Caribbean Community

EDICT OF GOVERNMENT

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CRCP 4 (2010) (English): Fish and Fishery Products

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CARICOM REGIONAL CODE OF PRACTICE

Code of hygiene practice for the handling of fish and fishery products

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CRCP 4: 2010

Caribbean Community

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Committee representation

This CARICOM Regional Code of Practice was developed under the supervision of the Regional Technical Committee for Foods, Subcommittee for Fish and Fishery Products (hosted by the CARICOM Member State, Jamaica), which at the time comprised the following members:

Members	Representing
Dr. Lloyd Webb **(Chairperson)**	Caribbean Food and Nutrition Institute
Ms. Peta-Ann Hutchinson	Newport Fish and Meats
Mr. Garth Wright	Rainforest Seafoods
Mrs. Christine Fray-Aiken	University of Technology
Ms. Angella Smith	Consumer Affairs Commission
Ms. Tanille Latty **(Technical Secretary)**	Bureau of Standards Jamaica (BSJ)

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Foreword

This CARICOM Regional Code of Practice has been prepared through the CARICOM Regional Organisation for Standards and Quality (CROSQ). It is an adaptation of the CODEX Alimentarius Commission Code of Practice for Fish and Fishery Products. This Code of Practice recommends general guidelines on the production, storage and handling of fish and fishery products on board fishing vessels and on shore. It incorporates the Hazard Analysis Critical Control Point (HACCP) approach, which is recommended to ensure the hygienic production of fish and fishery products to meet health and safety requirements.

A pre-requisite programme is described in the Code of Practice covering technological guidelines and the essential requirements of hygiene in the production of fish, shellfish and their products, which are safe for human consumption, and otherwise meets the requirements of the appropriate CODEX Alimentarius Commission product standards.

This Code of Practice will assist all those who are engaged in the handling and production of fish and 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 Alimentarius Commission Standards.

This Code of Practice was approved by the Thirtieth Meeting of the Council for Trade and Economic Development (COTED) on 3-4 May 2010.

1 Scope

This Code of Practice applies to the growing, harvesting, handling, production, processing, storage transportation and retail sale of fish, shellfish and aquatic invertebrates and products from marine and freshwater sources, which are intended for human consumption.

2 Normative references

The following reference documents are indispensible for the application of this document. The latest edition of the referenced documents (including any amendments) applies.

CARICOM Regional Code of Practice, CRCP 5, General principles for food hygiene

CARICOM Regional Standard, CRS 5, Labelling standard for pre-packaged foods

CODEX Alimentarius Commission, Code of Practice for Fish and Fishery Products

CODEX Alimentarius Commission, General Standard for Food Additives (CODEX STAN 192-1995)

CODEX Alimentarius Commission, Guidelines for Sensory Evaluation of Fish and Shellfish in Laboratories (CAC/GL 31-1999)

CODEX Alimentarius Commission, Guidelines for the Establishment of a regulatory programme for control of veterinary drugs residues in foods (CAC/GL 16-1993)

CODEX Alimentarius Commission, Methods of Sampling and Analysis (CODEX STAN 234-1999)

CODEX Alimentarius Commission, Methods for Determination of Glaze

CODEX Alimentarius Commission, Recommended Code of Practice on Good Animal Feeding (CAC/RCP 54 – 2004)

CODEX Alimentarius Commission, Standard for Fats and Oils not covered by Individual Standards (CODEX STAN 19-1981)

CODEX Alimentarius Commission, Standard for Frozen Fish Fingers, Fish Portions and Fish Fillets – Breaded or in Batter (CODEX STAN 166-1989)

CODEX Alimentarius Commission, Standard for Named Vegetable Oils (CODEX STAN 210-1999)

CODEX Alimentarius Commission, Standard for Olive Oils and Olive Pomace Oils (CODEX STAN 33-1981)

CODEX Alimentarius Commission, Standard for Quick Frozen Blocks of Fish Fillet, Minced Fish Flesh and Mixtures of Fillets (CODEX STAN 165-1989)

CODEX Alimentarius Commission, Standard for Quick Frozen Fish Fillets (CODEX STAN 190-1995)

FAO listing of shrimps, FAO Fisheries Synopsis No. 125, Volume 1, Shrimps and Prawns of the World

Food and Agriculture Organization, 1995, Code of Conduct for Responsible Fisheries

OIE Codes of Practice, 2003, 6th Edition, International Aquatic Animal Health Code

Recommended International Code of Hygienic Practice for Low-Acid and Acidified Low- Acid Canned Food (CAC/RCP 23-1979)

Recommended International Code of Hygienic Practice for the Transport of Food in Bulk and Semi-Packaged Food (CAC/RCP 47-2001)

Recommended International Code of Practice-General Principles of Food Hygiene, Section VIII-Transportation, CAC/RCP 1-1969

Recommended International Code of Practice for Control of the Use of Veterinary Drugs (CAC/RCP 38-1993)

3 Terms and definitions

For the purposes of this Code of Practice, the following terms and definitions shall apply.

3.1 General definitions

3.1.1
biotoxins
poisonous substances naturally present in fish and fishery products or accumulated by the animals feeding on toxin producing algae, or in water containing toxins produced by such organisms

3.1.2
chilling
process of cooling fish and shellfish to a temperature between 0°C and 4 °C

3.1.3
clean water
water from any source where harmful microbiological contamination, substances and or toxic plankton are not present in such quantities as may affect the quality of fish, shellfish and their products

3.1.4
cleaning
removal of soil, food residues, dirt, grease or other objectionable matter

3.1.5
contaminant
biological or chemical agent, foreign matter, or other substance not intentionally added to food which may compromise food safety or suitability

3.1.6
contamination
introduction or occurrence of a contaminant in fish, shellfish and their products

3.1.7
control measure
action and activity that can be used to prevent or eliminate a food safety hazard or reduce it to an acceptable level

NOTE For the purposes of this Code of Practice, a control measure is also applied to a defect.

3.1.8
corrective action
action to be taken when the results of monitoring at the CCP indicate a loss of control

NOTE For the purposes of this Code of Practice, this also applies to a Defect Action Point (DAP).

3.1.9
CCP
critical control point
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

3.1.10
critical limit
criterion, which separates acceptability from unacceptability

NOTE For the purposes of this Code of Practice, this also applies to a DAP.

3.1.11
decision tree
sequence of questions applied to each process step, with an identified hazard to determine which process steps are CCPs

NOTE For the purposes of this Code of Practice this also applies to a DAP.

3.1.12
decomposition
deterioration of fish, shellfish and their products including texture breakdown and causing a persistent and distinct objectionable odour or flavour

3.1.13
defect
condition found in a product which fails to meet essential quality, composition and or labelling provisions of the appropriate national, regional or international product standards

3.1.14
defect action point
step at which control can be applied and a quality (non-safety) defect can be prevented, eliminated or reduced to acceptable level, or a fraud risk eliminated

3.1.15
disinfection
reduction, by means of chemical agents and or physical methods, of the number of micro-organisms in the environment, to a level that does not compromise food safety or suitability

3.1.16
dressed
portion of fish remaining after heading and gutting

3.1.17
facility
premises where fish and fishery products are prepared, processed, chilled, frozen, packaged or stored.

NOTE For the purposes of this Code of Practice, premises also include vessels.

3.1.18
fish
cold-blooded (ectothermic) aquatic vertebrate excluding amphibians and aquatic reptiles

3.1.19
hazard
biological, chemical or physical agent in, or condition of, food with the potential to cause an adverse health effect

3.1.20
hazard analysis
process of collecting and evaluating information on hazards and conditions leading to their presence to decide which are significant for food safety

3.1.21
HACCP
hazard analysis critical control point
system which identifies, evaluates, and controls hazards which are significant for food safety

3.1.22
monitor
act of conducting a planned sequence of observations or measurements of control parameters to assess whether a CCP is under control

3.1.23
potable water
water, fit for human consumption and free from micro-organisms of public health significance and harmful toxic substances

3.1.24
pre-requisite programme
programme that is required prior to the application of the HACCP system to ensure that a fish and shellfish processing facility is operating according to the CARICOM Regional Code of Practice, CRCP 4, *General principles for food hygiene* and appropriate national food safety legislation

3.1.25
raw material
fresh and frozen fish, shellfish and or their parts which may be utilised to produce fish and shellfish products intended for human consumption

3.1.26
refrigerated water
clean water cooled by a suitable refrigeration system

3.1.27
shelf-life
period during which the product maintains its microbiological and chemical safety and sensory qualities at a specific storage temperature

NOTE It is based on identified hazards for the product, heat or other preservation treatments, packaging method and other hurdles or inhibiting factors.

3.1.28
shellfish
species of aquatic molluscs and crustaceans that are commonly used for food

3.1.29
step
point, procedure, operation or stage in the food chain including raw materials, from primary production to final consumption

3.1.30
validation
obtaining evidence that the elements of the HACCP plan are effective

3.1.31
verification
application of methods, procedures, tests and other evaluations, in addition to monitoring, to determine compliance with the HACCP plan

NOTE For the purposes of this Code of Practice, this also applies to a DAP.

3.1.32
whole fish
fish as captured, un-gutted

NOTE Also known as round fish.

3.2 Aquaculture

3.2.1
aquaculture
farming during part of or the whole life cycle of all aquatic animals, except mammalian species, aquatic reptiles and amphibians, intended for human consumption, but excluding bivalve molluscs

NOTE These aquatic animals are hereafter referred to as “fish”.

3.2.2
aquaculture establishment
premises for the production of fish intended for human consumption, including the supporting inner infrastructure and surroundings under the control of the same management

3.2.3
chemical
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

3.2.4
colouring
obtaining specifically coloured feature of a targeted organism by incorporating into the fish food a natural or artificial substance or additive approved for this purpose by the national competent authority

EXAMPLE Coloured feature include flesh, shell and gonad

3.2.5
diseased fish
fish on or in which pathological changes or other abnormalities that affect safety and quality are apparent

3.2.6
extensive farming
raising fish under conditions of little or incomplete control over the growing process and production conditions

3.2.7
feed additives
chemicals other than nutrients which are approved for fish

3.2.8
fish farm
aquaculture production unit usually consisting of holding facilities, plant, service equipment and stock

EXAMPLE 1 Production units may be either land or water based

EXAMPLE 2 Holding facilities include tanks, ponds, raceways and cages

EXAMPLE 3 Plant includes buildings, storage and processing areas

3.2.9
fish feed
fodder intended for fish in aquaculture establishments, in any form and of any composition

3.2.10
good aquaculture practices
practices of the aquaculture sector that are necessary to produce quality and safe food products conforming to food laws and regulations

NOTE Also known as good fish farming practices.

3.2.11
harvesting
operations involving removing the fish from the water

3.2.12
intensive farming
raising fish under controlled growing process and production conditions where their growth is completely dependent on externally supplied fish feed

3.2.13
competent authority
official authority or authorities charged by the government with the control of food hygiene and sanitation in aquaculture

3.2.14
pesticide
substance intended for preventing, destroying, attracting, repelling or controlling any pests 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

NOTE The term normally excludes fertilisers, plant and animal nutrients, food additives, and veterinary drugs.

3.2.15
pesticide residue
specified substance in food, agricultural commodities, or animal feed resulting from the use of a pesticide

NOTE The term includes any derivatives of a pesticide, such as conversion products, metabolites, reaction products, and impurities considered to be of toxicological significance.

3.2.16
residue
foreign substance including its metabolites, which remains in fish prior to harvesting as a result of either application or accidental exposure

3.2.17
semi-intensive farming
raising fish under conditions of partial control over the growing process and production conditions where their growth is dependent upon endogenously supplied nutrient inputs and externally supplied fish feed

3.2.18
stocking density
amount of fish stocked per unit of area or volume

3.2.19
veterinary drug
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

3.2.20
withdrawal time
period of time necessary between the last administration of a veterinary drug to fish, or exposure of these animals to a veterinary drug, and harvesting of them to ensure that the concentration of the veterinary drug in their edible flesh intended for human consumption, complies with the maximum permitted residue limits

3.3 Live and raw bivalve molluscs

3.3.1
accepted / acceptable / approved
approved by the competent authority

3.3.2
conditioning
placing live bivalve molluscs in tanks, floats or natural sites to remove sand, mud or slime and improve product acceptability

3.3.3
depuration
reduction of microorganisms to a level acceptable for direct consumption by the process of holding live bivalve molluscs for a period of time under approved, controlled conditions in natural or artificial, treated or untreated sea water suitable for the process

3.3.4
depuration centre
approved establishment for the depuration of live bivalve molluscs

3.3.5
distribution centre
approved on-shore or off-shore installation or establishment for the reception, conditioning, washing, cleaning, grading and packaging of live bivalve molluscs fit for human consumption from which the bivalve molluscs are dispatched alive

3.3.6
growing areas
brackish and marine areas approved for the production or harvesting of bivalve molluscs either by natural growth or by aquaculture destined for human consumption.

NOTE The growing areas may be approved as production or harvesting areas for bivalve molluscs for direct consumption, or they may be approved as production or harvesting areas for bivalve molluscs for either depuration or relaying.

3.3.7
heat shocking
process of subjecting bivalve molluscs 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 for the purpose of shucking

3.3.8
relaying
removal of bivalve molluscs from microbiologically contaminated growing area to an acceptable growing or holding area under the supervision of the competent authority and holding them there for the time necessary for the reduction of contamination to an acceptable level for human consumption

3.3.9
shucking
process of removing the edible portion of the mollusc from the shell by hand, mechanically or through heat shock with steam or hot water

3.4 Fresh, frozen and minced fish

3.4.1
candling
passing fillets over a translucent table illuminated from below to detect parasites and other defects

3.4.2
dehydration
loss of moisture from frozen products through evaporation

NOTE 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".

3.4.3
fillet
slice of fish of irregular size and shape removed from the carcass by cuts made parallel to the backbone

3.4.4
freezer
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

3.4.5
freezing process
process which is carried out in an appropriate equipment in such a way that the range of temperature of maximum crystallisation is passed quickly

3.4.6
frozen storage facility
facility that is capable of maintaining the temperature of fish at -18 °C

3.4.7
fresh fish
fish or fishery products which have received no preserving treatment other than chilling

3.4.8
frozen fish
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

NOTE For the purposes of this Code of Practice, the terms “frozen”, “deep frozen”, “quick frozen”, unless otherwise stated, are synonymous.

3.4.9
glazing
applications 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

3.4.10
minced fish
comminuted flesh produced by separation from skin and bones

3.4.11
MAP
modified atmosphere packaging
packaging in which the atmosphere surrounding the fish is different from the normal composition of air

3.4.12
separation
mechanical process for producing minced fish whereby the skin and bone are substantially removed from the flesh

3.4.13
separator
mechanical device used for separation

3.4.14
steak
section of fish, removed by cutting approximately at right angle to the backbone

3.5 Frozen surimi

3.5.1
de-watering
removal of excessive wash water from the minced fish flesh

3.5.2
frozen surimi
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 which is then minced, washed, refined, de-watered mixed with cryoprotective food ingredients and frozen

3.5.3
gel forming ability
ability of surimi to form an elastic gel when fish meat is comminuted with the addition of salt and then heated

NOTE This elasticity is a function possessed by myosin as the primary component of myofibrillar protein.

3.5.4
myofibrillar protein
generic term of skeletal muscle proteins such as myosin and actin

3.5.5
refining
process of removing from washed meat, by use 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

3.5.6
surimi-based products
variety of products produced from surimi with addition of ingredients and flavour such as "surimi gel" and shellfish analogues

3.5.7
washed meat
fish meat that is washed and then drained of water

3.5.8
washing
process of removing 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

3.5.9
water-soluble component
water-soluble protein, organic substance and inorganic salts contained in fish meat

3.6 Quick-frozen coated fish products

3.6.1
batter
liquid preparation from ground cereals, spices, salt, sugar and other ingredients and or additives for coating

NOTE Typical batter types include non-leavened batter and leavened batter.

3.6.2
breading
dry breadcrumbs or other dry preparations mainly from cereals with colourants and other ingredients used for the final coating of fishery products

NOTE Typical breading types include free-flowing breading, coarse breading, flour-type breading.

3.6.3
coating
covering the surface of a fishery product with batter and or breading

3.6.4
pre-frying
frying of breaded and battered fishery products in an oil bath in a way so that the core remains frozen

3.6.5
sawing
cutting of regular shapes of fish blocks into pieces suitable for later coating

3.7 Salted and dried salted fish

3.7.1
barrel
cylindrical container made from wood, plastic or other suitable food contact material with a lid for water-tight closure

3.7.2
black membrane
parietal peritoneum; the pigmented lining of the abdominal cavity

3.7.3
brine
solution of salt in water

3.7.4
brine injection
process of injecting brine directly into the flesh of the fish

3.7.5
brining
process of placing fish in brine for a period of time, sufficient for the fish tissue to absorb a specific quantity of salt

3.7.6
dry-salting
process of mixing fish with suitable food grade salt and stacking the fish in such a manner that the resulting brine drains away

3.7.7
dun
discolouration and development of the mould *Sporendonema epizoum*, which affect the fish surface and gives it a peppered appearance

NOTE The fish flesh is unaffected.

3.7.8
fatty fish
fish in which the main reserves of fat are in the body tissue and the fat content is more than 2 %

3.7.9
gibbing
process of removing the gills, long gut and stomach from fatty fish, such as herring, by inserting a knife or using hands at the gills; the milt or roe and some of the pyloric caeca are left in the fish

3.7.10
lean fish
fish in which the main reserves of fat are in the liver and less than 2 % fat in the body tissue

NOTE Also known as white fish.

3.7.11
maturing
process from the initial salting until the fish is salt-matured

3.7.12
nobbing
removing the head and gut from fatty fish, such as herring, in one operation by partially severing the head and pulling the head away together with attached gut; the roe or milt is left in

3.7.13
pickle
brine which may contain vinegar and spices

3.7.14
pickling
process whereby primary fatty fish is mixed with suitable salt which may contain vinegar and spices and stored in watertight containers under the resultant pickle which forms by solution of salt in the water extracted from the fish tissue

NOTE Pickle may be added to the container. Pickled products will always remain in a brine solution.

3.7.15
pink
discolouration caused by red halophilic bacteria which damages the flesh of the fish

3.7.16
salt
crystalline product consisting predominantly of sodium chloride

NOTE It is obtained from the sea, from underground rock salt deposits or from vacuum processed and refined brine.

3.7.17
salt-matured fish
salted fish that has an appearance, consistency and flavour characteristic of the final product

3.7.18
salted fish or salted fillet
fish or fillets which have been treated by either brining, brine injection, dry-salting, pickling or wet-salting, or a combination of these

3.7.19
saturated
water phase of the fish muscle which is saturated with salt (26.4 g salt/100 g water phase).

3.7.20
split fish
fish that have been cut open from throat or nape to the tail, with gills, guts, roe or milt removed

NOTE Head and whole or part of backbone may be left in or removed.

3.7.21
stacking
laying fish in piles with salt spread evenly on the surface

3.7.22
wet-salting
process whereby primary lean fish is mixed with suitable food grade salt and stored in watertight containers under the resultant brine which forms by solution of salt in the water extracted from the fish tissue

NOTE Brine may be added to the container. The fish can be removed from the container and stacked so that the brine drains away.

3.8 Shrimps and prawns

3.8.1
dehead
removing the head from the entire shrimp or prawn

3.8.2
de-veined shrimp
shrimp which has been peeled; the back of the peeled segments of the shrimp have been opened out and the gut (vein) removed

3.8.3
fresh shrimp
freshly caught shrimp which has been chilled or has not been otherwise preserved

NOTE This does not include freshly cooked shrimp.

3.8.4
peeled shrimp
shrimp with head and shell removed

3.8.5
raw headless shrimp
raw shrimp with head removed and the shell left intact

3.8.6
shrimp
species covered by the most recent edition of the FAO listing of shrimps, FAO Fisheries Synopsis No. 125, Volume 1, Shrimps and Prawns of the World.

NOTE Also called prawn.

3.9 Cephalopods

3.9.1
splitting
process of cutting cephalopods along the mantle to produce a single fillet

3.10 Canned fish and shellfish

3.10.1
canned food
commercially sterile food in hermetically sealed containers

3.10.2
commercial sterility of thermally processed food
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

3.10.3
hermetically sealed containers
containers which are sealed to protect the content against the entry of microorganisms during and after heat treatment

3.10.4
retort
pressure vessel designed for thermal processing of food packed in hermetically sealed containers

3.10.5
scheduled process
thermal process chosen by the processor for a given product and container size to achieve at least commercial sterility

NOTE Also known as sterilisation schedule.

3.10.6
sterilisation temperature
temperature maintained throughout the thermal process as specified in the scheduled process

3.10.7
sterilisation time
time between the moment sterilisation temperature is achieved and the moment cooling started

3.10.8
thermal process
heat treatment to achieve commercial sterility and is quantified in terms of time and temperature

3.10.9
venting
thorough removal of the air from steam retorts by steam prior to a scheduled process

3.11 Retail

3.11.1
retail
operation that stores, prepares, packages, serves, or otherwise provides fish, shellfish and their products directly to the consumer

NOTE This may be free standing seafood markets, seafood sections in grocery or department stores, packaged chilled or frozen and or full service.

3.11.2
packaged
placed in a container and displayed chilled or frozen for direct consumer pick-up

3.11.3
full service display
display of chilled fish, shellfish and their products to be weighed and wrapped by establishment personnel at the request of the consumer

4 Pre-requisite programme

4.1 General

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

NOTE 1 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.

NOTE 2 HACCP principles can also be applied to defect action points.

4.2 Fishing and harvesting vessel design and construction

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

a) for ease of cleaning and disinfection:

1) vessels should be designed and constructed to minimise sharp inside corners and projections to avoid dirt traps;

2) construction should facilitate ample drainage; and

3) a good supply of clean water or potable water at adequate pressure should be provided;

b) to minimise contamination:

1) all surfaces in 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 and microbial contamination;

2) where appropriate, adequate facilities should be provided for the handling and washing of fish and shellfish and should have an adequate supply of cold potable water or clean water for that purpose;

3) adequate facilities should be provided for washing and disinfecting equipment, where appropriate;

4) the intake for clean water should be located to avoid contamination;

5) all plumbing and waste lines should be capable of coping with peak demand;

6) non-potable water lines should be clearly identified and separated from potable water to avoid contamination;

7) objectionable substances, which could include bilge water, smoke, fuel oil, grease, drainage and other solid or semi-solid wastes should not contaminate the fish and shellfish;

8) containers for offal and waste material should be clearly identified, suitably constructed with a fitted lid and made of impervious material;

9) separate and adequate facilities should be provided to prevent the contamination of fish and shellfish by:

i) poisonous or harmful substances;

ii) dry storage of materials, packaging, etc.; and

iii) offal and waste materials;

10) adequate hand washing and toilet facilities, isolated from the fish and shellfish handling areas, should be available; and

11) prevent the entry of birds, insects, or other pests, animals and vermin;

c) to minimise damage to the fish, shellfish and other aquatic invertebrates:

1) surfaces in handling areas should have a minimum of sharp corners and projections;

2) boxing and shelving storage areas should be designed to preclude excessive pressure being exerted on the fish and shellfish;

3) chutes and conveyors should be designed to prevent physical damage caused by long drops or crushing; and

4) the fishing gear and its usage should minimise damage and deterioration to the fish and shellfish; and

d) to minimise damage when aquacultured products and molluscan shellfish are harvested using seines or nets or other means and are transported live to facilities:

1) seines, nets and traps should be carefully selected to ensure minimum damage during harvesting;

2) harvesting areas and all equipment for harvesting, catching, sorting, grading, conveying and transporting of live products should be designed for their rapid and efficient handling without causing mechanical damage; these should be easily cleaned and free from contamination;

3) conveying equipment for live and slaughtered products should be constructed of suitable corrosion-resistant material which does not transmit toxic substances and should not cause mechanical injuries to them;

4) where fish is transported live, care should be taken to avoid overcrowding and to minimise bruising; and

5) where fish are held or transported live, care should be taken to maintain factors that affect fish health.

EXAMPLE CO_2, O_2, temperature and nitrogenous wastes

4.3 Facility design and construction

The facility should be designed to facilitate rapid processing and subsequent storage taking into consideration the following:

a) for ease of cleaning and disinfection:

1) the surfaces of walls, partitions and floors should be made of impervious, non-toxic materials;

2) all surfaces with which fish, shellfish and their products might come in contact should be of corrosion-resistant and impervious material which is light-coloured, smooth and easy to clean;

3) walls and partitions should have a smooth surface up to a height appropriate to the operation;

4) floors should be constructed to allow adequate drainage;

5) ceilings and overhead fixtures should be constructed and finished to minimise the build-up of dirt, condensation and the shedding of particles;

6) windows should be constructed to minimise the build-up of dirt and be fitted with removable and cleanable insect-proof screens;

7) doors should have smooth, non-absorbent surfaces; and

8) joints between floors and walls should be constructed for ease of cleaning (round joints);

b) to minimise contamination:

1) facility layout should be designed to minimise cross-contamination which may be accomplished by physical or time separation;

2) all surfaces in 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;

3) working surfaces that come into direct contact with fish, shellfish and their products 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 detergents and disinfectants under normal operating conditions;

4) adequate facilities should be provided for the handling and washing of products and should have an adequate supply of cold potable water for that purpose;

5) suitable and adequate facilities should be provided for storage and or production of ice;

6) ceiling lights should be covered or otherwise suitably protected to prevent contamination by broken glass or other materials;

7) ventilation should be sufficient to remove excess steam, smoke and objectionable odours and cross-contamination through aerosols should be avoided;

8) adequate facilities should be provided for washing and disinfecting equipment;

9) non-potable water lines should be clearly identified and separated from potable water lines to avoid contamination;

10) all plumbing and waste lines should be capable of coping with peak demands;

11) accumulation of solid, semi-solid or liquid wastes should be minimised to prevent contamination;

12) containers for offal and waste material should be clearly identified, suitably constructed with a fitted lid and made of impervious material;

13) separate and adequate facilities should be provided to prevent the contamination by:

    i) poisonous or harmful substances;

    ii) dry storage of materials, packaging, etc.; and

    iii) offal and waste materials;

14) adequate hand washing and toilet facilities, isolated from handling area, should be available;

15) birds, insects, or other pests and animals should be prevented from entering the facilities; and

16) water supply lines should be fitted with back flow devices; and

c) adequate lighting should be provided for all work surfaces.

4.4 Design and construction of equipment and utensils

The condition of the equipment and utensils should be such that it minimises the build-up of residues and prevents them from becoming a source of contamination. The design and construction of equipment and utensils should take into consideration the following:

a) for ease of cleaning and disinfection:

1) equipment should be durable and movable and or capable of being disassembled to allow for maintenance, cleaning, disinfection and monitoring;

2) equipment, containers and utensils coming into contact with fish, shellfish and their products should be designed to provide for adequate drainage and constructed to ensure that they can be adequately cleaned, disinfected and maintained to avoid contamination;

3) equipment and utensils should be designed and constructed to minimise sharp inside corners and projections and tiny crevices or gaps to avoid dirt traps; and

4) a suitable and adequate supply of cleaning utensils and cleaning agents, approved by the national competent authority should be provided;

b) to minimise contamination:

1) all surfaces of equipment in 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;

2) accumulation of solid, semi-solid or liquid wastes should be minimised to prevent contamination of fish; and

3) adequate drainage should be provided in storage containers and equipment to minimize the possibility of contamination of the product; and

c) to minimise damage:

1) surfaces should have minimal sharp corners and projections;

2) chutes and conveyors should be designed to prevent physical damage caused by long drops or crushing; and

3) storage equipment should be fit for use and not lead to crushing of the product.

4.5 Hygiene control programme

4.5.1 Schedules

Schedules should be implemented to:

a) prevent the build-up of waste and debris;

b) protect the fish, shellfish and their products from contamination;

c) dispose of any rejected material in a hygienic manner;

d) monitor personal hygiene and health standards;

e) monitor the pest control programme;

f) monitor cleaning and disinfecting programmes; and

g) monitor the quality and safety of water and ice supplies.

4.5.2 Requirements

The hygiene control programme should take into consideration the following:

a) 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 (see Annex B for a permanent cleaning and disinfection schedule);

b) 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;

c) handlers or cleaning personnel 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;

d) 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;

e) buildings, materials, utensils and all equipment in the establishment including drainage systems should be maintained in a good state and order;

f) equipment, utensils and other physical facilities of the plant or vessel should be kept clean and in good repair;

g) procedures for the maintenance, repair, adjustment and calibration 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;

h) good hygienic practices should be employed to avoid creating an environment conducive to pests;

NOTE Pest control programmes could include preventing access, eliminating harbourage and infestations, and establishing monitoring detection and eradication systems.

i) physical, chemical and biological pest control agents should be properly applied by appropriately qualified personnel;

j) an ample supply of cold and hot potable water and or clean water under adequate pressure should be provided to avoid contamination;

k) ice should be manufactured using potable water or clean water and should be protected from contamination;

l) for operations which require steam, an adequate supply at sufficient pressure should be maintained;

m) 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;

n) offal and other waste materials should be removed from the premises of a processing facility or vessel on a regular basis;

o) facilities for the containment of offal and waste material should be properly maintained; and

p) vessel waste discharge should not contaminate vessel water intake system or incoming product.

4.6 Personal hygiene and health

4.6.1 General

Personal hygiene and facilities should ensure that an appropriate degree be maintained to avoid contamination.

4.6.2 Facilities and equipment

Facilities and equipment should include:

a) adequate means of hygienically washing and drying hands; and

b) adequate toilet and changing facilities for personnel which are suitably located and designated.

4.6.3 Personnel hygiene

Personal hygiene should be as follows:

a) no person known to be suffering from, or is a carrier of any communicable disease, or has an infected wound or open lesion should be engaged in the preparation, handling or transportation of fish and fishery products;

b) adequate and appropriate protective clothing, head covering and footwear should be worn;

c) all persons working in a facility should maintain a high degree of personal cleanliness and should take all necessary precautions to prevent contamination;

d) hand-washing should be carried out by all personnel working in a processing area:

   1) at the start of fish or shellfish handling activities and upon re-entering a processing area; and

   2) immediately after using the toilet; and

e) the following should not be permitted in handling and processing areas:

   1) smoking;

   2) spitting;

   3) chewing or eating;

   4) sneezing or coughing; or

   5) the wearing of personal effects such as jewellery, watches, pins or other items.

4.7 Transportation

Vehicles should be designed and constructed:

a) such that walls, floors and ceilings are made of a suitable corrosion-resistant material with smooth non-absorbent surfaces;

b) such that floors are adequately drained;

c) with chilling equipment to maintain temperatures from -18 °C to 0 °C as appropriate for chilled fish, shellfish and their products, frozen fish and frozen fish intended for canning;

d) such that live fish and shellfish are transported at temperatures tolerant to these species;

e) to provide the fish or shellfish with protection against contamination, exposure to extreme temperatures and the drying effects of the sun or wind; and

f) to permit the free flow of chilled air around the load when fitted with a mechanical refrigeration system.

4.8 Product traceability and recall procedures

Product traceability and recall procedures should take into consideration the following:

a) managers should ensure procedures are in place for the effective recall of any lot of fishery product from the market;

b) appropriate records of processing, production and distribution should be kept and retained for a period that exceeds the shelf-life of the product;

c) each container of fish, shellfish and their products intended for the consumer or for further processing should be clearly marked to ensure the identification of the producer and of the lot;

d) where there is a health hazard, products produced under similar conditions, and likely to present a similar hazard to public health, should be withdrawn. The need for public warnings should be considered; and

e) 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.

4.9 Training

4.9.1 All personnel should be aware of their role and responsibility in protecting fish or shellfish from contamination and deterioration.

4.9.2 Handlers should have the necessary knowledge and skill to enable them to handle fish or shellfish hygienically.

4.9.3 Personnel who handle strong cleaning chemicals or other potentially hazardous chemicals should be instructed in safe handling techniques.

4.9.4 Each fish and shellfish facility should ensure that managers arrange for adequate and periodic training of relevant employees in the principles and application of HACCP.

NOTE Training of personnel in the use of HACCP is fundamental to the successful implementation and delivery of the programme in fish or shellfish processing establishments. The practical application of such systems will be enhanced when the individual responsible for HACCP has successfully completed a course.

5 General considerations for the handling of fresh fish, shellfish and other aquatic invertebrates

5.1 General

5.1.1 Fish, shellfish and other aquatic invertebrates should not be accepted if they are known to contain parasites, undesirable microorganisms, pesticides, veterinary drugs or toxic, decomposed or extraneous substances known to be harmful to human health, unless they can be reduced to an acceptable level by normal sorting and or processing.

5.1.2 When fish and shellfish determined as unfit for human consumption are found, they should be removed and stored separately from the catch and either reworked and or disposed of in a proper manner.

5.1.3 All fish and shellfish deemed fit for human consumption should be handled properly with particular attention being paid to time and temperature control.

5.2 Time and temperature control

Fresh fish, fillets, shellfish and their products which are to be chilled should be held at a temperature as close as possible to 0 °C.

NOTE Temperature is the single most important factor affecting the rate of fish and shellfish deterioration and multiplication of micro-organisms. For species prone to scombrotoxin production, time and temperature control may be the most effective method in controlling food safety.

5.2.1 Minimise deterioration – time control

To minimise the deterioration, it is important that:

a) chilling should commence as soon as possible; and

b) fresh fish, shellfish and other aquatic invertebrates should be kept chilled, processed and distributed with minimum delay.

5.2.2 Minimise deterioration - temperature control

Where temperature control is concerned:

a) sufficient and adequate icing, or chilled or refrigerated water systems where appropriate, should be employed to ensure that fish, shellfish and other aquatic invertebrates are kept chilled at a temperature as close as possible to 0 °C;

b) fish, shellfish and other aquatic invertebrates should be stored in shallow layers and surrounded by finely divided melting ice;

c) live fish and shellfish are to be transported at temperatures tolerant to the species;

d) chilled or refrigerated water systems and or cold storage systems should be designed and maintained to provide adequate cooling and or freezing capacities during peak loads;

e) fish should not be stored in a densely packed manner in a refrigerated water systems so as to impair its working efficiency; and

f) monitoring and controlling the time and temperature and homogeneity of chilling should be performed regularly.

5.2.3 Minimise deterioration – handling

To minimise handling damage:

a) fish and shellfish should be handled and conveyed with care particularly during transfer and sorting in order to avoid physical damage such as puncture, mutilation, etc.;

b) where fish and shellfish are held or transported live, care should be taken to control factors that can influence fish health

EXAMPLE CO_2, O_2, temperature and nitrogenous wastes

c) fish and shellfish should not be trampled on;

d) where boxes are used for storage of fish and shellfish they should not be overfilled or overstacked;

e) while fish and shellfish are on deck, exposure to the elements should be kept to a minimum in order to prevent dehydration;

f) finely divided ice should be used to maximise cooling capacity and minimise damage to fish and shellfish; and

g) in refrigerated water storage areas, the packing of the fish should be controlled to prevent damage.

NOTE Poor handling practices can lead to damage of fresh fish, shellfish and other aquatic invertebrates which can accelerate the rate of decomposition and increase unnecessary post-harvest losses.

6 Hazard analysis critical control point (HACCP) and defect action point (DAP) analysis

An effective HACCP system should reduce the reliance on traditional end-product testing. 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. The establishment should follow the guidelines outlined in Annex C on how to use the principles of HACCP in the production of various fishery products.

7 Aquaculture production

7.1 General

7.1.1 Aquaculture establishments should comply with the recommendations of the Food and Agriculture Organization, Code of Conduct for Responsible Fisheries, 1995 in order to minimize any adverse impacts on human health and environment.

7.1.2 Fish farms should operate effective fish health and welfare management. Fry and fingerlings should be disease free and should comply with the OIE Codes of Practice (International Aquatic Animal Health Code, 6th Edition, 2003).

7.1.3 Growing fish should be monitored for disease.

7.1.4 When using chemicals at fish farms, special care should be exercised so that these substances are not released into the surrounding environment.

7.1.5 It should be recognised that in preparing a HACCP and or DAP plan it is essential to consult Annex C which provides guidance for the application of the principles of HACCP and DAP analysis.

NOTE See Annex D for an example of a flow diagram (figure D.2) for some of the common steps in aquaculture production.

7.2 General considerations of aquaculture production

7.2.1 Site selection

The general principles in 4 apply to aquaculture production, in addition to the following:

a) the siting, design and construction of fish farms should follow principles of good aquaculture practice, appropriate to species;

b) the physical environment with regard to temperature, current, salinity and depth should also be considered since different species have different environmental requirements;

c) closed recirculation systems should be able to adapt the physical environment to the environment requirements of the farmed fish species;

d) fish farms should be located in areas where the risk of contamination by chemical, physical or microbiological hazards is minimal and where sources of pollution can be controlled;

e) soil for the construction of earthen ponds should not contain such concentrations of chemicals and other substances, which may lead to the presence of unacceptable levels of contamination in fish;

f) ponds should have separate inlets and discharge canals, so that water supplies and effluent are not mixed;

g) adequate facility for treatment of effluent should be provided to allow sufficient time for sediments and organic load settlement before used water is discharged into the public water body;

h) water inlets and outlets to ponds should be screened to prevent the entrance of unwanted species;

i) fertilizers, liming materials or other chemicals and biological materials, should be used in accordance with good aquaculture practices; and

j) all sites should be operated so that fish produced does not adversely impact human health upon consumption.

7.2.2 Fish growing water quality

7.2.2.1 The water should be suitable for the rearing of fish which are safe for human consumption.

7.2.2.2 The water quality should be monitored regularly such that the health of the fish and sanitary condition of the water are continuously maintained to ensure aquaculture products are safe for human consumption.

7.2.2.3 Fish farms should be sited where there is no risk of contamination of the water in which fish are reared.

7.2.2.4 Fish farms should be appropriately designed and constructed to ensure control of hazards and prevention of water contamination.

7.2.3 Source of fry and fingerlings

The source of post-larvae, fries and fingerlings should be such to avoid the carryover of potential hazards into the growing stocks.

7.3 Hazards and defects

7.3.1 Hazards

Potential hazards that are specific to aquaculture products include: residues of veterinary drugs in excess of recommended guidelines and other chemicals used in aquaculture production, contamination of faecal origin where the facilities are close to human habitation or animal husbandry (see Annex C.4.1).

7.3.2 Defects

During transport of live fish stress should be reduced and care should be taken to minimise physical damage to fish (see Annex C.4.1).

7.4 Production operations

7.4.1 Feed Supply

Feeds used in aquaculture production should be in accordance with the relevant national requirements and or the CODEX Alimentarius Commission Recommended Code of Practice on Good Animal Feeding (CAC/RCP 54 – 2004).

7.4.1.1 Potential hazards

Potential hazards include, but are not limited to:

a) chemical and microbiological contamination; and

b) mycotoxins.

7.4.1.2 Potential defects

Potential defects include, but are not limited to:

a) decomposed feeds; and

b) fungal spoilage.

7.4.1.3 Technical guidance

Feed supply should be in accordance with the following:

a) feed and fresh stocks should be purchased and rotated and used prior to the expiry of their shelf life;

b) dry fish feeds should be stored in cool and dry areas to prevent spoilage, mould growth and contamination;

c) moist feed should be properly refrigerated according to manufacturers' instructions;

d) feed ingredients should not contain unsafe levels of pesticides, chemical contaminants, microbial toxins, or other adulterating substances;

e) industrially produced feeds and feed ingredients should be properly labelled; their composition should fit the declaration on the label and they should be hygienically acceptable;

f) ingredients should meet national requirements for levels of pathogens, mycotoxins, herbicides, pesticides and other contaminants which may give rise to human health hazards;

g) only approved colours of the correct concentration should be included in the feed;

h) moist feed or feed ingredients should be fresh and of adequate chemical and microbiological quality;

i) fresh or frozen fish should reach the fish farm in an adequate state of freshness;

j) fish silage and offal from fish, if used, should be properly cooked or treated to eliminate potential hazards to human health;

k) feed which is compounded industrially or at the fish farm 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 national competent authority;

l) products should be registered with the relevant national competent authority as required;

m) storage and transport conditions should conform to the specifications on the label;

n) veterinary drug and other chemical treatments should be administered in accordance with recommended practices and comply with national regulations;

o) medicated feeds should be clearly identified in the package and stored separately, in order to avoid errors;

p) farmers should follow manufacturers' instructions on the use of medicated feeds; and

q) product traceability of all feed ingredients should be assured by proper record keeping.

7.4.2 Veterinary drugs

7.4.2.1 Potential hazards

Potential hazards include, but are not limited to residues of veterinary drugs.

7.4.2.2 Potential defects

Potential defects are unlikely.

7.4.2.3 Technical guidance

The use of veterinary drugs should be in accordance with the following:

a) all veterinary drugs for use in fish farming should comply with national guidelines and or the Recommended International Code of Practice for Control of the Use of Veterinary Drugs (CAC/RCP 38-1993) and the CODEX Alimentarius Commission Guidelines for the Establishment of a regulatory programme for control of veterinary drugs residues in foods (CAC/GL 16-1993);

b) prior to administering veterinary drugs, a system should be in place to monitor the application of the drug to ensure that the withdrawal time for the batch of treated fish can be verified;

c) veterinary drugs or medicated feeds should be used according to manufacturers' instructions, with particular attention to withdrawal periods;

d) products should be registered with the appropriate national competent authority;

e) products should only be prescribed or distributed by personnel authorized under national regulations;

f) storage and transport conditions should conform to the specifications on the label;

g) control of diseases with drugs should be carried out only on the basis of an accurate diagnosis;

h) records should be maintained for the use of veterinary drugs in aquaculture production;

i) harvesting of a batch of fish which is tested and found to have a drug residue concentration above the nationally imposed Maximum Residual Limit (MRL) should be postponed until the batch complies with the national limits. After an assessment of the Good Aquaculture Practices

regarding pre-harvest measures, appropriate steps should be taken to modify the drug residue control system; and

j) a post harvest control should reject all fish that do not comply with the requirements set for veterinary drug residues by the competent national authority.

7.4.3 Growing

7.4.3.1 Potential hazards

Potential hazards include, but are not limited to, microbiological and chemical contamination.

7.4.3.2 Potential defects

Potential defects include, but are not limited to:

a) abnormal colour;

b) muddy flavour; and

c) physical damage.

7.4.3.3 Technical guidance

Growing of fish should be in accordance with the following:

a) source of post-larvae, fries and fingerlings should be controlled to assure healthy stock;

b) stocking densities should be based on culture techniques, fish species, size and age, carrying capacity of the fish farm, anticipated survival and desired size at harvesting;

c) diseased fish should be quarantined and dead fish should be disposed of immediately in a sanitary manner and the cause of death should be investigated;

d) good water quality should be maintained by using stocking and feeding rates that do not exceed the carrying capacity of the culture system;

e) growing water quality should be monitored regularly, so as to identify potential hazards and defects;

f) the fish farm should have a management plan that includes a sanitation programme, monitoring and corrective actions, defined fallowing periods, appropriate use of agrochemicals, verification procedures for fish farming operations and systematic records;

g) equipment such as cages and nets should be designed and constructed to ensure minimum physical damage to the fish during the growing stage; and

h) all equipment and holding facilities should be easy to clean and to disinfect and should be cleaned and disinfected regularly.

7.4.4 Harvesting

7.4.4.1 Potential hazards

Potential hazards are unlikely.

7.4.4.2 Potential defects

Potential defects include, but are not limited to:

a) physical damage; and

b) physical or biochemical change due to stress of live fish.

7.4.4.3 Technical guidance

Harvesting of fish should be carried out in accordance with the following:

a) appropriate harvesting techniques should be applied to minimize physical damage and stress;

b) live fish should not be subjected to extremes of heat or cold or sudden variations in temperature and salinity;

c) fish should be free from excessive mud and weed, soon after being harvested by washing it with clean seawater or fresh water under suitable pressure;

d) fish should be purged, where necessary, to reduce gut contents and pollution of the fish during further processing;

e) fish should be handled in a sanitary manner according to the guidelines in 5;

f) harvesting should be rapid so that fish are not exposed unduly to high temperatures; and

g) all equipment and holding facilities should be easy to clean and to disinfect and should be cleaned and disinfected regularly.

7.4.5 Holding and transportation

7.4.5.1 Potential hazards

Potential hazards include, but are not limited to, microbiological and chemical contamination.

7.4.5.2 Potential defects

Potential defects include, but are not limited to:

a) physical damage; and

b) physical or biochemical change due to stress of live fish.

7.4.5.3 Technical guidance

Holding and transportation of fish should be carried out in accordance with the following:

a) fish should be handled in such a way as to avoid unnecessary stress;

b) fish should be transported without undue delay;

c) equipment for the transport of live fish should be designed for rapid and efficient handling without causing physical damage or stress;

d) all equipment and holding facilities should be easy to clean and to disinfect and should be cleaned and disinfected regularly;

e) records for transport of fish should be maintained to ensure full product traceability; and

f) fish should not be transported with other products which may cause contamination.

7.4.6 Storage and transport of live fish

7.4.6.1 General

7.4.6.1.1 Potential hazards

Potential hazards include, but are not limited to:

a) microbiological contamination;

b) biotoxins; and

c) chemical contamination.

EXAMPLE Oil, cleaning and disinfecting agents

7.4.6.1.2 Potential defects

Potential defects include, but are not limited to:

a) dead fish;

b) physical damage;

c) off flavours; and

d) physical or biochemical change due to stress of live fish.

7.4.6.1.3 Technical guidance

Storage and transport of live fish should be in accordance with the following:

a) only healthy and undamaged fish should be chosen for live storage and transport. Damaged, sick and dead fish should be removed before introduction to the holding or conditioning tanks;

b) holding tanks should be checked regularly during storage and transportation. Damaged, sick and dead fish should be removed immediately when found;

c) clean water utilised to fill holding tanks, or to pump fish between holding tanks, or for conditioning fish, should be similar in properties and composition to the water from where the fish was originally taken to reduce fish stress;

d) water should be free from contamination; Holding tanks and transportation systems should be designed and operated in a hygienic way to prevent contamination of water and equipment;

e) water in holding and conditioning tanks should be well aerated before fish is transferred into them;

f) for species prone to toxic algae contamination, the use of seawater containing high concentration of toxic algae should be avoided in holding or conditioning tanks;

g) fish feeding should not occur during storage and transport and fish should not be fed 24 h before transporting;

h) material used in the construction of holding and conditioning tanks, pumps, filters, piping, temperature control system and in packaging should not be harmful to fish or present hazards to humans; and

i) all equipment and facilities should be cleaned and disinfected regularly.

7.4.6.2 Live fish stored and transported at ambient temperature

7.4.6.2.1 Potential hazards

Potential hazards include, but are not limited to:

a) microbiological contamination;

b) biotoxins; and

c) chemical contamination.

EXAMPLE Oil, cleaning and disinfecting agents

7.4.6.2.2 Potential defects

Potential defects include, but are not limited to:

a) dead fish;

b) physical damage;

c) off flavours; and

d) physical or biochemical change due to stress of live fish.

7.4.6.2.3 Technical guidance

Storage and transportation of live fish at ambient temperature should be in accordance with the following:

a) water intake of holding tanks on board vessels should be located so as to avoid contamination from sewage, waste and engine cooling discharge. Pumping of water should be avoided when the vessel comes into harbour or sailing through waters near sewage or industrial discharges. Equivalent precautions should be adopted for water intake on land;

b) facilities for storing and transportation of live fish should be able to:

   1) maintain the oxygenation of water in the holding tanks through either, continuous water flow, direct oxygenation, air bubbling, or regularly changing the water in the holding tank;

   2) maintain the temperature of storage and transport, for species sensitive to temperature fluctuations; and

   NOTE It may be necessary to insulate the holding tanks and install a temperature control system.

   3) keep water in reserve which might be needed in case the holding tank should drain. The volume in fixed storage facilities should be at least of the same volume of the total holding tanks in operation. The volume in land transport facilities should be at least able to compensate for water loss due to evaporation, leakage, purges, filter cleaning and eventual mixing of water for control purposes; and

c) for species known to exhibit strong territorial behaviour, cannibalism or hyperactivity when under stress, should be separated in individual tanks or appropriately secured to prevent damage to themselves and other fish.

NOTE An alternative method is reduction of temperature.

7.4.6.3 Live fish stored and transported at low temperatures

7.4.6.3.1 Potential hazards

Potential hazards include, but are not limited to:

a) microbiological and chemical contamination; and

b) biotoxins.

EXAMPLE Oil, cleaning and disinfecting agents

7.4.6.3.2 Potential defects

Potential defects include, but are not limited to:

a) dead fish;

b) physical damage;

c) off flavours; and

d) physical or biochemical change due to stress of live fish.

7.4.6.3.3 Technical guidance

Storage and transportation of live fish at low temperature should be in accordance with the following:

a) conditioning of the fish at low temperatures should be done according to the characteristics of the species;

NOTE Conditioning is a biological operation to reduce the metabolic rate of fish thereby minimising the stress caused by storage and transportation.

b) the level of temperature to be attained should be in accordance with the species, transport and packaging conditions;

NOTE There is a range of temperature in which fish do not exhibit or have reduced physical activity. The limit is attained at the temperature at which the metabolic rate of the fish is minimised without causing adverse effects to them.

c) anaesthetics and procedures approved by the national competent authority should be used when performing conditioning;

d) conditioned fish should be packed without delay in properly insulated containers;

e) remaining water or water for use with packaging material for conditioned fish should be clean, of similar composition and pH to the water from which the fish was taken and be of the same temperature as required for storage;

f) water absorbent pads, shredded wood, wood shavings or sawdust and tying material that may be utilised for packaging conditioned fish should be clean, free of possible hazards, be wet at the time of packaging and not be reused; and

g) conditioned and packed fish should be stored or transported under conditions that assure proper temperature control.

8 Live and raw bivalve molluscs

8.1 General

Annex C outlines the application of HACCP principles and Annex E provides additional information for pre-requisite programmes for live and raw bivalve molluscs.

8.2 Classification and monitoring of growing areas

8.2.1 Potential hazards and defects

8.2.1.1 Potential hazards

Potential hazards include, but are not limited to:

a) microbiological and chemical contamination;

b) biotoxins;

NOTE There are five different types of important hazards coming from the bivalve molluscs growing environment:

a) enteric bacterial pathogens;

EXAMPLE *Salmonella spp*.

b) enteric viral pathogens;

EXAMPLE Norovirus, viruses causing hepatitis

c) naturally occurring bacterial pathogens;

EXAMPLE *Vibrio spp*

d) biotoxins; and

EXAMPLE okadaic acid group (DSP), saxitoxin group (PSP), brevetoxin group (NSP), domoic acid group (ASP), azaspiracid group (AZP)

e) chemical contaminants.

EXAMPLE heavy metals such lead, cadmium and mercury

8.2.1.2 Potential defects

Potential defects are unlikely.

8.2.2 Classification of growing areas

8.2.2.1 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 bivalve molluscs. Resurveys should be conducted at an acceptable frequency and known pollution sources should be re-evaluated on a regular basis to determine any changes to their impact on the growing area.

NOTE 1 Sources may include municipal sewage outputs, industrial outputs, mine wastes, geophysical contaminants, domestic animal holding pens, nuclear power plants, refineries or other sources.

NOTE 2 The need to reschedule hygiene surveys will be determined by population shifts and changes in agricultural and industrial activities in the coastal area.

8.2.2.2 When pollution sources have been identified and evaluated, sampling stations for water and or bivalve molluscs and or sediments should be established and studies conducted to determine the effects of the pollutants on water and bivalve molluscs quality. The data should be evaluated by the national competent authority and growing areas should be classified according to national requirements and criteria.

8.2.2.3 When interpreting growing area data, the national competent authority should take into account variations which may affect the level of pollution during the most unfavourable hydrographical and climatic conditions as influenced by rainfall, tides, winds, methods of sewage treatment, population variations and other local factors. The authority should also consider that bivalve molluscs have the ability to accumulate toxic chemicals in their tissue in concentrations greater than the levels found in the surrounding water.

NOTE FAO, WHO, or other international or national food standards may be used as a guide to acceptable levels.

8.2.2.4 The national competent authority should immediately announce decisions concerning the classification of growing areas to the affected producers, depuration and distribution centres.

8.2.2.5 When sampling shellfish meats for classification purposes, if the limits of any biological or chemical hazard stipulated by the national competent authority are exceeded, appropriate measures should be taken under the responsibility of the national competent authority.

8.2.2.6 Classified growing areas should be clearly defined by the national competent authority as either:

a) suitable for harvesting for direct human consumption, relaying in acceptable water or depuration in an approved depuration centre or approved processing to reduce or limit target organisms; or

b) non-suitable for growing or harvesting bivalve molluscs.

8.2.3 Monitoring of growing areas

8.2.3.1 General

8.2.3.1.1 Growing areas should be routinely monitored for changes in water quality and or bivalve molluscs quality, and sub-standard areas patrolled to prevent harvesting for purposes other than that established by the national competent authority.

NOTE For early warning purposes, where appropriate, it is recommended to have a programme present to monitor growing areas for the species of plankton that can produce toxins and to recognize other environmental signals that a toxic event may be developing.

8.2.3.1.2 Harmful chemical substances within bivalve molluscs should not be present in amounts so that the calculated dietary intake exceeds the permissible daily intake.

8.2.3.1.3 When routine monitoring programmes or resurveys show that the growing area no longer meets the classification criteria, the area should be reclassified or closed for harvesting immediately by the national competent authority.

8.2.3.1.4 In determining the public health suitability of bivalve molluscs classified growing areas, the national competent authority should consider the following actions:

a) classification or reclassification of growing areas by sanitary survey, monitoring of *E.coli* or faecal coliforms or total coliforms at an appropriate frequency based on the risk of contamination, and other sanitary control measures, as applicable;

b) classification or reclassification of growing areas by monitoring of pathogens at an appropriate frequency based on the probability of contamination in bivalve mollusc meat (see 8.2.3.3);

c) closure or reopening of growing areas by the monitoring of biotoxins in bivalve molluscs alone or in combination with the monitoring of phytoplankton in seawater at an appropriate frequency based on the probability of contamination (see 8.2.3.4); and

d) control of chemical contaminants.

8.2.3.1.5 Under the responsibility of the national competent authority, the growing areas providing bivalve molluscs for direct human consumption should meet the following requirements at time of harvest:

a) the area is not subject to contamination that may present an actual or potential hazard to human health; and

b) the bivalve molluscs harvested meet the end product specification.

NOTE This can be determined by examination of mollusc's flesh or through adequate monitoring of the water, as appropriate.

8.2.3.2 *E. Coli*, faecal coliforms or total coliforms

8.2.3.2.1 All growing water and or molluscan flesh should be monitored for the presence of *E. coli,* faecal coliforms or total coliforms at an appropriate frequency based on the probability and degree of faecal contamination.

8.2.3.2.2 Tests for suitable indicator bacteria such as faecal coliforms or *E. coli,* total coliforms 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. These indicators do not correlate well with the presence of viruses, other controls such as shoreline surveys should always be employed If faecal contamination exceeds a certain threshold-level relaying or depuration for a time approved by the national competent authority may be allowed.

NOTE Other methods such as bacteriophage and viral detection could also be used as indicators when validated analytical methods become available in the future.

8.2.3.3 Pathogen monitoring

The species, and typically the actual strain of the pathogen should be known to ensure that monitoring addresses the source of the pathogen. Predetermined acceptance or rejection levels for the pathogen should be established in order to use such monitoring results for decision making. Other conditions including the sanitary survey requirements should be satisfied for the reopening of the harvest area.

NOTE Shellfish sanitation programs rely upon the use of indicator organisms for the presence of contamination rather than upon attempts to monitor for specific pathogens. However, where there has been a shellfish borne outbreak caused by an identified pathogen such as *Salmonella* and others (*Vibrio* and viruses), monitoring the bivalve molluscs may be appropriate as part of the process of closure or reopening the affected harvest area.

8.2.3.4 Marine biotoxin control

8.2.3.4.1 Growing areas should also be monitored for environmental signals of toxicity such as, dead or dying birds, mammals, or fish. The risk of toxic algae blooms should be recognised when drawing up monitoring schedules.

NOTE 1 Toxic algae blooms show seasonal variability. Areas may also be affected by toxic algae previously unknown in the surrounding sea or coastal waters.

NOTE 2 Phytoplankton monitoring is a valuable complementary tool that can be used, in combination with the required monitoring of marine biotoxins in shellfish tissue, to optimize program management and resources.

8.2.3.4.2 The implication that the absence of toxicity in indicator shellfish species signifies the absence of toxicity of other species in the growing area should be verified for each species and for each group of toxins before defining a particular species as an indicator for that growing area.

8.2.3.4.3 The national competent authority should immediately close and effectively patrol affected areas when acceptable levels of toxins are exceeded in edible portions of bivalve molluscs meats. These areas should not be re-opened before a toxicological investigation has revealed that the bivalve molluscs meat is free from hazardous amounts of biotoxins.

8.2.3.4.4 The national competent authority should immediately announce these decisions to the affected producers, depuration and distribution centres.

8.2.3.4.5 In establishing a sampling programme, consideration should be given to ensure an adequate location and number of sampling sites. Sampling frequency should be sufficient to address spatial-temporal changes in micro-algae, toxins in shellfish and to cover the risks of rapid rises in shellfish toxicity.

NOTE Testing for a particular biotoxin may not be appropriate when it has been demonstrated that this biotoxin has not been associated with bivalve molluscs in the growing and harvesting areas.

8.2.3.5 Spatial representational sampling

8.2.3.5.1 The selection of sampling stations for both benthic and suspended culture should be based on sites which have historically presented toxicity in the early stages of a toxic event In order to protect public health, the selection of sampling stations should give appropriate coverage of the extent of a toxic event or the likely “worst case scenario” in a growing area. This should be based on the following factors:

a) hydrography, known upwellings, fronts, current patterns and tidal effects;

b) access to sampling stations in all weather conditions during harvesting;

c) desirability of toxin and micro-algal sampling at the same sampling station;

d) in addition to primary stations, the need for secondary and offshore stations;

e) existence of *in situ* growth; and

EXAMPLE Toxic micro-algae from cyst beds

f) the advection of offshore toxic micro-algal blooms into growing areas.

8.2.3.5.2 When a toxic event is in progress or developing, targeted, depth-specific sampling should be considered.

NOTE Routine sampling for micro-algae generally means taking an integrated sample from the water column.

8.2.3.5.3 Sampling for shellfish grown in suspension should at least involve an integrated sample composed of shellfish taken from the top, middle and bottom of the lines.

8.2.3.6 Temporal representational sampling

8.2.3.6.1 Minimum weekly sampling frequencies should be adopted by most monitoring programmes in areas where toxicity is prevalent and where harvesting is taking place or about to take place. Decisions on the frequency of sampling should be based on risk evaluation.

NOTE Inputs into the decision may include factors such as seasonality (toxicity and or harvesting), accessibility, historical baseline information, including toxin and micro-algal data, and the effects of environmental factors such as wind, tide and currents.

8.2.3.6.2 Sampling frequency and the factors that may lead to changes should be described in a "Marine Biotoxin Action Plan" for the growing area.

8.2.3.7 Shellfish sample size

The number of shellfish sampled should be sufficient to address the variability of toxicity among individual shellfish. The number of shellfish in the sample, rather than the mass of the shellfish flesh should be the determining factor for the sample size. Additionally, the size of the sample should be sufficient to allow the test or tests for which the sample is being taken to be carried out, and the shellfish sampled should be of the size marketed.

NOTE There is no internationally agreed sample size for different shellfish species.

8.2.3.8 Marine biotoxin test methods

Methods suitable for the determination of marine biotoxins should be approved by the national competent authority.

8.2.3.9 Chemical contaminants

Growing areas should be monitored for chemical contaminants on a sufficiently frequent basis to provide confidence that any identified sources of chemical contamination are not contaminating the shellfish. Shellfish growing areas where there are no known point sources of likely chemical contamination should only require occasional checks every few years. Where there are known point sources of specific contamination, shellfish should be checked more frequently on a routine basis. There should also be the capacity to sample shellfish reactively if a defined event occurs such as spillage of anti-fouling paint.

8.3 Harvesting and transportation of live bivalve molluscs

8.3.1 Potential hazards

Potential hazards include, but are not limited to:

a) microbiological and chemical contamination; and

b) biotoxins.

8.3.2 Potential defects

Potential defects include, but are not limited to, physical damage.

8.3.3 Technical guidance

The harvesting and transportation of live bivalve molluscs should be carried out in accordance with the following:

a) dredges and other harvesting equipment, decks, holds and containers, which are contaminated, should be cleaned and disinfected before being reused;

b) holds or containers in which bivalve molluscs are kept should be so constructed that the bivalve molluscs are held above the floor level and drained so that they are not in contact with wash-down or bilge water, or shell fluid, where necessary a bilge pumping system should be provided;

c) suitable precautions should be taken to protect bivalve molluscs 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. Overboard discharge of wastes from harvest vessels should not occur around shellfish growing areas. Animals should not be allowed on harvest vessel;

d) wash-down pumps should draw water only from non-contaminated seawater;

e) bivalve molluscs should be harvested from and stored in a growing area or relaying area acceptable to the national competent authority;

f) on removal from water or during handling and transportation, bivalve molluscs should not be subjected to extremes of heat or cold or sudden variations in temperature;

g) special equipment, such as insulated containers and refrigeration equipment, should be used if prevailing temperatures and the time involved so require;

h) bivalve molluscs 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 they be held in closed containers with solid carbon dioxide. In most cases storage above 10 °C or below 2 °C should be avoided;

i) bivalve molluscs should be freed from excessive mud and weed soon after being harvested, by washing with clean seawater or potable water under suitable pressure. Wash-water should not be allowed to flow over bivalve molluscs which have been already cleaned;

NOTE The water could be re-circulated if it meets the definition for clean water.

j) the interval between harvesting and immersion in water for relaying, storage, conditioning or depuration should be kept as short as possible. This should also apply to the interval between final harvesting and handling in a distribution centre;

k) if bivalve molluscs are to be re-immersed after harvest they should be re-immersed in clean seawater; and

l) appropriate documentation should be maintained for harvesting and transportation activities.

8.4 Relaying

8.4.1 General

8.4.1.1 The requirements for classification and monitoring of growing areas should also apply to relaying areas.

8.4.1.2 Bivalve molluscs harvested for relaying should only be harvested from areas that are so designated or classified by the national competent authority.

NOTE Relaying is intended to reduce the level of biological contaminants that may be present in bivalve molluscs which have been harvested from contaminated areas to such levels that the bivalve molluscs will be acceptable for human consumption without further processing.

8.4.2 Potential hazards

Potential hazards include, but are not limited to:

a) microbiological contamination;

b) biotoxins; and

c) chemical contamination.

8.4.3 Potential defects

Potential defects are unlikely.

8.4.4 Technical guidance

Relaying should be carried out in accordance with the following:

a) relaying operations should be strictly supervised by the national competent authority to prevent contaminated bivalve molluscs from being diverted directly to the consumer market or from cross contamination of other bivalve molluscs. Boundaries of relaying areas should be clearly identified by buoys, poles or other fixed means. These areas should be adequately separated from the bivalve molluscs in adjacent waters and suitable control systems should be in place to prevent cross contamination and commingling;

b) holding time and minimum temperature in the accepted area prior to harvest should be determined by the national competent authority based on the degree of contamination before relaying, the temperature of the water, the bivalve molluscs species involved and local geographic or hydrographical conditions to ensure that contamination levels have been adequately reduced;

c) relaying sites should be monitored to ensure they do not become biotoxic from a bloom, or a source of environmental pathogens such as *Vibrio* bacteria;

d) bivalve molluscs should be laid out at a density which will permit them to open and undergo natural depuration; and

e) appropriate documentation should be maintained for relaying operation.

8.5 Depuration

8.5.1 General

8.5.1.1 Bivalve molluscs harvested for depuration should only be harvested from areas that are so designated or classified by the national competent authority.

NOTE Depuration is intended to reduce the number of pathogenic micro-organisms that may be present in bivalve molluscs which have been harvested from moderately polluted areas to such levels that the bivalve molluscs will be acceptable for human consumption without further processing. Depuration alone is not suitable for cleansing bivalve molluscs from more heavily contaminated areas or areas subject to contamination by hydro-carbons, heavy metals, pesticides, viruses, vibrios or biotoxins.

8.5.1.2 For natural functioning and for depuration to occur, molluscs should not be over-stressed or damaged during harvesting or handling and should not be in a seasonally weak or spawning condition.

8.5.1.3 Depuration centres should maintain the same hygiene standards as outlined in 4.3, 4.4, 4.5 and 4.6.

8.5.2 Potential hazards

Potential hazards include but are not limited to, microbiological contamination.

8.5.3 Potential defects

Potential defects include, but are not limited to, physical damage.

8.5.4 Technical guidance

Depuration should be carried out in accordance with the following:

a) depuration centres and tanks should be approved by the national competent authority;

b) bivalve molluscs subjected to the depuration process should not contain metallic ions, pesticides, industrial wastes or marine biotoxins in such quantities that they present a health hazard to the consumer;

c) shellstock approved by the national competent authority should be used;

d) the process and the equipment used for depuration should be approved by the national competent authority;

e) dead or damaged bivalve molluscs should be removed before the depuration process, where practicable. Surfaces of shells should be free from mud and soft commensal organisms. If necessary, the bivalve molluscs should be washed with clean sea water before the depuration process;

f) the length of the period of depuration should be adapted to the water temperature and physical water quality parameters such as clean sea water, salinity, dissolved oxygen and pH levels suitable to permit the bivalve molluscs to function normally, the degree of contamination before depuration and the bivalve molluscs species. Microbiological investigation of process water and of bivalve molluscs meat should be used to assess depuration parameters;

NOTE Viruses and *Vibrio spp*. are more persistent during depuration than the indicator bacteria mostly used for microbiological monitoring and that the reducing of the number of indicator bacteria does not always reflect the real situation with respect to contamination by viruses and *Vibrio spp*.

g) water used in depuration 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 bivalve molluscs treated and should depend on the degree of contamination of the bivalve molluscs;

h) bivalve molluscs undergoing depuration should remain immersed in clean sea water until it satisfies the sanitary requirements of the national competent authority;

i) bivalve molluscs should be laid out at a density which will permit them to open and undergo natural depuration;

j) during the process of depuration, the water temperature should not be allowed to fall below the minimum at which bivalve molluscs remain physiologically active. High water temperatures

which adversely affect the pumping rate and the depuration process should be avoided, and tanks should be protected from the direct rays of the sun when necessary;

k) equipment in contact with water 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 depuration processing;

l) unpurified bivalve molluscs should not be placed in the same tank as bivalve molluscs which have already undergone depuration;

m) on removal from the depuration system, bivalve molluscs should be washed with running potable water or clean sea water, and handled in the same manner as living bivalve molluscs taken directly from a non-polluted area. Dead and unwholesome bivalve molluscs should be removed;

n) water should be drained from the system to avoid re-suspension and re-ingestion, before removing the bivalve molluscs form the tanks. The tanks should be cleaned after each use and disinfected at suitable intervals;

o) after depuration the bivalve molluscs should meet the end product specification; and

p) appropriate documentation should be maintained for depuration.

8.6 Processing of bivalve molluscs in a distribution centre or an establishment

8.6.1 General

Distribution centres that prepare live bivalve molluscs suitable for direct consumption and establishments that prepare live and raw bivalve molluscs suitable for direct consumption should maintain the same hygiene standards as 4.3, 4.4, 4.5 and 4.6.

8.6.2 Reception

8.6.2.1 Potential Hazards

Potential hazards include, but are not limited to, microbiological, chemical and physical contamination.

8.6.2.2 Potential Defects

Potential defects include, but are not limited to:

a) viable parasites;

b) physical damage;

c) foreign matter; and

d) dead or dying bivalve molluscs.

8.6.2.3 Technical guidance

Reception of bivalve molluscs should be carried out in accordance with the following:

a) bivalve molluscs that are to be dispatched live from a distribution centre or other establishment should not be subjected to conditions of stress and excessive shocks; and

b) distribution centres and other establishments that prepare live bivalve molluscs should only accept bivalve molluscs which meet the national product specification and which originate from approved growing areas, relaying areas or depuration centres.

8.6.3 Conditioning and storage of bivalve molluscs

8.6.3.1 Potential hazards

Potential hazards include, but are not limited to:

a) microbiological and chemical contamination; and

b) biotoxins.

8.6.3.2 Potential defects

Potential defects include, but are not limited to:

a) physical damage;

b) foreign matter; and

c) dead or dying bivalve molluscs.

8.6.3.3 Technical guidance

Conditional storage of bivalve molluscs should be carried out in accordance with the following:

a) clean sea water should be used in the tanks, floats, natural sites or rafts and should be of an adequate salinity and have adequate physical water quality parameters to permit the bivalve molluscs to function normally. Where natural sites are used for conditioning these should be classified by the national competent authority;

NOTE Optimum salinity will vary with bivalve molluscs species and with the harvesting area. Water condition has to be satisfactory adequate for the process.

b) before conditioning or storage, bivalve molluscs should be washed to remove mud and soft commensal organisms and dead or damaged bivalve molluscs should be removed where practicable;

c) during storage, bivalve molluscs should be laid out under such conditions that will permit them to open and function normally;

d) the oxygen content in the seawater should be maintained at an adequate level at all times;

e) the temperature of the water in storage tanks should not be allowed to rise to such levels as to cause weakness of the bivalve molluscs. 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;

f) bivalve molluscs should be stored in clean sea water only for such time as they remain sound and active.;

g) tanks should be drained, cleaned and disinfected at suitable intervals; and

h) re-circulating wet storage systems should contain approved water treatment systems.

8.6.4 Washing, declumping, debyssing and grading

8.6.4.1 Potential hazards

Potential hazards include, but are not limited to microbiological contamination, chemical and physical contamination.

8.6.4.2 Potential defects

Potential defects include, but are not limited to mechanical damage.

8.6.4.3 Technical guidance

Washing, declumping, debyssing and grading should be carried out in accordance with the following:

a) 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;

b) bivalve molluscs should be handled carefully to reduce damage to shells and reduce the risk of contamination and deterioration;

c) handling of bivalve molluscs should be minimised;

d) excessive shocks should be avoided;

e) the different process steps should be supervised by technically competent personnel;

f) the outsides of the shells should be washed free of mud, and all soft and hard adhering organisms should be removed. Washing should be carried out using pressurised clean sea water; and

g) bivalve molluscs 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.

8.6.5 Packing and labelling

8.6.5.1 General

8.6.5.1.1 All steps in the process of packaging should be performed without delay and under conditions that will prevent the possibility of contamination, deterioration and the growth of pathogenic and spoilage micro-organisms.

8.6.5.1.2 The packaging material should be appropriate for the packaging and storage of the product 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.

8.6.5.2 Packing and labelling of live bivalve molluscs

8.6.5.2.1 Potential hazards

Potential hazards include, but are not limited to microbiological, physical and chemical contamination.

8.6.5.2.2 Potential defects

Potential defects include, but are not limited to:

a) incorrect labelling;

b) presence of damaged or dead bivalve molluscs; and

c) foreign matter.

8.6.5.2.3 Technical guidance

Packing and labelling of live bivalve molluscs should be carried out in accordance with the following:

a) before packing bivalve molluscs should undergo visual inspection. Bivalve molluscs which are dead, with broken shells, with adhering soil or otherwise un-wholesome should be rejected for human consumption;

b) the packaging material should avoid contamination and should be drained;

c) labels should be clearly printed and should comply with the labelling laws of the country where the product is marketed; and

NOTE The packaging material may be used to bear an indication as to how the bivalve molluscs should be kept at the time they were bought at the retailer. It is recommended to include the date of packaging.

d) 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.

8.6.5.3 Packing and labelling of raw bivalve molluscs

8.6.5.3.1 Potential hazards

Potential hazards include, but are not limited to, microbiological and physical contamination.

8.6.5.3.2 Potential defects

Potential defects include, but are not limited to:

a) objectionable matter such as shell pieces; and

b) incorrect labelling.

8.6.5.3.3 Technical guidance

Packing and labelling of raw bivalve molluscs should be carried out in accordance with the following:

a) labels should be clearly printed and must comply with the labelling laws of the country where the product is marketed;

NOTE The packaging material or label may be used as a means to convey appropriate storage instructions to the consumer after retail purchase. It is recommended to include the date of packaging.

b) all packaging material should be stored in a clean and sanitary manner. Only packaging material required for immediate use should be kept in the packing or filling area;

c) shucked and post harvest treated product should be packed and chilled or frozen as soon as possible;

d) freezing should take place quickly (see 9.4); and

NOTE Slow freezing will damage meat.

e) safety claims, if present on the label, relating to post harvest treatment should be specific to the target hazard that has been eliminated or reduced.

8.6.6 Storage

8.6.6.1 Storage of live bivalve molluscs

8.6.6.1.1 Potential hazards

Potential hazards include, but are not limited to microbiological contamination, chemical and physical contamination.

8.6.6.1.2 Potential defects

Potential defects include, but are not limited to physical damage.

8.6.6.1.3 Technical guidance

The storage of live bivalve molluscs should be carried out in accordance with the following:

a) the end product should be stored under such conditions to preclude the contamination with and or proliferation of micro-organisms. The packaging material used should not come into direct contact with the floor but should be placed on a clean, raised surface;

b) storage periods should be kept as short as possible; and

c) re-immersion in or spraying with water of live bivalve molluscs should not take place after they have been packed and have left the distribution centre or establishment except in the case of retail sale at the distribution centre.

8.6.6.2 Storage of raw bivalve molluscs

8.6.6.2.1 Potential hazards

Potential hazards include, but are not limited to, microbiological contamination, chemical and physical contamination.

8.6.6.2.2 Potential defects

Potential defects include, but are not limited to physical damage.

8.6.6.2.3 Technical guidance

The storage of raw bivalve molluscs should be carried out in accordance with the following:

a) the storage period should be kept as short as possible; and

b) damage to packaging of frozen product should be avoided.

8.6.7 Distribution and transport

8.6.7.1 Distribution of live bivalve molluscs

8.6.7.1.1 Potential hazards

Potential hazards include, but are not limited to, microbiological contamination.

8.6.7.1.2 Potential defects

Potential defects include, but are not limited to, physical damage.

8.6.7.1.3 Technical guidance

The distribution and transport of live bivalve molluscs should be carried out in accordance with the following:

a) the product should be dispatched in the sequence of the lot numbers;

b) the temperature should be maintained during distribution to control microbial growth;

c) bivalve molluscs intended for human consumption should only be distributed in closed packaging; and

d) the means of transport should provide sufficient protection of the bivalve molluscs against damage to the shells from shocks. The bivalve molluscs should not be transported with other products which might contaminate them.

NOTE See also 4.7 and 16.

8.6.7.2 Distribution of raw bivalve molluscs

8.6.7.2.1 Potential hazards

Potential hazards include, but are not limited to, microbiological contamination.

8.6.7.2.2 Potential defects

Potential defects are unlikely.

8.6.7.2.3 Technical guidance

The distribution and transportation of raw bivalve molluscs should be carried out in accordance with the following:

a) temperature should be maintained during distribution to control microbial growth;

b) the product should be dispatched in the sequence of the lot numbers; and

c) transportation should be capable of maintaining chilled or frozen product for safety and quality.

8.7 Processing to reduce or limit target organisms

8.7.1 General

Live and raw bivalve molluscs should meet all microbiological criteria associated with traditional harvest water controls designed to prevent faecal contamination and resulting introduction of enteric pathogens as well as toxins and other contaminants.

NOTE Processing to reduce or limit target microorganisms is intended to retain the sensory qualities of a live bivalve mollusc. However, these growing area controls are not designed for control of pathogens that are independent from faecal contamination.

8.7.2 Potential hazards

Potential hazards include, but are not limited to microbiological contamination.

8.7.3 Potential defects

Potential defects include, but are not limited to:

a) coagulation of meat;

b) defective meat texture; and

c) hydrostatic medium forced into the flesh.

8.7.4 Technical guidance

Processing to reduce or limit target organisms should be carried out in accordance with the following:

a) any treatment developed to eliminate or reduce pathogens should be scientifically validated to ensure that the process is effective;

b) the control treatments, such as heat and pressure, should be closely monitored to ensure that the flesh of the product does not undergo textural changes;

c) the treatment parameters established to reduce or limit pathogens should be approved by the national competent authority; and

d) each establishment which purifies bivalve molluscs with a heat treatment should develop a heat treatment process schedule, approved by the national competent authority. This schedule should address the following critical factors:

    1) species and size of bivalve molluscs;

    2) time of exposure to heat;

    3) internal temperature of bivalve molluscs;

    4) type of heat process used;

    5) water or steam to bivalve molluscs ratios;

    6) nature of heat equipment;

    7) measurement devices and their calibration;

8) post heating and chilling operations; and

9) cleaning and sanitising of heat process equipment.

8.8 Shucking

8.8.1 Hand and mechanical shucking and washing

Dirt, mud and detritus should be removed before further processing through washing or other means.

8.8.1.1 Potential hazards

Potential hazards include, but are not limited to, microbiological contamination and physical contamination.

8.8.1.2 Potential defects

Potential defects include, but are not limited to:

a) cuts and tears of the flesh; and

b) presence of sand and mud.

8.8.1.3 Technical guidance

Shucking should be carried out in the accordance with the following:

a) care should be taken to eliminate excess mud, detritus and sand from the shucking tables;

b) the product should be examined to ensure that cuts and tears are minimized; and

c) shucked molluscs should be rinsed or washed to further eliminate mud, sand, detritus and reduce the microbiological level of the products.

8.8.2 Heat shocking of bivalve molluscs followed by packing

8.8.2.1 Potential hazards

Potential hazards include, but are not limited to physical contamination.

8.8.2.2 Potential defects

Potential defects are unlikely.

8.8.2.3 Technical guidance

Heat shocking and packing of bivalve mollusc should be carried out in the accordance with the following:

a) The bivalve molluscs should come from approved growing areas, relaying areas or depuration centres. Each establishment which heat shucks bivalve molluscs should develop a heat shuck process schedule, acceptable to the national competent authority. The schedule should address such critical factors as:

1) species and size of bivalve molluscs;

2) time of exposure to heat;

3) internal temperature of bivalve molluscs;

4) type of heat process used;

5) water or steam to bivalve molluscs ratios;

6) nature of heat equipment;

7) measurement devices and their calibration;

8) post heating and chilling operations; and

9) cleaning and sanitising of heat process equipment;

b) all bivalve molluscs should be washed with pressurised potable water or clean sea water and culled for damaged and dead bivalve molluscs prior to heat treatment;

c) the bivalve molluscs should be inspected before heat shocking, to determine whether they are alive or damaged;

d) heat shocked bivalve molluscs should be cooled to 7 °C or less within two hours of being heat treated. This time should include the shucking process. This temperature should be maintained during transport, storage and distribution; and

e) the heat shocked bivalve molluscs should be packed as soon as possible. Before packing they should be examined for objectionable matter such as shell pieces.

8.9 Documentation

8.9.1 The transport of live bivalve molluscs from a growing area to a distribution centre, depuration centre, relaying area or establishment should be accompanied by documentation for the identification of batches of live bivalve molluscs.

8.9.2 Storage and transport temperatures should be indicated.

8.9.3 Permanent, legible and dated records of relaying and depuration, pertaining to each lot, should be retained for a minimum period of one year.

8.9.4 Depuration centres or tanks and distribution centres and establishments should only accept lots of live bivalve molluscs with documentation issued by or accepted by the national competent authority. Where appropriate, this documentation should contain the following information:

a) the identification and signature of the harvester;

b) the date of harvesting;

c) common and or scientific name and quantity of bivalve molluscs;

d) the location of the growing area and the status and its suitability for:

1) harvesting for direct human consumption;

2) relaying;

3) depuration; and

4) approved processing to reduce or limit target organisms;

e) for distribution centres and establishments, the date and duration of depuration and the identity and signature of the responsible personnel; and

f) for distribution centres and establishments, the date and duration of relaying, the location of the relaying area and the identity and signature of the responsible personnel.

8.9.5 Complete records of harvest area and date of harvest and length of time of relaying or depuration of each lot should be maintained by the distribution centre or establishment for a period designated by the national competent authority.

8.10 Lot identification and recall procedures

Each product should have an easy identifiable lot number. This lot number must include an identification code, the number of the establishment that distributes the product, the country of origin and day and month of packing, in order to facilitate the traceability or product tracing of the product. A record keeping system should be based on these lot numbers so that individual lots of bivalve molluscs can be traced from the growing area to the end user.

NOTE See also 4.8.

9 Processing of fresh, frozen and minced fish

9.1 General

9.1.1 Annex C provides the application of HACCP principles and additional information for pre-requisite programmes for processing of fresh, frozen and minced fish.

9.1.2 Processing of fresh fish in a MAP product, or minced or frozen fish, is used as the basis for all the other fish processing operations (see 11 to 15).

NOTE See Annex D for the example of the flow diagram which will provide guidance to some of the common steps involved in a fish fillet preparation line.

9.2 Finfish preparation

9.2.1 General

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

9.2.2 Raw, fresh or frozen fish reception (processing step 1)

9.2.2.1 Potential hazards

Potential hazards include, but are not limited to:

a) microbiological pathogens;

b) viable parasites;

c) biotoxins;

d) scombrotoxin;

e) chemicals (including veterinary drug residues); and

f) physical contamination.

9.2.2.2 Potential defects

Potential defects include, but are not limited to:

a) decomposition;

b) parasites; and

c) physical contamination.

9.2.2.3 Technical guidance

Raw, fresh or frozen fish reception should be carried out in the accordance with the following:

a) for raw fish material, product specifications could include the following characteristics:

   1) organoleptic characteristics such as appearance, odour, texture, etc;

   2) chemical indicators of decomposition and or contamination;

   EXAMPLE TVBN, histamine, heavy metals, pesticide residues, nitrates

   3) microbiological criteria, in particular for intermediate raw materials, to prevent the processing of raw material containing microbial toxins;

   4) foreign matter;

   5) physical characteristics such as size of fish; and

   6) species homogeneity;

b) 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;

c) 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 Alimentarius Commission Standard;

d) fish requiring gutting on arrival at the processing facility should be gutted efficiently, without undue delay and with care to avoid contamination (see 9.2.7);

e) 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; and

f) information on the harvesting area.

9.2.3 Sensory evaluation of fish

The best method of assessing the freshness or spoilage of fish is by sensory evaluation techniques as established in CAC/GL 31-1999. It is recommended that appropriate sensory evaluation criteria be used to evaluate the acceptability of fish, and to eliminate fish showing loss of essential quality provisions of the appropriate CODEX Alimentarius Commission standards. Fresh white fish species are considered unacceptable when showing the characteristics stated in Table 1.

Table 1 — Fresh white fish sensory evaluation criteria

Sensory evaluation criteria	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

9.2.4 Chilled storage (processing steps 2 and 14)

9.2.4.1 Potential hazards

Potential hazards include, but are not limited to:

a) microbiological pathogens;

b) biotoxin; and

c) scombrotoxin.

9.2.4.2 Potential defects

Potential defects include, but are not limited to:

a) decomposition; and

b) physical damage.

9.2.4.3 Technical guidance

Chilled storage should be carried out in accordance with the following:

a) fish should be moved to the chill storage facility without undue delay;

b) the facility should be capable of maintaining the temperature of the fish between 0 °C and 4 °C;

c) the chill room should be equipped with a calibrated indicating thermometer. Fitting of a recording thermometer is strongly recommended;

d) stock rotation plans should ensure proper utilisation of the fish;

e) the fish should be stored in shallow layers and surrounded by sufficient finely divided ice or with a mixture of ice and water before processing;

f) fish should be stored such that damage is prevented from over-stacking or over-filling of boxes; and

g) ice supply on the fish should be replenished or the temperature of the room should be altered.

9.2.5 Frozen storage (processing steps 3 and 20)

9.2.5.1 Potential hazards

Potential hazards include, but are not limited to:

a) microbiological pathogens;

b) toxins; and

c) viable parasites.

9.2.5.2 Potential defects

Potential defects include, but are not limited to:

a) dehydration;

b) rancidity; and

c) loss of nutritional quality.

9.2.5.3 Technical guidance

Frozen storage should be carried out in accordance with the following:

a) the facility should be capable of maintaining the temperature of the fish at or colder than -18 °C, and with minimal temperature fluctuations;

b) the store should be equipped with a calibrated indicating thermometer. Fitting of a recording thermometer is strongly recommended;

c) a systematic stock rotation plan should be developed and maintained;

d) product should be glazed and or wrapped to protect from dehydration;

e) 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; and

f) the freezing temperature and monitoring of duration of freezing should be combined with good inventory control to ensure sufficient cold treatment to destroy parasites harmful to human health.

9.2.6 Control thawing (processing step 4)

9.2.6.1 Potential hazards

Potential hazards include, but are not limited to:

a) microbiological pathogens;

b) biotoxin; and

c) scombrotoxin.

9.2.6.2 Potential defects

Potential defects include, but are not limited to, decomposition.

9.2.6.3 Technical guidance

Control thawing should be carried out in the accordance with the following:

a) 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 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;

b) 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;

c) where water is used as the thawing medium, it should be potable and with adequate circulation to provide even thawing;

d) where recycling of water is used, care should be taken to avoid the build up of micro-organisms;

e) during thawing, products should not be exposed to excessively high temperatures;

f) condensation and drip from the fish should be controlled and effectively drained;

g) after thawing, fish should be immediately processed or refrigerated and kept at the adequate temperature; and

h) the thawing schedule should be reviewed as appropriate and amended where necessary.

9.2.7 Washing and gutting (processing steps 6 and 7)

9.2.7.1 Potential hazards

Potential hazards include, but are not limited to:

a) microbiological pathogens;

b) biotoxins; and

c) scombrotoxin.

9.2.7.2 Potential defects

Potential defects include, but are not limited to:

a) presence of viscera;

b) bruising;

c) off-flavours; and

d) cutting faults.

9.2.7.3 Technical guidance

Washing and gutting should be carried out in accordance with the following:

a) gutting is considered complete when the intestinal tract and internal organs have been removed;

b) an adequate supply of clean sea water or potable water should be available for washing:

   1) whole fish to remove foreign debris and reduce bacterial load prior to gutting;

   2) gutted fish to remove blood and viscera from the belly cavity;

   3) surface of fish to remove any loose scales; and

   4) gutting equipment and utensils to minimise build-up of slime, blood and offal;

c) depending on the vessel or processing facility where a prescribed critical limit for staging time and temperature regime has been established the gutted fish should be drained and appropriately chilled for the control of histamine, or defects; and

d) separate and adequate storage facilities should be provided for the fish roe, milt and livers, if these are saved for later utilisation.

9.2.8 Filleting, skinning, trimming and candling (processing steps 8 and 9)

9.2.8.1 Potential hazards

Potential hazards include, but are not limited to:

a) viable parasites;

b) microbiological pathogens;

c) biotoxins;

d) scombrotoxin; and

e) presence of bones.

9.2.8.2 Potential defects

Potential defects include, but are not limited to:

a) parasites;

b) presence of bones;

c) objectionable matter; and

EXAMPLE skin and scales

d) decomposition.

9.2.8.3 Technical guidance

Filleting, skinning, trimming and candling should be carried out in accordance with the following:

a) to minimise time delays, the design of the filleting and candling lines, where applicable, should be continuous and sequential to permit the uniform flow without stoppages or slow-downs and removal of waste.;

b) an adequate supply of clean sea water or potable water should be available for washing:

   1) fish prior to filleting or cutting, especially fish that have been scaled;

   2) fillets after filleting, skinning or trimming to remove any signs of blood, scales or viscera; and

   3) filleting equipment and utensils to minimise build-up of slime, blood and offal;

c) 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 the following CODEX Alimentarius Commission standards CODEX STAN 165-1989, and CODEX STAN 190-1995 or commercial specifications;

d) the candling of skinless fillets, using optimal illumination should be employed in controlling parasites in fresh fish when implicated fish species are being used;

e) the candling table should be frequently cleaned during operation in order to minimise the build-up of microbial activity and the drying of fish residue due to heat generated from the lamp; and

f) 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 appropriately chilled, protected from dehydration and stored in appropriate areas within the processing facility.

9.3 Processing of vacuum or modified atmosphere packed fish

9.3.1 Weighing (processing step 10)

9.3.1.1 Potential hazards

Potential hazards are unlikely.

9.3.1.2 Potential defects

Potential defects include, but are not limited to incorrect net weight.

9.3.1.3 Technical guidance

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

9.3.2 Vacuum or modified atmosphere packaging (processing step 11)

9.3.2.1 Potential hazards

Potential hazards include, but are not limited to:

a) subsequent microbiological pathogens and biotoxins; and

b) physical contamination.

EXAMPLE metal

9.3.2.2 Potential defects

Potential defects include, but are not limited to subsequent decomposition.

9.3.2.3 Technical guidance

9.3.2.3.1 The extent to which the shelf-life of the product can be extended by vacuum or MAP will depend on the species, fat content, initial bacterial load, gas mixture, type of packaging material and the temperature of storage.

9.3.2.3.2 Modified atmosphere packaging should be strictly controlled by:

a) monitoring the gas to product ratio;

b) types and ratio of gas mixtures used;

c) type of film used;

d) type and integrity of the seal;

e) temperature control of product during storage;

f) occurrence of adequate vacuum and package; and

g) fish flesh should be clear of the seam area.

9.2.3.3.3 Packaging material should be inspected prior to use to ensure that it is not damaged or contaminated.

9.3.2.3.4 Packaging integrity of the finished product should be inspected at regular intervals by appropriately trained personnel to verify the effectiveness of the seal and the proper operation of the packaging machine.

9.3.2.3.5 Following sealing, MAP or vacuumed products should be transferred carefully and without undue delay to chilled storage.

9.3.2.3.6 Adequate vacuum should be attained, and the package seals should be intact.

9.3.3 Labelling (processing steps 12 and 18)

9.3.3.1 Potential hazards

Potential hazards are unlikely.

9.3.3.2 Potential defects

Potential defects include, but are not limited to incorrect labelling.

9.3.3.3 Technical guidance

Labelling should be carried out in accordance with the following:

a) prior to their application, labels should be verified to ensure that all information declared meet, where applicable, the latest edition of CRS 5, labelling provisions of the appropriate CODEX Alimentarius Commission Standard for products and or other relevant national legislative requirements; and

b) an appropriate assessment should be carried out to determine the reason(s) for incorrect labelling and the DAP plan should be modified where necessary.

9.3.4 Metal detection (processing steps 13 and 19)

9.3.4.1 Potential hazards

Potential hazards include, but are not limited to, metal contamination.

9.3.4.2 Potential defects

Potential defects are unlikely.

9.3.4.3 Technical guidance

Metal detection should be carried out in accordance with the following:

a) it is important that line speeds are adjusted to allow for the proper functioning of a metal detector;

b) routine procedures should be initiated to ensure product rejected by the detector is investigated as to the cause of the rejection; and

c) metal detectors, if used, should be periodically calibrated with a known standard to ensure roper operation.

9.4 Processing of frozen fish

9.4.1 Freezing Pprocess (processing step 15)

9.4.1.1 Potential hazards

Potential hazards include, but are not limited to, viable parasites.

9.4.1.2 Potential defects

Potential defects include, but are not limited to:

a) texture deterioration;

b) development of rancid odours; and

c) freezer burn.

9.4.1.3 Technical guidance

The freezing process should be carried out in accordance with the following:

a) the fish product should be subjected to a freezing process as quickly as possible to minimize quality deterioration;

b) to ensure that the range of temperature of maximum crystallisation is passed through as quickly as possible, a time and temperature regime for freezing should be established and should take into consideration:

   1) the freezing equipment and capacity;

   2) the nature of the fish product including thermal conductivity, thickness, shape and temperature; and

   3) the volume of production;

c) the thickness, shape and temperature of fish product entering the freezing process should be as uniform as possible;

d) production of the processing facility should be in accordance with the capacity of freezers;

e) frozen product should be moved to the cold storage facility as quickly as possible;

f) the core temperature of the frozen fish should be monitored regularly for completeness of the freezing process;

g) frequent checks should be carried out to ensure correct freezing operations;

h) accurate records of all freezing operations should be kept; and

i) the freezing temperature and monitoring of duration of freezing should be combined with good inventory control to ensure sufficient cold treatment for the destruction of parasites harmful to human health.

9.4.2 Glazing (processing step 16)

9.4.2.1 Potential hazards

Potential hazards include, but are not limited to, microbiological pathogens.

9.4.2.2 Potential defects

Potential defects include, but are not limited to:

a) subsequent dehydration; and

b) incorrect net weight.

9.4.2.3 Technical guidance

Glazing should be carried out in accordance with the following:

a) 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 or freezer-burn can occur;

b) where additives are used in the water for glazing, care should be taken to ensure its proper proportion and application with product specifications;

c) the weight of the glaze should be excluded from the net weight indicated on the label;

d) where spray nozzles are used for glazing, they should be monitored to prevent blockage; and

e) 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.

9.5 Processing of minced fish

9.5.1 Mincing fish using mechanical separation process (processing step 21)

9.5.1.1 Potential hazards

Potential hazards include, but are not limited to:

a) microbiological pathogens;

b) biotoxins and scombrotoxin; and

c) physical contamination.

EXAMPLE Metal, bones and rubber from separator belt

9.5.1.2 Potential defects

Potential defects include, but are not limited to:

a) incorrect separation;

EXAMPLE objectionable matter

b) decomposition;

c) presence of defective bones; and

d) parasites.

9.5.1.3 Technical guidance

Candling is recommended for fish suspected of high infestation with parasites prior to the mincing of fish using mechanical separation. The process of mincing of fish using mechanical separation should be carried out in the accordance with the following:

a) the separator should be fed continuously but not excessively;

b) split fish or fillets should be fed to the separator so that the cut surface contacts the perforated surface;

c) fish should be fed to the separator in a size that it is able to handle;

d) 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.

e) 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;

f) the separated residual material should be carefully removed on a continuous or near-continuous basis to the next processing stage; and

g) temperature monitoring should ensure undue temperature rises of the product are avoided.

9.5.2 Washing of minced fish (processing step 22)

9.5.2.1 Potential hazards

Potential hazards include, but are not limited to:

a) microbiological pathogens; and

b) scombrotoxin.

9.5.2.2 Potential defects

Potential defects include, but are not limited to:

a) poor colour;

b) poor texture; and

c) excess of water.

9.5.2.3 Technical guidance

Washing of minced fish should be carried out in accordance with the following:

a) the minced fish should be washed, if necessary, and should be adequate for the type of product desired;

b) 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 fish which will reduce the yield due to the formation of fines;

c) the washed minced fish may be partially de-watered by the use of rotary sieves or centrifugal equipment;

d) the process is completed by pressing the minced fish to appropriate moisture content and if necessary, and depending on the eventual end-use, should be either strained or emulsified

e) special attention should be taken to ensure that the minced fish being strained is kept cool; and

f) the resulting waste water should be disposed of in a suitable manner.

9.5.3 Blending and application of additives and ingredients to minced fish (processing steps 23 and 24)

9.5.3.1 Potential hazards

Potential hazards include, but are not limited to:

a) physical contamination; and

b) non-approved additives and or ingredients.

9.5.3.2 Potential defects

Potential defects include, but are not limited to:

a) physical contamination; and

b) incorrect addition of additives.

9.5.3.3 Technical guidance

The blending and application of additives and ingredients to minced fish should be carried out in accordance with the following:

a) where fish, ingredients and or additives are to be used, they should be blended in the proper proportions to achieve the desired sensory quality;

b) additives should comply with the requirements of the CODEX Alimentarius Commission Standard CODEX STAN 192-1995; and

c) 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.

9.5.4 Wrapping and packing (processing steps 17 and 25)

9.5.4.1 Potential hazards

Potential hazards include, but are not limited to, microbiological pathogens.

9.5.4.2 Potential defects

Potential defects include, but are not limited to:

a) subsequent dehydration; and

b) decomposition.

9.5.4.3 Technical guidance

Wrapping and packing should be carried out in accordance with the following:

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

b) the packaging operation should be conducted to minimise the risk of contamination and decomposition; and

c) products should meet appropriate labelling standards.

9.6 Packaging, labels and ingredients

9.6.1 Reception of packaging, labels and ingredients (processing steps 26 and 28)

9.6.1.1 Potential hazards

Potential hazards include, but are not limited to:

a) microbiological pathogens; and

b) chemical and physical contamination.

9.6.1.2 Potential defects

Potential defects include, but are not limited to incorrect description.

9.6.1.3 Technical guidance

Reception of packaging, labels and ingredients should be carried out in accordance with the following:

a) only ingredients, packaging material and labels complying with the processors' specification should be accepted into the processing facility;

b) 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 national competent authority; and

c) ingredients and packaging material not approved by the competent authority should be investigated and refused at reception.

9.6.2 Storage of packaging, labels and ingredients (processing steps 27 and 29)

9.6.2.1 Potential hazards

Potential hazards include, but are not limited to:

a) microbiological pathogens; and

b) chemical and physical contamination.

9.6.2.2 Potential defects

Potential defects include, but are not limited to, loss of quality characteristics of packaging materials or ingredients.

9.6.2.3 Technical guidance

Storage of packaging, labels and ingredients should be carried out in accordance with the following:

a) ingredients and packaging should be stored at an appropriate temperature and humidity;

b) a systematic stock rotation plan should be developed and maintained to avoid use of expired materials;

c) ingredients and packaging should be properly protected and segregated to prevent cross-contamination; and

d) defective ingredients and packaging should not be used.

10 Processing of frozen surimi

10.1 General

10.1.1 Annex C provides the application of HACCP principles and additional information for pre-requisite programmes for processing of frozen surimi.

10.1.2 Annex D provides an example of a flow chart for a frozen surimi production process.

10.2 General considerations of hazards and defects for frozen surimi production

10.2.1 Hazards

10.2.1.1 Many of the potential food safety hazards should be controlled during processing. Pathogenic bacteria such as *Listeria monocytogenes* and toxin formers such as *Clostridium botulinum* should be controlled during the cooking or pasteurising steps of final processing. *Staphylococcus aureus* contamination that produces heat-stable enterotoxins should be adequately controlled by the pre-requisite programme.

NOTE *Clostridium botulinum* becomes a hazard as a result of modified atmosphere packaging of the end product.

10.2.1.2 If scombrotoxin-forming fish that may accumulate ciguatera toxin are utilised for surimi, appropriate controls for this hazard should be developed.

10.2.1.3 Appropriate controls should be instituted to ensure that metal fragments such as bearings, bolts, washers, and nuts are excluded or eliminated in the end product.

10.2.2 Defects

10.2.2.1 Colour, moisture content, pH or gel strength are quality attributes of frozen surimi that are important for the successful manufacture of surimi-based products.

10.2.2.2 Species used that are known to contain *Myxosporidia*, a protease inhibitor, may be needed as an additive to attain the necessary gel strength capabilities.

10.2.2.3 Decomposed fish should not be used as raw material for frozen surimi production.

10.2.2.4 The washing and de-watering cycle should be sufficient to prevent water-soluble proteins remaining in the product as this may negatively affect the gel forming ability and the long term frozen storage shelf life.

10.2.2.5 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.

10.2.2.6 The use of additives to surimi should be in accordance with appropriate regulations and manufacturer's recommendations.

10.2.2.7 **C**old water marine fish should not be subjected to temperatures above 10 °C during processing to prevent protein denaturation.

10.3 Fish preparation (processing steps 1 to 8)

10.3.1 General

See 9.2, steps 1 through 8 for information regarding preparation of fish for processing. For frozen surimi processing, consideration should be given to the steps outlined in the following sub-clauses.

10.3.2 Raw, fresh and frozen fish reception (processing step 1)

10.3.2.1 Potential hazards

Potential hazards are unlikely when using marine ground fish as the raw material.

10.3.2.2 Potential defects

Potential defects include, but are not limited to:

a) decomposition; and

b) protein denaturation.

10.3.2.3 Technical guidance

Raw, fresh and frozen fish reception should be carried out in accordance with the following:

a) harvested fish intended for frozen surimi processing should preferably be kept at 4 °C or below;

b) the acceptable period after harvest should be as follows:

   1) round; within 14 days of harvest, when stored at 4 °C or below; or

   2) dressed; within 24 hours after dressing, when stored at 4 °C or below;

c) the following should be properly recorded and identified:

   1) date;

   2) time of harvesting;

   3) origin; and

   4) harvester or vendor of products received;

d) presence of decomposition in raw product should not be allowed, as it will negatively affect the gel strength capability of the end product;

e) fish flesh that is used for frozen surimi processing should be adequate for gel strength capability indicated by appropriate pH; and

EXAMPLE An aggregate flesh for Alaska Pollock (*Theragra chalcogramma*) should have pH of 7.0 ± 0.5

f) fish that is crushed and suffocated during harvesting should be removed from the line in order to avoid a negative effect to gel forming ability.

10.3.3 Chilled storage (processing step 2)

10.3.3.1 Potential hazards

Potential hazards are unlikely.

10.3.3.2 Potential defects

Potential defects include, but are not limited to protein denaturation.

10.3.3.3 Technical guidance

Chilled storage should be carried out in accordance with the following:

a) chilled storage at the processing facility should be minimised with prompt processing in order to minimise protein denaturation and loss of gel strength capability; and

b) raw fish should be stored at 4 °C or below and the dates of harvesting and the time of receipt of the fish should identify the lot of fish used for processing.

10.3.4 Washing and scaling (processing step 6)

10.3.4.1 Potential hazards

Potential hazards are unlikely.

10.3.4.2 Potential defects

Potential defects include, but are not limited to:

a) protein denaturation;

b) colour; and

c) objectionable matter.

10.3.4.3 Technical guidance

The epidermis, 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.

10.3.5 Washing (processing step 8)

10.3.5.1 Potential hazards

Potential hazards are unlikely.

10.3.5.2 Potential defects

Potential defects include, but are not limited to:

a) impurities; and

b) extraneous materials.

10.3.5.3 Technical guidance

Headed and gutted fish should be re-washed so as to lessen the level of impurities and extraneous material that can negatively affect the gel strength capability and colour of the end product.

10.4 Fish flesh separation process (processing step 9)

10.4.1 Potential hazards

Potential hazards include, but are not limited to metal fragments.

10.4.2 Potential defects

Potential defects include, but are not limited to impurities.

10.4.3 Technical guidance

Fish flesh separation should be carried out in accordance with the following:

a) metal detection equipment that is capable of sensing product that has become contaminated with metal fragments, should be installed at the most appropriate place in the process;

b) procedures should be established to ensure that chemical contamination of the product is not likely; and

c) separated minced fish 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.

10.5 Washing and de-watering process (processing step 10)

10.5.1 Potential hazards

Potential hazards include, but are not limited to pathogenic microbial growth.

10.5.2 Potential defects

Potential defects include, but are not limited to:

a) decomposition;

b) protein denaturation; and

c) residual water-soluble protein.

10.5.3 Technical guidance

Washing and de-watering should be carried out in accordance with the following:

a) 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;

b) 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.

c) product should be processed promptly to minimise possible pathogenic microbial growth;

d) minced fish should be spread uniformly in the water to ensure dilution of the water-soluble components and effect proper separation from the myofibrillar protein;

e) 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.;

f) a sufficient amount of potable water should be available for washing;

g) the pH of wash water should be near 7.0. Wash water should have a total hardness of 100 mg/kg or below in terms of converted Calcium Carbonate ($CaCO_3$);

h) salt or other de-watering aids with less than 0.3 % salt can be added in the final stage of washing to enhance dehydration efficiency;

i) food additives should be used in accordance with national regulations and manufacturer's instructions, if included in this process;

j) wastewater should be disposed of in a suitable manner; and

k) wash water should not be recycled unless there are appropriate controls on its microbial quality.

10.6 Refining process (processing step 11)

10.6.1 Potential hazards

Potential hazards include, but are not limited to:

a) pathogenic microbial growth; and

b) metal fragments.

10.6.2 Potential defects

Potential defects include, but are not limited to:

a) objectionable matter; and

b) protein denaturation.

10.6.3 Technical guidance

The refining process should be carried out in accordance with the following:

a) temperature of the minced fish flesh in the refining process should be adequately controlled to prevent the growth of pathogenic bacteria;

b) temperature of minced fish flesh should not exceed 10 °C in the refining process;

c) product should be processed promptly to minimise possible pathogenic microbial growth;

d) metal detection equipment that is capable of sensing product that has become contaminated with metal fragments, should be installed at the most appropriate place in the process;

e) 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;

f) equipment should be properly adjusted to effect efficient product throughput; and

g) refined product should not be allowed to accumulate on sieve screens for long periods of time.

10.7 Final de-watering process (processing step 12)

10.7.1 Potential hazards

Potential hazards include, but are not limited to, pathogenic microbial growth.

10.7.2 Potential defects

Potential defects include, but are not limited to:

a) decomposition; and

b) protein denaturation.

10.7.3 Technical guidance

The process of final de-watering should be carried out in accordance with the following:

a) temperature of the refined fish flesh in the final de-watering process should be adequately controlled to prevent the growth of pathogenic bacteria;

b) temperature of refined fish flesh should not exceed 10 °C for cold water fish species. For Pacific Whiting the temperature should not exceed 5 °C.

NOTE Some warm water species may be processed at temperatures up to 15 °C.

c) product should be processed promptly to minimise possible pathogenic microbial growth;

d) the moisture level of refined product should be controlled to specified levels with appropriate de-watering equipment.; and

e) consideration should be given to variations in moisture levels due to the age, condition or method of capture of the raw fish. In some cases dehydration should be performed before refining.

10.8 Mixing and addition of adjuvant ingredients process (processing step 13)

10.8.1 Potential hazards

Potential hazards include, but are not limited to:

a) pathogenic microbial growth; and

b) metal fragments.

10.8.2 Potential defects

Potential defects include, but are not limited to:

a) improper use of food additives; and

b) protein denaturation.

10.8.3 Technical guidance

The process of mixing and addition of adjuvant ingredients should be carried out in accordance with the following:

a) temperature of the product in the mixing process should be adequately controlled to avoid the growth of pathogenic bacterial;

b) temperature of dehydrated fish flesh during mixing should not exceed 10 °C for cold water fish species. For Pacific Whiting the temperature should not exceed 5 °C;

NOTE Some warm water species may be processed at temperatures up to 15 °C.

c) product should be processed promptly to minimise possible pathogenic microbial growth;

d) metal detection equipment that is capable of sensing product that has become contaminated with metal fragments, should be installed at the most appropriate place in the process to eliminate this hazard;

e) food additives should comply with CODEX Alimentarius Commission Standard CODEX STAN 192-1995;

f) food additives should be mixed homogeneously;

g) cryoprotectants should be used in frozen surimi. Sugars and or polyhydric alcohols are commonly used to prevent protein denaturation in the frozen state; and

h) food grade enzyme inhibitors should be used for species that exhibit high levels of proteolytic enzyme activity which reduces the gel forming ability of surimi. The use of protein plasma as an enzyme inhibitor should be appropriately labelled.

10.9 Packaging and weighing (processing step 14)

10.9.1 Potential hazards

Potential hazards include, but are not limited to, pathogenic microbial growth.

10.9.2 Potential defects

Potential defects include, but are not limited to:

a) foreign matter;

b) incorrect net weight;

c) incomplete packaging; and

d) protein denaturation.

10.9.3 Technical guidance

Packaging and weighing should be carried out in accordance with the following:

a) temperature of the product should be adequately controlled during packaging to avoid the growth of pathogenic bacteria;

b) product should be packaged promptly to minimise possible pathogenic microbial growth;

c) the packaging operation should have established procedures that minimise possible cross-contamination;

d) product should be packaged in clean plastic bags or containers, and properly stored;

e) product should be appropriately shaped;

f) packaging should be conducted quickly to minimise the risk of contamination or decomposition;

g) packaged products should not contain voids; and

h) the product should meet appropriate requirements for net weight.

NOTE See also 9.3.1 and 9.5.4.

10.10 Freezing operation (processing step 15)

10.10.1 Potential hazards

Potential hazards are unlikely.

10.10.2 Potential defects

Potential defects include, but are not limited to:

a) protein denaturation; and

b) decomposition.

10.10.3 Technical guidance

The freezing operation should be carried out in accordance with the following:

a) after packaging and weighing, the product should be promptly frozen to maintain its quality; and

b) procedures should be established that specify maximum time limits from packaging to freezing.

NOTE See 9.4.1 for general considerations for freezing fish and fishery products.

10.11 Dismantling freezing pan (processing step 16)

10.11.1 Potential hazards

Potential hazards are unlikely.

10.11.2 Potential defects

Potential defects include, but are not limited to, damage to plastic bag and product.

10.11.3 Technical guidance

Care should be taken to avoid damage to plastic bag and the product in order to avoid deep dehydration during long-term cold storage.

10.12 Metal detection (processing step 17)

10.12.1 Potential hazards

Potential hazards include, but are not limited to metal fragments.

10.12.2 Potential defects

Potential defects are unlikely.

10.12.3 Technical guidance

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

NOTE See 9.3.4 for general information.

10.13 Boxing and labelling (processing step 18)

10.13.1 Potential hazards

Potential hazards are unlikely.

10.13.2 Potential defects

Potential defects include, but are not limited to:

a) incorrect labels; and

b) damage to packaging.

10.13.3 Technical guidance

Boxing and labelling should be carried out in accordance with the following:

a) boxing should be clean, durable and suitable for the intended use;

b) the boxing operation should be conducted to avoid damage to packaging materials; and

c) product in damaged boxing should be re-boxed so that it is properly protected.

NOTE See 9.3.3 and 9.5.4.

10.14 Frozen storage (processing step 19)

10.14.1 Potential hazards

Potential hazards are unlikely.

10.14.2 Potential defects

Potential defects include, but are not limited to:

a) decomposition; and

b) protein denaturation.

10.14.3 Technical guidance

Frozen storage should be carried out in accordance with the following:

a) frozen surimi should be stored at -20 °C or colder;

b) stored frozen-product should have adequate air-circulation to ensure that it remains properly frozen; and

c) product should not be stored directly on the floor of the freezer.

10.15 Raw material reception - packaging and ingredients (processing steps 21 and 22)

See 9.6.1 for the packaging and ingredient requirements for raw material reception.

10.16 Raw material storage - packaging and ingredients (processing steps 23 and 24)

See 9.6.2 for the packaging and ingredient requirements for raw material storage.

11 Processing of quick-frozen coated fish and shellfish products

11.1 General

11.1.1 Annex C provides the application of HACCP principles and additional information for pre-requisite programmes.

11.1.2 Annex D provides an example of a flow chart for the processing of coated fish products.

11.2 Identification of hazards and defects

Annex C.3.4 provides additional identification of hazards and defects specific to quick-frozen coated fish and shellfish., aside from those described in this section.

11.2.1 Potential hazards

Potential hazards include, but are not limited to:

a) possible growth and toxins production of *Staphylococcus aureus;* and

b) possible growth and toxins production of *Bacillus cereus.*

NOTE See also C.3.4.2

11.2.2 Potential defects

Potential defects are outlined in the essential quality, labelling and composition requirements described in the relevant CODEX Alimentarius Commission Standard CODEX STAN 166-1989.

11.3 Technical guidance

General addition to pre-requisite programme should be carried out in accordance with the following:

a) conveyor systems used to transport fish should be designed and constructed to prevent damage to and contamination of the products;

b) 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;

c) where continuous processing is employed, an adequate number of processing lines should be available to avoid interruptions and batch-wise processing. intermediate products should be stored under deep-frozen conditions where the process has to be interrupted;

d) pre-frying baths and freezing cabinets used for re-freezing should be equipped with permanent temperature and belt speed control devices;

e) the proportion of sawdust should be minimised by using appropriate sawing equipment and

f) sawdust should be:

1) kept well separated from fish cores used for coated products;

2) temperature controlled;

3) kept at ambient temperature for very short periods, only; and

4) stored in frozen state prior to further processing into suitable products.

11.4 Processing operations - fish

11.4.1 Reception

11.4.1.1 Fish

11.4.1.1.1 Potential hazards

Potential hazards include, but are not limited to:

a) chemical and biochemical contamination; and

b) histamine.

11.4.1.1.2 Potential defects

Potential defects include, but are not limited to:

a) tainting;

b) block irregularities;

c) water and air pockets;

d) packaging material;

e) foreign matter;

f) parasites;

g) dehydration; and

h) decomposition.

11.4.1.1.3 Technical guidance

Reception of fish should be carried out in accordance with the following:

a) temperatures of all incoming lots should be recorded;

b) packaging material of frozen products should be examined for dirt, tearing and evidence of thawing;

c) cleanliness and suitability of the transport vehicle to carry frozen fish products should be examined;

d) use of temperature recording devices with the shipment is recommended; and

e) representative samples should be taken and examined for possible hazards and defects.

11.4.1.2 Other ingredients

11.4.1.2.1 Potential hazards

Potential hazards include, but are not limited to chemical, biochemical and microbiological contamination.

11.4.1.2.2 Potential defects

Potential defects include, but are not limited to:

a) mould;

b) colour deviations;

c) filth; and

d) sand.

11.4.1.2.3 Technical guidance

Reception of other ingredients should be carried out in accordance with the following:

a) 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;

b) cleanliness and suitability of the transport vehicle to carry food products should be examined and ingredients should be shipped only on transportation vehicles that are suitable for handling food products and ingredients;

c) vehicles that have previously hauled potentially unsafe or hazardous material should not be used for hauling food products or ingredients; and

d) 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.

11.4.1.3 Packaging materials

11.4.1.3.1 Potential hazards

Potential hazards include, but are not limited to, foreign matter.

11.4.1.3.2 Potential defects

Potential defects include, but are not limited to, tainting of products.

11.4.1.3.3 Technical guidance

Packaging material should be in accordance with the following:

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

b) for pre-fried products, it should be impermeable to fat and oil;

c) cleanliness and suitability of the transport vehicle to carry food packaging material should be examined; and

d) pre-printed labelling and packaging material should be examined for accuracy.

11.4.2 Storage of raw material, other ingredients and packaging material

11.4.2.1 Fish (frozen storage)

For details on frozen storage of fish, refer to 9.2.5.

11.4.2.2 Fish (chilled storage)

For details on chilled storage of fish, refer to 9.2.4.

11.4.2.3 Other ingredients and packaging materials

11.4.2.3.1 Potential hazards

Potential hazards include, but are not limited to biological, physical and chemical contamination.

11.4.2.3.2 Potential defects

Potential defects include, but are not limited to:

a) loss of quality and characteristics of ingredients; and

b) rancidity.

11.4.2.3.3 Technical guidance

Storage of raw material, other ingredients and packaging material should be carried out in accordance with the following:

a) other ingredients and packaging material should be stored in a dry and clean place under hygienic conditions;

b) other ingredients and packaging material should be stored appropriately in terms of temperature and humidity;

c) a systematic stock rotation plan should be developed and maintained to avoid out of date materials;

d) ingredients should be protected from insects, rodents and other pests; and

e) defective ingredients and packaging material should not be used.

11.4.3 Frozen fish block or fillet tempering

11.4.3.1 Potential hazards

Potential hazards are unlikely.

11.4.3.2 Potential defects

Potential defects include, but are not limited to incorrect dimension due to sawing of over-softened fish flesh for fish sticks.

11.4.3.3 Technical guidance

Frozen fish block or fillet tempering should be carried out in accordance with the following:

a) depending on the use of the fish, the tempering of frozen fish blocks/fillets should be carried out in a manner which will allow the temperature of the fish to rise without thawing;

b) tempering block or fillets of frozen fish in chilled storage usually requires at least 12 h or more;

c) microwave tempering is an alternate method but should also be controlled to prevent softening of outer layers; and

d) over-softening of the outer layers is undesirable and should be avoided by:

   1) maintaining facilities used for tempering at a temperature of 0 °C to 4 °C; and

   2) stacking fish blocks or fillets in layers.

11.4.4 Unwrapping, unpacking

11.4.4.1 Potential hazards

Potential hazards include, but are not limited to microbiological contamination.

11.4.4.2 Potential defects

Potential defects include, but are not limited to:

a) remaining undetected packaging material; and

b) contamination by filth.

11.4.4.3 Technical guidance

Unwrapping and unpacking should be carried out in accordance with the following:

a) care should be taken not to contaminate the fish during unwrapping and unpacking of fish blocks;

b) special attention has to be given to cardboard and or plastic material partly or fully embedded in the blocks;

c) all packaging material should be disposed of properly and promptly;

d) wrapped, unwrapped and unpacked fish blocks should be protected when cleaning and sanitizing processing lines during breaks and between shifts where the production process is interrupted.

11.4.5 Production of fish core

11.4.5.1 Sawing

11.4.5.1.1 Potential hazards

Potential hazards include, but are not limited to foreign material.

EXAMPLE metal or plastic parts of saws

11.4.5.1.2 Potential defects

Potential defects include, but are not limited to irregularly shaped pieces or portions.

11.4.5.1.3 Technical guidance

Production of fish core should be carried out in accordance with the following:

a) sawing instruments should be kept in clean and hygienic condition;

b) saw-blades should be inspected regularly, to avoid conditions that result in tearing and breakage of the product;

c) saw dust should not be allowed to collect on the saw-table and must be collected in special containers if used for further processing; and

d) sawn shims used to form irregularly shaped fish cores, by mechanical pressure, should be kept in clean, hygienic condition until further manufacturing.

11.4.5.2 Application of additives and ingredients

11.4.5.2.1 Potential hazards

Potential hazards include, but are not limited to:

a) foreign material; and

b) microbiological contamination.

11.4.5.2.2 Potential defects

Potential defects include, but are not limited to incorrect addition of additives.

11.4.5.2.3 Technical guidance

The temperature of the product in the mixing process should be adequately controlled to avoid the growth of pathogenic bacteria.

NOTE See also 9.5.3.

11.4.5.3 Forming

11.4.5.3.1 Potential hazards

Potential defects include, but are not limited to:

a) foreign material; and

b) microbiological contamination.

11.4.5.3.2 Potential defects

Potential defects include, but are not limited to:

a) poorly formed fish cores; and

b) cores subject to too much pressure.

11.4.5.3.3 Technical guidance

Forming should be carried out in accordance with the following:

a) forming machines should be kept in hygienic conditions; and

b) formed fish cores should be examined closely for proper shape, weight and texture.

11.4.6 Separation of pieces

11.4.6.1 Potential hazards

Potential hazards are unlikely.

11.4.6.2 Potential defects

Potential defects include, but are not limited to adhering pieces or portions.

11.4.6.3 Technical guidance

Separation of pieces should be carried out in accordance with the following:

a) the fish flesh cores, cut from the blocks or fish fillets or other irregular shaped, quick-frozen fish material should be separated from each other;

b) 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;

c) cored fish should be monitored for foreign material and other hazards and defects before coating; and

d) mis-shaped, broken, or out of specification pieces should be removed from production.

11.4.7 Coating

11.4.7.1 Wet coating

11.4.7.1.1 Potential hazards

Potential hazards include, but are not limited to microbiological contamination.

11.4.7.1.2 Potential defects

Potential defects include, but are not limited to insufficient or excessive cover of coating.

11.4.7.1.3 Technical guidance

Wet coating should be carried out in accordance with the following:

a) fish pieces should be well coated from all sides;

b) surplus liquid which is to be reused should be re-transported under clean and hygienic conditions;

c) surplus liquid on fish pieces should be removed by clean air;

d) viscosity and temperature of hydrated batter mixes should be monitored and controlled within industry parameters to effect the proper amount of breading pick-up; and

e) appropriate measures should be adopted to avoid microbiological contamination of the hydrated batter.

EXAMPLE temperature control, dumping liquid contents, regular or scheduled clean-ups and or sanitation during the manufacturing shift

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

11.4.7.2 Dry coating

11.4.7.2.1 Potential hazards

Potential hazards include, but are not limited to microbiological contamination.

11.4.7.2.2 Potential defects

Potential defects include, but are not limited to insufficient or excessive cover of coating.

11.4.7.2.3 Technical guidance

Dry coating should be carried out in accordance with the following:

a) dry coating should cover the whole product and should stick well on the wet coating;

b) surplus coating should be removed by blowing away with clean air and or by vibration of conveyors, in a clean and hygienic manner;

c) flow of breading from the application hopper should be free, even and continuous;

d) coating defects should be monitored and be in accordance to CODEX Alimentarius Commission Standard CODEX STAN 166-1989; and

e) the proportion of breading and fish core should be in accordance to CODEX Alimentarius Commission Standard CODEX STAN 166-1989.

11.4.8 Pre-frying

There are some variations in industrial production for the frying process, in so far, that quick-frozen coated products are completely fried, 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 coated fish products.

11.4.8.1 Potential hazards

Potential hazards are unlikely.

11.4.8.2 Potential defects

Potential defects include, but are not limited to:

a) over-oxidised oil;

b) insufficient frying;

c) loosely adhering coating; and

d) burnt pieces and portions.

11.4.8.3 Technical guidance

Pre-frying should be carried out in accordance with the following:

a) oil used for frying should have a temperature between approximately 160 °C and 195 °C.

b) coated fish pieces should remain in frying oil for sufficient time, depending on the frying temperature, to get a satisfying colour, flavour, and structure to adhere firmly to the fish core, but core should be kept frozen throughout the whole process;

c) oil used for frying should be replaced when colour becomes too dark or when concentration of fat degradation products exceeds stated limits;

d) remains from coating, which settle at the bottom of the frying bath, should be removed regularly; and

e) excessive oil should be removed from coated products after pre-frying by a suitable device.

11.4.9 Re-freezing

11.4.9.1 Potential hazards

Potential hazards include, but are not limited to foreign material.

11.4.9.2 Potential defects

Potential defects include, but are not limited to:

a) fish pieces sticking together; and

b) fish pieces sticking to walls of freezing equipment.

11.4.9.3 Technical guidance

Re-freezing should be carried out in accordance with the following:

a) re-freezing to -18 °C or lower of the whole product should take place immediately after pre-frying;

b) products should be allowed to remain for sufficient time in the freezer cabinet to ensure a core temperature of products of -18 °C or lower; and

c) cryogenic freezers should have sufficient compressed gas flow to effect proper freezing of the product.

11.4.10 Packaging and labelling

11.4.10.1 Potential hazards

Potential hazards include, but are not limited to microbiological contamination.

11.4.10.2 Potential defects

Potential defects include, but are not limited to:

a) under-packing or over-packing;

b) improperly sealed containers; and

c) wrong or misleading labelling.

11.4.10.3 Technical guidance

Packaging and labelling should be carried out in accordance with the following:

a) packaging should be made without delay after refreezing under clean and hygienic conditions. Where packaging is made later, re-frozen products should be kept under deep frozen conditions;

b) packages should be checked regularly by weight control and end products should be checked by a metal detector and or other detection methods where applicable;

c) packaging of cartons or plastic bags to master shipping containers should be done without delay and under hygienic conditions; and

d) both consumer packages and shipping containers should be appropriately lot coded for product tracing in the event of a product recall.

NOTE See 9.3.3, 9.5.4 and 9.3.1.

11.4.11 Storage of end products

11.4.11.1 Potential hazards

Potential hazards are unlikely.

11.4.11.2 Potential defects

Potential defects include, but are not limited to:

a) texture and flavour deviations due to fluctuations in temperature;

b) deep freezer burn;

c) cold store flavour; and

d) cardboard flavour.

11.4.11.3 Technical guidance

Storage of end products should be carried out in accordance with the following:

a) all end products should be stored at frozen temperature in a clean, sound and hygienic environment;

b) storage temperature fluctuation should not exceed ± 3 °C;

c) excessive storage time, on fat content of species used and type of coating, should be avoided;

d) products should be properly protected from dehydration, dirt and other forms of contamination; and

e) all end products should be stored in a freezer allowing for proper air circulation.

NOTE See 9.2.5.

11.4.12 Transport of end product

11.4.12.1 Potential hazards

Potential hazards are unlikely.

11.4.12.2 Potential defects

Potential defects include, but are not limited to thawing of frozen product.

11.4.12.3 Technical guidance

11.4.12.3.1 During all transportation steps, deep-frozen conditions should be maintained at -18 °C with maximum fluctuation of ± 3 °C until final destination of product is reached.

11.4.12.3.2 Cleanliness and suitability of the transport vehicle to carry frozen food products should be examined.

11.4.12.3.3 Use of temperature recording devices with the shipment is recommended.

NOTE See also 4.7 and 16.

11.5 Processing operations of molluscan shellfish

11.5.1 General

11.5.1.1 Coated molluscan shellfish should be manufactured from safe and wholesome molluscs.

11.5.1.2 Molluscan shellfish should be subject to regulation and controls of a competent authority that ensures safety for consumption.

11.5.1.3 Shellfish can be cooked or be raw prior to the coating process and should not contain significant defects.

EXAMPLE Significant defects include sand, cuts, parasites or discoloration

NOTE 1 Annex C provides the application of HACCP principles and additional information for pre-requisite programmes.

NOTE 2 Annex D provides an example of a flow chart for coated molluscan shellfish processing.

11.5.2 Reception

All incoming raw materials should be subject to an examination for food safety hazards and defects based on the appropriate CODEX Alimentarius Commission Standard CODEX STAN 234-1999.

11.5.2.1 Molluscan shellfish

11.5.2.1.1 Potential hazards

Potential hazards include, but are not limited to:

a) chemical and microbiological contamination; and

b) biotoxins.

11.5.2.1.2 Potential defects

Potential defects include, but are not limited to:

a) decomposition;

b) oxidation;

c) freezer-burn;

d) parasites;

e) torn or damaged molluscs;

f) packaging material; and

g) shells or pieces of shell.

11.5.2.1.3 Technical guidance

Molluscan shellfish should be processed in accordance with the following:

a) molluscan shellfish should be obtained from sources that are approved by a competent authority to ensure that marine biotoxins are properly controlled and that the product is handled and processed in accordance with hygienic standards and proper process controls, to manage food safety hazards;

b) the temperatures of all incoming lots should be recorded. Frozen product should be -18 °C or lower. Fresh product should not exceed 4 °C;

c) packaging material of frozen products should be examined for dirt, tearing and evidence of thawing;

d) cleanliness and suitability of the transport vehicle to carry fresh and frozen molluscan shellfish products should be examined for each incoming shipment; and

NOTE The use of temperature recording devices with the shipment is recommended.

e) representative samples should be taken to assess the level of possible hazards and defects.

NOTE See also 8.

11.5.2.2 Other ingredients

For details on other ingredients of molluscan shellfish, refer to 11.4.1.2.

11.5.2.3 Packaging materials

For details on packaging materials for molluscan shellfish, refer to 11.4.1.3.

11.5.3 Storage of raw material, other ingredients and packaging materials

11.5.3.1 Molluscan shellfish (frozen storage)

For details on frozen storage of molluscan shellfish, refer to 11.4.2.1.

11.5.3.2 Other ingredients and packaging materials

For details on other ingredients and packaging materials of molluscan shellfish, refer to 11.4.2.3.

11.5.3.3 Molluscan shellfish (refrigerated storage)

11.5.3.3.1 Potential hazards

Potential hazards include, but are not limited to:

a) physical and chemical contamination; and

b) microbiological growth.

11.5.3.3.2 Potential defects

Potential defects include, but are not limited to decomposition.

11.5.3.3.3 Technical guidance

Refrigerated storage of molluscan shellfish should be carried out in accordance with the following:

a) raw fresh molluscan shellfish should be stored between 0 ºC and 4 °C; and

b) raw fresh molluscan shellfish should be properly protected from contamination.

NOTE See 8.6.6.

11.5.4 Unpacking and unwrapping

For details on unpacking and wrapping of molluscan shellfish in refrigerated storage, refer to 11.4.4.

11.5.5 Production of coated molluscan shellfish

11.5.5.1 Thawing frozen product

11.5.5.1.1 Potential hazards

Potential hazards include, but are not limited to microbiological growth.

11.5.5.1.2 Potential defects

Potential defects include, but are not limited to:

a) decomposition; and

b) product damage.

11.5.5.1.3 Technical guidance

Thawing of frozen, coated molluscan shellfish should be carried out in accordance with the following:

a) frozen molluscan shellfish should be kept below 4 °C during the thawing process, to prevent the growth of pathogenic and spoilage bacteria;

b) controls should be instituted to ensure that the thawing product is not subject to unhygienic or unsanitary conditions; and

c) care should be taken to ensure that the raw thawed product is not subjected to conditions that cause tearing and breakage of the product.

11.5.5.2 Deglazing

11.5.5.2.1 Potential hazards

Potential hazards include, but are not limited to contamination from dirty deglazing water.

11.5.5.2.2 Potential defects

Potential defects include, but are not limited to:

a) thawing of product; and

b) contamination from dirty deglazing water.

11.5.5.2.3 Technical guidance

Deglazing should be carried out in accordance with the following:

a) controls should be instituted to ensure that individual frozen molluscan shellfish does not thaw during immersion to remove ice glaze; and

b) thaw immersion-water should be replaced at adequate intervals to ensure that the product is not subject to dirt and other contaminants.

11.5.5.3 Separation of individual molluscan shellfish

For details on separation of individual molluscan shellfish for deglazing, refer to 11.4.6.

11.5.6 Coating

For details on coating molluscan shellfish, refer to 11.4.7.

11.5.6.1 Wet coating

For details on wet coating molluscan shellfish, refer to 11.4.7.1.

11.5.6.2 Dry coating

For details on dry coating molluscan shellfish, refer to 11.4.7.2.

11.5.7 Pre-frying

For details on pre-frying molluscan shellfish, refer to 11.4.8.

11.5.8 Re-Freezing – Final freezing

For details on re-freezing – final freezing molluscan shellfish, refer to 11.4.9.

11.5.9 Packing and labelling

For details on the packing and labelling of molluscan shellfish, refer to 11.4.10.

11.5.10 Storage of end product

For details on the storage of the end product for molluscan shellfish, refer to 11.4.11.

11.5.11 Transport of end product

For details on transport of the end product for molluscan shellfish, refer to 11.4.12.

11.6 Processing operations of coated shrimp

11.6.1 General

11.6.1.1 Coated or breaded shrimp should be manufactured from good quality shrimp that have been subjected to sanitary conditions and processed under conditions that properly control food safety hazards.

11.6.1.2 Coated shrimp should be removed from their shells with the exception of the tail and with the alimentary canal or vein removed.

NOTE 1 See Annex C for the application of HACCP principles and additional information for pre-requisite programmes.

NOTE 2 See Annex D for an example of a flow chart for coated shrimp processing.

11.6.2 Reception

All incoming raw materials should be subject to an examination for food safety hazards and defects based on the appropriate CODEX Alimentarius Commission Standard CODEX STAN 234-1999.

NOTE See 13.

11.6.2.1 Shrimp

11.6.2.1.1 Potential hazards

Potential hazards include, but are not limited to sulphites.

11.6.2.1.2 Potential defects

Potential defects include, but are not limited to:

a) black spot;

b) soft flesh;

c) inadequate head;

d) viscera and leg removal; and

e) decomposition.

11.6.2.1.3 Technical guidance

The reception of shrimp should be carried out in accordance with the following:

a) sulphites applied to the shrimp for the purpose of preventing black spot enzyme autolysis should be controlled and the product labelled accordingly;

b) sulphites should be used in accordance with manufacturer's instructions, Good Manufacturing Practice and national regulations;

c) raw shrimp with extensive black spot damage should be eliminated as an undesirable quality factor;

d) incoming lots should be examined for soft flesh resulting from bacterial infection as this renders the raw shrimp unsuitable for further processing;

e) raw shrimp should not exhibit large amounts of viscera, head or leg material;

f) raw shrimp should be examined for signs of temperature abuse and decomposition;

g) temperatures of all incoming lots should be recorded. Frozen product should be -18 °C or lower. Fresh product should not exceed 4 °C;

h) packaging material of frozen products should be examined for dirt, tearing and evidence of thawing;

i) cleanliness and suitability of the transport vehicle to carry fresh and frozen shrimp products should be examined for each incoming shipment;

j) temperature recording devices should be used with the shipment; and

k) representative samples should be taken to assess the level of possible hazards and defects.

NOTE See 13.3.1

11.6.2.2 Other ingredients

For details on the presence of other ingredients in shrimp, refer to 11.4.1.2.

11.6.2.3 Packaging material

For details on the packaging material for shrimp, refer to 11.4.1.3.

11.6.3 Storage of raw material, other ingredients and packaging materials

11.6.3.1 Shrimp (frozen storage)

For details on the frozen storage of shrimp, refer to 11.4.1.2.1 and 13.3.2.

11.6.3.2 Other ingredients and packaging material

For details on other ingredients and packaging material for shrimp, refer to 11.4.2.3.

11.6.3.3 Shrimp (refrigerated storage)

11.6.3.3.1 Potential hazards

Potential hazards include, but are not limited to:

a) microbiological growth; and

b) physical and chemical contamination.

11.6.3.3.2 Potential defects

Potential defects include, but are not limited to decomposition.

11.6.3.3.3 Technical guidance

Refrigerated storage of shrimp should be carried out in accordance with the following:

a) raw fresh shrimp should be stored between 0 °C and 4 °C; and

b) fresh shrimp should be properly protected from contamination.

NOTE See 11.4.2.2.

11.6.4 Unpacking and unwrapping

For details on the unwrapping and unpacking of shrimp, refer to 11.4.4.

11.6.5 Production of coated shrimp

11.6.5.1 Thawing frozen product

11.6.5.1.1 Potential hazards

Potential hazards include, but are not limited to microbiological growth.

11.6.5.1.2 Potential defects

Potential defects include, but are not limited to:

a) decomposition;

b) product damage; and

c) physical contamination.

11.6.5.1.3 Technical guidance

Thawing of frozen, coated shrimp should be carried out in accordance with the following:

a) frozen shrimp should be kept below 4 °C during the thawing process, to prevent the growth of pathogenic and spoilage bacteria;

b) controls should be instituted to ensure that the thawing product is not subject to unhygienic or unsanitary conditions; and

c) care should be taken to ensure that the raw thawed product is not subjected to conditions that cause tearing and breakage of the product.

11.6.5.2 Peeling, deveining and butterflying

11.6.5.2.1 Potential hazards

Potential hazards include, but are not limited to:

a) microbiological and chemical contamination; and

b) metal inclusion.

11.6.5.2.2 Potential defects

Potential defects include, but are not limited to:

a) presence of shell;

b) presence of vein;

c) poor cut; and

d) damaged flesh.

11.6.5.2.3 Technical guidance

Peeling, deveining and butterflying of shrimp should be carried out in accordance with the following:

a) when hand peeling shrimp, care should be taken to ensure that pathogenic bacteria are not transmitted from workers' hands;

NOTE See 4.5.

b) thawed shrimp should be adequately protected from contamination and processed quickly so that the raw flesh does not deteriorate;

c) sufficient amounts of water should be applied to peeled shrimp to ensure that all shell remnants and veins are removed from the shrimp;

d) where veins are removed by hand, with a knife, the product should be monitored to ensure that the cuts are made to product specifications;

e) where the shrimp is butterfly cut by hand the product should be monitored to ensure that the cuts are made to product specifications; and

f) where the shrimp is butterfly cut by machine the cutting blades should be regularly inspected so that the cut does not result in damaged shrimp or metal inclusion.

11.6.6 Coating

For details on the coating of shrimp, refer to 11.4.7.

11.6.6.1 Wet coating

11.6.6.1.1 Potential hazards

Potential hazards include, but are not limited to:

a) microbiological growth and toxin production in rehydrated batter; and

b) toxin production.

11.6.6.1.2 Potential defects

Potential defects include, but are not limited to:

a) improper batter viscosity;

b) foreign material; and

c) defective coating.

11.6.6.1.3 Technical guidance

Wet coating should be carried out in accordance with the following:

a) batter ingredient powders should be checked against buying specification and ideally sieved before use to remove any packaging and extraneous materials;

b) liquid batter preparations should be properly refrigerated or discarded at regular intervals to prevent microbiological growth and toxin production;

NOTE Bacterial toxin production is a possibility in batter mixes therefore usage times and temperatures should be set and cleaning schedules of equipment defined and maintained;

c) batter viscosity should be monitored to ensure the proper pick-up of dry coating material;

NOTE Batter that is too thin or thick may result in a coating and flesh ratio that does not meet specifications and regulatory requirements.

d) bags of dry batter mix should be stripped of their outer layer before being emptied into batter tanks to prevent dust and other contaminants from entering the rehydrated batter mix and into the final product;

e) where tempura-style batters are used, additional crumb coatings may not be necessary. Frying temperatures and times are critical to ensure correct texture; and

f) where batter is for adherence of a crumb coating, formulation and viscosity will be different to tempura-styles.

NOTE See 11.4.7.1.

11.6.6.2 Dry coating

11.6.6.2.1 Potential hazards

Potential hazards are unlikely.

11.6.6.2.2 Potential defects

Potential defects include, but are not limited to:

a) defective coating;

b) improper flesh to coating ratio; and

c) foreign material.

11.6.6.2.3 Technical guidance

Dry coating should be carried out in accordance with the following:

a) breadcrumb formulation and grist, or particle size should be checked against buying specification and stored according to supplier instructions to avoid becoming stale;

b) individual shrimp should be separated during the coating process to ensure complete coating of the product;

c) total coating and flesh percentages should be regularly monitored using recognized methods to ensure that the specified flesh and coating ratio is attained;

d) air blowers that eliminate excess coating from the shrimp should be adjusted and regularly monitored to ensure that the proper coating level is maintained;

e) individual shrimp that exhibit incomplete or defective coating should be removed; and

f) bags of dry coating mix should be stripped of their outer layer before being emptied into batter tanks to prevent dust and other contaminants from entering the rehydrated batter mix and into the final product.

NOTE See 11.4.7.2.

11.6.7 Pre-frying

For details on the pre-frying of shrimp, refer to 11.4.8.

11.6.7.1 Frying

11.6.7.2 Technical guidance

11.6.7.2.1 Fryers should be operated by trained staff.

11.6.7.2.2 Oil should be changed on a regular basis to avoid oxidative rancidity.

11.6.7.2.3 Oil temperatures should be controlled to avoid burning crumb or fire risk.

NOTE Whilst frying is necessary for tempura batter coatings, it may not always be used for crumb coating operations, although it may aid adhesion.

11.6.8 Packaging and labelling

For details on the packaging and labelling of shrimp, refer to 11.4.10.

11.6.9 Re-freezing – final freezing

11.6.9.1 Potential hazards

Potential hazards are unlikely.

11.6.9.2 Potential defects

Potential defects include, but are not limited to:

a) poor product texture; and

b) excessive moisture migration from flesh to coating.

11.6.9.3 Technical guidance

Blast freezing should be carried out quickly with the appropriate temperature and air flow parameters routinely monitored.

NOTE When the internal product temperature is between 0 °C and – 4 °C, quick blast freezing minimizes crystallization of the flesh and the moisture migration that will occur from the flesh to the coating.

11.6.10 Casing

11.6.10.1 Potential hazards

Potential hazards include, but are not limited to microbiological growth.

11.6.10.2 Potential defects

Potential defects include, but are not limited to:

a) product thawing; and

b) moisture migration from flesh to coating.

11.6.10.3 Technical guidance

Casing of the frozen containers should be carried out quickly to prevent thawing and quality problems.

NOTE Texture changes of the shrimp flesh and moisture migration from the flesh to the coating can occur if casing is not carried out quickly.

11.6.11 Frozen storage of end product

For details on the frozen storage of the end product of shrimp, refer to 11.4.11.

11.6.12 Transport of end product

For details on the transport of the end product of shrimp, refer to 11.4.12.

12 Processing of salted and dried salted fish

12.1 General

12.1.1 Salted fish and fish products and dried salted fish and fish products should be wholesome, well prepared and packaged so that they will be protected from contamination and remain attractive and safe to eat.

NOTE 1 See Annex C for the application of HACCP principles and additional information for pre-requisite programmes.

NOTE 2 See Annex D for an example of a flow chart for the processing of salted and dried salted fish.

NOTE 3 See 9.2 for general handling prior to processing.

12.1.2 General processes for salting should be carried out in accordance with the following:

a) depending on the species, fish should be completely bled as soon as practical;

b) where appropriate, fresh fish intended for processing should be checked for visible parasites;

c) frozen fish should be thoroughly thawed and inspected for suitability, prior to being salted;

d) freezing, heating or an adequate combination of salt content and storage time should be used as treatment procedures for destroying living parasites;

e) when fish that accumulate histamine are being salted, exposure to temperatures that would support toxin formation by bacteria should be limited at each step in the process; and

f) to minimise time delays, the design of processing lines, where applicable, should be continuous and sequential to permit uniform flow without stoppages or slow-downs and removal of waste.

12.2 Preparing for salting

12.2.1 Splitting, washing and rinsing (processing step 7)

12.2.1.1 Potential hazards

Potential hazards are unlikely.

12.2.1.2 Potential defects

Potential defects include, but are not limited to improper splitting.

12.2.1.3 Technical guidance

Splitting, washing and rinsing should be carried out in accordance with the following:

a) fish should be split by a cut made parallel to the backbone straight down from the throat or 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 that the tail bone lies free;

NOTE It is important to cut the bone rather than to break it from the flesh.

b) splitting of fish should be carried out expertly so that blood in the nape and blood clots are removed;

c) immediately after splitting, fish should be washed in running potable water or clean sea water, to remove all blood from the fish;

d) all impurities, blood and livers should be removed;

e) visible parasites should be removed; and

f) where the black membrane has to be removed, it should be done after the splitting step.

12.2.2 Filleting, skinning and trimming (processing step 8)

For details on the filleting, skinning and trimming of fish for the drying and salting process, refer to 9.2.8.

12.2.3 Round fish (processing step 9)

For details on preparing round fish for drying and salting, refer to 9.2.2 to 9.2.7.

12.2.4 Nobbing (processing step 10)

12.2.4.1 Potential hazards

Potential hazards are unlikely.

12.2.4.2 Potential defects

Potential defects include, but are not limited to:

a) remaining gut content and intestines other than roe or milt; and

b) decomposition.

12.2.4.3 Technical guidance

Nobbing should be carried out in accordance with the following:

a) fish should be inspected for intestines remaining after nobbing;

b) fish should be thoroughly washed to remove blood, remaining intestines and scales after nobbing, if appropriate; and

c) nobbed fish should be drained and appropriately chilled in clean containers and stored in specially designated and appropriate areas within the processing facility.

12.2.5 Gibbing (processing step 11)

12.2.5.1 Potential hazards

Potential hazards are unlikely.

12.2.5.2 Potential defects

Potential defects include, but are not limited to:

a) remaining gut content; and

b) decomposition.

12.2.5.3 Technical guidance

Gibbing should be carried out in accordance with the following:

a) fish should be inspected for proper gibbing;

b) improperly gibbed fish should be sorted and used for other purposes;

c) fish should be thoroughly washed to remove blood, remaining undesirable intestines, heart and scales after gibbing; and

d) the gibbed fish should be drained and appropriately chilled in clean containers and stored in specially designated and appropriate areas within the processing facility.

12.3 Salt requirements and salt handling

12.3.1 Salt requirements (processing step 12)

12.3.1.1 Potential hazards

Potential hazards include, but are not limited to chemical and physical contamination.

12.3.1.2 Potential defects

Potential defects include, but are not limited to incorrect composition.

12.3.1.3 Technical guidance

Salt requirements should be in accordance with the following:

a) the composition of the salt used should be appropriate for the product;

NOTE 1 The composition of salt differs according to the origin. Mine salt and solar salt of marine origin contain several other salts like calcium sulphate, magnesium sulphate and chloride as impurities. Vacuum processed and refined salt is almost pure sodium chloride.

NOTE 2 Too much calcium may reduce the rate of salt penetration to an extent that spoilage may occur.

NOTE 3 Where present at too high a concentration, magnesium salts will give rise to unpleasant bitter flavours and may cause spoilage during the salting operation.

NOTE 4 Salt produced from marine sources may contain halophilic bacteria and mould which continue to live in the salt and dry salted fish and could contribute to spoilage.

b) salt used in salted fish should be inspected to ensure that it:

   1) is clean;

   2) has not been previously used;

   3) is free from foreign matter and foreign crystals; and

   4) shows no visible sign of contamination with dirt, oil, bilge or other extraneous materials;

c) the size of the salt granules used should be carefully considered;

NOTE 1 The use of very fine salt granules could result in the formation of clusters which are not favourable for ensuring the uniform distribution of salt on the fish.

NOTE 2 The use of very coarse salt granule could result in damage to the fish flesh during salting and may reduce the rate of maturation.

d) small crystals of salt should be used for dry-salting of fatty fish and large crystals for lean fish; and

e) salt used as an ingredient should be of food grade.

12.3.2 Salt handling (processing step 13)

12.3.2.1 Potential hazards

Potential hazards include, but are not limited to chemical and physical contamination.

12.3.2.2 Potential defects

Potential defects include, but are not limited to:

a) bacteria; and

b) mould.

12.3.2.3 Technical guidance

Salt handling should be carried out in accordance with the following:

a) salt used should be transported and stored dry and hygienically covered in salt bins, storerooms, containers or in plastic sacks; and

b) re-use of salt should be avoided in order to minimise the presence and growth of bacteria and moulds in salted fish.

12.4 Salting and maturing

12.4.1 General

12.4.1.1 Salted fish should be salt-matured, sound and wholesome.

12.4.1.2 In order to prevent the development of *Clostridium botulinum*:

a) the salting process, should be controlled; or

b) the fish should be eviscerated prior to brining.

12.4.1.3 Salting of fish either by brining, brine injection, 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 and temperature control.

12.4.1.4 Salted fish should be kept at a temperature lower than 8 °C to minimise the occurrence of bacteria and mould.

12.4.1.5 In order to minimise microbial contamination of salted fish, previously used and or contaminated salt should be removed from the plant.

12.4.1.6 During the process of salting, the quality of the salt should be maintained by utilizing low temperatures and avoiding light and oxygen in an effort to reduce rancidity.

12.4.2 Brining (processing step 14)

12.4.2.1 Potential hazards

Potential hazards include, but are not limited to:

a) viable parasites;

b) scombrotoxins; and

c) botulinum toxin.

12.4.2.2 Potential defects

Potential defects include, but are not limited to decomposition.

12.4.2.3 Technical guidance

Brining should be carried out in accordance with the following:

a) only fresh stabilized brine should be used for the salting process;

b) potable water should be used for preparation of brine;

c) the ratio of brine to fish and the concentration of the brine should be adjusted to desired product;

d) time and temperature control should be monitored where the brine concentration is lower than saturated;

e) concentration of brine should be monitored at regular intervals and incorrect concentration should be adjusted prior to use; and

f) fish should be of similar size to ensure proper salt penetration.

12.4.3 Brine injection (processing step 15)

12.4.3.1 Potential hazards

Potential hazards include, but are not limited to:

a) viable parasites;

b) scombrotoxins;

c) injection needle fragment; and

d) botulinum toxin.

12.4.3.2 Potential defects

Potential defects include, but are not limited to decomposition.

12.4.3.3 Technical guidance

Brine injection should be carried out in accordance with the following:

a) apparatus used for brine injection should be cleaned and disinfected at regular intervals;

b) needles of apparatus should be inspected daily for broken tips, blockages and deflections;

c) brine injection devices should be operated by trained personnel only;

d) metal detection should be conducted at this point or later in the process; and

e) reflux of injected brine into the reservoir should be avoided.

12.4.4 Wet-salting (processing step 16)

12.4.4.1 Potential hazards

Potential hazards include, but are not limited to:

a) viable parasites;

b) scombrotoxins; and

c) botulinum toxin.

12.4.4.2 Potential defects

Potential defects include, but is not limited to decomposition.

12.4.4.3 Technical guidance

Wet-salting should be carried out in accordance with the following:

a) fish for wet-salting should be salted and carefully arranged in the curing container such that voids and channels between the fish are minimised;

b) salt, time and temperature should be controlled to obtain the desired product;

c) salt concentration of the brine should be monitored with a salinometer according to specifications;

d) stacking of fish after salting should be done after the proper salt to water balance is obtained; when stacking, adequate amounts of salt should be added and evenly distributed over the whole surface of the fish; and

e) 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.

12.4.5 Dry-salting (processing step 17)

12.4.5.1 Potential hazards

Potential hazards include, but are not limited to:

a) viable parasites;

b) scombrotoxins; and

c) botulinum toxin.

12.4.5.2 Potential defects

Potential defects include, but are not limited to decomposition.

12.4.5.3 Technical guidance

Dry-salting should be carried out in accordance with the following:

a) fish for dry salting should be carefully arranged such that voids and channels between fish are minimised and that drainage is adequate;

b) fish piles should be placed off the floor or away from the wall;

c) salt, time and temperature should be carefully controlled to obtain the desired product;

d) 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;

e) where the fish is restacked on pallets, the pallet should be clean; and

f) exposure to freezing temperatures should be avoided during the salting process.

12.4.6 Pickling (processing step 18)

12.4.6.1 Potential hazards

Potential hazards include, but are not limited to:

a) viable parasites;

b) scombrotoxins; and

c) botulinum toxin.

12.4.6.2 Potential defects

Potential defects include, but are not limited to decomposition.

12.4.6.3 Technical guidance

Pickling should be carried out in accordance with the following:

a) salt should be adjusted to the quality of the primary fat content;

b) salt, sugar and spices should be weighed or measured and be evenly distributed;

c) during the pickling operation, all fish should be well immersed in the resulting pickle;

d) fish should be allowed to settle in containers and then salt or pickle added before the container is closed;

e) fatty fish should always be covered with pickle during curing; and

f) cured fatty fish should be kept in brine or pickle.

NOTE Pickling is primarily used for fatty fish. Under certain conditions dry salting of small fatty fish may be used.

12.4.7 Maturing (processing step 19)

12.4.7.1 Potential hazards

Potential hazards include, but are not limited to:

a) viable parasites;

b) scombrotoxins; and

c) botulinum toxin.

12.4.7.2 Potential defects

Potential defects include, but are not limited to:

a) decomposition;

b) rancidity and discolouration of the flesh or surface bacteria; and

c) mould.

12.4.7.3 Technical guidance

Maturing should be carried out in accordance with the following:

a) maturing time should depend on the fish species, size, quality, temperature and the amount of salt absorbed by the fish tissues;

b) the first part of the curing period, for fish that accumulate histamine, should be done at between 0 °C and 5 °C;

c) fatty fish should be kept between 5 °C to 10 °C during the maturing period; and

NOTE 1 The length of this period will vary from a few weeks, to several months, depending on the specific product.

NOTE 2 Where the containers are to be held at lower temperatures, the maturing period will increase.

d) Fish that accumulate histamine should be regularly monitored to determine the histamine content of the end product.

12.5 Sorting, drying, weighing, packaging, wrapping and labelling

In general, reference should be made to 9.3.3 and 9.5.4 for sorting, drying, weighing, packaging, wrapping and labelling of salted fish.

12.5.1 Sorting (processing step 20)

12.5.1.1 Potential hazards

Potential hazards are unlikely.

12.5.1.2 Potential defects

Potential defects include, but are not limited to:

a) incorrect sorting; and

b) high levels of bacteria.

12.5.1.3 Technical guidance

Sorting should be carried out in accordance with the following:

a) salted fish should be sorted into species, sizes and trade quality categories for the relevant market; and

b) loose salt should be removed from the fish before sorting and new salt should be added before packaging.

12.5.2 Drying (processing step 21)

12.5.2.1 Potential hazards

Potential hazards are unlikely.

12.5.2.2 Potential defects

Potential defects include, but are not limited to:

a) decomposition;

b) bacteria; and

c) mould.

12.5.2.3 Technical guidance

Drying should be carried out in accordance with the following:

a) time and temperature used for drying are dependent upon fish species, size and the handling and stacking of the fish;

b) fish should be of similar size to ensure proper drying; and

c) high temperatures should be avoided to prevent stoppage of the drying process.

12.5.3 Weighing, wrapping and packaging (processing step 22)

12.5.3.1 Potential hazards

Potential hazards include, but are not limited to microbiological contamination.

12.5.3.2 Potential defects

Potential defects are unlikely.

12.5.3.3 Technical guidance

Weighing, wrapping, and packaging should be carried out in accordance with the following:

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

b) barrels in which fatty fish are ready to be marketed should be clean, whole and hygienic;

c) the packaging operation should be designed to minimise the risk of contamination and decomposition; and

d) products should meet appropriate standards for labelling and weights established by the national competent authority.

12.5.3.4 Labelling (processing step 23)

In general, reference should be made to 9.3.3 and 9.6 for labelling.

12.6 Chill storage (processing step 24)

12.6.1 Potential hazards

Potential hazards are unlikely.

12.6.2 Potential defects

Potential defects are unlikely.

12.6.3 Technical guidance

Chill storage should be carried out in accordance with the following:

a) salt-matured fish should be stored in chill storage;

b) the temperature in the chill storage should be between 1 °c to 4 °c;

c) temperature and storage time should be monitored and recorded at regular intervals;

d) the products should be handled carefully and not be over-stacked.

12.7 Packaging, labels and ingredients (processing steps 25, 26, 27 and 28)

In general, reference should be made to 9.6 for packaging, labels and ingredients.

13 Processing of shrimp and prawns

13.1 General

Shrimp frozen for further processing should be whole, head-off or de-headed or raw headless, peeled, peeled and de-veined, or cooked on board harvest or processing vessels or at on shore processing plants.

NOTE See Annex C for the application of HACCP principles and additional information for pre-requisite programmes.

13.2 Frozen shrimp and prawns

Annex D provides an example of a flow chart for the processing of shrimp and prawns.

13.3 Shrimp preparation (processing steps 1 to 18)

13.3.1 Raw fresh and frozen shrimp reception (Process steps)

13.3.1.1 Potential hazards

Potential hazards include, but are not limited to:

a) phytotoxins;

b) microbiological contamination;

c) antioxidants;

d) sulphites;

e) pesticides; and

f) fuel oil.

13.3.1.2 Potential defects

Potential defects include, but are not limited to:

a) variable batch quality;

b) mixed species;

c) taints;

d) black spots;

e) softening from head enzymes; and

f) decomposition.

13.3.1.3 Technical guidance

Raw fresh and frozen shrimp reception should be carried out in accordance with the following:

a) inspection protocols should be devised to cover identified quality, haccp and dap plan parameters together with appropriate training for inspectors to undertake these tasks;

b) shrimp should be inspected upon receipt to ensure that they are iced or deep frozen and properly documented for product traceability; and

c) shrimp should be assessed for potential hazards based on origin and history, where there is no supplier assurance certification.

EXAMPLE These potential hazards include phytotoxins in sea caught shrimp (specifically for head on products) and potential antibiotics presence in aquaculture shrimp.

d) shrimp should be stored in suitable facilities and allocated use-by times for processing to ensure quality parameters are met in end products;

e) incoming lots of shrimp should be assessed for sulphites at harvesting;

f) a sensory evaluation should be performed on incoming lots to ensure that the product is of acceptable quality; and

g) fresh shrimp should be washed after reception, with a series of low velocity sprays of chilled clean water.

13.3.2 Frozen storage

13.3.2.1 Potential hazards

Potential hazards are unlikely.

13.3.2.2 Potential defects

Potential defects include, but are not limited to:

a) protein denaturation; and

b) dehydration.

13.3.2.3 Technical guidance

Frozen storage should be carried out in accordance with the following:

a) protective packaging should be undamaged;

b) damaged packaging should be replaced to exclude contamination and dehydration;

c) temperatures should be suitable for cold storage and with minimum fluctuation;

d) product should be processed within the best before time as indicated on the packaging; and

e) the cold storage facility should have a continuous temperature monitoring device to properly monitor and record ambient temperature.

13.3.3 Controlled thawing

13.3.3.1 Potential hazards

Potential hazards include, but are not limited to:

a) microbiological contamination; and

b) contamination from wrapping.

13.3.3.2 Potential defects

Potential defects include, but are not limited to decomposition.

13.3.3.3 Technical guidance

Controlled thawing should be carried out in accordance with the following:

a) thawing processes should be undertaken from block-frozen or quick-frozen shrimp depending on the raw material source. The packaging should be removed prior to defrosting to prevent contamination and extra care should be taken on block frozen prawns where inner wax or polyethylene packaging may be entrapped with blocks;

b) thawing tanks should be purpose-designed and allow for counter-current water defrosting maintaining the lowest temperatures possible. Water should not be re-used.

c) clean sea-water or water and ice of potable quality, when used for thawing, should be maintained lower than 20 °C by use of additional ice to achieve a defrosted product at a temperature cooler than 4 °C;

d) thawing should be achieved as quickly as possible to maintain quality;

e) the exit conveyor, leading from the defrost tanks, should be equipped with a series of low velocity sprays to wash the shrimp with chilled clean water; and

f) immediately after thawing, the shrimp should be re-iced or chilled to avoid temperature abuse before further processing.

13.3.4 Chilled storage

13.3.4.1 Potential hazards

Potential hazards include, but are not limited to microbiological contamination.

13.3.4.2 Potential defects

Potential defects include, but are not limited to decomposition.

13.3.4.3 Technical guidance

Chilled storage should be carried out in accordance with the following:

a) chilled storage rooms should be maintained at less than 4 °C after reception;

b) the chilled storage facility should have a continuous temperature monitoring device to monitor and record ambient temperatures; and

c) product should be placed in chilled storage without delay.

NOTE See 9.2.4

13.3.5 Selection

13.3.5.1 Potential hazards

Potential hazards are unlikely.

13.3.5.2 Potential defects

Potential defects include, but are not limited to decomposition.

13.3.5.3 Technical guidance

Shrimp should be selected for different quality grades according to specification requirements, and should be re-iced without delay.

13.3.6 Size grading

13.3.6.1 Potential hazards

Potential hazards include, but are not limited to microbiological contamination.

13.3.6.2 Potential defects

Potential defects include, but are not limited to decomposition.

13.3.6.3 Technical guidance

Size grading should be carried out in accordance with the following:

a) size grading of shrimp should be undertaken mechanically and manually.

NOTE Mechanically graded shrimp can become trapped in the bars of the graders therefore regular inspection is required to prevent 'carry over' of old prawns and bacteriological contamination.

b) shrimp should be re-iced and placed in chilled storage prior to further processing; and

c) the grading process should be carried out promptly to prevent unnecessary microbiological growth and product decomposition.

13.3.7 Addition of ingredients and use of additives

13.3.7.1 Potential hazards

Potential hazards include, but are not limited to:

a) chemical and microbiological contamination; and

b) sulphites.

13.3.7.2 Potential defects

Potential defects include, but are not limited to:

a) decomposition; and

b) improper use of additives.

13.3.7.3 Technical guidance

Addition of ingredients and use of additives should be carried out in accordance with the following:

a) where additives are used they should be in accordance with manufacturer's specifications and the CODEX Alimentarius Commission Standard CODEX STAN 192-1995;

b) where ingredients and additives are used, the process and product should be monitored to ensure:

   1) compliance with relevant standards;

   2) quality parameters are met; and

   3) where dip baths are used, the contents are changed on a regular basis according to drawn up plans; and

c) chill conditions should be maintained.

13.3.8 Full and partial peeling

13.3.8.1 Potential hazards

Potential hazards include, but are not limited to microbiological cross contamination.

13.3.8.2 Potential defects

Potential defects include, but are not limited to:

a) decomposition;

b) shell fragments; and

c) foreign matter.

13.3.8.3 Technical guidance

Full and partial peeling should be carried out in accordance with the following:

a) peeling tables should be kept clear of contaminated shrimp and shell fragments with the use of water jets; and

b) shrimp should be rinsed to ensure no carryover of shell fragments.

NOTE 1 This process applies mainly to warm water prawns and could be as simple as inspecting and preparing whole large prawns for freezing and down-grading blemished prawns for full peeling.

NOTE 2 Peeling stages could include full peeling or partial peeling leaving tail swimmers intact.

13.3.9 Deveining

13.3.9.1 Potential hazards

Potential hazards include, but are not limited to:

a) microbiological cross contamination; and

b) metal contamination.

13.3.9.2 Potential defects

Potential defects include, but are not limited to:

a) objectionable matter;

b) decomposition; and

c) foreign matter.

13.3.9.3 Technical guidance

Deveining should be carried out in accordance with the following:

a) removal of the vein should be carried out by cutting longitudinally along the dorsal region of the shrimp with a razor slide and pulling;

NOTE This may be partially achieved with head-off, shell-on shrimp as well.

b) cleaning and maintenance schedules should be in place for before, after and during processing by trained personnel; and

NOTE This operation is considered to be mechanical, though labour intensive.

c) damaged and contaminated shrimp should be removed from the line and debris build-up should not be allowed.

13.3.10 Washing

13.3.10.1 Potential hazards

Potential hazards include, but are not limited to microbiological contamination.

13.3.10.2 Potential defects

Potential defects include, but are not limited to:

a) decomposition; and

b) foreign matter.

13.3.10.3 Technical guidance

Washing should be carried out in accordance with the following:

a) peeled and deveined shrimp should be washed to remove shell and vein fragments; and

b) shrimp should be drained and chilled without delay prior to further processing.

13.3.11 Cooking Process

13.3.11.1 Potential hazards

Potential hazards include, but are not limited to:

a) survival of pathogenic micro-organisms due to insufficient cooking; and

b) microbiological cross contamination.

13.3.11.2 Potential defects

Potential defects include, but are not limited to over-cooking.

13.3.11.3 Technical guidance

The cooking process should be carried out in accordance with the following:

a) the cooking procedure, in particular, time and temperature, should be fully defined according to the specification requirements of the final product;

b) the cooking schedule should be reviewed before each batch and where continuous cookers are in use, process parameters should be monitored and recorded;

c) only potable water should be used for cooking, whether in water or via steam injection;

d) the monitoring methods and frequency should be appropriate for the critical limits identified in the scheduled process;

e) maintenance and cleaning schedules should be established and all operations should only be undertaken by trained staff; and

f) cooked shrimp, exiting the cooking cycle, should be adequately separated utilising different equipment to ensure there is no cross-contamination.

13.3.12 Peeling of cooked shrimp

13.3.12.1 Potential hazards

Potential hazards include, but are not limited to microbiological contamination.

13.3.12.2 Potential defects

Potential defects include, but are not limited to presence of shell.

13.3.12.3 Technical guidance

Peeling of cooked shrimp should be carried out in accordance with the following:

a) cooked shrimp should be properly peeled through mechanical or manual peeling in line with cooling and freezing processes; and

b) cleaning and maintenance schedules should be established and implemented by trained personnel to ensure efficient and safe processing.

13.3.13 Cooling

13.3.13.1 Potential hazards

Potential hazards include, but are not limited to:

a) microbiological contamination; and

b) toxin formation.

13.3.13.2 Potential defects

Potential defects are unlikely.

13.3.13.3 Technical guidance

Cooling should be carried out in accordance with the following:

a) cooked shrimp should be cooled as quickly as possible to bring the temperature of the product to a temperature range limiting bacteria proliferation or toxin production.

b) cooling schedules should enable the time-temperature requirements to be met. Maintenance and cleaning schedules should be established and implemented by trained personnel.

c) only cold or iced potable water should be used for cooling and should not be re-used. For continuous operations a top-up procedure and maximum run-length should be defined.

d) raw and cooked shrimp should be separated; and

e) shrimp should be frozen promptly after cooling and draining.

13.3.14 Freezing process

13.3.14.1 Potential hazards

Potential hazards include, but are not limited to microbiological contamination.

13.3.14.2 Potential defects

Potential defects include, but are not limited to:

a) slow-freezing textural quality; and

b) clumping of shrimp.

13.3.14.3 Technical guidance

The freezing process should be carried out in accordance with the following:

a) freezing operation should be according to the type of product;

NOTE 1 Raw, whole or head-off shrimp may be block or plate frozen in purpose-designed cartons into which potable water is poured to form a solid block with protective ice.

NOTE 2 Cooked and peeled *Pandalus* cold water prawns tend to be frozen through fluidised bed systems, whilst many of the warm water shrimp products are quick-frozen either on trays in blast freezers or in continuous belt freezers.

b) freezing conditions specified should be met, regardless of freezing process;

c) there should be no clumping of quick-frozen products;

d) product should be put into a blast freezer only after the operating temperature has been achieved to prevent glazed, slow frozen and contamination of the product; and

e) cleaning and maintenance schedules for freezers should be established and implemented by trained personnel.

13.3.15 Glazing

13.3.15.1 Potential hazards

Potential hazards include, but are not limited to microbiological contamination.

13.3.15.2 Potential defects

Potential defects include, but are not limited to:

a) inadequate glaze;

b) too much glaze;

c) spot welding; and

d) incorrect labelling.

13.3.15.3 Technical guidance

a) glazing should be applied to frozen shrimp to protect against dehydration and maintain quality during storage and distribution; and

NOTE 1 Ice block frozen shrimp is a form of glazing whereby frozen shrimp are dipped in chilled potable water and drained.

NOTE 2 A more sophisticated process is to pass frozen size graded shrimp under cold-water sprays on vibratory belts such that the shrimp pass at a steady rate to receive an even and calculable glaze cover.

b) glazed shrimp should be re-frozen prior to packing; but if not possible, they should be packaged and moved promptly to cold storage.

NOTE See CODEX Alimentarius Commission, Methods for the determination of glaze.

13.3.16 Weighing, packing and labelling of all products

In general, reference should be made to 9.5.4 and 9.6 for weighing, packing and labelling of all products.

13.3.16.1 Potential hazards

Potential hazards include, but are not limited to sulphites.

13.3.16.2 Potential defects

Potential defects include, but are not limited to:

a) incorrect labelling; and

b) decomposition.

13.3.16.3 Technical guidance

Weighing, packing and labelling of products should be carried out in accordance with the following:

a) all wrappings for products and packaging, including glues and inks, should be of food grade and odourless;

b) all food products should be weighed in packaging, with scales calibrated by a competent authority;

c) where products are glazed, the package should be labelled according to approved standards; and

d) labelling should be done in accordance with CRS 5.

13.3.17 Metal detection

13.3.17.1 Potential hazards

Potential hazards include, but are not limited to presence of metal.

13.3.17.2 Potential defects

Potential defects are unlikely.

13.3.17.3 Technical guidance

Products should be metal detected in final pack through machines set to the highest sensitivity possible.

NOTE Large packs will be detected at a lower sensitivity than smaller packs so that consideration should be given to testing product prior to packing. However, unless potential re-contamination prior to packing can be eliminated, it is probably still better to check in-pack.

13.3.18 Frozen storage of end product

In general, reference should be made to 9.2.5 for frozen storage of end product.

13.3.18.1 Potential hazards

Potential hazards are unlikely.

13.3.18.2 Potential defects

Potential defects include, but are not limited to:

a) texture and flavour deviations due to fluctuations in temperature;

b) deep freezer burn;

c) cold store flavour; and

d) card board flavour.

13.3.18.3 Technical guidance

Frozen storage of end product should be carried out in accordance with the following:

a) frozen products should be stored at the appropriate temperature in a clean, sound and hygienic environment;

b) the facility should be capable of maintaining the temperature of the shrimp at or below -18 °c with minimal temperature fluctuations of ± 3 °C;

c) the storage area should be equipped with a calibrated indicating thermometer;

NOTE Fitting of a continuous recording thermometer is strongly recommended.

d) a systematic stock rotation plan should be developed and maintained.

e) products should be properly protected from dehydration, dirt and other forms of contamination; and

f) all end products should be stored in the freezer in a manner to allow proper air circulation.

14 Processing of cephalopods

14.1 General

14.1.1 Fresh cephalopods 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 as they are extremely perishable.

14.1.2 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 promptly cooled to 0 °C.

NOTE 1 This section applies to fresh and processed cephalopods including cuttlefish (Sepia and Sepiella), squid (Alloteuthis, Berryteuthis, Dosidicus, Ilex, Lolliguncula, Loligo, Loliolus, Nototodarus, Ommastrephes, Onychoteuthis, Rossia, Sepiola, Sepioteuthis, Symplectoteuthis and Todarodes) and octopuses (Octopus and Eledone) intended for human consumption.

NOTE 2 See Annex C for the application of HACCP principles and additional information for pre-requisite programmes.

NOTE 3 See Figure D.12 for an example of a flow chart for the processing of cephalopods.

14.2 Reception of cephalopods (processing step 1)

14.2.1 Potential hazards

Potential hazards include, but are not limited to:

a) microbiological and chemical contamination; and

b) parasites.

14.2.2 Potential defects

Potential defects include, but are not limited to:

a) damaged products; and

b) foreign matter.

14.2.3 Technical guidance

Reception of cephalopods should be carried out in accordance with the following:

a) the processing facility should have an inspection programme for cephalopods on arrival at the factory. Only sound product should be accepted for processing;

b) product specifications may include:

   1) organoleptic characteristics which can also be used as indicators of fitness for consumption; and

   2) chemical indicators of decomposition and or contamination;

EXAMPLE TVBN

   3) microbiological criteria;

   4) presence of parasites; and

   5) presence of lacerations, breakages and discolouration of the skin, liver and or digestive organs inside the mantle; and

c) product inspection personnel should be adequately trained.

NOTE See 9 and the CODEX Alimentarius Commission Guidelines for Sensory Evaluation of Fish and Shellfish in Laboratories.

14.3 Storage of cephalopods

14.3.1 Chilled storage (processing steps 2 and 10)

14.3.1.1 Potential hazards

Potential hazards include, but are not limited to microbiological contamination.

14.3.1.2 Potential defects

Potential defects include, but are not limited to:

a) decomposition; and

b) physical damage.

14.3.1.3 Technical guidance

In general, reference should be made to 9.2.4.

14.3.2 Frozen storage (processing steps 2 and 10)

14.3.2.1 Potential hazards

Potential hazards include, but are not limited to heavy metals.

EXAMPLE Cadmium migration from the gut

14.3.2.2 Potential defects

Potential defects include, but are not limited to freezer-burn.

14.3.2.3 Technical guidance

Frozen storage should be carried out in accordance with the following:

a) consideration should be given to the fact that when there are high cadmium levels in the gut contents there may be migration of this heavy metal into the flesh; and

b) products should be properly protected from dehydration by sufficient packaging or glaze.

NOTE See 9.2.5.

14.4 Controlled thawing (processing step 3)

14.4.1 Potential hazards

Potential hazards include, but are not limited to microbiological contamination.

14.4.2 Potential defects

Potential defects include, but are not limited to:

a) decomposition; and

b) discolouration.

14.4.3 Technical guidance

Controlled thawing should be carried out in accordance with the following:

a) thawing parameters should be clearly defined and include time and temperature, to prevent the development of pale pink discoloration;

b) critical limits for the thawing time and temperature of the product should be established. Particular attention should be paid to the volume of product being thawed in order to control discoloration;

c) where water is used as the thawing medium, it should be potable; and

d) where re-circulated water is used then care should be taken to avoid the build up of micro organisms.

NOTE See 9.2.6.

14.5 Splitting, gutting and washing (processing steps 4, 5, 6, 11, 12 and 13)

14.5.1 Potential hazards

Potential hazards include, but are not limited to microbiological contamination.

14.5.2 Potential defects

Potential defects include, but are not limited to:

a) presence of gut contents;

b) parasites;

c) shells;

d) ink discolouration;

e) beaks; and

f) decomposition.

14.5.3 Technical guidance

Splitting, gutting and washing should be carried out in accordance with the following:

a) gutting should remove all intestinal material and the cephalopod shell and beaks if present;

b) any by-product of this process which is intended for human consumption should be handled in a timely and hygienic manner;

c) 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; and

d) an adequate supply of clean seawater or potable water should be available for the washing of whole cephalopods and cephalopod products.

14.6 Skinning and trimming (processing step 7)

14.6.1 Potential hazards

Potential hazards include, but are not limited to microbiological contamination.

14.6.2 Potential defects

Potential defects include, but are not limited to:

a) presence of objectionable matter;

b) bite damage;

c) skin damage; and

d) decomposition.

14.6.3 Technical guidance

Skinning and trimming should be carried out in accordance with the following:

a) the method of skinning should not contaminate the product nor should it allow the growth of micro-organisms.;

NOTE Enzymatic skinning or hot water techniques should have defined time or temperature parameters to prevent the growth of micro-organisms.

b) care should be taken to prevent waste material from cross contaminating the product; and

c) an adequate supply of clean seawater or potable water should be available for washing the product during and after skinning.

14.7 Application of additives

14.7.1 Potential hazards

Potential hazards include, but are not limited to:

a) physical contamination;

b) non-approved additives; and

c) non-fish allergens.

14.7.2 Potential defects

Potential defects include, but are not limited to:

a) physical contamination; and

b) additives exceeding their regulatory limits.

14.7.3 Technical guidance

The application of additives should be carried out in accordance with the following:

a) mixing and application of appropriate additives should be carried out by trained personnel;

b) where additives are used, the process and product should be monitored to ensure that the relevant standards are complied with and quality parameters are met; and

c) additives should comply with requirements of the CODEX Alimentarius Commission General Standard for Food Additives.

14.8 Grading, packing and labelling (processing steps 8 and 9)

In general, reference should be made to 9.3.3 for labelling.

14.8.1 Potential hazards

Potential hazards include, but are not limited to chemical or physical contamination from packaging.

14.8.2 Potential defects

Potential defects include, but are not limited to:

a) incorrect labelling;

b) incorrect weight; and

c) dehydration.

14.8.3 Technical guidance

Grading, packing and labelling should be carried out in accordance with the following:

a) packaging material should be clean, suitable for its intended purpose and manufactured from food grade materials;

b) grading and packing operations should be carried out promptly to prevent deterioration of the cephalopod; and

c) where sulphites are used, they should be properly labelled.

14.9 Freezing (processing step 10)

14.9.1 Potential hazards

Potential hazards include, but are not limited to parasites.

14.9.2 Potential defects

Potential defects include, but are not limited to:

a) freezer burn;

b) decomposition; and

c) loss of quality due to slow freezing.

14.9.3 Technical guidance

Freezing should be carried out in accordance with the following:

a) cephalopods should be promptly frozen to prevent product deterioration;

b) the time/temperature parameters developed should ensure rapid freezing of product and should take into consideration:

    1) type of freezing equipment;

    2) capacity;

    3) size and shape of the product; and

    4) production volume;

c) freezing capacity of the processing facility should be taken into consideration for production;

d) where freezing is used as a control point for parasites, time/temperature parameters should be established to ensure that the parasites do not survive;

e) the product temperature should be monitored regularly to ensure the core temperature is indicative of freezing temperature; and

f) adequate records should be kept for all freezing and frozen storage operations.

In general, reference should be made to 9.4.1 and Annex A.

14.10 Packaging, labels and ingredients – reception and storage

Consideration should be given to the potential hazards and defects associated with packaging, labelling and ingredients (see 9.6).

15 Processing of canned fish, shellfish and other aquatic invertebrates

15.1 General

This section applies to the processing of heat processed sterilised canned fish, shellfish and other aquatic invertebrate products which have been packed in hermetically sealed containers and intended for human consumption.

NOTE 1 See Annex C for the application of HACCP principles and additional information for pre-requisite programmes.

NOTE 2 See Annex D for an example of a flow chart for the processing of fish, shellfish and other aquatic invertebrates.

15.2 Technical guidelines

General additions to a pre-requisite programme should be carried out in accordance with the following**:**

a) design, working and maintenance of baskets and handling and loading devices aimed at retorting should be appropriate for the kind of containers and materials used. These devices should prevent any excessive abuse to the containers;

b) an adequate number of efficient sealing machines should be available to avoid undue delay in processing;

c) retorts should have a suitable supply of energy, vapour, water and or air so as to maintain sufficient pressure during sterilisation;

d) dimensions of retorts should be adapted to the production to avoid undue delays;

e) every retort should be equipped with an indicating thermometer, a pressure gauge and a time and temperature recorder;

f) an accurate and clearly visible clock should be installed in the retorting room;

g) canneries using steam retorts should consider installing automatic steam controller valves;

h) instruments used to control and monitor the process should be kept in good condition and be regularly verified or calibrated by a competent authority. Calibration of thermometers should be made in comparison with a reference thermometer; and

i) records concerning the calibration of instruments should be established and kept.

NOTE 1 See 4.

NOTE 2 See CODEX Alimentarius Commission Recommended International Code of Hygienic Practice for Low-Acid and Acidified Low- Acid Canned Food (CAC/RCP 23-1979).

15.3 General hazards and defects for canned fish, shellfish and other aquatic invertebrates

15.3.1 Biological hazards

15.3.1.1 Naturally occurring marine toxins

15.3.1.1.1 The identity of the species and or the origin of fish intended for processing are known as biotoxins and are generally heat-stable.

15.3.1.1.2 The status of the area of origin of molluscan shellfish or other affected species intended for processing are known as phycotoxins and are are heat stable.

15.3.1.2 Scombrotoxins

Good practices for the conservation and handling, from capture to heat processing, should be in place to prevent histamine production.

NOTE 1 Histamine is heat-stable, and so its toxicity remains practically intact in containers.

NOTE 2 The CODEX Alimentarius Commission adopted in its standards for some fish species maximum levels tolerated for histamine.

15.3.1.3 Microbiological toxins

15.3.1.3.1 High sterilisation values should be employed to destroy *Clostridium botulinum* spores, in particular those from proteolytic strains.

15.3.1.3.2 The proliferation and contamination risks of botulinum should be limited during processing.

15.3.1.3.3 The high risk of botulinum should be controlled by any of the following:

a) effective heat processing;

b) effective container integrity;

c) sanitary post process cooling water; and

d) sanitary wet conveying equipment.

NOTE 1 The botulism toxin is heat-sensitive. Botulism risk usually appears after an inadequate heat processing and inadequate container integrity. The heat processing effectiveness depends on the contamination level at the time of the treatment.

NOTE 2 Toxins from *Staphylococcus aureus* can be present in a highly contaminated raw material or can be produced by bacterial proliferation during processing. After canning, there is also the potential risk of post process contamination with *Staphylococcus aureus* if the warm wet containers are handled in an unsanitary manner. These toxins are heat-resistant, so should be taken into account in the hazard analysis.

15.3.2 Chemical hazards

Care should be taken to avoid contamination of the product from components of the containers.

EXAMPLE Lead and chemical products: lubricants, sanitizers, detergents

15.3.3 Physical hazards

Containers prior to filling may contain materials such as metal or glass fragments.

15.3.4 Defects

Potential defects are outlined in the essential quality, labelling and composition requirements described in the relevant CODEX Alimentarius Commission Standards. Where no CODEX Alimentarius Commission Standard exists, regard should be made to national regulations and or commercial specifications.

15.4 Processing operations

Processors may also refer to the Recommended International Code of Hygienic Practice for Low-Acid and Acidified Low-Acid Canned Foods (CAC/RCP 23-1979).

15.4.1 Reception of raw material

15.4.1.1 Fish and shellfish (processing step 1)

15.4.1.1.1 Potential hazards

Potential hazards include, but are not limited to:

a) chemical; and

b) biochemical contamination.

EXAMPLE DSP, PSP, scombrotoxin and heavy metals

15.4.1.1.2 Potential defects

Potential defects include, but are not limited to:

a) species substitution;

b) decomposition; and

c) parasites.

15.4.1.1.3 Technical guidance

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

NOTE See 9.2.2 and other relevant sections.

15.4.1.2 Container, cover and packaging materials (processing step 1)

15.4.1.2.1 Potential hazards

Potential hazards include, but are not limited to subsequent microbiological contamination.

15.4.1.2.2 Potential defects

Potential defects include, but are not limited to tainting of the product.

15.4.1.2.3 Technical guidance

Container, cover and packaging materials should be in accordance with the following:

a) containers, cover and packaging materials should be suitable for:

   1) the type of product;

   2) conditions provided for storage;

   3) filling, sealing and packaging equipment; and

   4) the transportation conditions;

b) 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; and

c) containers and covers for canned fish and shellfish should meet the following requirements:

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

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

   3) their outer surfaces should be resistant to corrosion under any likely conditions of storage; and

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

NOTE See 9.6.1.

15.4.1.3 Other ingredients (processing step 1)

In general, reference should be made to 9.6.1.

15.4.2 Storage of raw material, containers, covers and packaging materials

15.4.2.1 Fish and shellfish (processing step 2)

In general, reference should be made to 9.2.4, 9.2.5 and 8.6.3.

15.4.2.2 Containers and packaging (processing step 2)

15.4.2.2.1 Potential hazards

Potential hazards are unlikely.

15.4.2.2.2 Potential defects

Potential defects include, but are not limited to foreign matter.

15.4.2.2.3 Technical guidance

Containers and packaging should be stored in accordance with the following:

a) all materials for containers or packages should be stored in clean and hygienic conditions;

b) during storage, empty containers and covers should be protected from dirt, moisture and temperature fluctuations, to prevent condensations on containers and the development of corrosion of tin cans; and

c) empty containers should be protected from shock during loading, stowing, transportation and unloading to prevent deformation of the can body or flange, that can compromise tightness or be prejudicial to appearance.

NOTE See 9.6.2.

15.4.2.3 Other ingredients (processing step 2)

In general, reference should be made to 9.6.2.

15.4.3 Unwrapping and unpacking (processing steps 3 and 4)

15.4.3.1 Potential hazards

Potential hazards are unlikely.

15.4.3.2 Potential defects

Potential defects include, but are not limited to foreign matter.

15.4.3.3 Technical guidance

Unwrapping and unpacking should be carried out in accordance with the following:

a) during unwrapping and unpacking operations, precautions should be taken in order to limit product contamination and foreign matter; and

b) further processing should be carried out promptly to avoid microbial proliferation.

15.4.4 Thawing (processing step 5)

In general, reference should be made to 9.2.6.

15.4.5 Fish and shellfish preparatory processes (processing step 6)

15.4.5.1 Fish preparation (gutting and trimming)

15.4.5.1.1 Potential hazards

Potential hazards include, but are not limited to:

a) microbiological contamination; and

b) biochemical development.

EXAMPLE histamine

15.4.5.1.2 Potential defects

Potential defects include, but are not limited to:

a) objectionable matter;

EXAMPLE viscera, skin, scales

b) off flavours;

c) presence of bones; and

d) parasites.

15.4.5.1.3 Technical guidance

Where skinning of fish is performed by soaking in soda solution, an appropriate neutralisation should be carried out.

NOTE See 9.2.7 and 9.2.8.

15.4.5.2 Preparation of molluscs and crustaceans

15.4.5.2.1 Potential hazards

Potential hazards include, but are not limited to:

a) microbiological contamination; and

b) hard shell fragments.

15.4.5.2.2 Potential defects

Potential defects include, but are not limited to objectionable matter.

15.4.5.2.3 Technical guidance

Preparation of molluscs and crustaceans should be carried out in accordance with the following:

a) where live shellfish are used, inspection should be carried out in order to discard dead or badly damaged animals; and

b) particular care should be taken to ensure that shell fragments are removed from shellfish meat.

NOTE Refer to 8.8.2.

15.5 Pre-cooking and other treatments

15.5.1 General

15.5.1.1 Potential hazards

Potential hazards include, but are not limited to:

a) chemical contamination; and

EXAMPLE Polar components of oxidised oils

b) microbiological or biochemical growth.

15.5.1.2 Potential defects

Potential defects include, but are not limited to:

a) water release in the final product; and

b) abnormal flavours.

15.5.1.3 Technical guidance

Pre-cooking and other treatments should be carried out in accordance with the following:

a) methods used to pre-cook fish or shellfish for canning, should be designed to bring about the desired effect promptly with minimum amount of handling;

NOTE The choice of method is usually strongly influenced by the nature of the treated material.

b) for products canned in oil, pre-cooking should be sufficient in order to avoid excessive release of water during heat processing;

c) the amount of handling subsequent to pre-cooking should be minimal;

d) where eviscerated fish is used, 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;

e) where appropriate, molluscan shellfish, lobsters, crabs, shrimp, prawns and cephalopods should be pre-cooked according to technical guidance laid down in 8, 13 and 14;

f) temperature abuse of scombrotoxic species should be prevented prior to pre-cooking.

g) pre-cooking schedule should be carried out in accordance with the following:

    1) the pre-cooking method, with respect to time and temperature, should be clearly defined;

    2) the pre-cooking schedule should be monitored; and

    3) fish pre-cooked together in batches should be similar in size and of the same temperature when they enter the cooker;

h) control of quality of pre-cooking oils and other fluids should be carried out in accordance with the following:

1) only good quality vegetable oils should be used in pre-cooking fish or shellfish for canning;

NOTE See CODEX Alimentarius Commission Standard for Named Vegetable Oils (CODEX STAN 210-1999), CODEX Alimentarius Commission Standard for Olive Oils and Olive Pomace Oils (CODEX STAN 33-1981) and CODEX Alimentarius Commission Standard for Fats and Oils not Covered by Individual Standards (CODEX STAN 19-1981).

2) cooking oils should be changed frequently in order to avoid the formation of polar compounds;

3) water used for pre-cooking should be changed frequently to prevent contamination; and

4) oil or the other fluids used should not impart an undesirable flavour to the product; and

i) cooling should be carried out in accordance with the following:

1) cooling of pre-cooked fish or shellfish should be carried out promptly to prevent proliferation of microorganisms or toxin production;

NOTE The exception is for products which are packed when still hot.

2) potable water or clean seawater, should be used to cool crustacea for immediate shucking; and

3) water used for cooling should not be used for more than one batch;

15.5.2 Use of brine and other dips

15.5.2.1 Potential hazards

Potential hazards include, but are not limited to microbiological and chemical contamination by the dip solution.

15.5.2.2 Potential defects

Potential defects include, but are not limited to:

a) adulteration; and

b) abnormal flavours.

15.5.2.3 Technical guidance

The use of brine and other dips should be carried out in accordance with the following:

a) Solution strength and time of immersion should both be controlled to bring about the optimum effect where fish or shellfish are dipped or soaked in:

1) brine;

2) other conditioning solutions;

3) flavouring agents; or

4) additives in preparation for canning;

b) dip solutions should be replaced and dip tanks and other dipping apparatus should be thoroughly cleaned at frequent intervals; and

c) confirmation should be sought whether or not the ingredients or additives used in dips are permitted in canned fish and shellfish, by the relevant CODEX Alimentarius Commission Standards and the countries where the product will be marketed.

15.5.3 Packing in containers – filling, sealing and coding (processing step 8)

15.5.3.1 Filling

15.5.3.1.1 Potential hazards

a) Potential hazards include, but are not limited to:

b) microbiological growth;

c) microbiological survival growth;

d) recontamination after heat processing due to incorrect filling or faulty containers; and

e) foreign material.

15.5.3.1.2 Potential defects

Potential defects include, but are not limited to:

a) incorrect weight; and

b) foreign material.

15.5.3.1.3 Technical guidance

Filling of containers should be carried out in accordance with the following:

a) a representative sample of 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;

b) empty containers should be cleaned as appropriate;

c) as a precaution, all containers should be turned upside down to make certain that they do not contain any foreign material before they are used;

d) faulty containers should be removed to prevent jamming of filling or sealing machines, or which cause interruptions during heat processing;

e) empty containers should not be left on the packing tables or in conveyor systems during clean up to avoid contamination or splashes;

f) where appropriate, to prevent microbial proliferation, containers should be filled with hot fish and shellfish at a temperature greater than 63 °C, or should be filled after the end of the pre-treatments;

g) fish and shellfish should be chilled where they are held for a long time, before packing into containers;

h) containers of canned fish and shellfish should be filled as directed in the scheduled process;

i) mechanical or manual filling of containers should be monitored in order to comply with the filling rate and the headspace specified in the adopted sterilisation schedule;

NOTE 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.

j) the filling should also take into account the heat processing method. Headspace should be allowed as specified by the container manufacturer;

NOTE The necessary amount of headspace will depend partly on the nature of the contents;

k) containers should be filled such as the end product meets the regulatory provisions or the relevant standards concerning weight of contents;

l) where canned fish and shellfish are packed by hand, there should be a steady supply of all the ingredients to prevent build-up of fish, shellfish and filled containers at the packing table;

m) the operation, maintenance, regular inspection, calibration and adjustment of filling machines should be monitored. The machine manufacturers' instructions should be followed;

n) the quality and the amount of oil, sauce and vinegar should be controlled to bring about the optimum desired effect;

o) where 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;

p) filled containers should be inspected:

   1) to ensure that they have been properly filled and will meet accepted standards for weight of contents; and

   2) to verify product quality and workmanship just before they are closed; and

q) manually filled products should be monitored by the operators to verify that container flanges or closure surface do not have any product residues, which could impede the formation of a hermetic seal. For automatic filled products, a sampling plan should be implemented.

15.5.3.2 Sealing

15.5.3.2.1 Potential hazards

Potential hazards include, but are not limited to contamination due to a bad seam.

15.5.3.2.2 Potential defects

Potential defects are unlikely.

15.5.3.2.3 Technical guidance

Sealing of containers should be carried out in accordance with the following:

a) sealing operation, maintenance, regular inspection and adjustment of sealing machines should be monitored;

b) 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;

c) seams and other closures should be well formed with dimensions within the accepted tolerances for the particular container;

NOTE Qualified personnel should conduct this operation.

d) Where vacuum is used during packing, it should be sufficient to prevent the containers from bulging under any condition likely to be encountered during the distribution of the product.

NOTE 1 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.

NOTE 2 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.

e) to obtain the best methods to create a vacuum, competent technologists should be consulted;

f) regular inspections should be made during production to detect potential external defects on containers;

g) seams or closure system, for other types of containers which are used, should be regularly inspected by competent personnel to ensure a closure in accordance with specifications; inspections should consider vacuum measurements and seam teardown;

h) a sampling plan should be used for the inspections;

i) inspection should be carried out, in particular, at:

   1) each start of the production line;

   2) each change in container dimensions;

   3) after a jamming;

   4) a new adjustment; or

   5) a restarting after a prolonged stop of the sealing machine; and

j) all appropriate observations should be recorded.

15.5.3.3 Coding

15.5.3.3.1 Potential hazards

Potential hazards include, but are not limited to subsequent contamination due to damaged containers.

15.5.3.3.2 Potential defects

Potential defects include, but are not limited to loss of traceability due to an incorrect coding.

15.5.3.3.3 Technical guidance

Coding of containers should be carried out in accordance with the following:

a) each container of canned fish and shellfish should bear indelible code markings from which all-important details concerning its manufacture can be determined; and

NOTE Manufacture details include: type of product, cannery where the canned fish or shellfish was produced, production date, etc.

b) Coding equipment must be carefully adjusted so that the containers are not damaged and the code remains legible.

NOTE Coding may sometimes be carried out after the cooling step.

15.5.4 Handling of containers after closure (processing step 9)

15.5.4.1 Potential hazards

Potential hazards include, but are not limited to:

a) microbiological growth; and

b) subsequent contamination due to damaged containers.

15.5.4.2 Potential defects

Potential defects are unlikely.

15.5.4.3 Technical guidance

Handling of containers after closure should be carried out in accordance with the following:

a) containers should be handled in such a way as to prevent any damage that could cause defects and microbiological recontamination;

b) where 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;

c) filled and sealed containers should be promptly heat processed, to avoid microbial proliferation;

d) where the filled and sealed containers are to be held for a long time before heat processing, the product should be held at temperature conditions which minimise microbial growth; and

e) 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.

15.5.5 Thermal processing (processing step 10)

15.5.5.1 General

The Recommended International Code of Hygienic Practice for Low-Acid and Acidified Low-Acid Canned Foods (CAC/RCP 23-1979) provides detailed advice on heat processing.

15.5.5.2 Potential hazards

Potential hazards include, but are not limited to survival of spores of *Clostridium botulinum*.

15.5.5.3 Potential defects

Potential defects include, but are not limited to survival of micro-organisms responsible for decomposition.

15.5.5.4 Technical guidance

Thermal processing should be carried out in accordance with the following:

a) sterilisation schedule:

1) to determine the sterilisation schedule, the heat process required to obtain the commercial sterility should be established first;

NOTE When determining the sterilisation schedule, consideration should be given but not limited to microbial flora, dimensions and nature of the container, and product formulation. A sterilisation schedule is established for a certain product in a container of a given size.

2) proper heat generation and temperature distribution should be carried out;

3) 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; and

4) before any changes are made in the sterilisation operations, competent technologists should be consulted as to the need for re-evaluation of the process;

b) heat processing operation:

1) only qualified and properly trained personnel should operate retorts;

2) retort operators should control the processing operations and ensure the sterilisation schedule is followed, including timing, monitoring temperatures and pressures, and maintaining records;

3) the initial temperature described in the schedule process should be complied with to avoid under-processing;

4) sterilisation schedule should take into account refrigeration temperatures where the filled containers were held at these temperatures prior to heat processing;

5) air should be evacuated from the retort through a venting procedure that is deemed efficient by a competent technologist, so that heat processing is effective and the process temperature is controlled;

NOTE Container size and type, retort installation and loading equipment and procedures should be considered.

6) timing of heat processing for other types of retorts should commence only when:

i) the specified heat processing temperature has been reached;

ii) the conditions to maintain uniform temperature throughout the retort achieved; and

iii) the minimum safe venting time has elapsed.

NOTE See the Recommended International Code of Hygienic Practice for Low-Acid and Acidified Low-Acid Canned Foods (CAC/RCP 23-1979).

7) process schedule used should be sufficient to provide commercial sterility for all container sizes processed, where canned fish and shellfish in different size containers, are processed together in the same retort load;

8) initial temperature of the water in the retort should be slightly lower than that of the product being loaded, where processing fish and shellfish in glass containers; and

NOTE The air pressure should be applied before the water temperature is raised.

c) monitoring of heat processing operation:

1) sterilisation process and factors should be in accordance with the sterilisation schedule, during the application of heat processing;

2) retort temperatures should always be determined from the indicating thermometer, never from the temperature recorder;

3) permanent records of the time, temperature and other pertinent details should be kept concerning each retort load;

4) thermometers should be calibrated regularly to ensure that they are accurate. Calibration records should be maintained;

5) the recording thermometer readings should never exceed the indicating thermometer reading;

6) inspections should be made periodically to ensure that retorts are equipped and operating in a manner that will provide thorough and efficient heat processing;

7) inspections should be made periodically to ensure 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 entire processing period; and

8) inspections should be made under the guidance of a competent technologist.

15.5.6 Cooling (processing step 11)

15.5.6.1 Potential hazards

Potential hazards include, but are not limited to:

a) recontamination due to a bad seam; and

b) contaminated water.

15.5.6.2 Potential defects

Potential defects include, but are not limited to:

a) formation of struvite crystals;

b) buckled containers; and

c) scorch.

15.5.6.3 Technical guidance

Cooling should be carried out in accordance with the following:

a) after heat processing, canned fish and shellfish should preferably be water cooled under pressure, to prevent deformations and resulting loss of tightness;

b) in the case of recycling, potable water should always be chlorinated or treated by other appropriate means;

c) the residual chlorine level in cooling water and the contact time during cooling, should be checked in order to minimise the risk of post-processing contamination;

NOTE Efficiency of the treatment other than chlorination should be monitored and verified.

d) the internal temperature of containers should be promptly lowered, to prevent organoleptic defects of the canned fish and shellfish, including scorch and overcooking.

NOTE Rapid cooling of canned fish and shellfish avoids the formation of struvite crystals.

e) for glass containers, the temperature of the coolant in the retort should be lowered slowly at the beginning, to reduce the risks of breaking due to thermal shock;

f) 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;

g) heat processed canned fish and shellfish should not be unnecessarily touched by hand or articles of clothing, 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;

h) every cannery should develop a system to prevent unprocessed containers being mixed with processed containers; and

i) monitoring after heat processing and cooling should be in accordance with the following:

   1) canned fish and shellfish should be assessed for quality soon after they are produced, but before labelling;

   2) 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; and

   3) Texture, colour, odour, flavour and condition of the packing medium should be assessed and where desired, stability tests could be made in order to verify the heat processing, in particular.

NOTE This assessment 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 promptly corrected. Segregating and properly disposing of all defective units or lots that are unfit for human consumption should be ensured.

15.5.7 Labelling, casing and storage of finished products (processing steps 12 and 13)

15.5.7.1 Potential hazards

Potential hazards include, but are not limited to subsequent recontamination due to the damage of containers or an exposition to extreme conditions.

15.5.7.2 Potential defects

Potential defects include, but are not limited to incorrect labelling.

15.5.7.3 Technical guidance

Labelling, casing and storage of finished products should be carried out in accordance with the following:

a) the materials used for labelling and casing canned fish and shellfish should not be conducive to corrosion of the container;

b) cases should have an adequate size in order that the containers fit them and are not damaged by any movement inside;

c) cases and boxes should be the correct size, and strong enough to protect the canned fish and shellfish during distribution;

d) code marks appearing on containers of canned fish and shellfish should also be shown on the cases in which they are packed;

e) storage for canned fish and shellfish should be made in such a way as not to damage the containers; and

NOTE 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.

f) canned fish and shellfish should be so stored that they will be kept dry and not exposed to extremes of temperature.

NOTE See 9.3.3.

15.5.8 Transportation of finished products (processing step 14)

15.5.8.1 Potential hazards

Potential hazards include, but are not limited to subsequent recontamination due to the damage of containers or an exposition to extreme conditions.

15.5.8.2 Potential defects

Potential defects are unlikely.

15.5.8.3 Technical guidance

Transportation of finished products should be in accordance with the following:

a) transportation of canned fish and shellfish should be made in such a way as not to damage the containers;

NOTE Forklift trucks used during the loading and unloading should be used in a proper manner.

b) cases and boxes should be kept completely dry; and

c) metal containers should be kept dry during transportation in order to avoid corroding and or rust.

NOTE See section 16.

16 Transport

16.1 General

16.1.1 Annex C provides the application of HACCP principles and additional information for pre-requisite programmes.

NOTE Refer to the Recommended International Code of Practice-General Principles of Food Hygiene, Section VIII- Transportation, CAC/RCP 1-1969 and the Code of Hygienic Practice for the Transport of Food in Bulk and Semi-Packaged Food (CAC/RCP 47-2001).

16.1.2 During the transportation of fresh, frozen or refrigerated fish, shellfish and their products, steps should be taken to ensure that the chill or frozen temperature is maintained under controlled conditions and any increase in temperature of the product is minimised. In addition, appropriate measures should be applied to minimize damage to products and their packaging.

16.2 Fresh, refrigerated and frozen products

16.2.1 Potential hazards

Potential hazards include, but are not limited to:

a) biochemical development;

b) microbial growth; and

c) contamination.

16.2.2 Potential defects

Potential defects include, but are not limited to:

a) decomposition;

b) physical damage; and

c) chemical contamination.

15.4.1 Technical guidance

Transport of fresh, refrigerated and frozen products should be carried out in accordance with the following:

a) temperature of product should be verified before loading;

b) unnecessary exposure to elevated temperatures should be avoided during loading and unloading of fish, shellfish and their products;

c) product should be loaded in such a way as to ensure a good air flow between product and wall, floor and roof panels;

NOTE Load stabilizer devices are recommended.

d) air temperatures inside the cargo hold should be monitored during transportation; and

NOTE The use of a recording thermometer is recommended.

e) during transportation:

1) frozen products should be maintained at -18 °C ± 3 °C;

2) fresh fish, shellfish and their products should be kept at a temperature as close as possible to 0 °C;

3) fresh whole fish should be kept in shallow layers and surrounded by finely divided melting ice;

4) adequate drainage should be provided in order to ensure that water from melted ice does not stay in contact with the products or melted water from one container does not cross contaminate products in other containers;

5) transportation of fresh fish in containers with dry freezer bags should be considered where appropriate;

6) transportation of fish in an ice slurry, chilled sea water or refrigerated sea water should be considered where appropriate. Chilled sea water or refrigerated sea water should be used under approved conditions;

7) refrigerated processed products should be maintained at the temperature specified by the processor but generally should not exceed 4 °C; and

8) fish, shellfish and their products should be provided with adequate protection against contamination from dust, exposure to higher temperatures and the drying effects of the sun or wind.

NOTE See 4.7

16.3 Live fish and shellfish

Reference should be made to the specific provisions laid down in the relevant sections of this Code.

16.4 Canned fish and shellfish

Reference should be made to the specific provisions laid down in 15.

16.5 All products

16.5.1 Technical guidance

Transportation of all products should be carried out in accordance with the following:

a) the cleanliness, suitability and sanitation of the cargo hold of the vehicles should be verified before loading;

b) loading and transportation should be done in such a way as to avoid damage and contamination of the products and to preserve the integrity of the packaging; and

c) waste should be disposed of in a suitable manner, and its accumulation should be avoided after unloading.

17 Retail

17.1 General

17.1.1 Annex C provides the application of HACCP principles and additional information for pre-requisite programmes.

17.1.2 Fish, shellfish and their products at retail should be received, handled, stored and displayed to consumers in a manner that minimizes potential food safety hazards and defects and maintains essential quality. Consistent with the HACCP and DAP approaches to food safety and quality, products should be purchased from known or approved sources under the control of competent health authorities that can verify HACCP controls. Retail operators should develop and use written purchase specifications designed to ensure food safety and desired quality levels. Retail operators should be responsible to maintain quality and safety of products.

17.1.3 Proper storage temperature after receipt is critical to maintain product safety and essential quality and chilled products should therefore be stored in a hygienic manner at temperatures ≤ 4 °C, MAP products at 3 °C or lower, while frozen products should be stored at temperatures ≤ -18 °C.

17.1.4 Preparation and packaging should be carried out in a manner consistent with the principles and recommendations found in 4 and relevant CODEX Alimentarius Commission Labelling Standards. Product in open full display should be protected from the environment by use of display covers. At all times, displayed seafood items should be held at temperatures and conditions that minimize the development of potential bacterial growth, toxins and other hazards, and loss of essential quality.

17.1.5 Consumer information at the point of purchase that inform consumers about storage, preparation procedures and potential risks of seafood products if mishandled or improperly prepared, is important to ensure that product safety and quality is maintained.

EXAMPLE Consumer information includes placards or brochures

17.1.6 A system of tracking the origin and codes of fish, shellfish and their products should be established to facilitate product recall or public health investigations in the event of the failure of preventive health protection processes and measures.

NOTE These systems exist for molluscan shellfish in some countries in the form of molluscan shellfish tagging requirements.

17.2 Reception of fish, shellfish and their products at retail

17.2.1 Potential hazards

In general, reference should be made to, 8.6.2.1 and 9.2.2.1

17.2.2 Potential defects

In general, reference should be made to 8.6.2.2 and 9.2.2.2

17.2.3 Technical guidance

Reception of fish, shellfish and their products at retail should be carried out in accordance with the following:

a) transport vehicles should be examined for overall hygienic condition.

NOTE Products subject to filth, taint or contamination should be rejected.

b) transport vehicles should be examined for possible cross contamination of ready to eat fish and fishery products by raw fish and fishery products;

NOTE Determine that cooked, ready-to-eat product has not been exposed to raw product, juices or live molluscan shellfish and that raw molluscan shellfish has not been exposed to other raw fish or shellfish.

c) seafood should be regularly examined for adherence to purchasing specifications;

d) all products should be examined for decomposition and spoilage at receipt. Products exhibiting signs of decomposition should be refused; and

e) where a log of the cargo hold temperature for the transport vehicle is kept, records should be examined to verify adherence to temperature requirements.

17.3 Reception of chilled products at retail

17.3.1 Potential hazards

Potential hazards include, but are not limited to:

a) pathogen growth;

b) microbiological contamination;

c) chemical and physical contamination;

d) scombrotoxin formation; and

e) *C.botulinum* toxin formation.

17.3.2 Potential defects

Potential defects include, but are not limited to:

a) spoilage;

b) contaminants; and

c) filth.

17.3.3 Technical guidance

Reception of chilled products at retail should be carried out in accordance with the following:

a) product temperature should be taken from several locations in the shipment and recorded; and

b) chilled fish, shellfish and their products should be maintained at or below 4 °C. MAP product, if not frozen, should be maintained at or below 3 °C.

17.4 Chilled storage of products at retail

17.4.1 Potential hazards

Potential hazards include, but are not limited to:

a) scombrotoxin formation;

b) microbiological contamination;

c) pathogen growth;

d) chemical contamination; and

e) *C.botulinum* toxin formation.

17.4.2 Potential defects

Potential defects include, but are not limited to:

a) decomposition;

b) contaminants; and

c) filth.

17.4.3 Technical guidance

Chilled storage of products at retail should be carried out in accordance with the following:

a) products in chilled storage should be held at 4 °C. MAP product should be held at 3 °C or below;

b) seafood should be properly protected from filth and other contaminants through proper packaging and storing off the floor;

c) a continuous temperature recording chart for seafood storage coolers is recommended;

d) the cooler room should have proper drainage to prevent product contamination;

e) ready-to-eat items and molluscan shellfish should be kept separate from each other, and other raw food products in chilled storage. Raw product should be stored on shelves below cooked product to avoid cross contamination from drip; and

f) a proper product rotation system should be established.

NOTE This system could be based on first in, first out usage, production date or best before date on labels, and sensory quality of the lot, as appropriate.

17.5 Frozen storage of products at retail

17.5.1 Potential hazards

Potential hazards are unlikely.

17.5.2 Potential defects

Potential defects include, but are not limited to:

a) chemical decomposition; and

b) dehydration.

17.5.3 Technical guidance

Frozen storage of products at retail should be carried out in accordance with the following:

a) product should be maintained at -18 °C or less. Regular temperature monitoring should be carried out. A recording thermometer is recommended; and

b) seafood products should be stored off the floor. Product should be stacked to allow proper air circulation.

17.6 Preparation and packaging of chilled seafood at retail

17.6.1 Potential hazards

Potential hazards include, but are not limited to:

a) microbiological contamination;

b) scombrotoxin formation;

c) pathogen growth;

d) physical and chemical contamination; and

e) allergens.

17.6.2 Potential defects

Potential defects include, but are not limited to:

a) decomposition; and

b) incorrect labelling.

17.6.3 Technical guidance

Preparation and packaging of chilled seafood at retail should be carried out in accordance with the following:

a) handling and packaging of the product should be conducted in accordance with guidelines in 4;

b) labelling should be in accordance with guidelines in 4 and relevant CODEX Alimentarius Commission labelling standards, especially for known allergens;

c) product should not be subjected to temperature abuse during packaging and handling; and

d) cross-contamination of ready-to-eat and raw shellfish, shellfish and their products should be avoided at the work areas.

NOTE See 9.3.3.

17.7 Preparation and packaging of frozen seafood at retail

17.7.1 Potential hazards

Potential hazards include, but are not limited to:

a) microbiological contamination;

b) chemical or physical contamination; and

c) allergens.

17.7.2 Potential defects

Potential hazards include, but are not limited to:

a) thawing; and

b) incorrect labelling.

17.7.3 Technical guidance

Preparation and packaging of frozen seafood should be carried out in accordance with the following:

a) allergens should be identified on the label, in accordance with section 4, pre-requisite programme and relevant CODEX Alimentarius Commission labelling standards;

b) cross-contamination of ready-to-eat and raw product should be avoided; and

c) frozen seafood products should not be subjected to ambient room temperatures for a prolonged period of time.

NOTE See 9.3.3.

17.8 Retail display of chilled seafood

17.8.1 Potential hazards

Potential hazards include, but are not limited to:

a) scombrotoxin formation;

b) microbiological growth;

c) microbiological contamination; and

d) *C. botulinum* toxin formation.

17.8.2 Potential defects

Potential defects include, but are not limited to:

a) decomposition; and

b) dehydration.

17.8.3 Technical guidance

Retail display of chilled seafood should be in accordance with the following:

a) products in chilled display should be kept at 4 °C or below. Temperature of product should be taken at regular intervals;

b) ready-to-eat items and molluscan shellfish should be separated from each other and from raw food products in a chilled full service display;

NOTE A diagram of display is recommended to ensure that cross contamination does not occur.

c) if ice is used, proper drainage of melt water should be in place. Retail displays should be self-draining. Ice should be replaced daily and ready-to-eat products should not be placed on ice upon which raw product was previously displayed;

d) each commodity in a full service display should have its own container and serving utensils to avoid cross contamination;

e) product arranged in a large mass or depth should be in such a way as to allow for the maintenance of chilling and prevent product quality compromise;

f) drying of unprotected products, in full service displays, should be avoided;

g) product should not be added above the “load line”, in order to maintain the chilled state in self-service display cases of packaged product;

h) product should not be exposed to ambient room temperature for a prolonged period of time when filling or stocking display cases; and

i) seafood in full service display cases should be properly labelled to indicate the commonly accepted name of the fish so the consumer is informed about the product.

17.9 Retail display of frozen seafood

17.9.1 Potential hazards

Potential hazards are unlikely.

17.9.2 Potential defects

Potential defects include, but are not limited to:

a) thawing; and

b) dehydration.

17.9.3 Technical guidance

Retail display of frozen seafood should be in accordance with the following:

a) product should be maintained at -18 °C or less. Regular temperature monitoring should be carried out;

NOTE A recording thermometer is recommended.

b) product should not be added above the "load line" of cabinet self-service display cases. Upright freezer self-service display cases should have self-closing doors or air curtains to maintain a frozen state;

c) when filling or stocking display cases, product should not be exposed to ambient room temperature for a prolonged period of time;

d) a product rotation system to ensure first in, first out usage of frozen seafood should be established; and

e) frozen seafood in retail displays should be examined periodically to assess packaging integrity and the level of dehydration or freezer burns.

Annex A
(informative)

Potential hazards associated with fresh fish, shellfish and other aquatic invertebrates

A.1 Examples of possible biological hazards

A.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 food-borne 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 if the products are kept in the brine for a sufficient time but may not eliminate it. Candling, trimming belly flaps and physically removing the parasite cysts will also reduce the hazards but may not eliminate it.

A.1.1.1 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;* as the infective stage of the parasite is killed by heating (60 °C for 1 min) and by freezing (-20 °C for 24 hrs) in the fish core.

A.1.1.2 Cestodes

Cestodes are tapeworms and the species of most concern associated with the consumption of fish is *Dibothriocephalus latus*. This parasite occurs worldwide and both fresh and marine fish are intermediate hosts. Similar to other parasitic infections, the food-borne 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.

A.1.1.3 Trematodes

Fish-borne trematode (flatworm) infections are major public health problems that occur endemically in about 20 countries around the world. 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*. Food-borne 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 hrs will kill the infective stages of these parasites.

A.1.2 Bacteria

A.1.2.1 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.

A.1.2.2 There are two broad groups of bacteria of public health importance that may contaminate products at the time of capture - those that are normally or incidentally 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 food-borne illness and which have been isolated occasionally from fish are *Edwardsiella tarda*, *Pleisomonas shigeloides* and *Yersinia enterocolitica*. *Staphyloccocus aureus* may also appear and may produce heat resistant toxins.

A.1.2.3 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.

A.1.2.4 *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. Certain strains of *Vibrio parahaemolyticus* can be pathogenic.

A.1.3 Viral Contamination

A.1.3.1 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.

A.1.3.2 Generally 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.

A.1.3.3 Occurrence of viral gastro-enteritis can be minimized by controlling sewage contamination of shellfish farming areas and pre-harvest monitoring of shellfish and growing waters as well as controlling other sources of contamination during processing. Depuration and relaying are alternative strategies but longer periods are required for shellfish to purge themselves clean of viral contamination than for bacteria. Thermal processing (85 °C to 90 °C for 1½ min) will destroy viruses in shellfish.

A.1.4 Biotoxins

A.1.4.1 General

A.1.4.1.1 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.

A.1.4.1.2 For some fish, the toxins are present in the blood and are called *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) and are called *ichtyosarcotoxins*. The tetrodotoxic species responsible for several poisonings, often lethal, are in this category.

A.1.4.1.3 In general these toxins are known to be heat-stable and the only possible control measure is to check the identity of the used species.

A.1.4.2 Ciguatoxin

And 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.

A.1.4.3 PSP/DSP/NSP/ASP

A.1.4.3.1 Paralytic Shellfish Poison (PSP), Diarrhetic Shellfish Poison (DSP), Neurotoxic Shellfish Poison (NSP), and Amnesic Shellfish Poison (ASP) complex are produced by phytoplankton. They concentrate in bivalve molluscan shellfish which filter the phytoplankton from the water, and also may concentrate in some fish and crustacea.

A.1.4.3.2 Generally, the toxins remain toxic through thermal processing so the knowledge of the species identity and or origin of fish or shellfish intended for processing is important.

A.1.4.4 Tetrodotoxin

Fish mainly belonging to the family Tetradontidea (“puffer fishes”) may accumulate this toxin which is responsible for several poisonings, often lethal. The toxin is generally found in the fish liver, roe and guts, and less frequent in the flesh. Differently from most other fish biotoxins that accumulate in the live fish or shellfish, algae do not produce this toxin. The mechanism of toxin production is still not clear, however, apparently there are often indications of the involvement of symbiotic bacteria.

A.1.4.5 Scombrotoxin

Scombroid intoxication sometimes referred to as histamine poisoning, results from eating fish that have been incorrectly chilled after harvesting. Scombrotoxin is attributed mainly to *Enterobacteriaceae* which can produce high levels of histamine and other biogenic amines 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 fish families such as *Clupeidae*. 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 heat processing. In addition, fish may contain toxic levels of histamine without exhibiting any of the usual sensory parameters characteristic of spoilage.

A.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. Chemicals, organochloric compounds and heavy metals may accumulate in products that can cause public health problems. Veterinary drug 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. Fish can also be contaminated with chemicals such as diesel oil, when incorrectly handled and detergents or disinfectants when not properly rinsed out.

A.3 Physical hazards

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

Annex B
(informative)

A permanent cleaning and disinfecting schedule

B.1 Cleaning and disinfecting process

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

a) pre-cleaning – preparation of area and equipment for cleaning;

NOTE This involves steps such as removal of all fish, shellfish and their products from area, protection of sensitive components and packaging materials from water, removal by hand or squeegee of fish scraps, etc.

b) pre-rinse – rinsing with water to remove remaining large pieces of loose soil;

c) cleaning – the removal of soil, food residues, dirt, grease or other objectionable matter;

d) rinse – rinsing with potable water or clean water to remove all soil and detergent residues;

e) disinfection – application of chemicals, approved by the national competent authority and or heat to destroy most microorganisms on surface;

f) post-rinse – a final rinse with potable water or clean water to remove all disinfectant residues; and

g) storage – cleaned and disinfected equipment, container and utensils should be stored in a fashion which would prevent its contamination.

Annex C
(normative)

HACCP and DAP analysis

C.1 HACCP principles

C.1.1 The HACCP System consists of seven principles (see Figure C.1):

a) PRINCIPLE 1 Conduct a hazard analysis;

b) PRINCIPLE 2 Determine the Critical Control Points (CCPs);

c) PRINCIPLE 3 Establish critical limit(s);

d) PRINCIPLE 4 Establish a system to monitor control of the CCP;

e) PRINCIPLE 5 Establish the corrective action to be taken when monitoring indicates that a particular CCP is not under control;

f) PRINCIPLE 6 Establish procedures for verification to confirm that the HACCP system is working effectively;

g) PRINCIPLE 7 Establish documentation concerning all procedures and records appropriate to these principles and their application.

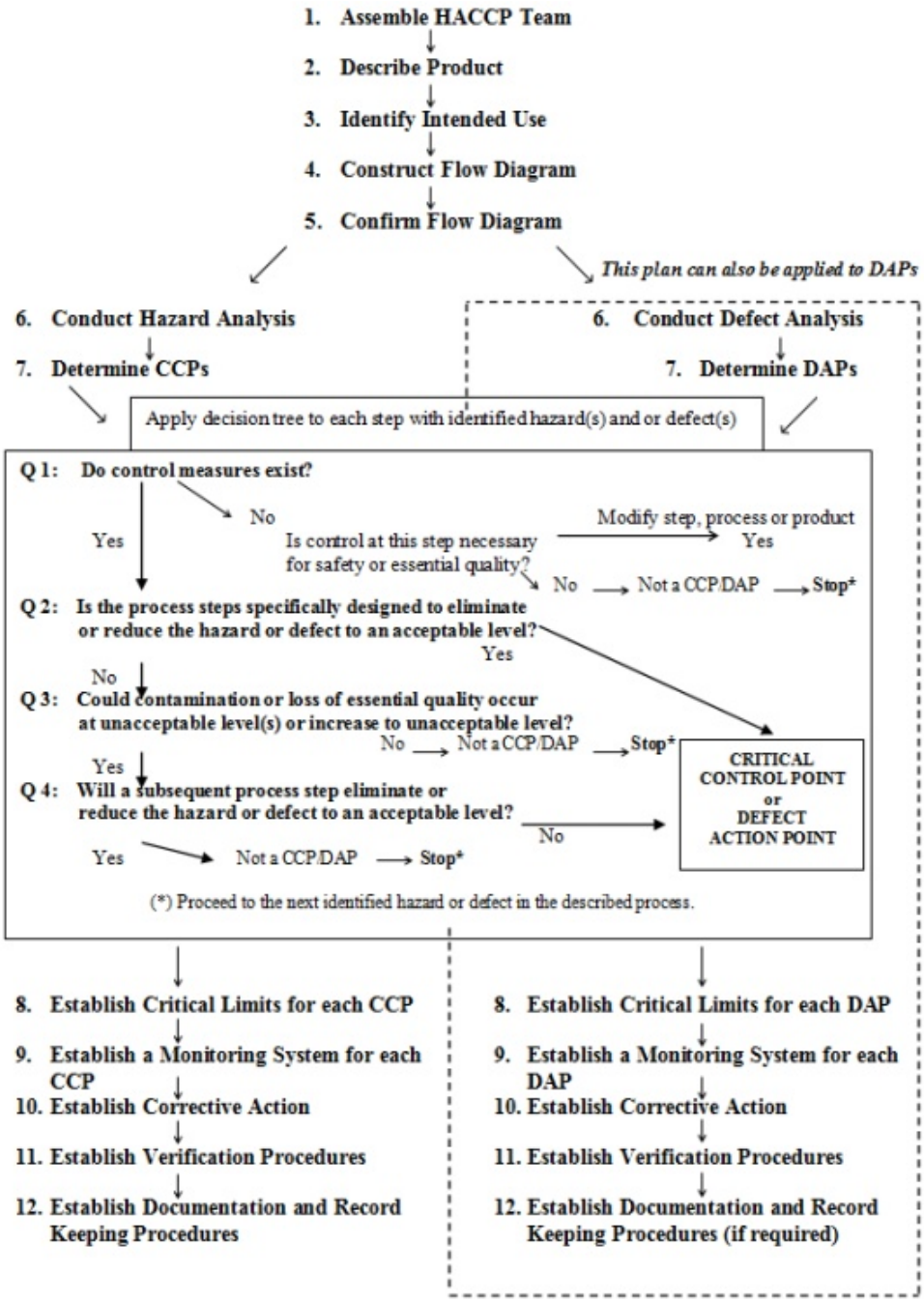

Figure C.1 — Summary of the implementation of a HACCP and defect analysis

C.1.2 These principles have to be followed when considering a HACCP plan.

C.1.3 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 for HACCP to be effective. In following HACCP principles, users are requested to list all of the hazards that may be reasonably expected to occur for each type of product 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.

C.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, it includes both the CCPs and defect action points (DAP). The HACCP principles may be applied to the determination of a DAP, with quality instead of safety parameters being considered at the various steps.

C.3 Application

C.3.1 General

C.3.1.1 Each aquaculture, molluscan shellfish, shellfish and fish facility should ensure that the provisions of the appropriate CODEX Alimentarius Commission 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, that segment must be supported by a pre-requisite programme based on good hygienic practice (see 4). It should be noted that parts of the pre-requisite programme may be classified as a CCP or DAP within a particular process.

C.3.1.2 The established food management system should indicate responsibility, authority and the interrelationships of all personnel who manage, perform and verify work affecting the performance of such systems. 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. The personnel comprising the team should include the processing facility manager, a microbiologist, a quality assurance or quality control specialist, and others such as buyers, operators, and other personnel as necessary. For small-scale operations, it may not be possible to establish such a team and therefore external advice should be sought.

C.3.1.3 The scope of the HACCP plan should be identified and should describe which segments of the food chain are involved and the general classes of hazards to be addressed.

C.3.1.4 The design of this programme should identify critical control points in the operation where the processing facility or product will be controlled, 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.

C.3.1.5 Verification activities include the application of methods; procedures (review/audit) and tests in addition to those used in monitoring to determine:

a) the effectiveness of the HACCP or DAP plan in delivering expected outcomes including validation;

b) compliance with the HACCP or DAP plan; and

EXAMPLE Audit or review

c) whether the HACCP or DAP plan or its method of application needs modification or revalidation.

C.3.1.6 The implementation of HACCP principles is better identified in the Logic Sequence for implementation of HACCP (see Figure C.1).

C.3.2 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. Table C.1 provides an example of the type of information used in describing a product.

Table C.1 — A product description for canned tuna in salted water

Product name(s)	**Objective**	**Example**
	Identify the species and method of processing.	Canned tuna in salted water
Source of raw material	Describe the origin of the fish	Yellow fin 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 Alimentarius Commission Standard Canned Tuna and Bonito; 'low-acid' food; can seal integrity.
Ingredients	List every substance added during processing. Only ingredients approved by the national competent authority may be used.	water, salt
Packaging	List all packaging materials. Only materials approved by the national competent authority 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	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

C.3.3 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 D.1 represents an example of a flow diagram for a canned tuna fish processing line.

C.3.4 Conduct hazard and defect analysis

The purposes of hazard analysis are to identify all such food safety hazards at each step, to determine their significance and to assess whether control measures for those hazards are available at each step. Defect analysis serves the same purpose for potential quality defects.

C.3.4.1 Identification of hazards and defects

C.3.4.1.1 It cannot be stressed enough that where practical and feasible each individual facility should gather sound scientific and technical data relevant to the businesses 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 of the hazards that may reasonably likely to occur and defects that, in the absence of control measure(s), may likely result in the production of an unacceptable food. Potential hazards, which have been known to be associated with fresh fish and shellfish, are described in Annex A. Table C.2 summarises possible pre-harvest and harvest safety hazards in incoming fish and shellfish and Table C.3 summarises possible safety hazards introduced in the post harvest and further processing of fish and shellfish.

C.3.4.1.2 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.

NOTE 1 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 or shellfish will undergo, and its subsequent storage, will determine their risk to human health 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.

NOTE 2 For hazards relating to specific products see the relevant processing section.

Table C.2 — Examples of pre-harvest and harvest hazards in incoming fish and shellfish

Biological		Chemical		Physical	
Parasites:	Parasites of public health significance: Trematodes, Nematodes, Cestodes	**Chemicals:**	Pesticides, herbicides, algicides, fungicides, anti-oxidants (added in feeds)	**Foreign Matter**	fish hooks
Pathogenic bacteria:	*Salmonella*, *Shigella*, *E. coli*, *Vibrio cholerae*, *Vibrio parahaemolyticus*, *Vibrio vulnificus*	**Veterinary drug residues:**	Antibiotics, growth promoters (hormones), other veterinary drugs and feed additives		
Enteric Viruses:	Norwalk virus	**Heavy metals:**	Metals leached from marine sediments and soil, from industrial wastes, from sewage or animal manures		
Biotoxins:	Biotoxins, Scombrotoxin				
		Miscellaneous:	Petroleum		

Table C.3 — Examples of hazards introduced in the post harvest and further processing of fish and shellfish

Biological		Chemical		Physical	
Pathogenic bacteria:	*Listeria monocytogenes, Clostridium botulinum, Staphylococcus aureus*	**Chemicals:**	Disinfectants, sanitizers or lubricants (misapplication)	**Foreign matter**	Metal fragments; hard or sharp objects
Enteric Viruses:	*Hepatitis A, Rotavirus*		Disinfectants, sanitizers or lubricants (non-approved)		
Biotoxins:	*Scombrotoxin, Staph. Enterotoxin, botulinum toxin*				
		Ingredients and additives:	Misapplication and non-approved		

C.3.4.1.3 For the example on canned tuna developed in this section, the essential potential hazards as indicated in table C.4 can be identified.

Table C.4 — An example of potential hazards for canned tuna

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

C.3.4.1.4 For the example on canned tuna developed in this section, the potential defects can be identified as seen in Table C.5.

Table C.5 — An example of potential defects of canned tuna

	In raw materials (frozen tuna)	During processing or storage or transportation
Biological	Decomposition	Decomposition, survival of micro-organisms responsible for decomposition, etc
Chemical		Oxidation during storage, etc
Physical		Objectionable matters (viscera, scales, skin, etc), formation of struvite crystals, container defects (panelled container, etc)
Others	Species substitution	Abnormal flavours, incorrect weight, incorrect coding, incorrect labelling

C.3.4.2 Hazards

It is equally important to consider, naturally occurring food safety hazards in the environment from which fish or shellfish are harvested. In general, risks to consumer health from seafood 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 and crustacean from the marine environment. The risks of food borne 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 or shellfish are consumed either raw or partially cooked, there is an increased risk of food borne parasitic or bacterial disease. In order to perform a hazard analysis as part of the process of developing a HACCP plan, processors must have scientific information on potential hazards associated with raw material and products for further processing.

C.3.4.3 Significance of hazards and defects

C.3.4.3.1 One of the most important activities, which must be performed in a processing facility as part of the food safety management system is to determine if an identified hazard or defect is significant. The two primary factors that determine whether a hazard or defect is significant for HACCP purposes are probability of occurrence of an adverse health effect and the severity of the effect. A hazard that has a high severity of effect, such as death from *Clostridium botulinum* toxin, may impose a socially unacceptable risk at very low probability of occurrence, and thus warrant the application of HACCP controls (i.e., be a significant hazard for purposes of HACCP). Thus, in the processed canned tuna, *Clostridium botulinum* should be considered a significant hazard to be controlled through the application of a validated thermal process schedule. On the other hand, a hazard with a relatively low severity, such as mild gastroenteritis, might not warrant the HACCP controls at the same very low probability of occurrence, and thus not be significant for purposes of HACCP.

C.3.4.3.2 Information gathered during the product description exercise (see C.3.2) could also help facilitate the determination of significance since the likelihood of occurrence of hazard or defect can be affected by factors such as how the consumer will likely use the product (such as to be consumed or cooked raw); the types of consumers who will likely consume it (such as immuno-compromised, elderly, children, etc.) and the method of storage and distribution (such as refrigerated or frozen).

C.3.4.3.3 Once significant hazard and defects have been identified, consideration needs to be given to assess their potential to be introduced or controlled at each step of the process. The use of a flow diagram (see C.3.3) is beneficial for this purpose. Control measures must be considered for significant hazard(s) or defect(s) associated with each step with the aim of eliminating its possible occurrence or to reduce it to an acceptable level. A hazard or defect may be controlled by more than one control measure. For illustrative purposes, Tables C.6 and C.7 demonstrate an approach to listing significant hazards and defects and the related control measures for the processing step Heat Processing.

Table C.6 — An example of the significant hazard survival of *C. botulinum* at the step of heat processing for canned tuna

Processing step	Potential hazard	Is the potential hazard significant?	Justification	Control measures
12. Heat processing	*C. botulinum* viable spores	Yes	An insufficient heat processing may result in survival of *C. botulinum* spores and therefore, possibility of toxin production. A product must be commercially sterile	Ensure adequate heat applied for proper time at retort

Table C.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	Product does not meet quality or customer requirements	Controlled temperature in the storage premises Stock management procedure Maintenance procedure of the refrigeration system Personnel training and qualification

C.3.5 Determine critical control points and defect action points

A thorough and concise determination of CCPs and DAPs 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 Alimentarius Commission standard. The CODEX Alimentarius Commission decision tree (Figure C.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 Alimentarius Commission decision tree to a hazard and defect using the canned tuna fish processing line, are shown in Tables C.7 and C.8, respectively.

Table C.7 — A schematic example of a hazard analysis with corresponding control measures and the application of the CODEX Alimentarius Commission decision tree for the determination of a critical control point at processing step 12 of the example process as set out in Figure D.1

Processing step N° 12 **Heat processing**		**Application of CODEX Alimentarius Commission Decision Tree**			
Potential hazards	**Control measures**				
C. botulinum viable spores	Ensure adequate heat applied for proper time at retort	**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 *C. 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 this 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**			

Table C.8 — 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 D.1

Processing step 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 storage premises. Stock management procedure.	**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**			

C.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 to the determined level. Table C.9 illustrates critical limits for a CCP and a DAP using a canned tuna fish processing line as an example.

C.3.7 Establish monitoring procedures

C.3.7.1 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.

C.3.7.2 Since each process is unique for each 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 C.9.

C.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 programme 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. For example, fish and shellfish should be held and rejected if they are known to contain harmful substances and or defects which would not be eliminated or reduced to an acceptable level by normal procedures of sorting or preparation. 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, that appropriate product disposition has occurred and that preventative action has been initiated. An example of a corrective action approach for a CCP and DAP using a canned tuna fish processing line is illustrated in Table C.9.

C.3.9 Establish verification procedures

A processing facility should establish a verification procedure carried out by qualified individuals, to periodically assess if the HACCP and DAP plans are adequate, implemented and working properly. This step will help determine if CCPs and DAPs are under control. Examples of verification activities include: validation of all components of the HACCP plan including: 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 should be carried out by qualified competent individuals. 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 C.9.

C.3.10 Establish documentation and record keeping procedures

C.3.10.1 Documentation may include Hazard Analysis, CCP determination, critical limit determination, and procedures for monitoring, corrective action and verification.

C.3.10.2 A current, accurate and concise record keeping system will greatly enhance the effectiveness of a HACCP programme 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 C.9.

Table C.9 — An example of the results of the application of HACCP principles to the two specific steps in the canned tuna process (tables 8 and 9), for a CCP and a DAP, respectively

CCP				
Processing step No. 12 : Heat processing **Hazard: *Clostridium botulinum* viable spores**				
Critical Limit	**Monitoring Procedure**	**Corrective Action**	**Records**	**Verification**
Those specific parameters associated with heat processing.	**Who**: Qualified person assigned to heat processing **What**: All parameters **Frequency**: every batch **How**: Checks of sterilisation schedule and other factors	**Who**: qualified personnel **What**: Personnel retraining New heat processing or batch destruction Corrective maintenance of equipment Hold product until safety can be evaluated. **Who**: Appropriate trained personnel	Monitoring records, corrective action records, product evaluation records, calibration records, validation records, audit records, HACCP plan review record	Validation, finished product evaluation, internal audit, review of records, calibration of machinery (may be a prerequisite), review of HACCP plan, external audit

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

C.3.11 Review of HACCP and DAP plans

Upon completion of all the steps for the development of HACCP and DAP plans as outlined in Figure C.1, a full review of all components should be conducted. The purpose of these reviews is to verify that the plans are capable of meeting their objectives.

C.4 Conclusion

C.4.1 Annex C 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 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, the objectives of the process, its environment and expected outcomes. The example of the canned tuna processing line is intended to illustrate how to apply the principles, given the outcome of a commercially sterile product, and why a HACCP and DAP plan will be unique to each operation.

C.4.2 The remaining sections in the Code concentrate on aquaculture and molluscan shellfish production and to the handling and processing of fish, shellfish and their products 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 4 and Annex C before turning to the appropriate processing section for specific advice. It should also be noted that 9 refers to processing of fresh, frozen and minced fish and will provide useful guidance for most of the other processing operations.

Annex D
(informative)

Flow Diagrams

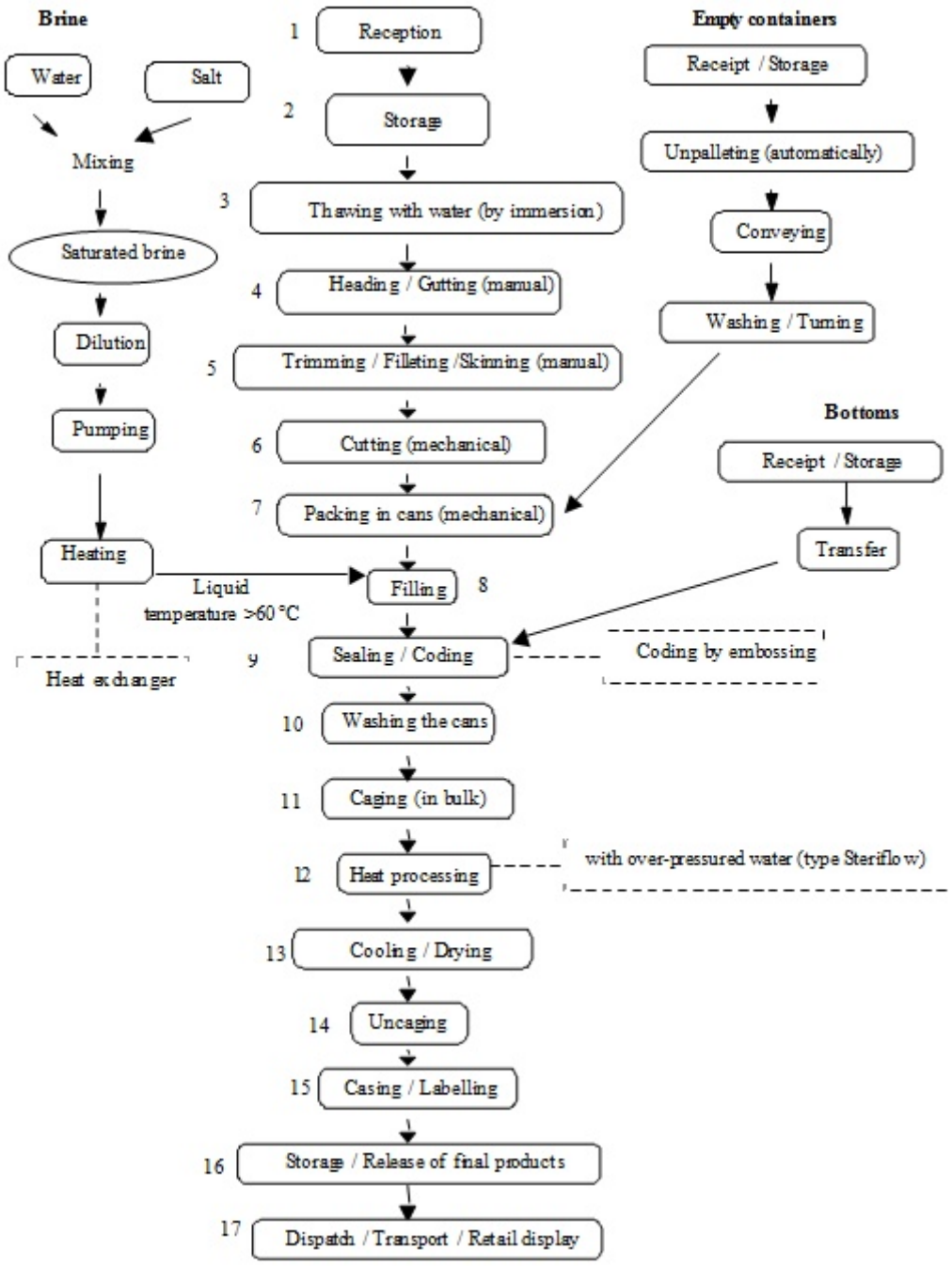

Figure D.1 — Example of a flow diagram for a processing line of canned tuna fish in brine

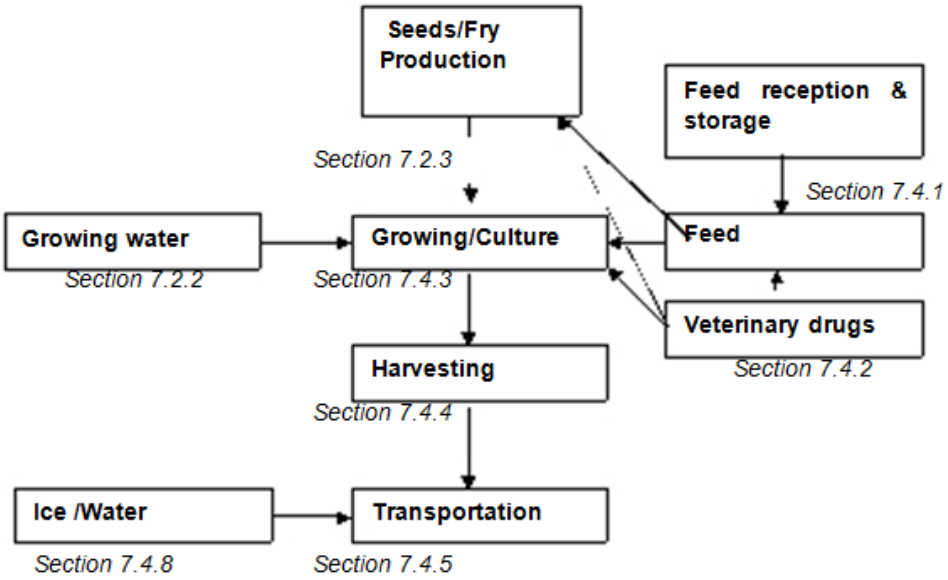

Figure D.2 — Example of a flow chart for aquaculture production

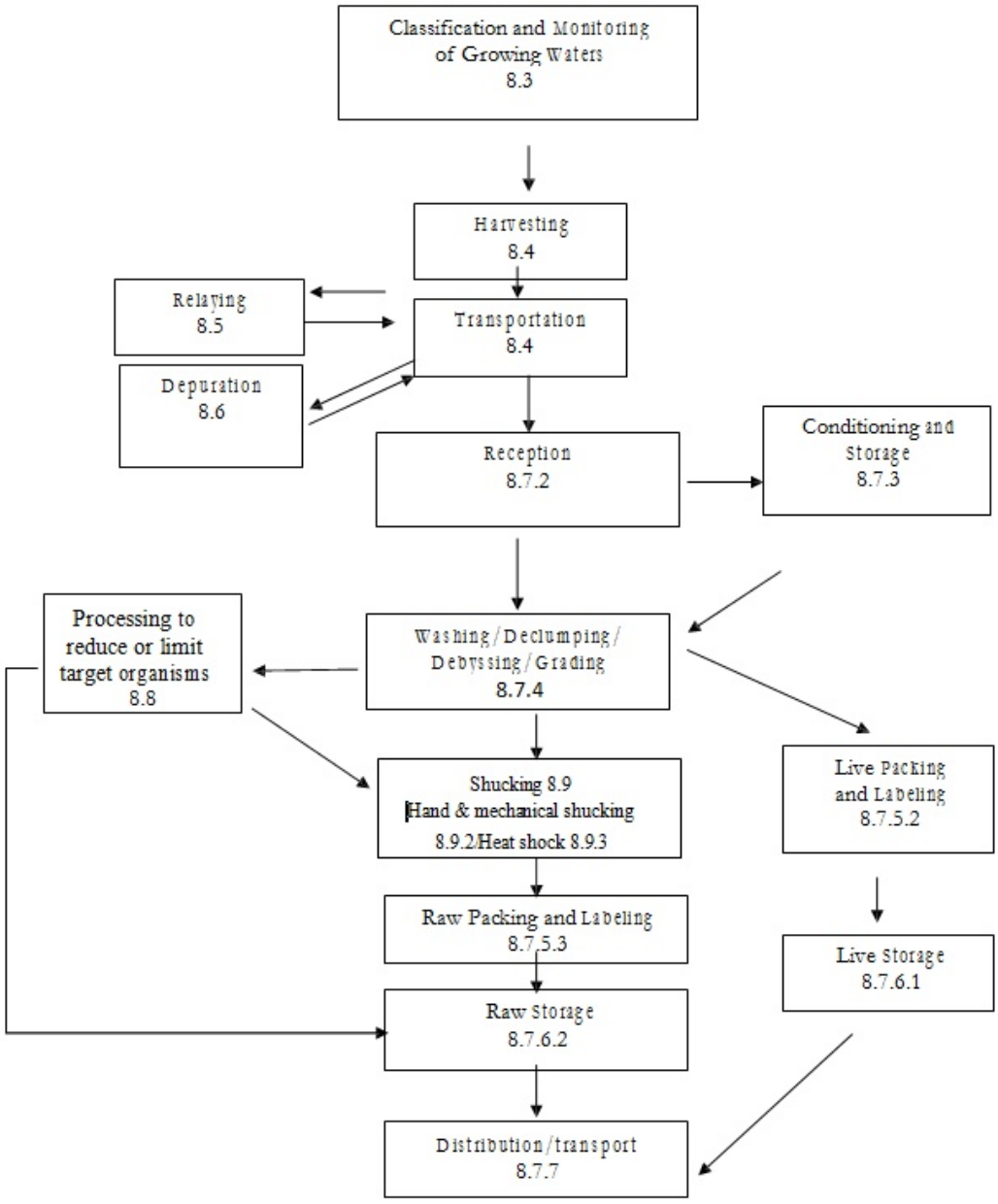

Figure D.3 — Example of a simplified flow diagram for production of live and raw bivalve molluscs

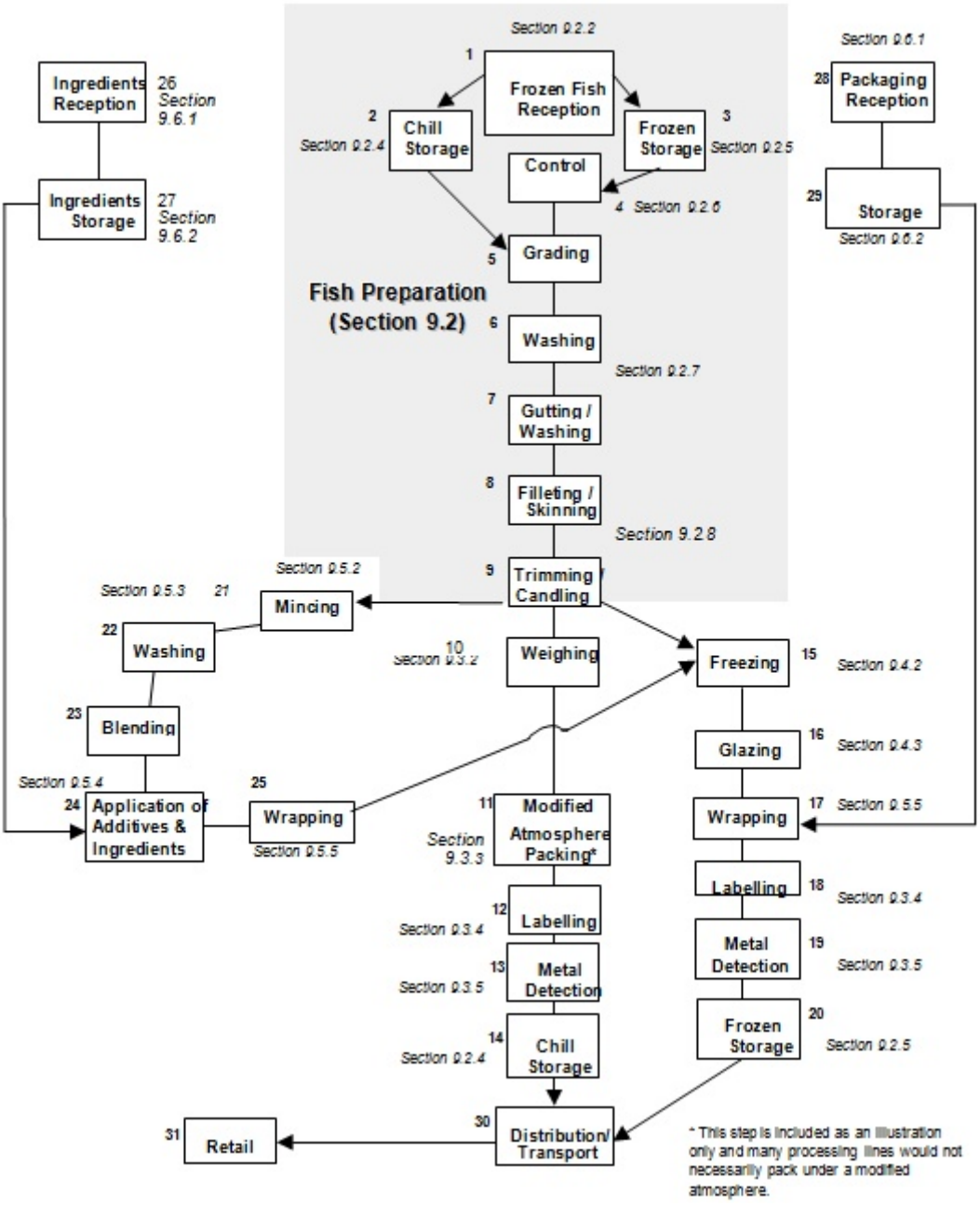

Figure D.4 — Example of a flow chart of a fish fillet preparation line, including MAP, mincing and freezing process

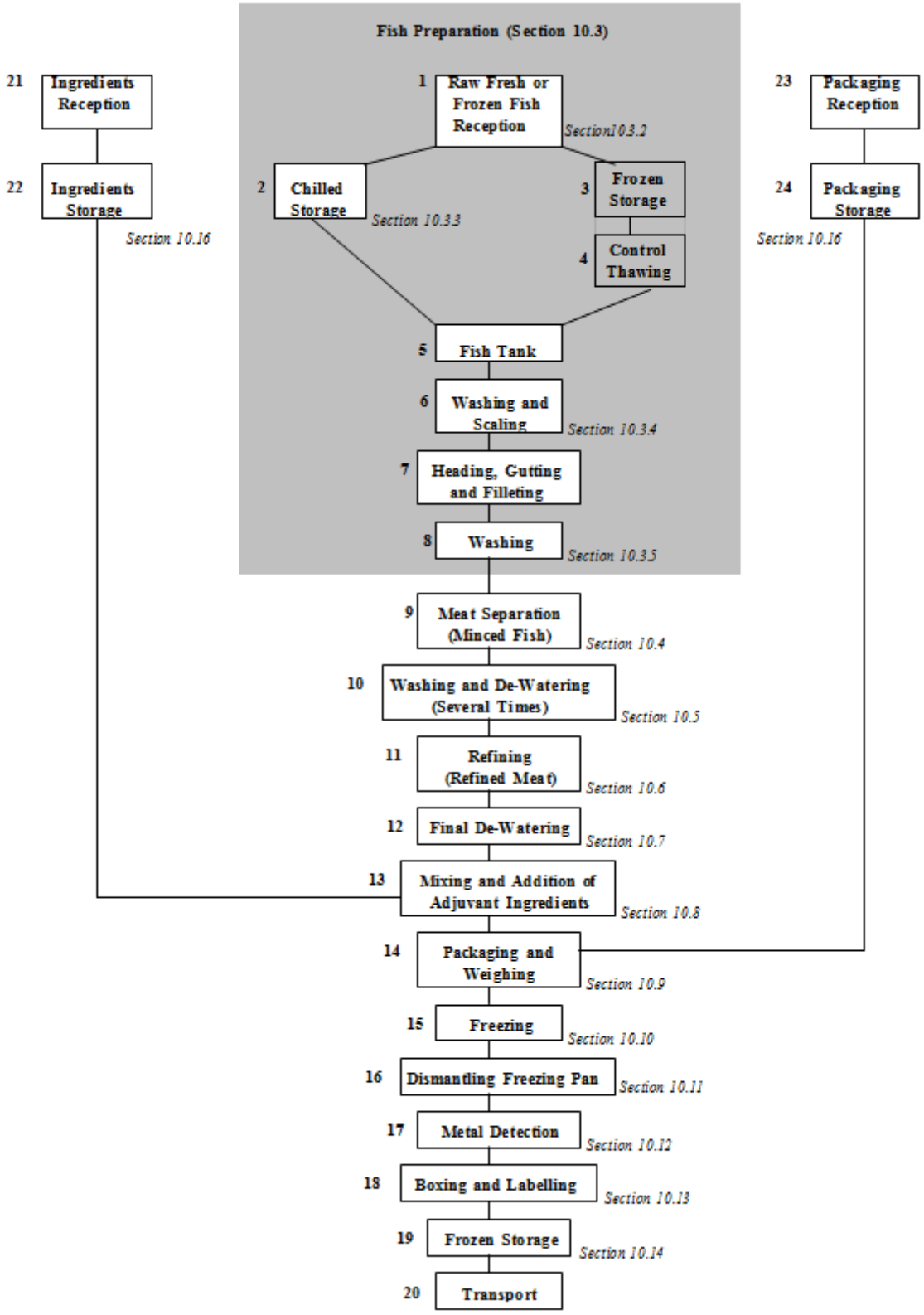

Figure D.5 — Example of a flow chart of a frozen surimi production process

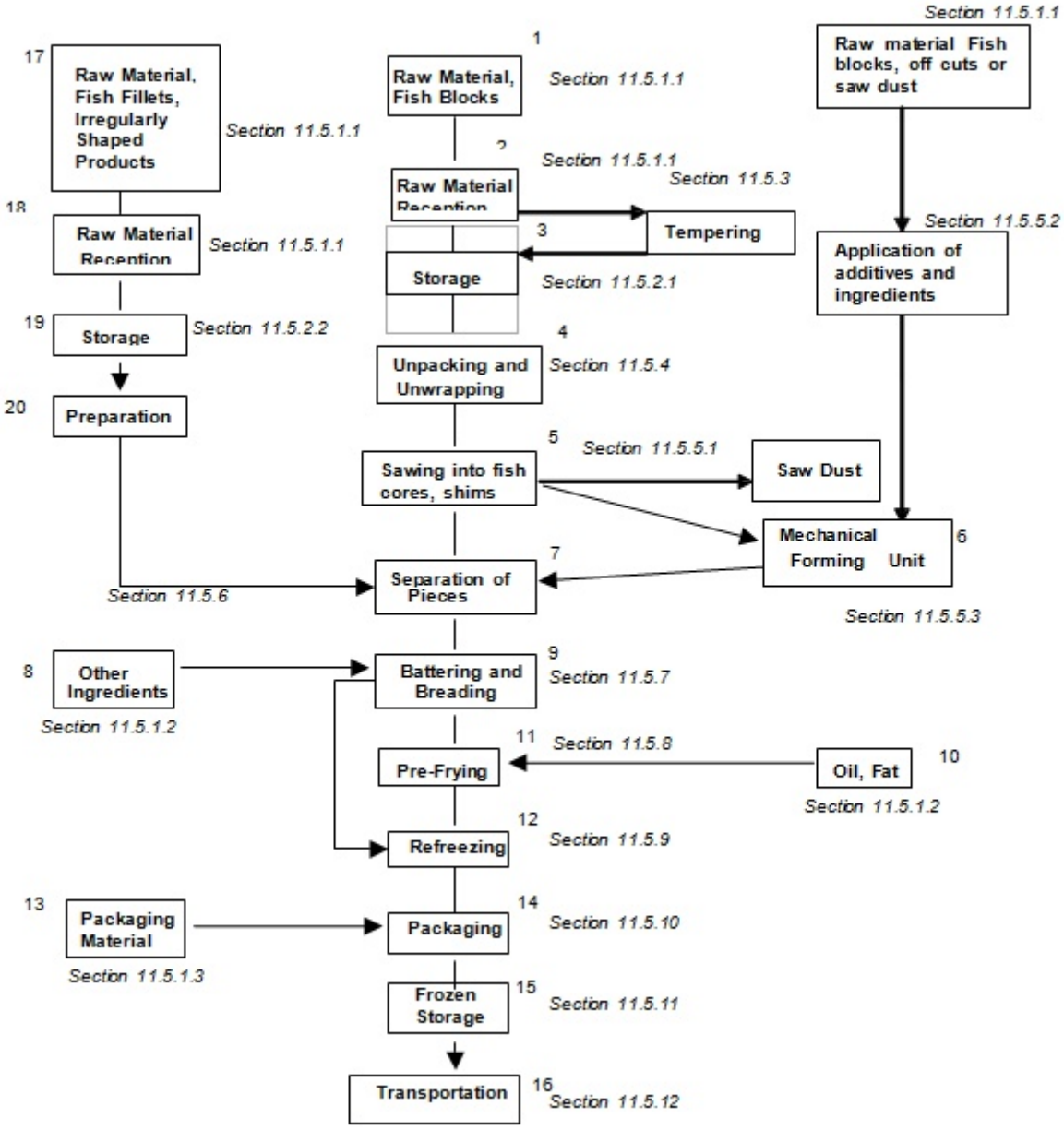

Figure D.6 — Example of a flow chart for the processing of coated fish products

NOTE The production and storage of batter for application to fish portions, fillets, etc., may involve either rehydration of a commercial batter mix or preparation from raw ingredients. During the preparation of this batter and its use, the potential hazard must be controlled.

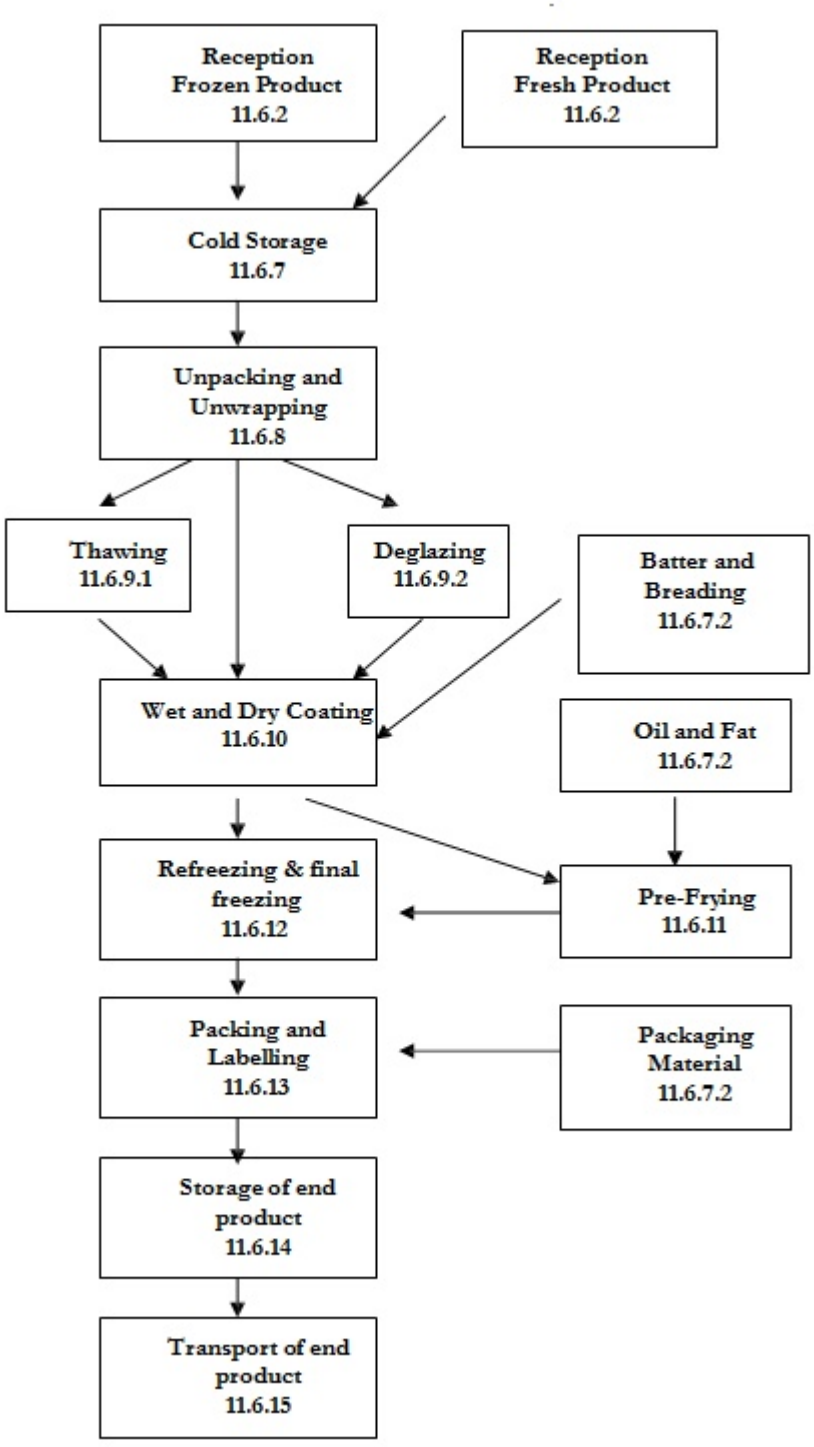

Figure D.7 — Example of a flow chart for coated molluscan shellfish processing

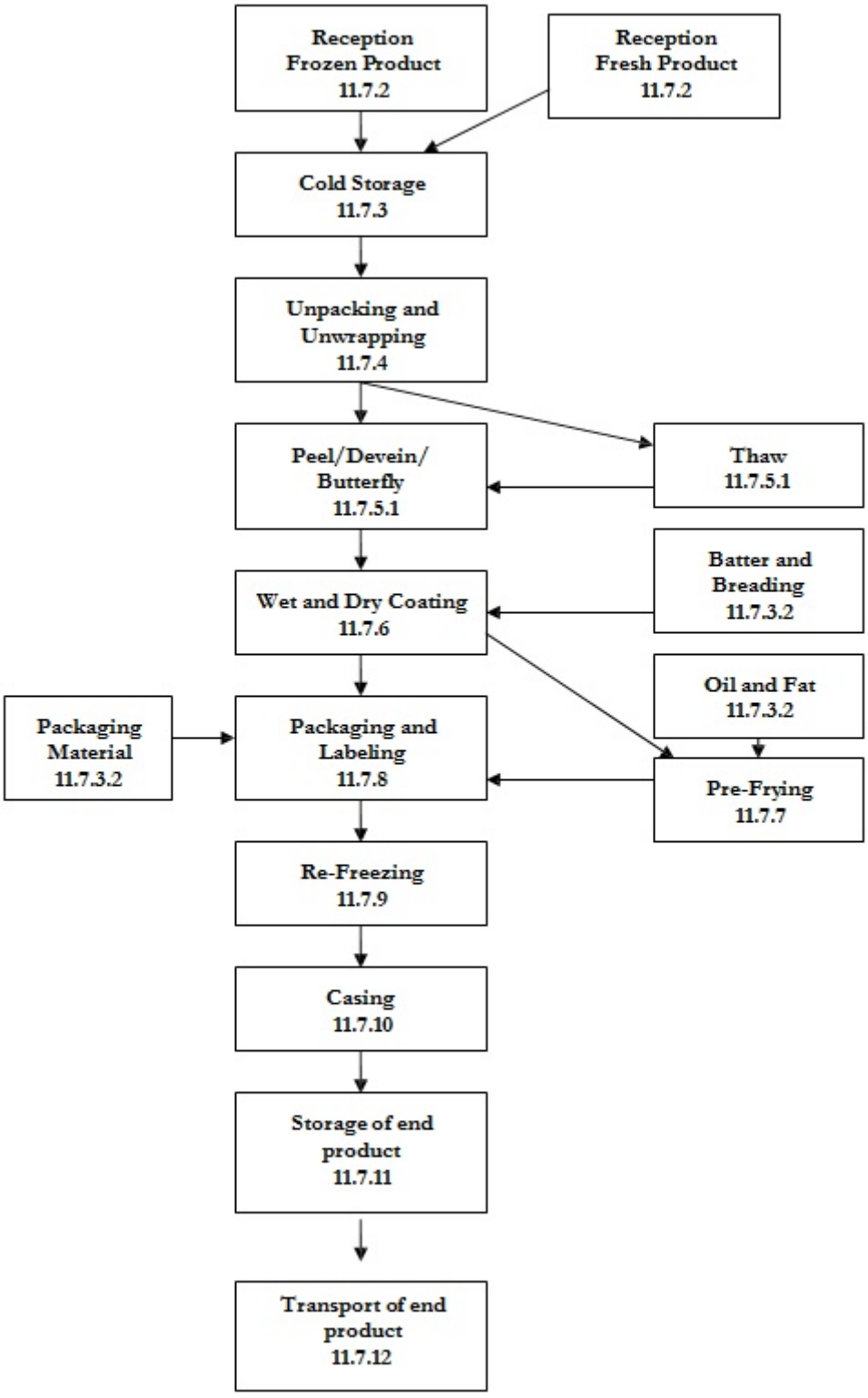

Figure D.8 — Example of a flow chart of a coated shrimp processing line

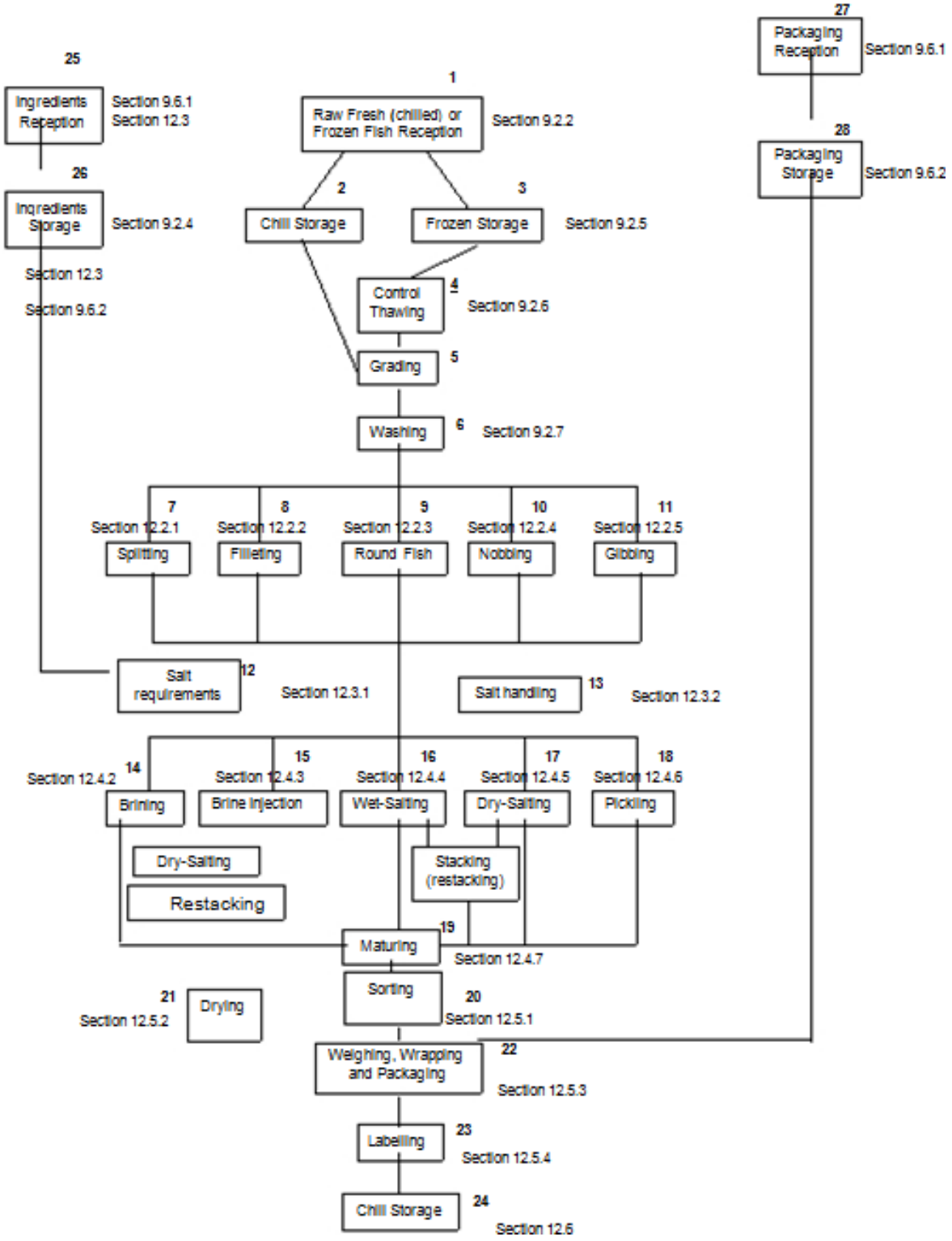

Figure D.9 — Example of a flow chart for salted and dried salted fish processing line

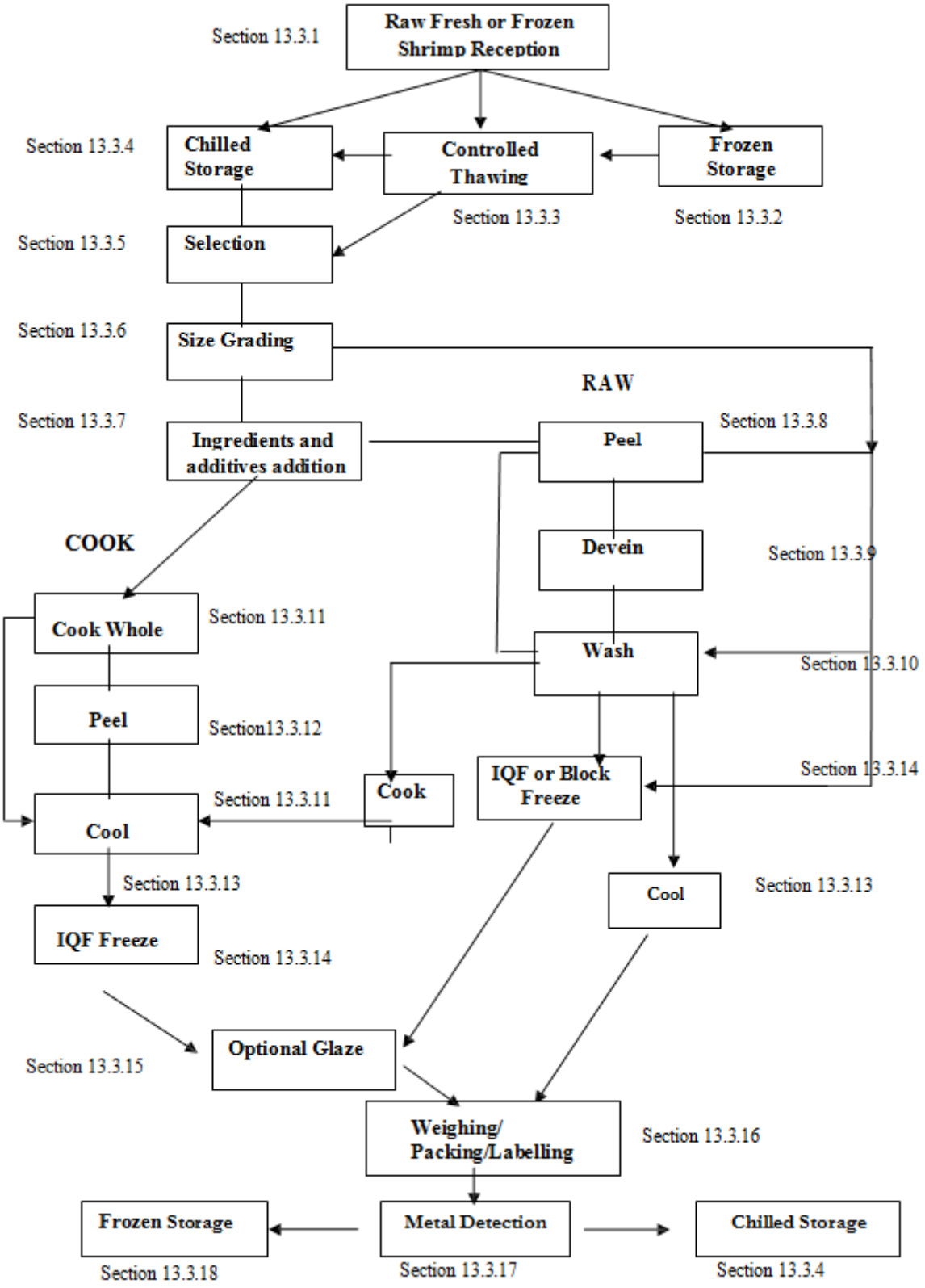

Figure D.10 — Example of a flow chart of a shrimp and prawn processing line

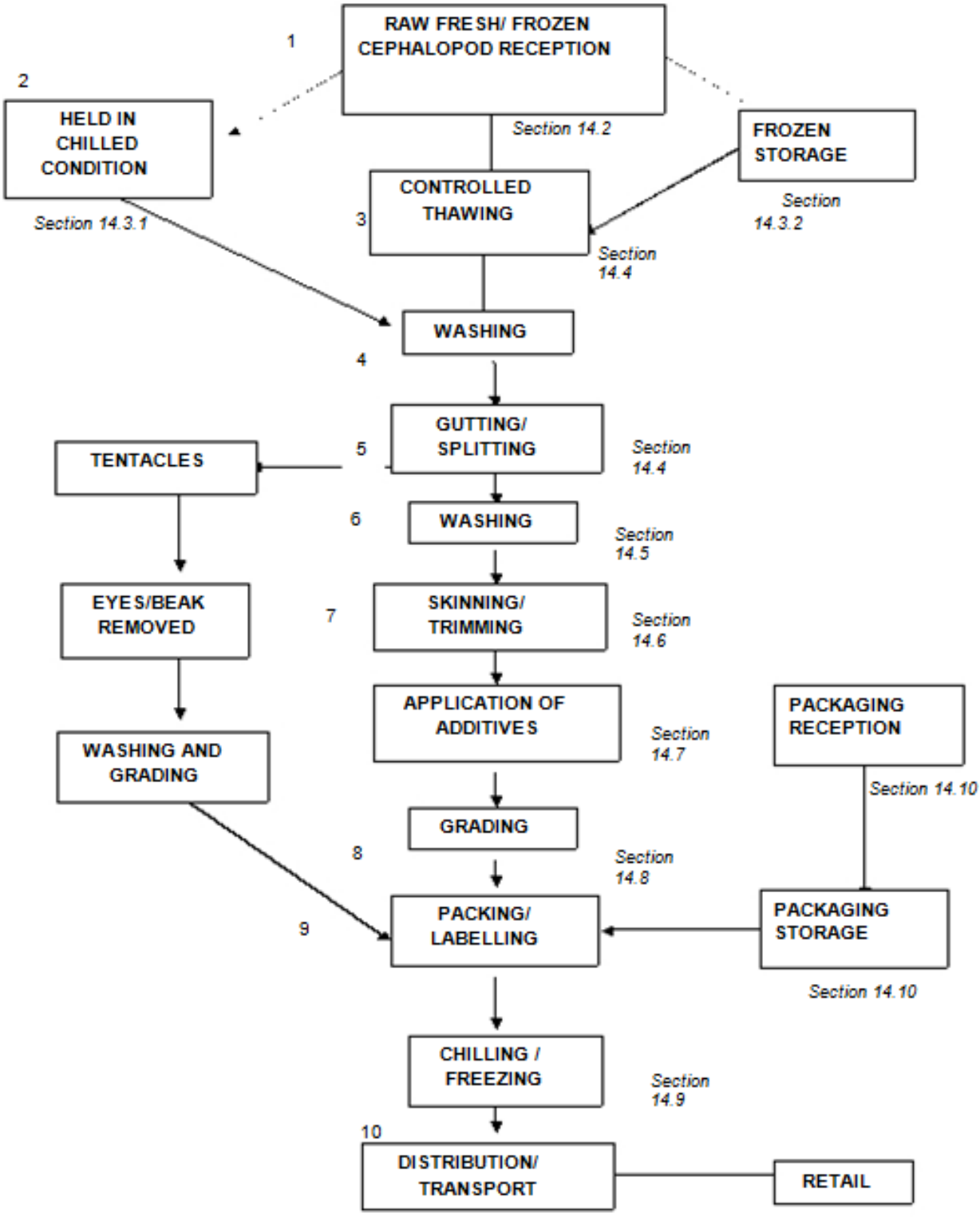

Figure D.11 — Example of a possible squid processing line

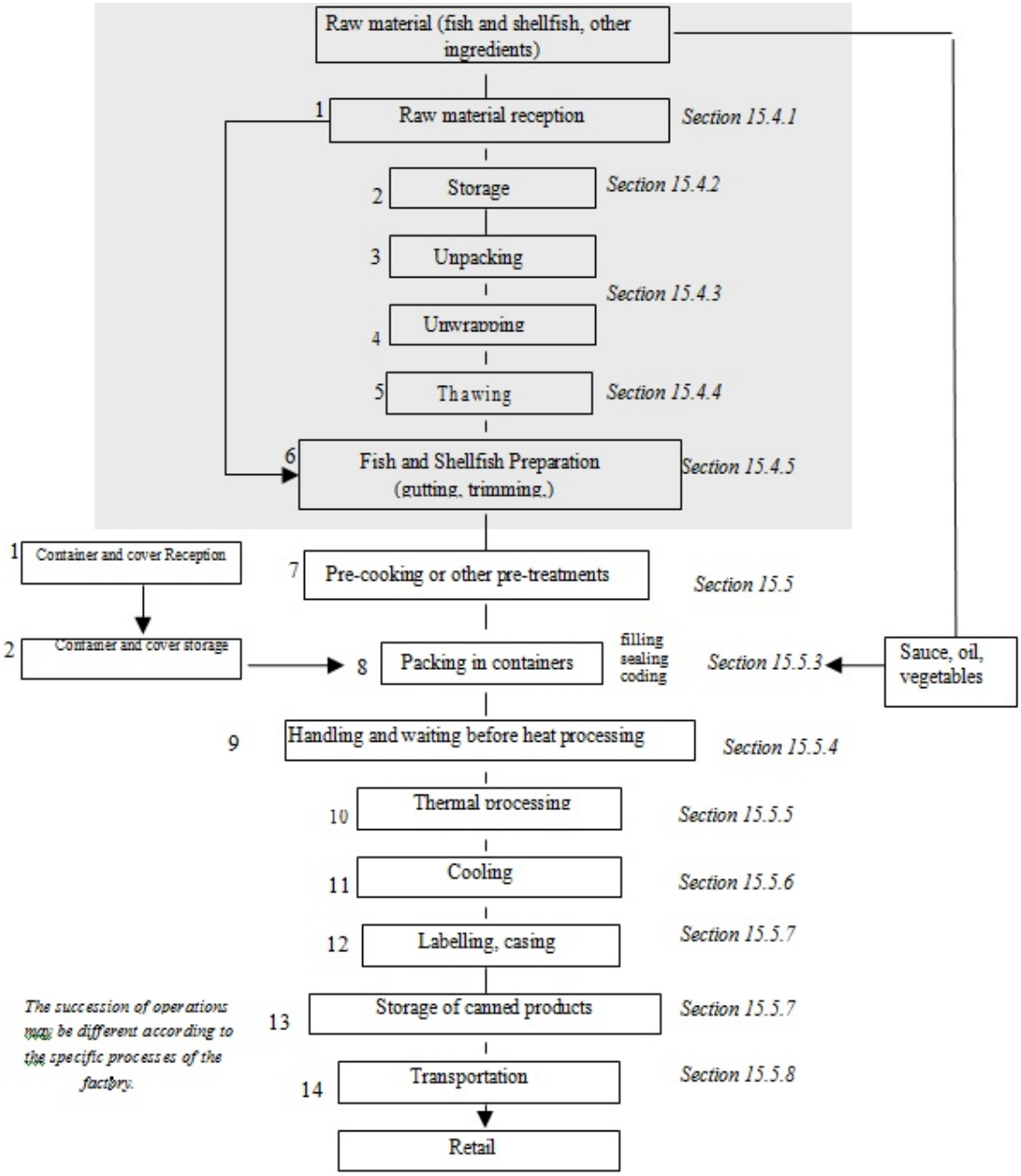

Figure D.12 — Example of a flow chart for the processing of canned fish and shellfish

Annex E
(normative)

General remarks, addition to the pre-requisite programme

E.1 Bivalve molluscs 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 dry conditions soon die out of water and are best handled as chilled products or processed.

NOTE When spawning (following "gonad ripening") occurs, it becomes undesirable and in many instances impracticable to trade them as live animals. Stress can induce spawning.

E.2 The main hazard known for the production of bivalve molluscs is microbiological contamination of waters in which they grow, especially when the bivalve molluscs are intended to be eaten live or raw. Since molluscs are filter feeders they concentrate contaminants to a much higher concentration than the surrounding sea water. The contamination with bacteria and viruses 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 a result from agricultural run-off and or sewage contamination like enteric bacterial and or viral pathogens (Norovirus, viruses causing hepatitis) or from natural occurring bacterial pathogens (*Vibrio* spp.). Another hazard is formed by biotoxins. Biotoxins produced by some algae can cause various forms of serious poisoning like diarrhetic shellfish poisoning (DSP), paralytic shellfish poisoning (PSP), neurotoxic shellfish poisoning (NSP), amnesic shellfish poisoning (ASP) or poisoning caused by Azaspiracid (AZP). Chemical substances, such as heavy metals, pesticides, organochlorides, petro-chemical substances may also form a hazard in certain areas.

E.3 Control of hazards, identification and monitoring of growing areas is very important for bivalve molluscs safety. The identification, classification and monitoring of these areas should be carried out by the competent authorities in cooperation with fishermen and primary producers. *E. coli*/ or faecal coliforms or total coliforms may be used as an indicator for the possibility of faecal contamination. If biotoxins are found in the bivalve molluscs flesh in hazardous amounts the growing area must be closed for harvesting bivalve molluscs until toxicological investigation has made clear that the bivalve mollusc meat is free from hazardous amount of biotoxins. Harmful chemical substances should not be present in the edible part in such amounts that the calculated dietary intake exceeds the permissible daily intake.

E.4 Bivalve molluscs from waters subject to microbiological contamination, as determined by the authority having jurisdiction, can be made safe by relaying in a suitable area or a depuration process to reduce the level of bacteria if the process is continued long enough, or by processing to reduce or limit target organisms. Depuration is a short-term process commonly used to reduce low levels of bacterial contamination, but long term relaying is required if there is a greater risk of contamination.

E.5 Stress and excessive shocks of the bivalve molluscs must be avoided especially when the bivalve molluscs need to undergo relaying or depuration to be eaten live or raw. This is important because these bivalve molluscs should be able to function again during depuration, relaying or conditioning.

Annex F
(informative)

Examples of unacceptable sensory characteristics

The best method of assessing the freshness or spoilage of fish is by sensory evaluation techniques. It is recommended that appropriate sensory evaluation criteria be used to evaluate 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:

Table F.1 — A product description for canned tuna in salted water

Body part/ Physical characteristic	**Unacceptable 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

Annex G
(informative)

Optional final product requirements - Salted fish

G.1 Product specification

These products specifications describe the optional defects for salted fish. The descriptions of optional defects will assist buyers and sellers in describing those defect provisions. These descriptions are optional and are in addition to the essential requirements prescribed in the appropriate CODEX product standards.

G.2 Product designation of salted fish of family Gadidae

G.2.1 Reference is given to the CODEX Standard for Salted Fish and Dried Salted Fish of the Gadidae Family of Fishes (CODEX STAN 167-1989).

G.2.2 Products from the species as identified in Table G.1, all belong to the Gadidae family, should have been bled, gutted, beheaded and split so that approximately two thirds of the backbone is removed, washed and fully saturated with salt. Salted Fish used for production of Dried Salted Fish shall have reached 95 % salt saturation prior to drying.

Table G.1 — Species used to produce dried salted fish

English name	Latin name
Blue ling	Molva dypterygia
Cod	Gadus morhua
Forkbeard	Phycis blennoides
Greenland cod	Gadus ogac
Haddock	Gadus aeglefinus / Melanogrammus aeglefinus
Ling	Molva molva
Pacific cod	Gadus macrocephalus
Polar cod	Boreogadus saida
Pollack	Pollachius pollachius
Saithe	Pollachius virens
Tusk	Brosme brosme

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