 14)

Potential hazards : *subsequent recontamination due to the damage of containers or to an exposition to extreme conditions*

Potential defects : *Unlikely*

Technical guidance

Refer to section 17 (Transportation); and also :

- transportation of canned fish and shellfish should be made in order not to damage the containers. In particular, the forklift trucks used during the loading and unloading should be used in a proper manner;
- cases and boxes should be completely dry. In fact, moisture has effects on the mechanical characteristics of boxes and the protection of containers against damages during transportation couldn't be sufficient;
- metal containers should be kept dry during transportation in order to avoid corroding and/or rust.

SECTION 14 PROCESSING OF FROZEN SURIMI

Frozen surimi is an intermediate food ingredient made from myofibrillar fish protein isolated from other constituent fish protein by repeated washing and de-watering of minced fish. Cryoprotectants are added so that the mince can be frozen and will retain the capacity to form gel when heat-treated after thawing. Frozen surimi is usually blended with other components and further processed into surimi-based products such as kamaboko or crab analogs (imitation crab) that utilise its gel forming ability.

The main emphasis of this section of the code is to give guidance to the manufacture of frozen surimi processed from marine groundfish such as Alaska Pollock and Pacific Whiting by mechanised operations that are common in Japan, the United States and some other countries in which there are processors under mechanised operation.

The vast majority of frozen surimi is processed from marine groundfish such as Alaska Pollock and Pacific Whiting. However, technological advances and the change of main raw fish species for frozen surimi production will necessitate periodic revision of this section of the Code of Practice.

14.1 GENERAL CONSIDERATIONS OF HAZARDS AND DEFECTS FOR FROZEN SURIMI PRODUCTION

14.1.1 Hazards

Frozen surimi is an intermediate ingredient that will be further processed into surimi-based products such as kamaboko and crab analogs. Many of the potential food safety hazards will be controlled during subsequent processing. For example, pathogenic bacteria such as *Listeria monocytogenes* and toxin formers such as *Clostridium botulinum* (that becomes a hazard due to modified atmosphere packaging of the end product) should be controlled during the cooking or pasteurising steps of final processing. Possible *Staphylococcus aureus* contamination that produces heat-stable enterotoxins should be adequately controlled by the pre-requisite program. Parasites will not be a hazard since the final product will be cooked or pasteurised.

If scombrotoxin-forming fish such as tuna or mackerel or tropical reef fish that may accumulate ciguatera toxin are utilised for surimi, appropriate controls for these hazards should be developed. Likewise, due to the highly mechanised nature of surimi processing, appropriate controls should be instituted to assure that metal fragments (e.g., bearings, bolts, washers, and nuts) are excluded or eliminated in the end product.

In countries that produce frozen surimi by traditional non-mechanised methods from locally available fish species for local consumption, extensive consideration should be given to pre-requisite programmes described in section 3.

14.1.2 Defects

Certain quality attributes of frozen surimi are important for the successful manufacture of surimi-based products such as kamaboko and crab analogs that meet consumer expectations of quality. Some of these important factors are colour, moisture content, pH or gel strength. These and others are described in more detail in Appendix X of the code entitled Optional Final Product Requirements for Frozen Surimi.

Myxosporidia is a parasite that is common in marine groundfish such as Pacific Whiting. This organism contains protease enzymes that chemically separate proteins that can ultimately affect the gel strength of surimi even at very low incidence. If species are used that are known to contain this parasite, protease inhibitors such as beef plasma protein or egg whites may be needed as additives to attain the necessary gel strength capabilities for kamaboko or crab analogs production.

Decomposed fish should not be used as raw material for frozen surimi production. The sensory qualities will not be sufficient to produce acceptable kamaboko or crab analog end products. It also necessary to note that decomposed fish should not be used as raw material for production of frozen surimi, because proliferation of spoilage bacteria that cause decomposition of the end product will cause negative effects on the gel forming ability of frozen surimi by denaturing salt soluble protein.

The washing and de-watering cycle should be sufficient to achieve separation of the water-soluble protein from the myofibrillar proteins. If water-soluble proteins remain in the product it will negatively affect the gel forming ability and the long term frozen storage shelf life.

Objectionable matter such as small bones, scales and black belly lining should be minimised as it negatively affects the usability of frozen surimi for processing into end products.

Due to the comminuted nature of raw surimi, the use of food additives may be necessary to achieve the level of quality that is desired. These additives should be introduced to surimi in accordance to appropriate regulations and manufacturer's recommendation in order to avoid quality problems and regulatory actions.

Consideration should be given to the thermal stability of fish proteins. At normal room temperatures most fish proteins will undergo denaturing that will inhibit the gel forming ability of the product. Alaska Pollock and other cold water marine fish should not be subjected to temperatures above 10°C during processing. Warm water fishes may denature at a slower rate and may not be as temperature sensitive.

In countries that produce frozen surimi by traditional non-mechanised methods from locally available fish species for local consumption, special consideration should be given to several defects. Since the growth of spoilage bacteria that cause decomposition and protein denaturation increases with temperature, the conditions that the raw and processed product is subjected to should be carefully monitored.

14.2 FISH PREPARATION (Processing Steps 1 to 8)

Refer to Section 6.1 steps 1 through 8 for information regarding preparation of fish for processing. For frozen surimi processing, consideration should be given to the following for each step:

Frozen surimi is manufactured using various methods, but this flow chart shows the most typical procedure.

This flow chart is for illustrative purpose only. For in-factory HACCP implementation a complete and comprehensive flow chart has to be drawn up for each process.

References correspond to relevant Sections of the Code.

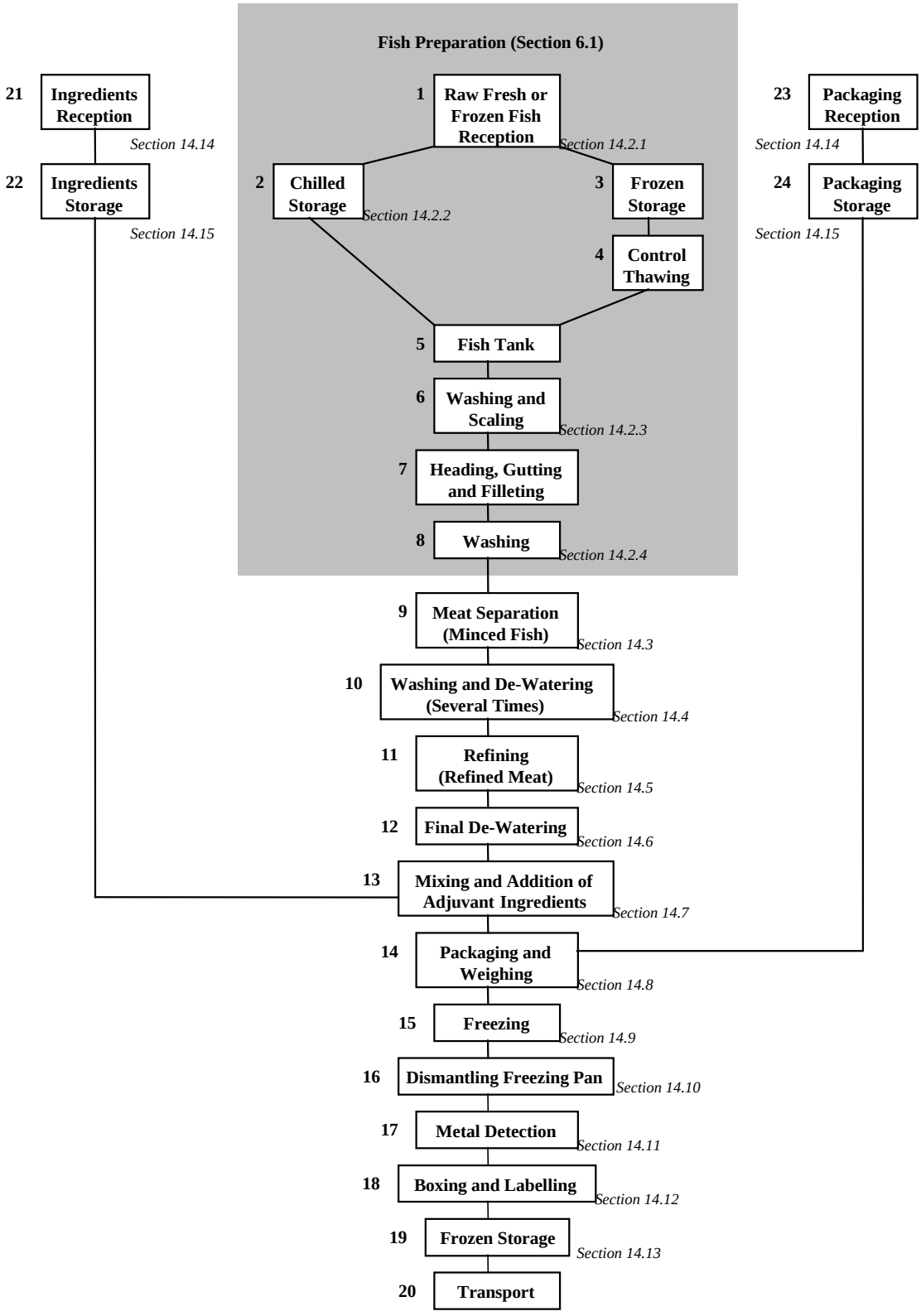

Figure 14.1 Example of a flow chart of a frozen surimi production process

14.2.1 Raw Fresh and Frozen Fish Reception (Processing Step 1)

Potential Hazards: *Unlikely when using marine ground fish as the raw material*

Potential Defects: *Decomposition, protein denaturation*

Technical Guidance:

- if toxic marine algae blooms such as paralytic shellfish poisoning, ciguatera and amnesic shellfish poisoning are known to occur in the harvesting area of the fish used for frozen surimi processing, appropriate controls should be instituted to assure that affected raw product is not used for further processing;
- if scombrotoxic species are used for frozen surimi production, appropriate procedures at reception should be instituted to assure that scombrotoxin is not contained more than at an appropriate level of histamine in the raw fish;
- harvested fish intended for frozen surimi processing should preferably be kept at 4°C or below;
- consideration should be given to the age and condition of fish used for surimi processing as the factors will affect the final gel strength capability. Especially, care should be taken to raw fish received many hours after harvest. For example acceptable period after harvest should be as follows, but processing as fast as possible after harvest will better retain adequate quality of frozen surimi:
  - round; within 14 days of harvest, when stored at or 4°C;
  - dressed; within 24 hours after dressing, when stored at or below 4°C.
- date, time of harvesting, origin and harvester or vendor of products received should be properly recorded and identified;
- presence of decomposition in raw product should not be allowed, as it will negatively affect the gel strength capability of the end product. Harvested fish in poor condition may not result in specified colour characteristics;
- Alaska Pollock (*Theragra chalcogramma*) that is used for frozen surimi processing should have a flesh pH of 7.0 ± 0.5 for adequate gel strength capability.
- fish that is crushed and suffocated due to abnormally big tow size and duration during harvesting should be deleted from the line in order to avoid negative effect to gel forming ability.

14.2.2 Chilled Storage (Processing Step 2)

Potential Hazards: *Unlikely*

Potential Defects: *Protein denaturation*

Technical Guidance:

- chilled storage at the processing facility should be minimised with prompt processing in order to minimise protein denaturation and loss of gel strength capability;
- in case storing raw fish, the fish should be preferably stored at 4°C or below and the date of harvesting or the time of preservation should identify the lot.

14.2.3 Washing and Scaling (Processing Step 6)

Potential Hazards: *Unlikely*

Potential Defects: *Protein denaturation, colour, objectionable matter*

Technical Guidance:

- the epidermis (slime layer), scales and loose pigment should be removed before heading and gutting. This will lessen the level of impurities and extraneous material that can negatively affect the gel strength capability and colour of the end product.

14.2.4 Washing (Processing Step 8)

Potential Hazards: *Unlikely*

Potential Defects: *Impurities, extraneous materials*

Technical Guidance:

- headed and gutted fish should be re-washed. This will lessen the level of impurities and extraneous material that can negatively affect the gel strength capability and colour of the end product.

14.3 MEAT SEPARATION PROCESS (Processing Step 9)

Potential Hazards: *Metal fragments*

Potential Defects: *Impurities*

Technical Guidance:

- fish flesh is minced using mechanical separation process, therefore metal detection equipment that is capable of sensing product that has become contaminated with metal fragments of the size likely to cause human injury should be installed at the most appropriate place in the process to eliminate the hazard;
- procedures should be established to assure that chemical contamination of the product is not likely;
- separated minced meat should be immediately spread into water and transferred to the washing and de-watering step to prevent blood from congealing and causing loss of gel strength capability.

14.4 WASHING AND DE-WATERING PROCESS (Processing Step 10)

Potential Hazards: *Pathogenic microbial growth*

Potential Defects: *Decomposition, protein denaturation, residual water-soluble protein*

Technical Guidance:

- temperature of the water and minced fish flesh in the rotating sieve or wash water should be adequately controlled to prevent the growth of pathogenic microbes;
- for good quality of frozen surimi, wash water should be 10°C or below for adequate separation of water-soluble proteins. Wash water for Pacific Whiting should be lower than 5°C since this species will usually have a high protease activity. Some warm water species may be processed at temperatures up to 15°C;
- product should be processed promptly to minimise possible pathogenic microbial growth;
- minced fish should be spread uniformly in the water to assure dilution of the water-soluble components and effect proper separation from the myofibrillar protein;
- consideration should be given to the specific design of the washing and de-watering step in regards to the desired yield, quality and fish species;
- a sufficient amount of potable water should be available for washing;
- the pH of wash water should be near 7.0;
- wash water should preferably have a total hardness of 100 mg/kg or below in terms of converted $CaCO_3$;
- salt or other de-watering aids can be added (less than 0.3% salt) in the final stage of washing to enhance dehydration efficiency;
- food additives should be added in accordance with national regulations and manufacturer's instructions, if use in this process;
- wastewater should be disposed of in a suitable manner;
- wash water should not be recycled unless there are appropriate controls on its microbial quality.

14.5 REFINING PROCESS (Processing Step 11)

Potential Hazards: *Pathogenic microbial growth, metal fragments*

Potential Defects: *Objectionable matter, protein denaturation*

Technical Guidance:

- temperature of the minced fish flesh in the refining process should be adequately controlled to prevent the growth of pathogenic bacteria;
- for preventing protein denaturation, temperature of minced fish flesh should not exceed 10°C in the refining process;
- product should be processed promptly to minimise possible pathogenic microbial growth;
- metal detection equipment that is capable of sensing product that has become contaminated with metal fragments of the size likely to cause human injury should be installed at the most appropriate place in the process to eliminate the hazard;

- objectionable matter such as small bones, black membranes, scales, bloody flesh and connective tissue should be removed from washed flesh with appropriate refining equipment before final de-watering;
- equipment should be properly adjusted to effect efficient product throughput;
- refined product should not be allowed to accumulate on sieve screens for long periods of time.

14.6 FINAL DE-WATERING PROCESS (Processing Step 12)

Potential Hazards: *Pathogenic microbial growth*

Potential Defects: *Decomposition, protein denaturation*

Technical Guidance:

- temperature of the refined fish flesh in the final de-watering process should be adequately controlled to prevent the growth of pathogenic bacteria;
- for good quality of frozen surimi, temperature of refined fish flesh should not exceed 10°C for cold water fish species, such as Alaska Pollock. For Pacific Whiting the temperature should not exceed 5°C, since this species usually will have a high protease activity. Some warm water species may be processed at temperatures up to 15°C;
- product should be processed promptly to minimise possible pathogenic microbial growth;
- the moisture level of refined product should be controlled to specified levels with appropriate de-watering equipment (e.g., centrifuge, hydraulic press, screw press);
- consideration should be given to variations in moisture levels due to the age, condition or mode of capture of the raw fish. In some cases dehydration should be performed before refining.

14.7 MIXING AND ADDITION OF ADJUVANT INGREDIENTS PROCESS (Processing Step 13)

Potential Hazards: *Pathogenic microbial growth, metal fragments*

Potential Defects: *Improper use of food additives, protein denaturation*

Technical Guidance:

- temperature of the product in the mixing process should be adequately controlled to avoid the growth of pathogenic bacteria;
- for good quality of the product, temperature of dehydrated fish flesh during mixing should not exceed 10°C for cold water fish species such as Alaska Pollock. For Pacific Whiting the temperature should not exceed 5°C since this species usually will have a high protease activity. Some warm water species may be processed at temperatures up to 15°C;
- product should be processed promptly to minimise possible pathogenic microbial growth;
- metal detection equipment that is capable of sensing product that has become contaminated with metal fragments of the size likely to cause human injury should be installed at the most appropriate place in the process to eliminate the hazard;
- food additives should be added in accordance with national regulations and manufacturer's instructions;
- food additives should be mixed homogeneously;
- Cryoprotectants should be used in frozen surimi. They are commonly sugars and/or polyhydric alcohol that are used to prevent protein denaturation in the frozen state;
- food grade enzyme inhibitors (e.g. egg white, beef protein plasma) should be used for species that exhibit high levels of proteolytic enzyme activity such as Pacific Whiting that reduce the gel forming ability of surimi during kamaboko or crab analogs processing.

14.8 PACKAGING AND WEIGHING (Processing Step 14)

Potential hazards: *Pathogenic microbial growth, cross contamination*

Potential defects: *Foreign matter (packaging), incorrect net weight, incomplete packaging, denaturation of protein*

Technical Guidance:

- temperature of the product should be adequately controlled during packaging to avoid the growth of pathogenic bacteria;
- product should be packaged promptly to minimise possible pathogenic microbial growth;
- the packaging operation should have procedures established that make possible cross contamination unlikely;

- product should be stuffed into clean plastic bags or packaged into clean containers that have been properly stored;
- product should be appropriately shaped;
- packaging should be conducted rapidly to minimise the risk of contamination or decomposition;
- packaged products should not contain voids;
- the product should meet appropriate standards for net weight.

See also Section 6.2.1 "Weighing" and Section 6.4.4 "Wrapping and Packing".

14.9 FREEZING OPERATION (Processing Step 15)

Refer to Section 6.3.1 for general considerations for freezing fish and fishery products.

Potential Hazards: *Unlikely*

Potential Defects: *Protein denaturation, decomposition*

Technical Guidance:

- after packaging and weighing the product should be promptly frozen to maintain the quality of the product;
- procedures should be established that specifies maximum time limits from packaging to freezing.

14.10 DISMANTLING FREEZING PAN (Processing Step 16)

Potential Hazards: *Unlikely*

Potential Defects: *Damage to plastic bag and product*

Technical Guidance:

- care should be taken to avoid breakage of plastic bag and the product itself in order to refrain from deep dehydration during long-term cold storage.

14.11 METAL DETECTION (Processing Step 17)

Refer to Section 6.2.4 "Metal Detection" for general information.

Potential Hazards: *Metal fragments*

Potential Defects: *Unlikely*

Technical Guidance:

- Metal detection equipment that is capable of sensing product that has become contaminated with metal fragments of the size likely to cause human injury should be installed at the most appropriate place in the process to eliminate the hazard.

14.12 BOXING AND LABELLING (Processing Step 18)

Refer to Section 6.4.4 "Wrapping and Packaging" and Section 6.2.3 "Labelling".

Potential Hazards: *Unlikely*

Potential Defects: *Incorrect label, damage to packaging*

Technical Guidance:

- boxing should be clean, durable and suitable for the intended use;
- the Boxing operation should be conducted to avoid the damage of packaging materials;
- product in damaged boxing should be re-boxed so that it is properly protected;
- product labelling should meet all appropriate standards.

14.13 FROZEN STORAGE (Processing Step 19)

Refer to Section 6.1.3 "Frozen Storage" for general information concerning fish and fishery products.

Potential Hazards: *Unlikely*

Potential Defects: *Decomposition, protein denaturation*

Technical Guidance:

- frozen surimi should be stored at -20°C or colder to prevent protein denaturation from taking place. Quality and shelf life will be maintained more adequately if the product is stored at -25°C or colder;
- stored frozen product should have adequate air circulation to assure that it remains properly frozen. This includes preventing product from being stored directly on the floor of the freezer.

14.14 RAW MATERIAL RECEPTION - PACKAGING AND INGREDIENTS (Processing Steps 21 and 22)

Refer to Section 6.5.1 ”Raw Material Reception - Packaging, Labels and Ingredients".

14.15 RAW MATERIAL STORAGE - PACKAGING AND INGREDIENTS (Processing Steps 23 and 24)

Refer to Section 6.5.2 "Raw Material Storage - Packaging, Labels and Ingredients".

SECTION 15 PROCESSING OF COATED QF FISHERY PRODUCTS

In the context of recognising controls at individual processing steps, this section provides examples of the application of HACCP and DAP and describes the technological guidelines involved in the processing of coated QF fish and shellfish products. Within each of the processing steps examples of potential hazards and defects are given, where appropriate, together with guidance on control measures and corrective actions. However, within the scope of this Code of Practice it is not possible to give details of critical limits, monitoring procedures, record keeping and verification for each of the steps since these are specific to particular hazards and defects. Nevertheless, it should be recognised that in preparing a HACCP and/or DAP plan as described in Section 5.1 it will be necessary also to specify critical limits for each step. Additionally, monitoring (which will include how and what should be monitored, the frequency and who is responsible for the monitoring), consideration of what records are necessary, and how the requirements for each step should be verified will have to be specified.

15.1 GENERAL ADDITION TO PRE-REQUISITE PROGRAMME

- conveyor systems used to transport uncoated and coated fish should be designed and constructed to prevent damaging and contamination of the products;
- shims sawn for formed fish production and held for tempering should be kept at temperatures that will prevent deterioration of the essential quality of the product;
- if the whole process is run continuously an adequate number of processing lines should be available to avoid interruptions and batch-wise processing. If the process has to be interrupted, intermediate products have to be stored under deep-frozen conditions until being further processed;
- pre-frying baths, freezing cabinets used for re-freezing should be equipped with permanent temperature and belt speed control device;
- the proportion of sawdust should be minimised by using appropriate sawing equipment;
- sawdust should be kept well separated from fish cores used for coated products, should be temperature controlled, not stay too long at ambient temperature and should be stored preferably in frozen state prior to further processing into suitable products.

15.2. IDENTIFICATION OF HAZARDS AND DEFECT

Refer also to Section 5.3.3 and Appendix XI.
This Section describes the main hazards and defects specific to QF coated fish and shellfish.

15.2.1 Hazards

See Section 5.3.2

15.2.2 Defects

Potential defects are outlined in the essential quality, labelling and composition requirements described in the relevant Codex Standard for Quick Frozen Fish Sticks (Fish Fingers), Fish Portions and Fish Fillets – Breaded or in Batter (CODEX STAN. 166-1989, Rev. 1-1995).

End product specifications outlined in Appendix XI describe optional requirements specific to QF coated fishery products.

15.3 PROCESSING OPERATIONS

Refer to figure 15.1 for an example of a flow chart for coated fish product processing.

15.3.1. Raw Material Reception

[All incoming raw materials are subject to an examination for food safety hazards and defects based on appropriate Codex Alimentarius sampling plans.]

15.3.1.1 Fish

Potential Hazards: *chemical and biochemical contamination, decomposition;*

Potential Defects: *tainting, block irregularities, water and air pockets, packaging material, foreign matter;*

Technical Guidance:

- Temperatures of all incoming lots should be recorded;
- Packaging material of frozen products should be examined for dirt, tearing and evidence of thawing;
- Cleanliness and suitability of the transport vehicle to carry frozen fish products should be examined;
- Use of temperature recording devices with the shipment is recommended;
- Representative samples should be taken for further examination for possible hazards and defects;

15.3.1.2 Other Ingredients

Potential Hazards: *mould, chemical, biochemical and microbiological contamination*

Potential Defects: *colour deviations, filth, sand*

Technical Guidance:

- breading and batter should be inspected for broken packaging material, signs of rodent and insect infestations and other damage such as dirt on packaging materials and wetness;
- cleanliness and suitability of the transport vehicle to carry food products should be examined;
- representative samples of the ingredients should be taken and examined to ensure that the product is not contaminated and meets specifications for use in the end product;
- ingredients should be shipped on transportation vehicles that are suitable for handling food products and ingredients. Vehicles that have previously hauled potentially unsafe or hazardous material should not be used for hauling food products or ingredients.

15.3.1.3 Packaging Materials

Potential Hazards: *foreign matter*

Potential Defects: *tainting of products*

Technical Guidance:

- packaging material used should be clean, sound, durable, sufficient for its intended use and of food grade material;
- for pre-fried products it should be impermeable for fat and oil;
- cleanliness and suitability of the transport vehicle to carry food packaging material should be examined.

15.3.2 Storage of Raw Material, Other Ingredients and Packaging Materials

15.3.2.1 Fish (Frozen Storage)

Potential Hazards: *unlikely*

Potential Defects: *dehydration, rancidity*

Technical Guidance:

- all fish intended for later processing must be stored at -18°C or colder with minimal temperature fluctuations;
- all frozen fish lots should be stored under clean and hygienic conditions;
- **the storage area should be equipped with a calibrated indicating thermometer. Fitting of a recording thermometer is strongly recommended;**
- a systematic stock rotation plan should be developed and maintained;
- fish should be rejected if known to contain defects that subsequently cannot be reduced or eliminated to an acceptable level;
- all fish should be stored to allow proper air circulation.

This flow chart is for illustrative purposes only. For in-factory HACCP implementation a complete and comprehensive flow chart has to be drawn up for each process.

References correspond to relevant Sections of the Code.

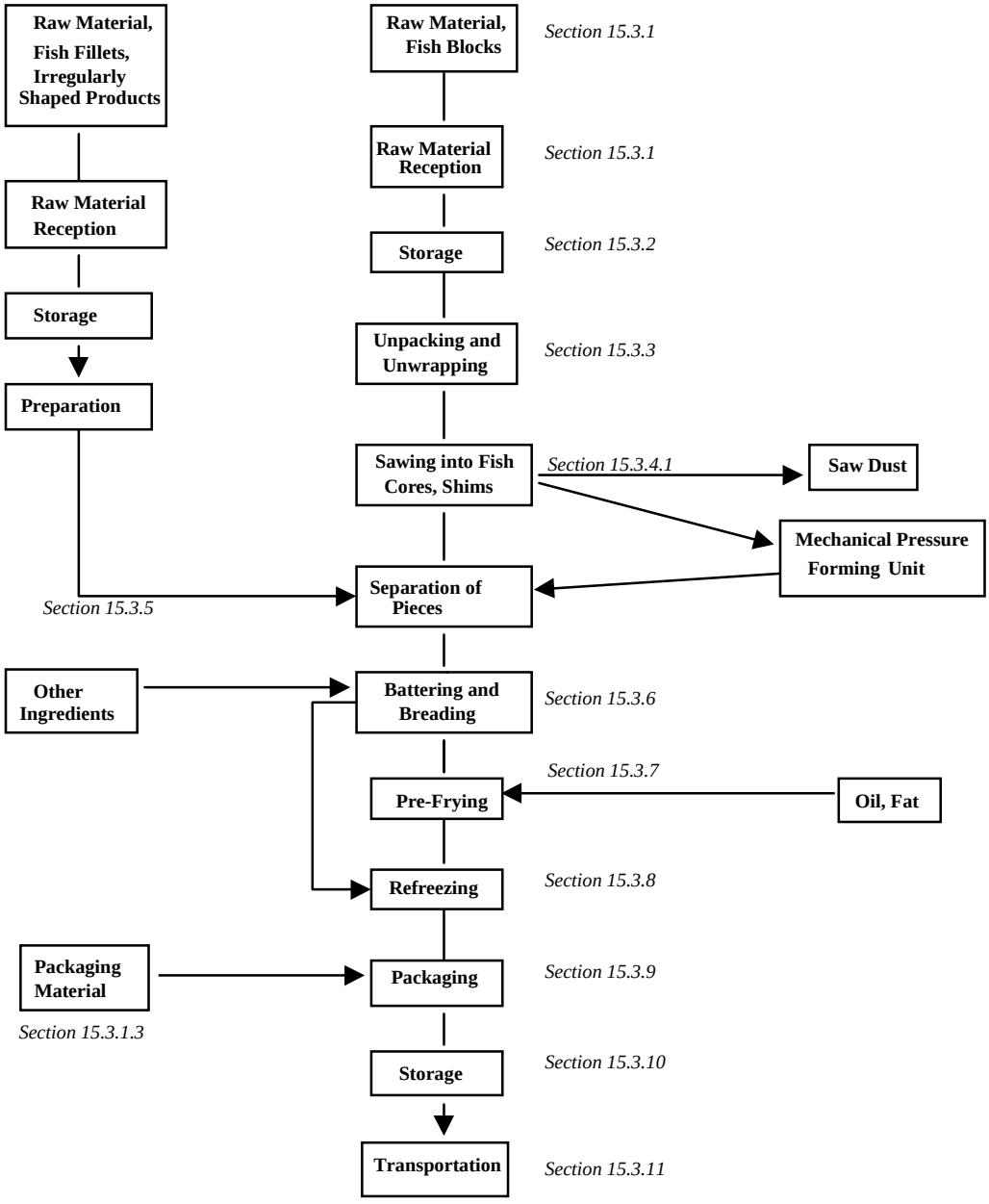

Figure 15.1 Example of a flow chart for the processing of coated fish products

15.3.2.2 Other Ingredients and Packaging Materials

Potential Hazards: *biological, physical and chemical contamination*

Potential Defects: *loss of quality and characteristics of ingredients, rancidity*

Technical Guidance:

- all other ingredients and packaging material should be stored in a dry and clean place under hygienic conditions;
- all other ingredients and packaging material should be stored appropriately in terms of temperature and humidity;
- a systematic stock rotation plan should be developed and maintained to avoid out of date materials;
- ingredients should be protected from insects, rodents and other pests;
- defective ingredients and packaging material should not be used.

15.3.3 Unwrapping, Unpacking

Potential Hazards: *contamination by personnel*

Potential Defects: *remaining undetected packaging material, contamination by filth*

Technical Guidance:

- during unwrapping and unpacking of fish blocks care should be given not to contaminate the fish;
- special attention has to be given to cardboard material partly or fully embedded in the blocks;
- all packaging material should be disposed of properly and promptly.

15.3.4 Production of Fish Core

15.3.4.1 Sawing

Potential Hazards: *foreign material (metal or plastic parts of saws)*

Potential Defects: *irregularly shaped pieces or portions*

Technical Guidance:

- sawing instruments should be kept in clean and hygienic conditions;
- saw-blades must be inspected regularly, to avoid tearing of the product and breakage;
- saw dust must not collect on the saw-table and must be collected in special containers;
- sawn shims used to form irregularly shaped fish cores by mechanical pressure should be kept in clean, hygienic conditions until further manufacturing.

15.3.4.2 Forming

Potential Hazards: *foreign material (metal or plastic from machine)*

Potential Defects: *poorly formed fish cores, cores subject to too much pressure (mushy, rancid)*

Technical Guidance:

Forming of fish cores is a highly mechanised method of producing fish cores for battering and breading. It utilises hydraulic pressure to force shims (sawn portions of fish blocks) into moulds that are ejected onto the conveyor belt.

- forming machines should be kept in hygienic conditions;
- formed fish cores should be examined closely for proper shape, weight and texture.

15.3.5 Separation of Pieces

Potential Hazards: *foreign material*

Potential Defects: *adhering pieces or portions*

Technical Guidance:

- the fish flesh cores cut from the blocks or fish fillets or other irregular shaped QF fish material must be well separated from each other and should not adhere to each other;
- fish cores that are touching each other going through the wet coating step should be removed and placed back on the conveyor in order to get a uniform batter coat and a uniform breading pick-up;

- cored fish should be monitored for foreign material and other hazards and defects before coating.

15.3.6 Coating

In industrial practice the order and the number of coating steps may differ and may therefore deviate considerably from this scheme.

15.3.6.1 Wet Coating

Potential Hazards: *Microbiological contamination of liquid coating material during storage or being pumped through pipes*

Potential Defects: *Insufficient cover or excessive cover of coating*

Technical Guidance:

- fish pieces must be well coated from all sides;
- surplus liquid, which should be reused, must be re-transported under clean and hygienic conditions;
- surplus liquid on fish pieces should be removed by clean air;
- viscosity and temperature of hydrated batter mixes should be monitored and controlled within certain parameters to effect the proper amount of breading pick-up;
- to avoid microbiological contamination of the hydrated batter, appropriate means should be adopted to ensure that significant growth does not take place, such as temperature control, dumping liquid contents and regular or scheduled clean-ups and sanitation during the manufacturing shift.

15.3.6.2 Dry Coating

Potential Hazards: *contamination by mould or micro-organisms*

Potential Defects: *insufficient coating or excessive coating*

Technical Guidance:

- dry coating must cover the whole products and should stick well on the wet coating;
- surplus coating is removed by blowing away with clean air and/or by vibration of conveyors and must be removed in a clean and hygienic way if further use is intended;
- flow of breading from the application hopper should be free, even and continuous;
- coating defects should be monitored and be in accordance to Codex Standard for Frozen Fish Fingers, Fish Portions and Fish Fillets – Breaded or in Batter (Codex Standard 166-1989, Rev.1-1995);
- the proportion of breading and fish core should be in accordance to Codex Standard for Frozen Fish Fingers, Fish Portions and Fish Fillets – Breaded or in Batter (Codex Standard 166-1989, Rev. 1-1995).

15.3.7 Pre-Frying

There are some variations in industrial production for the frying process in so far that QF coated products are completely fried including fish core and re-frozen later. For this case alternative hazards and defects have to be described and not all statements in this section apply. In some regions it is common practice to manufacture raw (not pre-fried) coated fish products.

Potential Hazards: *none likely*

Potential Defects: *over-oxidised oil, insufficient frying, loosely adhering coating, burnt pieces and portions*

Technical Guidance:

- frying oil should have a temperature between approx. 160°C and 195°C;
- coated fish pieces should remain in frying oil for sufficient time to get a satisfying colour, flavour, and structure to adhere firmly to the fish core, but core should be kept frozen throughout the whole time;
- frying oil has to be exchanged when colour becomes too dark or when concentration of fat oxidation products exceeds certain limits;
- remains from coating which concentrate at the bottom of the frying bath have to be removed regularly to avoid partial dark coloration on coated products caused by upwelling of oil;
- excessive oil should be removed from coated products after pre-frying by a suitable device.

15.3.8 Re-freezing

Potential Hazards: *foreign material*

Potential Defects: *Insufficient freezing leads to sticking of units together or to walls of freezing equipment and facilitates mechanical removal of breading/batter*

Technical Guidance:

- re-freezing to -18°C or lower of the whole product should take place immediately after pre-frying;
- products should be allowed to stay sufficient time in freezer cabinet to assure core temperature of products of -18°C or lower;
- cryogenic freezers should have sufficient compressed gas flow to effect proper freezing of the product;
- processors that utilise blast freezers may package the product in the consumer containers before freezing.

15.3.9 Packaging, Labelling

Potential Hazards: *contamination by personnel, foreign material*

Potential Defects: *Under- or overpacking, improper sealed containers, wrong or misleading labelling*

Technical Guidance:

- packaging should be made without delay after refreezing under clean and hygienic conditions. If packaging is made later (e.g. batch processing) re-frozen products should be kept under deep frozen conditions until being packed;
- packages should be checked regularly by weight control, end products should be checked by a metal and foreign material detector;
- packaging of cartons or plastic bags to master shipping containers should be done without delay and under hygienic conditions;
- both consumer packages and shipping containers should be appropriately lot coded for traceability in the event of a product recall;
- labels should be examined to ensure that they correspond to the product that has been manufactured.

15.3.10 Storage of End Products

Potential Hazards: *none likely*

Potential Defects: *texture and Flavour deviations due to fluctuations in temperature, deep freezer burn, cold store flavour, cardboard flavour*

Technical Guidance:

- all end products should be stored at frozen temperature in a clean, sound and hygienic environment;
- severe fluctuations of storage temperature (greater than 3°C) has to be avoided;
- too long storage time (depending on fat content of species used and type of coating) should be avoided;
- the facility should be capable of maintaining the temperature of the fish at or colder than -18°C with minimal temperature fluctuations;
- the storage area should be equipped with a calibrated indicating thermometer. Fitting of a recording thermometer is strongly recommended;
- a systematic stock rotation plan should be developed and maintained;
- products should be properly protected from dehydration, dirt and other forms of contamination;
- all end products should be stored in the freezer to allow proper air circulation.

15.3.11 Transport of End Product

Potential Hazards: *none likely*

Potential Defects: *see section 3.6*

Technical Guidance:

- during all transportation steps deep-frozen conditions should be maintained -18°C (maximum fluctuation ± 3°C) until final destination of product is reached;
- cleanliness and suitability of the transport vehicle to carry frozen food products should be examined;
- use of temperature recording devices with the shipment is recommended.

[SECTION 16 AQUACULTURE PRODUCTION [TO BE REVISED]

16.1 INTRODUCTION

This Section of the Code applies to industrialised and commercial aquaculture operations, producing fish and crustaceans, hereafter referred to as "fish" that are internationally traded, and that are intended for direct human consumption. Such intensive or semi-intensive aquaculture systems use high stocking densities, stock from hatcheries, use formulated feeds and may rely on medication and vaccines. This Code is not intended to cover extensive fish farming systems that prevail in many developing countries or integrated livestock and fish culture systems.

Once a fish farm has established a pre-requisite programme (Section 3), the principles of HACCP can then be applied to each individual production process. This model HACCP plan presented in the Code has been produced as guidance to fish farmers who wish to, or are required to, prepare HACCP plans for the production of fish in aquaculture systems. It is meant to serve only as a model and an establishment must prepare a plan for the specific conditions prevailing in a production unit, and for a particular product.

16.2 IDENTIFICATION OF HAZARDS

Consumption of fish and fishery products is associated with a variety of human health hazards, and broadly the same hazards are present in aquaculture products as in corresponding varieties caught in the wild (Section 4.3.2) The risk of harm from a particular hazard might be increased under some circumstances in aquaculture products compared with fish caught in the wild, for instance the presence of residues of veterinary drugs. High stocking densities compared with the natural situation might increase the risk of cross-infection of pathogens within a population of fish. On the other hand, farmed fish can also present a lower risk of harm. In systems where the fish receive artificial feeds, the risks associated with transmission of hazards through the food consumed by the fish is very much reduced. For example, infection with nematode parasites is absent from, or very much reduced in, farmed salmon compared with salmon caught in the wild.

16.3 PRODUCT DESCRIPTION

The products within the scope of this model HACCP plan are raw vertebrate fish and raw crustacean shellfish. They are produced by a controlled growing system, which might include the full production cycle from the egg, or just the later, 'growing-on', stages. The products usually receive very little processing after harvesting and before dispatch from the fish farm. Typically this will include no more than slaughtering, sorting, packing, icing, and perhaps gutting, bleeding or beheading. Any further processing or handling than this should be subject to an HACCP plan for the particular operations, as described in Section 5.

16.4 INTENDED USE

The purpose of this step in the procedure is to identify if the product will be used in a way, which increases the risk of harm to the consumer, or if the product will be particularly used by consumers who are especially susceptible to a hazard.

Mostly the products will be cooked before consumption, but sometimes they might be consumed raw or after treatments which might not kill or inactivate biological agents or toxins. As far as preparation for consumption is concerned, aquaculture products are generally not treated differently from the equivalent products harvested from the wild. Nevertheless, the assessment team drawing up the HACCP plan must determine if a particular product is likely to be consumed without a prior process that would inactivate biological agents, and bear this in mind when developing the HACCP plan.

The intended consumer is the general public, which could include vulnerable groups like the elderly, the very young, and people with low resistance to infection, but generally aquaculture products are not targeted towards particular sections of the public and are distributed along with fish products harvested from the wild.

16.5 FLOW DIAGRAM

A generalised flow diagram for aquaculture production is shown in Figure X. A more detailed flow diagram must be prepared for a particular installation. Cultural practices differ among the varieties of fish and crustacea grown in aquaculture systems, and among production systems, and a particular production unit might not have all the steps shown in this diagram. Growing practices do not of themselves generate hazards to human health and are not elaborated in the diagram.

16.6 DEVELOPMENT OF THE HACCP PLAN

When the flow diagram has been drawn up, each step in the process is examined to decide if it is a Critical Control Points (CCP), according to the process summarised in Figure 1 in Section 4. The investigation team considers what hazards could be introduced, or produced, at that step, and whether or not any hazard could be controlled at that step to eliminate or reduce the risk. For a step to be a CCP there must exist a preventive measure that reduces or eliminates the risk from that hazard. More than one preventive measure may be applied at a CCP to control more than one hazard. Each preventive measure is associated with critical limits, which act as bounds to the extent of that measure within which the hazard is effectively controlled. It is central to the idea of a CCP that the property that controls the hazard can be measured, monitored, and controlled under the circumstances that exist at the potential CCP. If these conditions can be satisfied then a protocol for sampling and measuring the property is specified in the monitoring step in the HACCP plan. If the result of the monitoring action shows that the criterion for control has gone outside the control limits then the system should be altered to bring the process under control. The HACCP plan will specify the action to be taken for this, and might require that farmed fish exposed to the hazard at that step since the last monitoring point be isolated for more detailed examination and possible treatment to reduce the risk. Keeping accurate and adequate records of all monitoring procedures and of actions taken following monitoring is an essential part of the HACCP system.

There are three Critical Control Points (CCPs) associated with the proposed model in Figure 16.1, which are steps where control is necessary to prevent or eliminate a food safety hazard or to reduce it to an acceptable level. The CCPs are the site or location of the fish pond, the water supply, and the feed supply. The nature of CCPs will depend on the aquaculture system and it is essential to consider the unique conditions that exist within each fish farm when developing a HACCP plan.

This flow chart is for illustrative purposes only. For in-factory HACCP implementation a complete and comprehensive flow chart has to be drawn up for each process.

References to be added to correspond to relevant Sections of the Code.

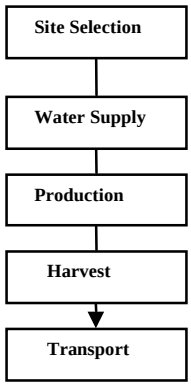

Figure 16.1 Model flow diagram for aquaculture production

16.7 SITE SELECTION

The siting, design and construction of fish farms should follow principles of good aquacultural practice. Hazards may exist with the location of the fish pond and site selection, relating to chemical contamination of the environment and soil/water interaction that will influence water quality (Table 1). Soil properties are directly related to the nutrients in the pond water and such factors as acidity or alkalinity, will be related to soil quality. Acidic soils may cause low pH and leaching of metals that may accumulate in fish. Fish farms can be subject to pesticide and chemical run-off from adjacent agricultural land or industrial sources, and this can lead to unacceptable levels of chemical contaminants in cultured products. Control measures involve activities that can be used to prevent or eliminate a food safety hazard or to reduce it to an acceptable level. Such measures relate to the selection of a site for locating a fish pond and will include a soil survey in order to establish the soil suitability for aquaculture. Fish ponds should be located in areas where the risk of contamination with hazardous chemical effluents is minimal and where sources of pollution can be controlled.

Monitoring procedures include a sequence of observations or measurements to assess that a CCP is under control. With respect to the location of the fish pond this will initially involve soil analysis in the immediate area, and will also involve regular inspection of the locality for likely sources of pollution. Corrective actions have to be taken if the results of monitoring the CCP indicate a loss of control. If soil analysis shows that the site is not suitable to locate a fish farm, then an alternative must be found. Batches of fish may have to be isolated or pond water treated if unacceptable pollution of fish ponds occurs.

Before building an aquaculture establishment a survey of the soil should be conducted in order to determine the concentration and extent of any parameters which are of importance for the safety of end products. The decision on which parameters should be measured as well as what should be the type of the survey will depend on the local situation concerning the potential contaminants and the availability of previous data. Soil for the construction of earthen ponds should not contain such concentrations of chemicals, which may lead to the presence of unacceptable levels of contamination in fish.

Table 1: Application of HACCP to Site Selection

An example of hazard identification and control measures for illustrative purposes only.	
Site Selection (CCP No. 1)	
Hazard	Harmful chemical contamination
Control Measures	Review soil survey data when selecting farm site; implement pollution monitoring plan.
Critical limits	Water quality standards; soil limitation rating.
Monitoring procedure	Soil analysis of site and surrounding area; Water analysis; survey pollution sources.
Corrective action	Water treatment; isolate batches of fish;

16.8 WATER QUALITY

The hazards presented by the water in which fish is raised, or by the water supply to the installation, vary greatly with the cultural system. Some broad classes of systems can be identified based on the hazards and risks.

Raising fish in cages in a marine environment poses the fewest hazards and lowest risks. The marine environment is generally not polluted except in estuaries of rivers receiving industrial or human or animal wastes. Siting of the installation is important for reducing or eliminating these hazards. Water-borne parasites generally are not a hazard in this marine environment. The artificial feeding required for caged fish considerably reduces, or eliminates, risks from hazards transmitted through natural feed.

Cage systems in freshwater might be at risk of water-borne parasitic infections or bacterial contamination. The risk is reduced the more the unit is free from sources of human or animal sewage, and siting is again an important factor in reducing risk.

Land-based installations usually have scope for controlling the quality of the water used in the system. One of the objectives of controlling the quality of the water supply is to protect the health of the stock, and adventitiously the same controls will reduce or eliminate human health risks. Any process of water treatment should be subjected to an HACCP analysis for control of human health hazards.

Fish should not be cultured in water where the presence of harmful substances would lead to an contamination of products with an unacceptable level of such substances. Establishments should be sited at a safe distance from potential sources of water contamination in order to ensure protection of products from contamination. Attention to good hygienic design and construction, appropriate location, and the provision of adequate facilities, is necessary to enable hazards to be effectively controlled.

The hygienic design of aquaculture systems where fish are raised in cages or pens or in any other form of enclosure in open water, or in ponds or raceways should take into consideration the following recommendations:

16.8.1 Land-based Establishments

- the water in which fish are raised should be suitable for the production of products which are safe for human consumption;
- the establishment should not be sited where there is a risk of contamination of the water in which fish are reared;
- the immediate vicinity of establishments should be free of potential sources of water contamination;

Locations close to industry or mining, especially if they lie within the same watershed, as well as small locations for Stillwater establishments within large fields for plant crops may be exposed to risks from unexpected chemical contamination. Locations close to densely populated areas or downstream from concentrations of animal husbandry or close to hospitals may be exposed to unexpected contamination, which can render the fish unfit for consumption.

Roadways and railroads in the vicinity of the site should have adequate drainage, which should not be directly connected with the water used in the growing area including any water used during harvesting and processing operations.

16.8.2. Water-based Establishments

- aquaculture systems where fish are raised in cages or pens or in any other form of enclosure in open waters should be sited in water of a quality acceptable for the production of fish for human consumption;
- cages, pens or any other form of enclosures should be sited away from routes of water-borne traffic, and preferably upstream of any water-borne traffic;
- cages, pens or any other form of enclosures should be sited away from, and preferably upstream of, any natural or man-made discharges of contamination.

Table 2: Application of HACCP to the aquaculture water supply

An example of hazard identification and control measures for illustrative purposes only.	
Water Quality (CCP No. 2)	
Hazard	Parasites Chemical contamination
Control Measures	Water supply selection Water treatment Eliminate food-borne trematodes or their intermediate hosts.
Critical limit	Conforming to national or international guidelines. Absence of parasite and intermediate hosts.
Monitoring	Laboratory analysis or certification of the water supply. Visual inspection for snails and fish infected with parasites.
Corrective Action	Alternative sources of water; Isolate batches of infected fish; Water treatment: Remove parasites; re-condition ponds.

16.9 FEED SUPPLY AND FEEDING

Feeding regimes vary widely in aquaculture from no supplementary feeding at all to full feeding with compounded feeds. Depending on species, age, rearing systems and conditions, the nutritional requirements of fish for good growth and health can be met either by natural food which should be made available by proper technology in the rearing unit, or by a mixture of natural and added (supplemental) feed, or by a complete diet. Feeds, which completely satisfy the known nutritional requirements of fish, are produced either industrially or at the establishment by mixing of ingredients and other components in accordance with the formulation. Most supplemental feeds consist of a single ingredient, providing mainly energy, and are often of local origin.

In order to ensure fish feeds of a quality that will not result in farmed products which will pose a hazard to consumers, the following are recommended:

- fish feeds should be stored to prevent spoilage, protect against contamination and minimise damage; stocks should be rotated and used prior to the expiry of their shelf life;
- industrially produced complete feeds and industrially produced feed ingredients should be properly labelled; their composition must fit the declaration on the label and they should be hygienically acceptable;
- moist feed or feed ingredients should be fresh and of adequate chemical and microbiological quality;

Fresh or frozen fish, fish silage, offal from fish or animal slaughter and rejects from animal slaughterhouses should reach the establishment in an adequate state of freshness. Decomposing moist feed can cause stress and diseases in fish and endanger its quality. Rejects from animal slaughterhouses must be sterilised by an approved procedure prior to acceptance.

Feed which is compounded industrially or at the establishment should contain only such additives, growth promoting substances, fish flesh colouring agents, anti-oxidising agents, caking agents or veterinary drugs which are permitted for fish by the official agency having jurisdiction.

16.9.1 Registration and Distribution of Veterinary Drugs

- all veterinary therapeutic products and medicinal premixes for inclusion in fish feeds should comply with the OIE Code of Practice for the Registration of Veterinary Drugs;
- products should be registered with the appropriate national authority;
- products should only be distributed through veterinarians (or appropriately authorised/trained persons), registered wholesalers, pharmacists or other retail outlets permitted by national laws and regulations;

- storage and transport conditions should conform to the specifications on the label.

16.9.1 Handling and Administration of Veterinary Drugs

- control of diseases with drugs should be carried out only on the basis of an accurate diagnosis by a veterinarian or a qualified fish disease specialist;
- laboratory examination may be required for proper drug selection and for ensuring an appropriate route for application;
- in determining treatments veterinarians/authorised persons should be guided by the principles of maximum effectiveness combined with minimum risk;
- veterinary drugs must be used in compliance with regulations of the official agency having jurisdiction;
- veterinary drugs should be used according to manufacturers instructions and note should be taken of all warning statements and contra- indications for use, in particular any incompatibility with other medicinal products;
- drugs used for treatment as well as prophylaxis must not be given to fish during a certain period of time before slaughtering. Such time must be at least as long as the withdrawal period established by the authority for the species and the drug in question.

Uncontrolled and unlimited use of medicinal products may lead to the accumulation of undesirable residues in the fish treated and in the environment, and that the continuous use of antibacterial, antiprotozoan or anthelminthic products may favour the development of resistance. It is the responsibility of the veterinarian or other authorised persons to draw up programmes of preventive medicine for the fish farmer and to stress the importance of sound management and good husbandry in order to reduce the likelihood of fish diseases. Every effort should be made to use only those drugs known to be effective in treating the specific disease.

In disease circumstances where no authorised product exists or certain indications or target species are not provided for in the product literature, the veterinarian/authorised person can on his/her own responsibility or with advice from the manufacturer, have recourse to other licensed products for off-label use. Administration of products in this manner, however, may have unpredictable side effects and may give rise to unacceptable residue levels. Veterinarians should therefore only embark on such uses after the most careful consideration of the needs of the disease or physiological need situation and provided the following criteria are met: (1) a medical diagnosis is made by an attending veterinarian within the context of a valid veterinary-client-patient relationship; (2) a determination is made that no marketed drugs is currently labelled to treat the condition diagnosed or the recommended dosage on the labelling has been found to be clinically ineffective in the fish to be treated; and (3) procedures are instituted to assure the identity of the treated fish is carefully maintained. Under these circumstances, a significantly extended withdrawal time should be assigned for drug withdrawal prior to marketing the fish. The veterinarian is responsible for providing written instructions on the use of withdrawal times for all medicines used off-label. Off-label use by persons other than veterinarians must not be permitted except when such use is conducted or permitted under the supervision or prescription of the veterinarian.

The veterinarian/authorised person should assess the need for diseased fish to be segregated from healthy stock or fish and treated individually. Close observation of fish during medication in water and following medication in feed is required, to monitor adverse reactions. Beyond his/her responsibility for advice on measures that will reduce the incidence of disease and for controlling it when it arises, the veterinarian is also responsible for taking the welfare of fish stock fully into account.

16.9.2 Withdrawal Period - Control Related to the Protection of Public Health

Good practice in the use of veterinary drugs (GPVD), as defined by the Codex Alimentarius Commission, is the official recommended or authorised usage including withdrawal periods, approved by national authorities, of veterinary drugs under practical conditions. The maximum residue limit for veterinary drugs (MRLVD) is based on the type and amount of residue considered to be without toxicological hazard for human health while taking into account other relevant public health risks.

Drugs applied to fish tend to remain in their tissues for a longer time compared to other animals; as fish are poikilothermic metabolism is primarily dependent on water temperature. In addition to water temperature, the length of time for elimination of drug and of drug metabolites depends on other factors, such as drug properties, route of application, fish species and its physiological condition, salinity of water. These variable factors make it difficult to set withdrawal periods.

The best way of controlling drug residues in fish is preslaughter control. If the average drug concentration in tested fish is above the MRL, slaughter of the batch has to be postponed.
The official agency having jurisdiction should have access to laboratory services to ensure that drug residues in slaughtered fish are within the acceptable range.

Appropriate methods should be used for sampling, analytical procedures and examination to determine compliance with Codex recommendations. At harvesting, veterinary drug residues in fish must not be above the maximum permissible levels set up by the official agency having jurisdiction. A post slaughter control should reject all fish that do not comply with the requirements set for veterinary drug residues by the Codex Alimentarius.

To avoid the presence of unacceptable residues in fish or by-products of fish origin it is essential that the fish farmer adheres to the withdrawal period established for each product and dose regime, or, to a suitably lengthy withdrawal period where none is specified. Full instructions should be given as to how this period is to be calculated including the use of on site residue detection methods where applicable and on the disposition of any fish harvested during treatment or before the end of the withdrawal period. Fish must not be slaughtered before the end of the withdrawal period, and if sold live before the end of that period the buyer must be informed.

16.9.3 Information on Veterinary Drugs

Product information considered essential by the national authority to ensure the safe and effective use of veterinary medicinal products must be made available in the form of labelling and nationally approved data sheets or leaflets produced by the manufacturer or supplier of the medicinal product. Information on dosage schedules should be complemented by instructions on dose- related recommended withdrawal periods, contra-indications and any other constraints on the use of the product including any precautions regarded as necessary.

16.9.4 Preparation of Medicines and Occupational Risks

Incorporation of medicines into feed on the fish farm and handling and administration of medicated feeds, may give rise to potentially hazardous effects in the human operator. The preparation of medicines and medicated feeds should be undertaken by suitably trained personnel, using appropriate techniques and equipment, and according to manufacturer instructions.

Table 3: Application of HACCP to feed supply.

An example of hazard identification and control measures for illustrative purposes only. **Feed Supply (CCP No. 3)**	
Hazards	Biological or chemical contaminants. Uncontrolled use of veterinary drugs.
Control Measure	Obtain feeds from a reputable supplier; correct storage of feeds. Selection of components for feeds prepared on-farm. Supervised use of veterinary drugs according to manufacturers' instructions.
Critical Limit	National or international guidelines. Quantities used in line with manufacturer codes or regulatory limits.
Monitoring Procedure	Certificates of quality from suppliers; laboratory testing Supervision of quantities used; withdrawal periods observed.
Corrective Action	Reject uncertified feeds; Isolate batches of fish; extend purification periods.

16.10 PRODUCTION FACILITIES

Production facilities are all the infrastructures, buildings, and equipment used in the growing of the aquaculture product. The facilities can range from the very simple to quite elaborate structures and constructions. Hazards associated with facilities are reduced or eliminated by selection of the site and adherence to the pre-requisite programme described in Section 3 of this Code and following the Codex Recommended International Code of Practice - General Principles of Food Hygiene (CAC-RCP 1-1969, Rev. 2-1997).

16.11 Harvesting and handling

The actual harvesting of the fish, that is, removal from the water, is unlikely to pose a hazard and food safety hazards are predominately associated with postharvest handling of the product. The guidelines described in Section 5 of this Code should apply to post-harvest handling of farmed products.

16.12 TRAINING

Fish production should be supervised by suitably trained and experienced personnel .
Supervision of all phases, steps and operations in the production process should ensure the adherence to good production practices during the whole technological procedure on the establishment, including maintenance of adequate conditions for living and growth of fish, protection of fish health, proper and careful handling of live fish, proper handling and application of fish feed and of other inputs, as well as the observation of regulations and instructions for the use of veterinary drugs, pesticides and other chemicals.

The goal of the supervision should be to secure good performance in production under conditions, which will prevent the possibility of contamination of fish and assure high quality of end products.

16.13 RECORDS

The results of all monitoring actions, and of any corrective actions taken after monitoring must be recorded. Each CCP should have one or more standard forms for recording the results of inspections and tests, and of any action taken.

One purpose of record keeping is traceability, that is, the ability to document the history of any material that has caused a health problem. All production batches must be identified and be allocated batch codes. The history of the batch must be fully documented.

Also, the establishment will need to examine records as part of its reviews of the HACCP system. Records must be held long enough for both these purposes and storage for at least a year would be reasonable for aquaculture products. Regulatory authorities might specify minimum holding times for records, which could be longer than one year.

16.14 DOCUMENTATION

The preparation of the HACCP plan, and any amendments to it, must be fully documented. This documentation is distinct from the keeping of records of monitoring activities. The various papers must be collected together systematically so that they can be inspected easily by a regulatory authority.
The documentation should include the following:

- names and qualifications of members of the HACCP team that produced the plan;
- description of the product, its intended use, and the hazards and risks associated with its use;
- the flow diagram for the process showing the CCPs, and justification for classifying these steps in the process as CCPs;
- the hazards associated with each CCP, and the preventive measures;
- critical limits for each CCP;
- sources of information on hazards, preventive measures, and critical limits, including relevant legislation and the requirements of regulatory authorities;
- the HACCP plan worksheet;
- monitoring procedures, including protocols for inspection, sampling and testing, and procedures for quality assurance of testing procedures;
- corrective actions to be taken if the monitoring indicates loss of control, including the names or job titles of persons responsible for initiating the action;
- copies of forms used in monitoring, and procedures for storing the records;
- procedures for review of the HACCP plan and system.

16.15 REVIEW AND VERIFICATION

The HACCP plan is the written document derived from the systematic application of the principles of HACCP, and describes the procedures to be adopted to ensure the safety of the product; the HACCP system is the result of the implementation of the plan. The system must be periodically reviewed to determine if it complies with, and is operating according to, the HACCP plan, and the plan itself must be verified, and perhaps modified, at intervals. The operations of review and verification are distinct from those of monitoring. The HACCP plan will describe procedures for review and verification.

Reviews of parts of the system might take place at perhaps daily, weekly, monthly, or at other intervals, depending on circumstances. The review will consist essentially of examination by senior members of the

management, particularly those involved in quality assurance and production, of records, or summaries of records, of monitoring and corrective actions to confirm that the process is under control. They will take into account reports of any problems concerning products dispatched from the establishment, and the outcome of any testing of final products. Generally, an HACCP plan does not call for chemical or microbiological examination of products during production, but relies on control of the process. Testing of end products gives no immediate control of the production process, but it has a role in review and verification of the HACCP plan and system. Some procedures might be changed in the light of these reviews and any changes must be fully documented.

The HACCP plan should be reviewed, perhaps verified, whenever there is a change in the process or when a new product introduced.

Verification is a more thorough review of the HACCP plan to confirm the decisions on which the plan was based, and might be undertaken annually. Verification essentially involves going through all the steps of preparing an HACCP plan using the existing plan as a basis, but taking into account the conclusions of periodic reviews of the existing plan and any new knowledge concerning hazards and risks of the products and their control. The management of the establishment might want to bring in outside experts to help in this verification. **]**

[SECTION 17 TRANSPORTATION [TO BE REVISED]

It is particularly important throughout the transportation of fish and fishery products that care is taken to minimise any rise in temperature of the fish and that the chill or frozen temperature, as appropriate, is maintained under controlled conditions.

Potential Hazards: *Unlikely*

Potential Defects: *Decomposition, physical damage and cross contamination.*

Technical Guidance:

17.1 VEHICLES SHOULD BE DESIGNED AND CONSTRUCTED :

- such that walls, floors and roofs, where appropriate, are made of a suitable corrosion-resistant material with smooth non-absorbent surfaces. Floors should be adequately drained;
- to maintain chilled fish during transport to a temperature as close as possible to 0°C;
- to ensure the temperature of frozen fish and fishery products is maintained at -18°C or colder;
- to provide the fish with protection against contamination from dust, exposure to higher temperatures and the drying effects of the sun or wind;
- to permit the free flow of chilled air around the load when fitted with mechanical refrigeration means.

17.2 TO MINIMISE DAMAGE AND THE RATE OF DECOMPOSITION OF FISH AND FISHERY PRODUCTS DURING TRANSPORTATION:

- pre-cool containers before loading;
- avoid unnecessary exposure to elevated temperatures during loading and unloading of fish products and fishery products;
- ensure the free passage of chilled air to all parts of the load;
- monitor temperatures during transportation. **]**

[SECTION 18 RETAIL [TO BE REVISED]

Fish should be presented to the consumer in the **best** possible condition. It is important throughout the whole retail system that adequate temperature control is maintained and that stock is rotated in a proper manner.

Potential Hazards: *Unlikely.*

Potential Defects: *Decomposition, cross-contamination (ready to eat products) and incorrect labelling.*

Technical Guidance:

18.1 TO MINIMISE THE RATE OF DECOMPOSITION OF FISH DURING RETAIL

- ensure adequate temperature control and monitoring in all storage and retail display areas;

- do not store product above the designated 'load line' in any display cabinet;
- frozen fish should be offered for sale from refrigerated cabinets designed for the purpose;
- ensure proper stock rotation;
- display cabinets should be defrosted as required;
- for wet counters the temperature of the fish should be maintained as close as possible to that of melting ice. For other display cabinets and chilled storage areas the air temperature should be no greater than +5°C;
- utensils used to handle raw seafood should be kept separate or adequately cleaned before being used for ready to eat seafood;
- unpackaged raw fish should be kept physically separated from ready to eat products;
- proper and adequate labelling should inform consumers of storage requirements and durability.

APPENDIX I

MODIFIED ATMOSPHERE PACKING

GOOD PROCESS CONTROLS ARE ESSENTIAL WHEN PACKING FILLETS AND SIMILAR PRODUCTS IN A MODIFIED ATMOSPHERE

Modified atmosphere packing (MAP), in which the composition of the atmosphere surrounding the fillet is different from the normal composition of air, can be an effective technique for delaying microbial spoilage and oxidative rancidity in fish.

For white fish gas mixtures containing 35-45% CO_2, 25-35% O_2 and 25-35% N_2 are recommended. Gas mixtures containing up to 60% CO_2 in combination solely with N_2 are recommended for oily fish. The inclusion of CO_2 is necessary for inhibiting common aerobic spoilage bacteria such as *Pseudomonas* species and *Acinetobacter/Moraxella* species. However, for retail packs of fillets or similar products, too high a proportion of CO_2 in the gas mixture can induce pack collapse, excessive drip and may cause bleaching. Other gases, N_2 and O_2, are included as diluents to prevent these effects. O_2 is preferentially excluded from oily fish in MA packs so as to inhibit oxidative rancidity. A gas/product ratio of 3:1 is commonly recommended. Any reductions in this ratio can result in an impaired shelf-life extension.

The extent to which the shelf-life of the product can be extended by MAP will depend on the species, fat content, initial bacterial load, gas mixture, type of packaging material and, especially important, the temperature of storage. Determination of the shelf life of a particular product should be by a suitably qualified person such as a food technologist or microbiologist. Since fish can be contaminated with *Clostridium botulinum* type E great care has to be exercised when determining the shelf life. Although it is generally accepted that *Clostridium botulinum* does not grow at temperatures below +3°C other factors, e.g. salt content or pH etc., can also have an inhibitory effect. Thus when determining the shelf life of MAP fresh fish it is advisable to do challenge tests on the product which accurately reflect the product conditions and storage and distribution environment. It is very important to note that the inclusion of O_2 does not preclude the growth of *Clostridium botulinum* type E and temperature control throughout the shelf-life of the product is very important. In many circumstances it is considered undesirable to use ice to cool these packs and therefore mechanical refrigeration methods are preferred.

Seal integrity of MA packs is a critical control point since it determines whether a MA pack is susceptible to external microbial contamination and air dilution of the gas mixture. Essential checks on heat sealing should include proper alignment of the sealing heads or jaws, dwell time, temperature, pressure and machine speed. Great care should be taken to ensure that the seal area is not contaminated with product, product drip or moisture since seal integrity may be reduced. In addition, the quality of the film used is important, particularly with regard to gas permeability, and only film with a clearly defined specification from reputable manufacturers should be used.

Maintenance of the correct gas mixture injected into MA packs is essential to ensure product quality, appearance and shelf life extension. For these reasons routine gas analysis of MA packs should be included as part of the process control. Analysis of the gases within MA packs can indicate faults with seal integrity, MA materials, MAP machinery or gas mixing prior to flushing. The use of continuous gas analysers is recommended. Immediate gas analysis following packing is necessary as CO_2 absorption takes place rapidly.

APPENDIX II

OPTIONAL FINAL PRODUCT REQUIREMENTS[13] - FRESH, FROZEN AND MINCED FISH

These end product specifications describe the optional defects for quick frozen fish. The descriptions of optional defects will assist buyers and sellers in describing those defect provisions, which are often used in commercial transactions or in designing specifications for final products.

The following definitions are recommendations for use by purchasers or sellers of quick frozen fish in designing specifications for final product. These specifications are optional and are in addition to the essential requirements prescribed in the appropriate Codex Product Standards and may be appropriately applied for purchases or sales of fresh fish.

1.1 Quick Frozen Finfish, Uneviscerated and Eviscerated

Defect	Recommended Defect Description
a) Body Deformation	Deformation of the back (hump-back) or of the head if present (hooked snout) as a result of the extension of cartilaginous material in these areas as the fish approaches spawning condition.
b) Damage to protective coating	Voids in the ice glaze or tears in the covering membrane.
c) Surface defects:	
Discoloration from bruises	Readily discernible localised discoloration caused by diffusion of blood into the flesh.
Cuts, wounds and other skin breaks	Readily discernible damage to the skin
Discoloured skin	Readily discernible deviation from the normal characteristic colour of the species concerned.
d) Gutting and Cleaning Defects	Improper washing Belly burn or loose belly bones.
Gill and body cavity cuts	Misplaced cuts made during gutting. Incomplete removal of the viscera.
Remains of viscera	Inadequate removal of slime, blood and bits of viscera from the surface of the fish and from the body cavity. Readily discernible enzymatic damage to the tissues in the area of the belly cavity, or loose belly bones in the abdominal cavity, which have become detached from the flesh.

1.2 Quick Frozen Fish Fillets[14]

Defect	Recommended Defect Description
a) Moderate Dehydration	A loss of moisture from the surface of the sample unit, which is colour masking, but does not penetrate the surface and can be easily removed by scraping. Over 10% of the total surface area; or

Pack Size	Defect Area
a) <200 g units	>25cm^2
b) 201-500 g units	>50cm^2
c) 501- 5000 g units	>150cm^2
d) 5001-8000 g units	>300cm^2
e) 8000 g units	>500 cm^2

b) Ragged or Torn Fillets	Longitudinal edges markedly and excessively irregular. Each instance.
c) Small Pieces (not applicable to fillets cut from blocks)	A fillet piece weighing less than 25 g.
d) Skin and black membrane(does not include sub-cutaneous layer). In flat fish white skin is not	Skinless fillets Each piece greater than 3 cm^2

[13] Optional final product specifications for Quick-frozen Finfish, Uneviscerated and Eviscerated were developed from the Codex Standard for Quick-frozen Gutted Pacific Salmon (Codex Stan 36 1981).

[14] In skinless Flat Fish, small pieces of white skin should not be regarded as defects, provided that the skin does not exceed more than 10% of the surface area of the fillets in the sample unit.

regarded as defect.

e) Black Membrane or Belly Lining (does not include white membrane)	Skin-on fillets Each piece greater than 3 cm^2
f) Scales:	Skin-on fillets - scaled
Attached to skin	Each area of scale greater than 3 cm^2
Readily noticeable loose scales	Skinless fillets More than 5, or in the case of hake fillets, more than 10 loose scales
g) Blood Clots (spots)	Any mass or lump of clotted blood greater than 5 mm in diameter.
h) Bruises & Discoloration	Diffused blood causing distinct reddish, brownish or other off-coloration. Any aggregate area of discoloration or bruising exceeding 3 cm^2.
i) Fins or part of fins	Two or more bones connected by membrane, including internal or external bones, or both in a cluster. Any instance where a bone in the fin exceeds 40 mm in length.
j) Bones	Any bone greater than or equal to 10 mm in length or with a diameter greater than or equal to 1 mm; any bone greater than or equal to 5 mm in length is not to be considered if the diameter is not greater than or equal to 2 mm. The foot of a bone (where it has been attached to the vertebra) shall be disregarded if its width is less than or equal to 2 mm or if it can be easily stripped off by a finger nail
Critical Bone	Each defect whose maximum profile cannot be fitted into a rectangle, drawn on a flat solid surface, which has a length of 40 mm and a width of 10 mm.
k) Packaging Material	Each instance.
l) Viscera	Each instance of the internal organs.

1.3 Quick Frozen Blocks of Fish Fillet, Minced Fish Flesh and Mixtures of Fillets and Minces Fish Flesh

Defect	Recommended Defect Description
a) Block Irregularity (applies only to blocks intended for cutting into cores for fish slices or fish portions)	Deviations from declared dimensions (e.g. length, width and thickness of a block), non-uniformity of shape, poor angles, ragged edges, ice pockets, air pockets or other damage which would result in product loss. Deviation from declared (nominal) dimensions: Length, width and thickness (i)Over 5mm in any dimension. (ii)Edges (formed by two surfaces) A gap greater than 10 mm between the actual and true edge. (iii)Angles (formed by three edges) A gap greater than 10 mm between the actual and true corner.
b) Ice pockets	Each pocket with a surface area greater than 10 cm^2.
c) Air pockets (including troughs)	Each pocket with a surface area greater than 2 cm^2 and with a depth greater than 3 mm
d)Moderate Dehydration	A loss of moisture from the surface of the sample unit which is colour masking, but does not penetrate the surface and can be easily removed by scraping. Over 10% of total surface area, or

Pack Size	Defect Area
a) <200g units	>25cm^2
b) 201-500g units	>50cm^2
c) 501-5000g units	>150 cm^2
d) 5001-8000g units	>300 cm^2
e) >8000g units	>500 cm^2

e) Skin and Black Membrane Skin (does not include sub-cutaneous layer). In flat fish white skin is not regarded as a defect.	Skinless fillet block Each piece greater than 3 cm^2
f) Black Membrane or Belly Lining (does not include white membrane)	Skin-on fillet blocks Each instance greater than 3 cm^2
g) Scales (Attached to skin)	Skin-on fillet blocks (scaled) Each area of scale greater than 3 cm^2
Scales (Readily noticeable loose scales)	Skinless fillet blocks More than 5, in the case of hake fillets, more than 10 loose scales.
h) Blood Clots (spots)	Any mass or lump of clotted blood.
i) Bruises and Discoloration	Diffused blood causing distinct reddish brownish or other off coloration which appears as significantly intense discoloration due to melanin deposits, bile stains, liver stains or other causes. . Any aggregate area of discoloration or bruising exceeding 3 cm^2.

Minced part of mixed blocks:		Objectionable discoloration, spots or particles derived from skin, black membrane, blood clots, blood spots, spinal cord or viscera. (i) Distinctly discoloured, spotted or otherwise heavily deviating from the colour of the species**.** (ii) Objectionable deviation from the colour of the fillet.
j) Fins or Parts of Fins		Two or more bones connected by membrane, including internal or external bones, or both, in a cluster. Any instance where a bone in the fin exceeds 40 mm in length.
k) Bones		Any bone greater than or equal to 10 mm in length or with a diameter greater than or equal to 1 mm; any bone less than or equal to 5 mm in length is not to be considered if the diameter is not greater than 2 mm. The foot of a bone (where it has been attached to the vertebra) shall be disregarded if its width is less than 2 mm or if it can be easily stripped off by a finger nail.
	Critical Bone	Each bone whose maximum profile cannot be fitted into a rectangle, drawn on a flat solid surface, which has a length of 40 mm and a width of 10 mm.
l)	Viscera	Each instance.
m)	Packaging Material	Each instance.]

APPENDIX III - OPTIONAL FINAL PRODUCT REQUIREMENTS - MOLLUSCAN SHELLFISH [TO BE COMPLETED]

APPENDIX IV - OPTIONAL FINAL PRODUCT REQUIREMENTS – LOBSTERS AND CRABS(TO BE COMPLETED)

The following definitions are recommendations for use by purchasers or sellers of lobsters in designing specifications for final product. These specifications are optional and are in addition to the essential requirements prescribed in the appropriate Codex Product Standard.

Quick Frozen Lobsters

Defect	Recommended Defect Description
a) Appearance	(i) Not easily separated without thawing when labelled as individually quick frozen. (ii) Colour not generally uniform and non-characteristic of the product, species and habitat or areas from which harvested. (iii) In the case of products in the shell, the shell is not firm and is broken.
b) Damaged	Broken telson, cuts or scars penetrating the shell, crushed or cracked shell.
c) Soft-Shell	The shell is easily flexed by hand.
	The raw meat is not characteristically translucent. (% affected by weight)
d) Opacity	The meat of lobster, rock lobsters, spiny
e) Texture	lobsters and slipper lobsters is tough, fibrous, mushy or gelatinous. (% affected by weight).

APPENDIX V :
OPTIONAL FINAL PRODUCT REQUIREMENTS:- SHRIMPS & PRAWNS

A. FROZEN AND I.Q.F. PEEL AND DE-VEIN SHRIMPS OR PRAWN

QUALITY FACTOR
Determination of Grade

The grade should be determined by examining the product in the frozen, thawed and cooked states, using the table of deduction:

100 to 90 **First quality**
89 to 80 **Second quality**

Flavour: Characteristic, without unpleasant flavours.
Frozen: Means the product with a thermal centre of maximum temperature of -18° C (0° F)
Odour: Characteristic. Yodoform odour isn't considered a defect.
Dehydration: The shell and/or meat of the shrimps or prawns have parts that affect appearance, texture and flavour.
Texture: Texture should be firm, but tender and moist.
Slight: fairly firm, only slightly tough or rubbery, does not form a fibrous mass in the mouth, moist but not mushy.
Moderate: moderately tough or rubbery, has noticeable tendency to form a fibrous mass in the mouth, moist but not mushy.
Excessive: excessively tough or rubbery, has marked tendency to form a fibrous mass in the mouth, or is very dry or very mushy.

Black spots: The shell and/or meat of the shrimps or prawns should be absent of black spots that affect the appearance.

Broken: Shrimps with a broken part bigger than ¾ of the size.
Piece: Part of shrimps or prawns, minimal ¼ of the size.

Extraneous material: All the material present in the pack that isn't part of shrimps or prawn and is not dangerous.

Uniformity of size: Select by count 10 of the largest shrimps or prawns, and 10 of the smallest shrimps or prawns and divide the largest weight by the smallest weight to get a weight ratio.

Evaluation of flavour and odour:

For the evaluation of odour hold the shrimps or prawns close to the nose for evaluation. If the results of the raw odour evaluation indicate the existence of any off-odours, the sample shall be cooked to verify the flavour and odour.

Steam method:

Put the sample in a plastic bag, and place on a wire rack suspended over boiling water in a covered container. Steam the packaged product for 5 to 10 minutes.

Examination for physical defects:

Each of the shrimps or prawns in the sample should be examined for defects using the list of defect definitions.

Schedule of Point Deductions per Sample

Type of Product	Factor scored	Method of determining score	Deduct
Frozen State	Dehydration	Up to 5% From 5.1% to 10% More than 10% More than 15%	0 3 6 11
Thaw State	Black spot only in shell	Absence Up to 5%	0 1.5

		Each 4% additional or less	2
	Black spot in meat	Absence Up to 3% From 3.1% to 5% Each 5% additional or less	0 1 2 2
	Broken, damaged and pieces	Up to 1% From 1.1% to 3% Each 3% additional or less	1 2.5 2.5
	Dehydration	Absence Up to 2% From 2.1 to 5% More than 5%	0 3 6 11
	Dehydration in meat	Absence Slight Moderate Excessive	0 3 6 11
	Heads and unacceptable shrimps or prawns	Up to 1% Each 1% additional or less	2 3
	Extraneous material, not dangerous	1 piece 2 pieces More than 2 pieces Sand	1 2 4 21
	Uniformity of size	Slightly larger or smaller. Each 3% or fraction. Larger or smaller. Each 3% or fraction.	1 2
	Odour	Characteristic. Slightly different to characteristic. Moderately different to characteristic. Excessively different to characteristic.	0 6 12 21
	Inappropriate peel and de-vein	Absence Over 1%; not over 6% Over 6.1%; not over 10% More than 10%	0 1 2 4
	Shells	Up to 3% Each 1% additional or less	0 2
Cooked State	Texture	Firm, but tender and moist Slight Moderate Excessive	0 2 4 21
	Odour	Characteristic Slight Unpleasant	 0 21

B. BREADED SHRIMPS OR PRAWNS

QUALITY FACTOR

Determination of Grade

The grade should be determined by examining the product in the frozen and cooked states, using the table of deduction:

100 to 85 First quality
84 .to 75 Second quality

Schedule of Point Deductions per Sample:

Type of Product	Factor scored	Method of determining score	Deduct
Frozen State	Broken	Break or cut greater than ¾ of the size	15
	Uniformity of size	Over 1.0; not over 1.35 Over 1.36; not over 1.40 Over 1.41; not over 1.45 Over 1.46; not over 1.50	0 1 1.5 2

			Over 1.51; not over 1.55 Over 1.56; not over 1.60 Over 1.61; not over 1.65 Over 1.65	2.5 3.0 3.5 4
	Easy of separation		Slight: Hand separation difficult. Each affected. Moderate: Separated with knife. Each affected.	 1 2
Cook State	Black spot in meat		Absence Up to 5% Each 4% additional or less	0 1.5 2
	Coating defects		Absence Up to 3% From 3.1% to 5% Each 5% additional or less	0 1 2 2
	Texture	Shrimp flesh	Firm, but tender and moist Slight Moderate Excessive	0 2 4 15
		Coating	Moderately dry, soggy or tough Mealy, pasty, very tough	5 15

APPENDIX VI - OPTIONAL FINAL PRODUCT REQUIREMENTS -CEPHALOPODS [TO BE COMPLETED]

APPENDIX VII - OPTIONAL FINAL PRODUCT REQUIREMENTS - SALTED FISH [TO BE COMPLETED]

APPENDIX VIII OPTIONAL PRODUCT REQUIREMENTS – SMOKED FISH

[TO BE COMPLETED]

APPENDIX IX

OPTIONAL FINAL PRODUCT REQUIREMENTS - CANNED FISH

The following definitions are recommendations for use by purchasers or sellers of canned fish in designing specifications for final product. These specifications are optional and are in addition to the essential requirements prescribed in the appropriate Codex Product Standards.

1. Canned finfish

Defects	Recommended Defect Description
a) Drained or Washed Drained Weight	The drained weight of fish (liquid pack), or the washed drained weight of fish (sauce packs) shall be not less than the following % (m/m) of water capacity of the can when packed in : (i) edible oil 70% (ii) own juice ; brine or water ; marinade ; aspic 60% (iii) sauces, also with other packing media added 50%
Exuded water (oil packs only)	Water content (expressed as % of declared net contents of can). (i) fish packed in oil > 8% (ii) fish packed in oil with own juice > 12%
Separation of sauces	Sauce separated into solid and liquid (except oil)
b) Appearance	The product in a can shall comprise fish of an appearance and colour characteristic of the genus processed and packed in the manner indicated.
Dressed Fish and Cutlets in Various Packing Media	Cutting, Trimming and Evisceration (i) Parts of tail (except for small fish) and/or head (ii) Hard scutes (jack mackerel) (iii) More than one fish with feed except for small fish and cutlets in the belly uncut. Excessive amount of viscera (one or more fish not eviscerated). Non characteristic pieces (i) Each additional small piece (ii) Over 10% of flake or further disintegrated fish flesh, skin, bone or fin fragments.
Fillets, Bits, and Flakes in Various Packing Media	Cutting and Trimming Parts of head, tail, viscera or scutes each instance. Skin (fillets labelled skinless) - Each instance greater than 3 cm^2 Black Membrane - Each instance greater than 5 cm^2 Non characteristic pieces (fillets and pieces only) Flake or further disintegrated fish flesh clearly separated from fillets or pieces of fillets (expressed as % of drained fish solids material)
Discoloration, packing media	The packing medium not of normal colour and consistency for the type of pack.
Fill of Container	A can not well filled with fish and packing media not in accordance with the type of pack.

2. Canned sardines and sardine-type products

Defects	Recommended Defect Description
a) Appearance	The fish in the container : (i) are not reasonably uniform in size ; (ii) are not of an appearance or colour characteristic of the species processed or packed in the manner indicated ; (iii) are not neatly cut to remove the head ; (iv) have excessive ventral breaks (unsightly rupture of the ventral area), or breaks and cracks in the flesh. (v) More than 40% of fish in a can having ventral breaks of half the length or more of the abdominal cavity (vi) The packing medium is not of normal colour and consistency for the type. (vii) The can is not well filled with fish.

b) Exuded water (oil packs only)	Water content expressed as % of net contents of can

3. Canned tuna and bonito

No optional defects have been developed for this product.

4. Canned salmon

Defect	**Recommended Defect Description**
a) Appearance	(i) The can is not well filled with fish.
(i) Cross fill (ii) Ragged appearance	(ii) In the case of regular packs, the sections of fish are not arranged so that the cut surfaces are approximately parallel to the opened end and the skin side is not parallel to the walls of the can. Regular packs are not reasonably free from cross packs and pieces or sections of vertebrae across the top of the can. (iii) The oil and liquid released during processing are not normal and characteristic of the species packed.
b) Bones	Hard bone
c) Colour of Flesh	Fish having the appearance and colour of the following : (i) Mixed colours in a single can (ii) Abnormal pale colour for the species (iii) Belly burn
d) Bruising and Blood Spots	Presence of bruising or blood spots expressed as a % of the net content of the can.

5. Canned crab meat

Defect	**Recommended Defect Description**
Appearance	On opening the cans are not well filled and are not well arranged where appropriate for the style of presentation.

6. Canned shrimps or prawns

No optional defects have been developed for this product.

APPENDIX X

OPTIONAL FINAL PRODUCT REQUIREMENTS - FROZEN SURIMI

These end product specifications describe the optional defects for frozen surimi. The descriptions of optional defects will assist buyers and sellers in describing those defect provisions which are often used in commercial transactions or in designing specifications for final products.

Frozen surimi is myofibrillar protein concentrate prepared from fish meat without retaining the original shape of fish, so that it is difficult to determine its quality from its appearance. Moreover, it is generally not consumed directly, but further processed. This means that the quality of frozen surimi is measured by both the compositional properties and the functional properties for surimi-based products. Therefore, it is strongly recommended to inspect such functional properties, as the following quality attributes, that are different from those for other fishery products.

It is most important to evaluate the following primary test attributes: moisture content, pH and objectionable matter of raw surimi and gel strength, deformability, and colour of cooked surimi gel. Other secondary attributes may be measured as desired.

1. Primary Quality Attribute

1.1 Raw Surimi Tests

Preparation of test sample:
Put 2-10 kg of frozen surimi in a polyethylene bag, seal the bag, and temper the surimi at room temperature (20°C) or below so that the temperature of the surimi rises to approximately -5°C. Do not soften the surface of the test sample.

1.1.1 Moisture

Sample for moisture content should be taken from the interior of a surimi block to insure no freezer burn (surface dehydration) of the sample has occurred. Put the test sample in a polyethylene bag or polyethylene bottle, seal the bag or bottle and let the test sample thaw so that the temperature of the sealed article rises to room temperature. Then measure the moisture using any of the following methods:

In case of using a drying oven method (see AOAC Method);

In case of using an infrared lamp moisture tester, take out 5 g of the test sample precisely weighed with a sample tray, and dry it immediately [Details of the method to be provided]; or

In case of using a microwave drying moisture tester (see AOAC Method). [Details of an alternate method to be provided].

Calculate the moisture according to the following formula to the first decimal place.

In using any of the measurement methods, test two or more pieces of the test sample, and indicate the average value obtained thereby.

When measuring a fatty test sample with a microwave drying moisture tester, cover the top of the sample tray with glass fiber paper to prevent fat from splashing, as being dried.

$$\text{Moisture (\%)} = \frac{\text{Pre-dry weight (g) - After-dry weight (g)}}{\text{Pre-dry weight}}$$

1.1.2 pH

Add 90 or 190 *ml* as needed to disperse the sample of distilled water to 10 g of the test sample as need to disperse. Homogenize it, and then measure pH of the suspension with a glass electrode pH meter to second decimal place. Indicate the value obtained thereby.

1.1.3 Objectionable Matter

The term "objectionable matter" as used in this item shall mean skin, small bone and any objectionable matter other than fish meat.

Spread 10 g of the test sample to the thickness of 1 mm or less, and count the number of visible objectionable matter in it. Indicate the value obtained thereby, provided an objectionable matter of 2 mm or larger shall be counted as one and an objectionable matter smaller than 2 mm shall be counted as one half, respectively, and any unnoticeable matter smaller than 1 mm shall be disregarded.

The inspection method for distinguishing scales visibly unnoticeable is specified in Section 2.1.1 of this Appendix.

1.2 Cooked Surimi Gel Tests

1.2.1 Gel Strength and Deformability

Two methods are presented here. The test to use should be decided upon between buyer and seller.

1.2.1.1 Puncture Test

Preparation of test sample:
Put 2-10 kg of frozen surimi in a polyethylene bag, seal the bag, and temper the surimi at room temperature (20°C) or below so that the temperature of the surimi rises to approximately -5°C. Do not soften the surface of the test sample.
Preparation of surimi gel for testing: Surimi gel not containing added starch

A. Comminution

Sample volume necessary for surimi paste preparation depends on the capacity of mixing instrument used. Use of 1.5 kg or more is necessary to represent the property of 10 kg of block. Regarding that enough amount of surimi is necessary for consistency of testing, equipment of large capacity which can mix surimi of 1.5 kg or more must be installed in laboratory. When you use larger size of the equipment, you also need to put in adequate amount of surimi in accordance with equipment to secure enough texture of surimi paste. Crush 1.5 kg or more of the test sample with a silent cutter, then add 3% of salt to it, and further grind and mash it for 10 minutes or more into homogenized meat paste. Remember to keep the temperature of the material to be tested, at 10°C or less.
Desirable timing for adding salt is at -1.5°C.
Desirable temperature of the test material is 5-8°C.

B. Stuffing

Stuff a polyvinylidene chloride tube of 48 mm width (30mm in diameter), when flatten, with approximately 150 g (resulting in approximately 20 cm in length) of the meat paste by the use of a stuffer with a 18 mm diameter stuffing tube, and tie the both ends of the tube.

C. Heating

Heat the test material in hot water of 84-90°C for 30 minutes.
At the time the test material is being put in, the temperature drop should not exceed 3°C.

D. Cooling

Immediately after finishing the heating treatment, put the test material in cold water and fully cool it, and then leave it at the room temperature for 3 hours or longer.

Test Method

Perform between 24 and 48 hours after cooking the following measurements of the prepared inspection sample of surimi gel of which temperature should equilibrate to the room temperature and record the temperature of the sample at the time of measurement.
Measure the gel strength and deformability of the inspection sample of surimi gel with a squeeze stress tester (rheometer). Use a spherical (plunger), of which diameter shall be 5 mm and speed shall be 60 mm/minute.
Remove film off the inspection sample of surimi gel, cut it into 25 mm long test specimen, and place test specimen on the sample deck of the tester so that the center of the test specimen will come just under the plunger. Apply load to the plunger, and measure the penetration force in g and the deformation in mm at breakage.
Record the obtained value of the penetration and deformation in g by integral number. Record the obtained value of the deformation in mm to the first decimal place.
Prepare six or more test specimens from the same inspection sample of Surimi gel, and test each of them. Record the average values obtained thereby.

1.2.1.2 Torsion Test

Preparation of the surimi gel test specimen

A. Comminution

Temper frozen surimi at room temperature (near 25 degree C) for 1 hr., or in a refrigerated tempering room to approximately -5°C. Cut the tempered surimi blocks into slices or chunks and load into bowl of a silent cutter or cutter/mixer equipped for vacuum use. First reduce the frozen surimi to a powder by comminution at low speed without vacuum. Add sodium chloride (2% on total batch weight basis) and ice/water (sufficient to obtain 78% final moisture content on total batch weight basis). Secure the lid and begin chopping again at low speed with no vacuum, gradually (if possible) increasing to high speed (about 2000 rpm). At the point that the mixture becomes a single mass, turn on the vacuum pump and allow approximately 70-80% of a full vacuum (approximately 20- 25 inch Hg or 500-650 mm Hg) to be obtained. During comminution insure that paste is scraped from the walls and balls of paste are forced down into the blades of a cutter/mixer. Discontinue chopping when a temperature of 5-8°C is obtained. A minimum 6 minute chopping time is recommended.

B. Stuffing

Transfer the paste to the sausage stuffer with a minimum of air incorporation. Maintain paste temperature below 10°C at all times. Stuff into polycarbonate or stainless steel tubes 1.9 cm (i.d.) of an appropriate length, typically about 20 cm. Tubes should be sprayed with lecithin release agent prior to filling. Stuff the paste uniformly and without air pockets into tubes. Cap or seal both ends and place in ice bath until ready to heat process (within one hour).

C. Heating

Heat process by immersing filled tubes in a water bath previously equilibrated to the proper temperature. Time-temperature relationships for thermal processing are: low temperature setting ability: 0-4°C for 12-18 hours, followed by 90°C for 15 min; median temperature setting ability: 25°C for 3 hours, followed immediately by 90°C for 15 min; high temperature setting ability: 40°C for 30 minutes, followed immediately by 90°C for 15 min; evaluation of protease activity: 60°C for 30 minutes, followed immediately by 90°C for 15 min; rapid cooking effect: 90°C for 15 minutes. It is recommended that water baths be heated to about 5°C higher than the intended treatment temperature, to account for the heat loss experienced upon loading, and the temperature be adjusted approximately within 2 minutes, possibly requiring ice addition.

Only cold water species will demonstrate good setting ability at lower temperatures. The heat process used to prepare the sample should be specified; if not, it is assumed that only the rapid cooking effect is being assessed. Relative proteolytic activity is assessed by comparing tests conducted on gels prepared at 60/90°C with those processed only at 90°C.

Ohmic heating can be used as a means of heating method. Heat is uniformly generated through electrical resistance. Paste placed in a chlorinated PVC tube is heated between two electrodes. Internal temperature of 90 can be reached within 1 min. Heating rate (fast and slow) can be controlled linearly. This method provides another advantage: Pacific whiting surimi or others with proteolytic enzymes can be successfully gelled (without enzyme inhibitors) under ohmic heating because fast heating can inactivate the enzyme.

D. Cooling

After heat processing, quickly transfer tubes to an ice water bath and equilibrate to 0°C. Remove gels from tubes with a plunger and seal in plastic bags. Keep samples refrigerated until tested (within 48 hours).

Test Method

Perform within 24 hours the following measurements of the prepared inspection sample of surimi gel, whose temperature should be equilibrated to the room temperature (20-25°C).

Measurement of Stress and Strain:

The gel-forming ability of surimi is evidenced by the fundamental rheological properties of the test product when strained to failure (breakage). Allow refrigerated samples to reach room temperature (near 25°C) before testing. Cut test specimens to length of about 30 mm. Attach specimens to mounting discs at each flat end with cyanoacrylate glue, being careful to place samples in center of mounting discs. Mill center of test specimens to a capstan shape, the milled portion being 1 cm. in diameter. Mount the milled test specimen in the torsion rheometer. Rotate top of sample to the point of sample failure (breakage) and record torque and rotational distance at this point. Calculate and report stress and strain at sample failure as: Stress = t = 1581 x (torque units); Strain = $\ln [1+(g^2/2) + g(1+g^2/4)^{0.5}]$, where g = 0.150 x (rotational distance, mm) - 0.00847 x (torque units). In practice these equations are normally programmed onto a computer linked to the torsion rheometer for data acquisition and analysis, thus yielding directly the stress and strain measurements.

1.2.2 Colour

Cut the inspection sample of Surimi gel into flat and smooth slices 15 mm or more thickness, and immediately measure with a colour-difference meter the cross section of the slice pieces in the values of L*(lightness) ,a* (red-green) and b* (yellow-blue) to the first decimal place. Test three or more slice pieces, and indicate the averages of the values obtained thereby.

2. Secondary Quality Attributes

2.1 Raw Surimi Tests

Preparation of test sample:
Put 2-10 kg of frozen surimi in a polyethylene bag, seal the bag, and defrost the surimi at room temperature (20°C) or below so that the temperature of the surimi rises to approximately -5°C. Do not soften the surface of the test sample.

2.1.1 Objectionable Matter(Scales)

After the measurement according to Appendix.1.1.3 add 100 *ml* of water to the same test sample, homogenize it, further add 100 *ml* of 0.2M-NaOH solution to it, and dissolve it with a stirrer. Filter the dissolved solution with filter paper (No.2), wash the residue with water, and then dry it at 105 for two hours. Count the number of scales obtained thereby, and indicate that number in (brackets) appearing subsequent to the number of the objectionable matter according to Section.1.1.3 of this Appendix.

After having dissolved, leave the dissolved solution still to insure precipitation, and scoop up as much skim as possible before filtration.

2.1.2 Crude Protein Content

AOAC Kjeldahl Method

2.1.3 Sugar Content

Precisely weigh 10 g of the test sample, put it in a 50 ml beaker, add to it 10 ml of 2% trichloroacetic acid (TCA) solution, and fully stir the material. Leave it still for approximately 10 minutes, stir it again, and leave it still for 10 minutes. Filter it with filter paper(No.2), drop some part of the filtered liquid on a refractometer (for Brix 0-10% use), and read the graduation on the refractometer. Apply it to the following formula and calculate a value to the first decimal place. Indicate the value obtained thereby.

Calibrate in advance the refractometer at a specified temperature with distilled water.

Sugar(%)=2.04 x Brix(%) - 2.98

2.1.4 Crude Fat Content

Put in a mortar, a precisely weighed 5-10 g of the test sample with approximately same quantity of anhydrous sodium sulphate and a small amount of refined sea sand. Mash the material uniformly into dry powder, and put it in a cylindrical filter paper. Do not fail to take out and put in the cylindrical filter paper the powder remaining in the mortar by the use of a small amount of ethyl ether and absorbent cotton. Extract and determine the fat according to Soxhlet method, and calculate a value according to the following formula to the first decimal place. Indicate the value obtained thereby.

Fill the ends of the cylindrical filter paper with a slight amount of absorbent cotton so that the material to be tested will not fall out.

Dry the extraction receptacle in advance at 100 - 106°C, and weigh it.

Extraction speed shall be 20 times per hour.

$$\text{Crude Fat}(\%) = \frac{(W_1 - W_0)}{S} \times 100$$

S : Quantity of test sample taken(g)
W_0 : Weight of receptacle(g)

W_1 : Weight of receptacle after fat has been extracted(g)

2.1.5 Colour and Whiteness

Colour: Temper frozen surimi completely to room temperature (near 25°C). Fill into a 50 ml glass beaker (4 cm diameter, 5.5 cm height) and measure colour values of L*, a*, and b* (CIE Lab system) to the first decimal point. Complete contact between the test specimen and the colorimeter measurement port, as well as filling of the beaker with no voids, is recommended for consistent results. Measure three or more samples and record the average value.

Whiteness: Whiteness can be calculated as: whiteness = L* - 3b* or whiteness = 100 - $[(100 - L^*)^2 + a^{*2} + b^{*2}]^{0.5}$.

2.1.6 Pressure Induced Drip

Defrost 50 g of the test sample and put it in a circular cylinder of 35 mm inner diameter and 120-150 mm long made of stainless steel or synthetic resin and having 21 holes of 1.5 mm diameter distant 3 mm from each other opened in the bottom. Immediately apply 1 kg of load with a pressurizing cylindrical rod of 34 mm diameter, of which weight shall be included in the load. Leave as it is for 20 minutes, and then measure the weight of the dripped liquid. Calculate its percentage to the weight of the test sample to the first decimal place. Indicate the value obtained thereby.

2.2 Cooked Surimi Tests

2.2.1 Preparation of test sample

2.2.1.1 Water-added Surimi gel:

A. *Comminution*

Sample volume necessary for surimi paste preparation depends on the capacity of mixing instrument used. Use of 1.5 kg or more is necessary to represent the property of 10 kg of block. Regarding that enough amount of surimi is necessary for consistency of testing, equipment of large capacity which can mix surimi of 1.5 kg or more must be installed in laboratory. When you use larger size of the equipment, you also need to put in adequate amount of surimi in accordance with equipment to secure enough texture of surimi paste. Crush 1.5 kg or more of the test sample with a silent cutter, then add to it 3% of salt and 20% of 3% cooled salt water, and further grind and mash it for 10 minutes or more into homogenized meat paste. However, if using the remaining water-unadded, starch-unadded test material under Section 1.2.1.1.A of this Appendix, add 20% of 3% cooled salt water only, and further grind and mash it for 5 minutes into homogenized meat paste, while keeping the temperature at 10°C or less for cold water species, such as Alaska Pollocks (*Theragra chalcogramma*) . Warm water species may be processed at a slightly higher temperature (not to exceed [15°C]). However, better quality will be achieved at a lower temperature.

B. Casing

Same as Section1 2.1.1.B of this Appendix

C. Heating

Same as Section 1.2.1.1.C of this Appendix

D. Cooling

Same as Section 1.2.1.1.D of this Appendix

2.2.1.2 Starch-added Surimi gel

A. Comminution

Add 5% of potato starch to the meat paste prepared according to the method under Section 1.2.1.1.A of this Appendix, and mix (homogenize) within 5 minutes. Remember to keep the temperature of the test material at 10°C or below all the while. Desirable temperature of the test material is 7-8°C.

B. Stuffing

Same as Section 1.2.1.1.B of this Appendix

C. Heating

Same as Section 1.2.1.1.C of this Appendix. However, if performing treatment to secure Suwari (setting), same as Section 2.2.1.3.C of this Appendix Suwari- treated surimi gel.

D. Cooling

Same as Section 1.2.1.1.D of this Appendix.

2.2.1.3 Suwari (setting)-treated Surimi gel

A. Comminution

Same as Section 1.2.1.1.A of this Appendix.

B. Casing

Same as Section 1.2.1.1.B of this Appendix.

C. Heating

After treatment to secure Suwari(setting) in warm water of 30 (28-32)°C for 60 minutes, perform the same heating as Section 1.2.1.1.C of this Appendix.

D. Cooling

Same as Section 1.2.1.1.D of this Appendix.

2.2.2 Test method

Perform between 24 and 48 hours after cooking the following measurements of the prepared inspection sample of surimi gel which temperature should equilibrate to the room temperature and record the temperature of the sample at the time of measurement.

2.2.2.1 Whiteness

Whiteness, as an index for the general appearance of a surimi gel, can be calculated as: Whiteness = L* - 3b*. or: Whiteness = $100 - [(100 - L^*)^2 + a^{*2} + b^{*2}]^{0.5}$.

2.2.2.2 Expressible Moisture

Place a slice of surimi gel (2 cm daimeter X 0.3 cm thick and about 1 g in weight) between two filter papers and press them by an oil pressure equipment under a fixed pressure (10 kg/cm^2) for 20 sec.
Calculate the expressible water according to the following formula to the first decimal piace.
Test three or more pieces of the test sample, and indicate the average value obtained thereby.

$$\text{Expressible water (\%)} = \frac{\text{Pre-pressed weight (g)-after-pressed weight (g)}}{\text{Pre-pressed weight (g)}}$$

Water holding capacity is also used as an index of surimi gel as well as the expressible water.

Water holding capacity (%) is calculated as follows.

$$\text{Water holding capacity (\%)} = \frac{\text{Expressible water content (g)}}{\text{Total moisture content of pre-pressed sample(g)}}$$

2.2.2.3 Folding test:

The folding test is conducted by folding a 5-millimeter thick slice of gel slowly in half and in half again while examining it for signs of structural failure (cracks). Make sure the sample is folded completely in half. Keep the folded state for five seconds, and then evaluate the change in the shape by 5 - stage merit marks. The minimum amount of folding required to produce a crack in the gel determines the score for this test. Test three or more slice pieces of the same inspection sample, and indicate the average mark obtained. In case of folding by hand, apply constant power throughout the folding surface.

Merit Mark	Property
5	No crack occurs even if folded in four.
4	No crack occurs if folded in two but a crack(s) occur(s) if folded in four.
3	No crack occurs if folded in two but splits if folded in four.
2	Cracks if folded in two.
1	Splits into two if folded in two.

2.2.2.4 Sensory (Biting) Test

Bite a 5 mm thick slice piece of the gel sample, and evaluate its resilience upon touch to teeth and cohesiveness upon bite by 10-stage merit marks. Test three or more slice pieces of the same inspection sample by a panel consisting of three or more experts, and indicate the average mark obtained thereby. Merit marks 2, 3, 4, 5 and 6 corresponds to the folding merit marks 1, 2, 3, 4 and 5 under (2), respectively.

Merit Mark	"Ashi (footing) Strength"
10	Extremely strong
9	Very strong
8	Strong
7	Slightly strong
6	Fair
5	Slightly weak
4	Weak
3	Very weak
2	Extremely weak
1	Incapable to form gel

APPENDIX XI:
OPTIONAL FINAL PRODUCT REQUIREMENTS:- COATED QF FISHERY PRODUCTS

Type of product	Defect	Recommended Description
Frozen state	Presence of Surplus Loose Coating	Any excessive amount of loose material in the package as percentage of declared net weight.
	Excessive Fat (Oil)	Each instance of perceptible amounts of oil which have stained the inside of and soaked through the packaging.
	Ease of separation	Upon removal from the pack units do not separate easily by slight force exerted by hand without damage and without packaging material sticking to the surface, percentage of stick (fingers) or portions (fillets) affected.
	Broken Products	Broken products, which have been separated into pieces. Each instance.
	Damaged Products	Damaged products, which have been squashed, mashed or otherwise mutilated to an extent that appearance is materially affected. Each instance
	Discoloration of Coating	Colour of individual units which are black or very dark brown. Each instance. Colour significantly different from other units in the sample. Each instance. Widespread black spots derived from burnt breadcrumbs.
	Size uniformity (if declared)	Deviation of the individual size of stick or portion expressed as percentage of weight.
	Coating	Fish sticks (fingers), portions or fillets where the surface is not completely covered by breading and/or batter.
	Ice Pockets (which may result in coating damage during cooking)	Ice pockets with a surface area greater than1cm^2 (each instance). Air pockets with a surface area of greater than1cm^2 and with a depth of greater than 3 mm, each instance.
	Deep Dehydration	An excessive loss of moisture from the surface of the sample unit, which shows clearly on the surface and cannot be easily removed by scraping. Each instance greater than 5 cm^2
Thawed state	Skin and black membranes (does not include sub-cutaneous layer silver lining)	Skinless fillet. Each piece greater than 3 cm^2
	Black membrane or belly-lining (does result in coating damage during cooking)	Skin-on fillet. Each instance greater than 3 cm^2 (not including white membrane)

	Scales (attached to skin) Readily noticeable loose scales	Skin-on fillet – scaled. Each area of scale greater than 3 $cm^{2.}$ Skinless fillet. More than 5 loose scales except in the case of hake fillets, 10
	Blood clots (spots)	Any mass of lump of clotted blood. Each instance greater than 5 mm in diameter.
	Bruises and Discoloration	Diffused blood causing distinct reddish, brownish or other off-coloration. Any aggregate area of discoloration or bruising exceeding 3 cm^2
	Fins or part of fins	Two or more bones connected by a membrane, including internal or external bones, or both in a cluster. Any instance where a bone in the fin exceeds 40 mm in length
	Viscera	Any viscera. Each instance.
	Embedded packaging material	Each instance.

APPENDIX XII

CODEX CODES AND STANDARDS CONCERNING FISH AND FISHERY PRODUCTS AND RELATED DOCUMENTS

Recommended International Code of Practice for the Processing and Handling of Quick-Frozen Foods	CAC/RCP 8-1976
Method of Checking Product Temperature of Quick-Frozen Foods	Addendum 1, 1978 to CAC/RCP 8-1976
Recommended International Code of Practice for Fresh Fish	CAC/RCP 9-1976
Recommended International Code of Practice for Canned Fish	CAC/RCP 10-1976
Recommended International Code of Practice for Frozen Fish	CAC/RCP 16-1978
Recommended International Code of Hygienic Practice for Shrimp or Prawns	CAC/RCP 17-1978
Recommended International Code of Hygienic Practice for Molluscan Shellfish	CAC/RCP 18-1978
Recommended International Code of Practice for Lobsters	CAC/RCP 24-1979
Recommended International Code of Practice for Smoked Fish	CAC/RCP 25-1979
Recommended International Code of Practice for Salted Fish	CAC/RCP 26-1979
Recommended International Code of Practice for Minced Fish Prepared by Mechanical Separation	CAC/RCP 27-1983
Recommended International Code of Practice for Crabs	CAC/RCP 28-1983
Standard for Quick Frozen Raw Squid	CODEX STAN 191-1995
Standard for Salted Fish and Dried Salted Fish of the Gadidae Family	CODEX STAN 167-1989, Rev. 1-1995
Standard for Canned Salmon	CODEX STAN 3-1981, Rev. 1-1995
Standard for Quick Frozen Finfish	CODEX STAN 36-1981, Rev. 1-1995
Standard for Canned Shrimp or Prawns	CODEX STAN 37-1981, Rev. 1-1995
Standard for Quick Frozen Fish Fillets	CODEX STAN 190-1995
Standard for Canned Tuna and Bonito	CODEX STAN 70-1981, Rev. 1-1995
Standard for Canned Crab Meat	CODEX STAN 90-1981, Rev. 1-1995
Standard for Quick Frozen Shrimp or Prawns	CODEX STAN 92-1981, Rev. 1-1995
Standard for Canned Sardines and Sardine-type Products	CODEX STAN 94-1981, Rev. 1-1995
Standard for Quick Frozen Lobster	CODEX STAN 95-1981, Rev. 1-1995
Standard for Canned Finfish	CODEX STAN 119-1981, Rev. 1-1995
Standard for Quick Frozen Blocks of Fish Fillets, Minced Fish Flesh and Mixtures of Fish Fillets and Minced Fish Flesh	CODEX STAN 165-1989, Rev. 1-1995
Standard for Quick Frozen Fish Sticks (Fish Fingers), Fish Portions and Fish Fillets-Breaded or in Batter	CODEX STAN 166-1989, Rev. 1-1995
Guide to Shellfish Hygiene by P.C. Wood	WHO Offset Publication No. 31 (1976)
Recommended International Code of Practice - General Principles of Food Hygiene (including an Annex on the HACCP System and Guidelines for its Application:	CAC/VOL. A - Ed. 1
WHO Guidelines for Drinking Water Quality	2nd edition, 1993