Training Modules on Food Safety Practices for Aquaculture

Food Safety Practices for Aquaculture









Introduction

This module is part of a training program on Food Safety Practices for the Aquaculture Industry.

This program was developed through a partnership facilitated by the Partnership Training Institute Network (PTIN) of the Food Safety Cooperation Forum (FSCF) of the Asia Pacific Economic Cooperation (APEC) Forum. The educational content was designed by faculty at Michigan State University. Funding for this effort was provided by The World Bank Group.

To learn more about the APEC FSCF Partnership Training Institute Network, please visit <u>http://fscf-ptin.apec.org/</u>.

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Ensuring Food Safety During Post-Harvest Handling and Processing











Food Safety in Post-Harvest and Processing Module Overview

Building an effective food safety system requires the establishment and maintenance of appropriate good practices which provide an environment conducive to producing safe food. In a food manufacturing setting, these practices are often collectively referred to as prerequisite programs (PRPs). These PRPs can include a wide variety of foundational programs such as Good Manufacturing Practices (GMPs) covering the design and operation of the facility as well as sanitation and hygiene practices such as facility cleaning and disinfection procedures and worker hygiene.

The following topics will be discussed in this section:

- Food Safety Prerequisite Programs
- Facility Design and Construction
- Equipment and Utensils
- Hygiene Control Programs
- Worker Health and Personal Hygiene
- Transportation
- Product Tracing and Recall Procedures
- Training











Food Safety in Post-Harvest and Processing Food Safety Prerequisite Programs

Having effective prerequisite programs in place is necessary before a facility can effectively implement an integrated food safety management system such as Hazard Analysis and Critical Control Points (HACCP).

Effective PRPs provide the strong foundation necessary to ensure the food facility has an overall environment that is conducive for producing safe food. These PRPs must be in place and operational at all times to ensure the success of the overall food safety management system.

The established PRPs should be specific for each establishment and require monitoring and evaluation to ensure their continued effectiveness.

The figure on the right illustrates the critical importance of GMPs and other PRPs. These programs are the foundation of an effective food safety management system.



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Food Safety in Post-Harvest and Processing Food Safety Prerequisite Programs

The following are examples of common prerequisite programs :

- Building and equipment design, fabrication and maintenance
- Production line design and product flow
- Cleaning and disinfection programs
- Equipment calibration
- Management commitment
- Supplier approval
- Product Specifications
- Water quality
- Staff hygiene practices
- Staff training
- Staff health
- Pest control
- Waste control
- Storage and Distribution
- Product recall



Photo: Serfling US FDA









Food Safety in Post-Harvest and Processing Facility Design and Construction

Proper design, construction and maintenance of the food facility is important for ensuring food safety by minimizing the potential for cross-contamination, facilitating appropriate cleaning and disinfection, and minimizing contamination from pests. This section will discuss the following:

- Facility location
- External grounds maintenance
- Facility layout
- Facility construction
- Potable and waste water systems
- Hand washing and toilet facilities
- Lighting
- Storage
- Monitoring of facilities



Photo: Serfling US FDA









Food Safety in Post-Harvest and Processing Facility Location

The site where the food facility is located is extremely important for the safety and quality of products. Products can easily be affected by factors outside of the facility. For example, activities carried out in adjoining premises may result in:

- dust
- smoke
- odor
- volatile compounds
- shared drainage
- harborage for pests

Proximity to rivers or waterways may also create problems, such as the potential for contamination in the event of flooding.

If you are unable to change the location of the facility or new factors which could affect the facility are introduced, you must put control measures in place to ensure that the safety and quality of the products are not compromised by the local environment.

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Food Safety in Post-Harvest and Processing Maintenance of Roads, Yards, and Parking Areas

Roads, yards, and parking areas must be maintained to an appropriate standard to prevent contamination of products.

Particularly in dry areas, roads, yards, and parking lots can have problems with dust which can be swept up by vehicles and blown into the facility. Keeping these areas free from a build-up of grit and dust will significantly reduce the risk of contamination. Good maintenance of these areas will also reduce the risk of staff carrying any contamination on shoes or clothes into the food production areas.



Photo by Zach K / Flickr











Food Safety in Post-Harvest and Processing Harborage of Pests

The location of the facility and its surrounding area is important since pests may become a problem. Facilities that are near a water source or heavily-vegetated overgrown areas will have an increased risk of pests entering the facility, particularly at certain times of the year when their food sources and shelter may become scarce. If you are unable to change the location of the facility, then be sure to deny pests harborage. You must control and manage the external areas around the facility to reduce the likelihood of pest ingression and possible infestation. Pest control measures such as baiting for rodents at the perimeter of the factory should be considered.

When planning pest control measures, you also need to consider waste management procedures and the storage of materials used at the facility.



Photo by Fin Fahey / Flickr











Food Safety in Post-Harvest and Processing **Protection from Pests**

The construction of the building and its maintenance should be such as to prevent the entry or harborage of pests such as rodents, insects, and birds.

Building materials that are joined or seamed should have no gaps. Piping or ducting entering or exiting the factory should be sealed.

The actual building design should not encourage roosting areas for birds or have large voids which are difficult to access and clean. For example, suspended ceilings allow food particles to accumulate and thus create ideal conditions for pests such as insects to live and breed without hindrance.



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Food Safety in Post-Harvest and Processing Storage of Equipment and Waste

Where possible, there should be no external storage of equipment or materials. However, when equipment needs to be stored outside the facility it should be stored in a manner to eliminate any risk of contamination of the product, carefully inspected on a regular basis, and cleaned before use.

In some cases, materials such as packaging may be stored externally but you should take measures to protect the material from contamination. The material must be regularly monitored for contamination by foreign materials or infestation by pests.

Where raw materials are stored in silos or other containers external to the production area, these need to be maintained to the appropriate hygiene standards, protected against pest infestation, and regularly inspected.

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Food Safety in Post-Harvest and Processing Drainage and Treatment of Waste

Surface water drainage should be designed so that the surface water is diverted away from the facility as quickly as possible. Correcting any drainage problem is particularly important where high levels of rainfall occur. There should be no area in close proximity to the facility where surface water doesn't drain appropriately and is able to accumulate.

Any waste treatment and disposal systems should be outside the facility and as far away as possible from the production and storage areas. The waste treatment and disposal systems should be operated properly and pose no risk of product contamination either by atmospheric contamination, physical contamination, or pest infestation.

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Food Safety in Post-Harvest and Processing Facility Layout

Proper design of the food facility is critical to ensuring food safety. The facility should include a product flow pattern that is designed to prevent potential sources of contamination, minimize process delays (which could result in further reduction in quality), and prevent crosscontamination of finished products with potential food safety hazards from raw materials.

Fish, shellfish and other aquatic invertebrates are highly perishable foods and must be handled carefully and rapidly chilled to minimize proliferation of microbial pathogens and other microorganisms which cause decomposition. Therefore, the facility should be designed to facilitate rapid processing and subsequent storage.



Diagram: FAO (http://www.fao.org/docrep/003/x6556e/X6556E01.htm)











Food Safety in Post-Harvest and Processing Design and Layout

The design and layout of a facility is important to minimize the risk of product contamination due to poor personal hygiene practices or exposure to microbiological, chemical or physical hazards. The following factors also should be carefully considered when designing an appropriate facility layout:

- Equipment placement and storage of materials in a manner that will minimize the potential for cross-contamination.
- Points of entry for workers and incoming ingredients including raw materials.
- Provision of adequate hand-washing facilities.
- Provision of adequate toilet facilities.
- Ensuring the incoming water supply is able to deliver sufficient quantities of potable water at peak demand and that waste water systems are adequate in capacity and designed to minimize contamination of food, ingredients and packaging materials.
- The design of the facility should minimize the risk of contamination of food products.

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Food Safety in Post-Harvest and Processing Design to Reduce Contamination of Products

A facility can be carefully designed so that the number of possible food contact surfaces is reduced, therefore minimizing the risk of product contamination.

The physical separation of foods, either by the use of designated areas or the movement and control of packaged raw materials, will also significantly reduce the risk of cross-contamination.

Where possible, workflow should be linear and progress in a uniform and logical direction from raw material to finished product. The movement and separation of staff is an important factor in reducing risk of contamination, particularly in relation to high-risk foods or where allergen control is deemed important. Good practice procedures such as color-coding the different work areas, having staff wear protective clothing, and implementing quick and thorough cleaning of equipment and process utensils are policies staff must follow.



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Food Safety in Post-Harvest and Processing Facility Construction

The materials used in the construction of the facility also are fundamentally important to minimize the risk of product contamination. Inappropriate or inadequate materials used in the facility construction can lead to product contamination or a reduction in quality of products.

This section looks not only at the construction of elements in a facility such as floors, walls and ceilings, but also at the equipment and the ventilation systems used within the facility.

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Food Safety in Post-Harvest and Processing Materials and Design of Floors, Walls, and Ceilings

Ceilings should be smooth, clean, fire-resistant, non-flaking, lightcolored, covered at wall joints, and easy to clean.

Walls should be clean, smooth, impervious, non-flaking, durable, light-colored, and capable of being thoroughly-cleaned or disinfected. Surfaces should be resistant to spillages, chemicals, grease, heat, and impact.

Floor surfaces should be clean, durable, non-absorbent, anti-slip, free from crevices, and capable of being effectively cleaned. Depending upon the products processed, floors may need to be resistant to acids, grease, and salts, and, where necessary, should slope sufficiently for liquids to drain to trapped gullies.

The surfaces of walls, partitions and floors should be made of impervious, non-toxic materials.

Joints between floors and walls should be constructed for ease of cleaning (round joints).

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Food Safety in Post-Harvest and Processing Windows and Doors

Windows and doors are probably the most vulnerable part of the facility with respect to pests and other contaminants entering the factory. This section covers the measures that you can take to reduce the risk of pests and contaminants entering the facility, including proofing, screening, and a procedure for closing doors.

Windows should be constructed to minimize the buildup of dirt and, where necessary, be fitted with removable and cleanable insect-proof screens. Where necessary, windows should be fixed.

Doors should have smooth, non-absorbent surfaces.

Modern food facilities very rarely have glass windows as part of their design because of the risk of glass contamination in finished food products. If your facility has glass windows then make sure that there is adequate protection against breakage. You can do this by covering them with a screen or a clear plastic film so that if there is a breakage, no glass is deposited into the facility.

Photo by Jóhann Heiðar Árnason

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Food Safety in Post-Harvest and Processing Windows and Doors

Pest-proofing or screens should be used on all windows and doors in the facility. These screens should be easy to clean and cleaned regularly to prevent contamination. If there is an issue with dust coming into the facility, then dust screens should be added to all windows and doors.

Doors should not have significant gaps at the bottom since rodents can easily enter the facility. A rule used is that "if a pencil can fit under the door, then so can rodents." Instead of replacing the door completely, pest excluders can be attached to the door, preventing pests from entering the facility.

In any food production facility, it is bad practice to have doors open for long periods of time. Since factories are usually busy places and doors are used frequently, it is easy for staff to forget to close doors behind them. Wherever possible, external doors should be self-closing or on a timed switch where they close when not in use.

Doors fitted with curtains to prevent the ingression of flying insects or birds are not 100% effective, so doors should be fully closed when not in use.

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Food Safety in Post-Harvest and Processing **Ventilation**

Ventilation should be sufficient to remove excess steam, smoke and objectionable odours, and cross contamination through aerosols should be avoided.

Where there is a risk of foreign body contamination, such as dust or dirt particles or atmospheric contamination from odors or volatile compounds, there should be adequate ventilation systems in place.

When designing ventilation systems, you should take care to ensure that there are screening or filtration systems incorporated into the ventilation systems to prevent other contaminants such as insects from entering the factory.

When ventilation systems are incorporated into the factory, these should be included in the factory cleaning schedules.

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Food Safety in Post-Harvest and Processing Water Supply, Ice, and Waste Water Systems

The facility water supply should be adequate with respect to quantity and quality of water , and always be derived from an appropriate source. Water that comes from a private source, such as a well or natural spring, must be tested for microbiological quality and other possible contaminants. Good practice dictates that water must be tested at least once per year if it is derived from a properly constructed well or treated municipal water source, but actual testing frequencies for water by a facility should be based on a risk assessment. Any problems with the safety of the water supply should be corrective immediately.

Fish packing and transportation operations often utilize large quantities of ice. Suitable and adequate facilities must be provided for production and storage of ice. Ice should only be produced using potable water.

Waste water systems from the factory should be adequate in size and design to prevent the possibility of used or foul water flowing back into the factory and causing significant risk to health.

If production increases at your facility, make sure the incoming water supply is able to accommodate this increase. Measures may need to be taken to ensure the quality and quantity of water is still adequate. Adequacy of waste water systems must be also be considered if there is an increase of waste water volume produced by the facility.

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Food Safety in Post-Harvest and Processing Backflow Prevention

<u>Backflow</u> is defined as the flow of water or other liquids, mixtures, or substances into a potable water system from any source, other than the intended source.

A <u>cross connection</u> is defined as any connection or structural arrangement between a potable water system and a non-potable source, liquid or otherwise, through which backflow can occur.

Water systems must be designed in a manner that minimizes the risk of backflow of non-potable water or waste into the potable water system. This design will typically require the use of air gaps, air breaks, and backflow prevention devices.

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Food Safety in Post-Harvest and Processing Backflow Prevention

Examples of an air gap or air break in a waste line, and backflow prevention devices.

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Food Safety in Post-Harvest and Processing Lighting

Adequate lighting with respect to the level of luminosity and light color is necessary to provide safe and satisfactory working conditions for staff and to allow essential activities such as cleaning and raw material inspection to take place under optimum conditions.

When reviewing the position of lighting in your facility, you should eliminate any possible contamination risk with respect to breakage. Fluorescent bulbs which can be easily damaged could break and contaminate product.

This section describes considerations for lighting and procedures to be taken to minimize the risk of glass contamination from lighting units in the facility.

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Food Safety in Post-Harvest and Processing Adequate Lighting

The intensity of lighting should be appropriate in relation to the activities undertaken within that area of the factory. Low levels of lighting can be a safety issue for staff and also allow pests such as rodents to remain undetected. Furthermore, inadequate lighting can hinder the effectiveness of cleaning and disinfection procedures.

Certain steps during production, such as the visual inspection of raw materials for possible contaminants, may require specific strategically-placed lighting units to ensure an optimum level of luminosity and color at all times of day. The use of natural or low-level lighting for such processes would mean that workers at night or workers with low levels of natural light would not achieve effective inspection or control of contamination.

The color of lighting is important, particularly when inspecting for color defects in products such as fruits and vegetables. The color of some light sources may prevent inspection staff from identifying product defects.

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Food Safety in Post-Harvest and Processing Lighting Maintenance Procedures

Maintenance procedures should be in place for lighting units. It is important for maintenance staff to be aware of the risk of product contamination by glass if these procedures are not followed. To minimize any risk, maintenance on lighting units should occur only when there are no production activities taking place. It is good practice to document maintenance procedures and make staff aware of these procedures. It is also good practice to have procedures in place in the event of light units breaking, either when production is being carried out or during lighting maintenance.

All glass lighting units such as fluorescent bulbs should be protected by diffusers which will prevent breakage under normal use. These diffusers, however, should be regularly cleaned as part of the factory hygiene and cleaning schedule.

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Food Safety in Post-Harvest and Processing **Storage**

As a food safety manager, your attention should be focused on the production areas of the factory. However, product storage areas are equally as important since incorrect storage can pose a risk to the product and the factory itself. The control of storage areas and product does not just include raw materials; it also involves the finished products, transportation, and waste storage.

Separate and adequate facilities must be provided in order to prevent contamination :

- by poisonous or harmful substances,
- by offal and waste materials, or
- during dry storage of materials, packaging, etc.

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Food Safety in Post-Harvest and Processing Storage of Raw Materials and Finished Products

The controls that exist for materials in the production area should be the same for raw materials. Raw materials and ingredients must be protected from contamination by physical, chemical, and microbiological contaminants, for they will have a significant effect on the finished product's quality, safety, and legality. Your company will also experience significant commercial loss if raw materials are destroyed or if contamination of raw materials impacts the safety of semi-processed and finished products.

You must have raw material monitoring processes in place during receipt of products and their subsequent storage. If deterioration in quality or pest infestation is found immediate corrective actions should be taken.

Perishable raw materials and finished products should be stored under conditions, such as refrigeration or freezing, to prevent any potentially pathogenic bacteria from multiplying and to slow down the rate of spoilage. Storage methods must be conducive to following the "first in, first out" rule. Also, specific storage-related procedures should be in place and results recorded.

The finished food products should be stored in a suitable manner so that they cannot become contaminated or perish rapidly. If possible, finished products should also be stored away from raw materials since contact could lead to post-process contamination and, in some cases, pose a significant risk to health.

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Food Safety in Post-Harvest and Processing Monitoring of Facilities

Monitoring is particularity important to ensure that the facility continuously meets requirements. Regular inspections are important and a schedule to do so should be in place. Problems unnoticed during daily production may go undetected and cause significant contamination issues. A regular inspection should address things such as ventilation systems, overhead pipes, or external building fabrication that may not be noticed on a daily basis. If problems are found, the maintenance staff should be notified immediately and corrective actions taken as soon as possible. As always, monitoring procedures should be documented.

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Food Safety in Post-Harvest and Processing Equipment and Utensils

The equipment and utensils used for the handling and processing of fishery products in a facility will vary greatly depending on the nature and type of operation involved. The condition of the equipment and utensils should be such that it minimizes the buildup of residues and prevents them becoming a source of contamination.

Equipment used in the facility should be able to be easily and effectively cleaned and properly maintained. There should be adequate space around the equipment to allow routine maintenance and cleaning. If the facility does not have adequate space around each piece of equipment, then it should be easily moveable to create space when maintenance and cleaning are required.

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Food Safety in Post-Harvest and Processing Equipment and Utensils

The design and construction of equipment and utensils in the facility should take into consideration the following factors to ensure ease of cleaning and disinfection procedures:

- Equipment should be durable and movable and/or capable of being disassembled to allow for maintenance, cleaning, disinfection and monitoring.
- Equipment, containers and utensils coming into contact with fish, 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.
- Equipment and utensils should be designed and constructed to minimize sharp inside corners and projections and tiny crevices or gaps in order to avoid dirt traps.
- A suitable and adequate supply of cleaning utensils and cleaning agents, approved by the official agency having jurisdiction, should be provided.

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Food Safety in Post-Harvest and Processing Equipment and Utensils

The design and construction of equipment and utensils in the facility should take into consideration the following factors to minimize contamination of fish and fish products:

- All surfaces of equipment in handling areas should be non-toxic, smooth, impervious and in sound condition to minimize the buildup of fish slime, blood, scales and guts and to reduce the risk of physical contamination.
- Accumulation of solid, semi-solid or liquid wastes should be minimized to prevent contamination of fish.
- Adequate drainage should be provided in storage containers and equipment.
- Drainage should not be permitted to contaminate products.

Furthermore, the equipment and utensils in the facility should have the following characteristics to minimize damage to the fish and fish products:

- Surfaces should have a minimum of sharp corners and projections.
- Chutes and conveyors should be designed to prevent physical damage caused by long drops or crushing.
- Storage equipment should be fit for the purpose and not lead to crushing of the product.

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Food Safety in Post-Harvest and Processing Food Contact Materials

All food contact materials should be non-corrosive and made of non-toxic materials. Most suppliers of food processing equipment will produce a certificate of conformance with the relevant legal requirements for food contact materials.

The equipment should be of sound construction, durable, easy to maintain and clean and, where appropriate, easy to disinfect.

All equipment which comes into direct contact with food should be regularly inspected to ensure that it does not pose any risk to food safety. With respect to high-risk foods, it is good practice to carry out regular swab checks to assess the microbiological populations on a particular work surface. The presence of significant populations of microorganisms on food contact surfaces could indicate that cleaning and disinfection procedures may need to be reassessed.

There are occasions when, if a piece of equipment that comes into direct contact with food has a highly damaged surface, the prescribed cleaning processes may be inadequate to fully sanitize the surface of the equipment. A good example is a meat cutting board where general cleaning processes undertaken during a production period are ineffective. In such cases, the equipment or utensil should be replaced, resurfaced or refurbished, as appropriate.

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Food Safety in Post-Harvest and Processing Seams of Food Contact Surfaces

Where there are seams or joints in food contact surfaces, these should be smoothly bonded and, where appropriate, sealed. Poor seams that are not smoothly bonded can provide an environment where food residues can accumulate and support the growth of bacteria. These areas are notoriously difficult to clean properly, so the risk of microbiological hazards significantly increases.

A primary area of concern involves food that is processed or conveyed within closed pipe systems. Poor internal surfaces formed around pipe seams and joints which cannot be appropriately cleaned can provide an environment where food residues accumulate and continuously contaminate food with bacteria. For this reason, it is particularly important to ensure that equipment and piping in food facilities doesn't have any "dead ends" or other areas where food residues can be trapped.

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Food Safety in Post-Harvest and Processing Maintenance of Facility

As the manager responsible for food safety, you should ensure that regular inspections are carried out in relation to the condition of the facility and equipment. In the event it is determined that conditions in the facility could compromise food safety, you should undertake maintenance or cleaning action immediately to resolve any issues.

To ensure these inspections are carried out on a defined frequency, it is good practice to develop and maintain a schedule specifying where and when areas must be inspected for repair and the effectiveness of cleaning and sanitizing.

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Food Safety in Post-Harvest and Processing **Hygiene Control Programs**

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

Schedules should be implemented to:

- prevent the buildup of waste and debris,
- protect the fish, shellfish and their products from contamination,
- dispose of any rejected material in a hygienic manner,
- monitor personal hygiene and health standards,
- monitor the pest control program,
- monitor cleaning and disinfecting programs, and
- monitor the quality and safety of water and ice supplies.

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Food Safety in Post-Harvest and Processing The Importance of Cleaning and Disinfection

Appropriate and timely cleaning and disinfection of equipment, utensils and food contact surfaces protects the safety and quality of foods.

Accumulated soils on equipment used for the production of food can support the growth of pathogenic microorganisms that can compromise the safety of products. This is why it is important to have a defined cleaning and disinfection schedule for all equipment and any other food contact surfaces. Regular cleaning and disinfection will significantly reduce the risk of potential microbiological contamination.

With respect to the factory premises, if residues of food are not cleaned within your factory (for example spillages and poorly maintained waste containers) these accumulated food residues can attract and support pests. These pests can be a source of pathogenic microorganisms, therefore posing a contamination risk to your food products.

Effective cleaning and disinfection can also significantly reduce the level of spoilage microorganisms in the environment and in finished food products, which in turn can also improve the shelf life and quality of food products.

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Food Safety in Post-Harvest and Processing Cleaning and Disinfection – Definitions

It is important to understand the difference between cleaning and disinfection.

<u>Cleaning</u> is the *removal* of soil, food residue, dirt, grease or other objectionable matter.

Disinfection is the *reduction* by means of chemical agents and/or physical methods, of the number of microorganisms in the environment to a level that does not compromise food safety or suitability. This is sometimes referred to as sanitizing.

Photo by grreeblie/Flickr

Food Safety in Post-Harvest and Processing Cleaning and Disinfection Process

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

- 1. Precleaning: Preparation of area and equipment for cleaning. 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.
- 2. Pre-rinse: A rinsing with water to remove remaining large pieces of loose soil.
- 3. Cleaning: The removal of soil, food residues, dirt, grease or other objectionable matter.
- 4. Rinse: A rinsing with potable water or clean water, as appropriate, to remove all soil and detergent residues.
- 5. Disinfection: Application of chemicals, approved by the official agency having jurisdiction, and/or heat to destroy most micro-organisms on surface.
- 6. Post-rinse: As appropriate, a final rinse with potable water or clean water to remove all disinfectant residues.
- 7. Storage: Cleaned and disinfected equipment, container and utensils should be stored in a fashion that would prevent their contamination.

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Food Safety in Post-Harvest and Processing Cleaning and Disinfection Schedule

A permanent cleaning and disinfection schedule should be drawn up to ensure that all parts of the processing facility and equipment therein are cleaned appropriately and regularly.

The cleaning and disinfection of all food-contact surfaces must be undertaken on a pre-determined cleaning schedule, or as required to minimize the risk of contamination.

Good practice dictates the development of detailed cleaning schedules which specify what, how, when, and by whom food contact surfaces are cleaned and disinfected.

The schedule should be reassessed whenever changes occur to the processing facility and/or equipment. Part of this schedule should include a "clean as you go" policy.

It is imperative as part of the cleaning and disinfection process that you verify that cleaning and sanitation procedures are effective and expected levels of cleanliness have been achieved.

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Food Safety in Post-Harvest and Processing Example of Recommended Cleaning Schedule

The following table provides an example of a recommended cleaning schedule that you may use within your factory. Note that this is just an example for illustrative purposes. The cleaning and disinfection schedule and procedures used in your facility should be developed based on the food products produced, the nature of the equipment and production methods used, and other considerations.

Type of Surface	Recommended Cleaning Substance	Frequency of Use
Stainless steel	Alkaline, not abrasive	Daily
	Acid, not abrasive	Weekly
Metals (copper, aluminum, galvanized surfaces)	Moderately alkaline substances with corrosion inhibitors	Daily
Wood	Detergents with surfactants	Daily
Rubber	Alkaline Substances	Daily
Glass	Moderately alkaline substances	Daily
Concrete Floors	Alkaline	Daily

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Food Safety in Post-Harvest and Processing Personnel Responsibilities

In each processing plant, trained individuals should be designated to be responsible for the sanitation of the facility and the equipment therein.

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

The individuals responsible for cleaning and disinfection procedures also should be well-versed in:

- cleaning and disinfection schedules,
- appropriate procedures, including safe handling and storage of cleaning and disinfecting chemicals, and
- Appropriate record-keeping procedures to document activities.

Food Safety in Post-Harvest and Processing Maintenance of Premises, Equipment and Utensils

Buildings, materials, utensils and all equipment in the establishment – including drainage systems – should be maintained in a good state and order.

Equipment, utensils and other physical facilities of the plant or vessel should be kept clean and in good repair.

Procedures for the maintenance, repair, adjustment and calibration, as appropriate, of apparatus should be established. For each item of equipment, these procedures should specify the methods used, the persons in charge of their application, and their frequency.

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Food Safety in Post-Harvest and Processing Pest Control Systems

Good hygienic practices should be employed to avoid creating an environment conducive to pests.

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

Physical, chemical and biological agents should be properly applied by appropriately qualified personnel.

Pest control procedures should be implemented and monitored routinely to ensure effectiveness.

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Food Safety in Post-Harvest and Processing Supply of Water, Ice and Steam

<u>Water</u>

- An ample supply of cold and hot potable water5 and/or clean water under adequate pressure should be provided where appropriate.
- Potable water should be used wherever necessary to avoid contamination.

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- Ice should be produced using potable water or clean water.
- Ice should be protected from contamination.

<u>Steam</u>

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

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Food Safety in Post-Harvest and Processing Waste Management

Offal and other waste materials should be removed from the premises of a processing facility. Facilities for the containment of offal and waste material should be properly maintained.

Waste within the facility should be stored in closed containers and segregated from processing areas. It is good practice to have a policy in place to identify waste as soon as possible and remove it from the production line on a regular basis to reduce the risk of contamination.

The waste that is being stored should be protected from pest infestation, which means keeping it in rodent-proof containers that are fully closed to prevent insect attraction.

The amount of waste being produced by the facility should be monitored since a build-up could mean an inadequate number of waste receptacles, resulting in waste being stored incorrectly.

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Food Safety in Post-Harvest and Processing Personal Hygiene and Health

Personal hygiene and facilities should be such to ensure that an appropriate degree of personal hygiene can be maintained in order to avoid contamination.

This section will address:

- Hand washing, toilet and changing facilities
- Hand washing procedures
- Personal cleanliness
- Personal behaviors in a food handling area
- Illnesses and injuries
- Visitor procedures within a facility

Food Safety in Post-Harvest and Processing Hand-Washing Facilities

Staff and visitor hand-washing procedures are extremely important. Hand-washing is considered the most important aspect of personal hygiene to minimize the risk of microbiological contamination.

Hand-washing facilities should be adequate in number and be supplied with hot and cold water, soap, and have appropriate provisions for hand drying. Single use towels or hot air blowers are acceptable means of hand drying, but multi-use towels are not acceptable due to the potential for cross-contamination.

The number of wash basins should reflect the number of staff working at the facility. In many countries there are legal requirements for the ratio of the numbers of wash basins to the number of staff.

The location of wash basins is also important. Staff members are more likely to use the wash basins if they are situated at the entrance to a production area. Hand-washing facilities should also be placed in particularly dirty areas or high-risk areas so that staff have the opportunity to wash their hands on a regular basis.

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Photo: Leslie Bourquin

Food Safety in Post-Harvest and Processing **Toilet Facilities**

There should be an adequate number of toilets for the number of staff working in the facility.

The toilets should not open directly into a food preparation area. Jurisdictions typically have building codes which specify the required characteristics of toilet facilities, including the numbers of doors or other barriers between the toilet and food preparation areas.

The toilet areas also should have hand-washing facilities supplied with hot and cold water, soap and hand-drying equipment available. Signs informing staff of the need to wash their hands before leaving the toilet area should be placed in easily visible places.

The toilet area should be cleaned and disinfected on a regular basis. It is good practice to post a cleaning schedule so that there is a record of when cleaning has taken place. As a food safety manager, you should ensure these areas are inspected and monitored on a regular basis to verify the effectiveness of the cleaning procedures.

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Food Safety in Post-Harvest and Processing **Protective Clothing and Changing Facilities**

Every food handler should wear protective clothing designed to protect the food products from contamination. If not controlled and monitored, protective clothing itself can become a source of product contamination. Buttons, fibers, or dirt may fall into or contaminate the product. Therefore, food handlers must wear clean, undamaged protective clothing. Domestic clothing must not be worn.

Protective clothing should be stored under clean hygienic conditions and be regularly cleaned and thoroughly laundered to a high level of cleanliness. The company needs to ensure that a sufficient quantity of clean protective clothing is available at all times.

Lockable storage facilities should also be available in designated changing areas where protective clothing is available. This will allow workers to easily change their clothes and confidently store their belongings that are not suitable to bring production floor.

Hair also poses a major contamination risk. To prevent this risk, hair must be fully covered by suitable head coverings (hairnets/ hats), or in the case of facial hair, beard nets or snoods. Foot wear must be clean, free from debris, and designed in a way that does not pose any risk to the product.

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Food Safety in Post-Harvest and Processing Hand Washing

It is widely recognized that hands are a potential source of contamination. Food handlers, if poorly trained and managed, pose possibly the greatest risk of microbiological contamination to food. In short, food handlers who practice poor personal hygiene practices may unwittingly poison foods and thus harm consumers.

Frequent hand washing and good personal hygiene practices will significantly minimize the risk of product contamination. You must establish and maintain a system that ensures food handlers wash their hands:

- upon entering a food handling or processing area, including before starting work,
- after any absence from a work station, including breaks,
- after blowing nose or touching face,
- immediately after using the toilet,
- after handling raw food or any contaminated material which could result in contamination of other food items,
- after eating, drinking, or smoking,
- after handling equipment cleaning machines or equipment cleaning utensils,
- after picking up objects from the floor, and
- before and after wearing disposable gloves.

Food Safety in Post-Harvest and Processing Hand Washing Methodology

Each food handler should use the following method to ensure hands are appropriately clean.

- 1. Wet hands with warm running water and apply liquid soap or use a clean soap bar.
- 2. Rub hands vigorously for at least 20 seconds, giving special attention to the backs of the hands, wrists, between the fingers, and under the fingernails.
- 3. Rinse hands well while leaving the water running.
- 4. Dry hands with a clean single-use disposable towel or air drier.
- 5. Where a disposable towel is used, dispose of it without risk of contamination to the food products.
- 6. When turning off the water (if it is not automatically done), use dry hands or a clean disposable towel.

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Food Safety in Post-Harvest and Processing Hand Washing Verification

Since proper hand washing is critically important for the microbiological safety of food, the person responsible for food safety within the facility should monitor this activity carefully.

Employees should be monitored on a routine basis to ensure they are washing their hands at appropriate times and using correct hand washing techniques. This monitoring should not follow a set schedule and should occur at a frequency sufficient to ensure compliance with requirements established in the facility.

It may also be necessary to conduct occasional visual checks on the cleanliness of hands. These random checks should focus on high risk periods such as after toilet visits and shift changes.

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Food Safety in Post-Harvest and Processing Personal Cleanliness

Food handlers are held to a high standard of personal cleanliness that other jobs may not require. Policies regarding personal cleanliness of employees in food operations are intended to minimize the risk of product contamination with physical, chemical, and microbiological contaminants.

Food handlers should:

- wear clean protective clothing to protect food from contamination,
- not wear jewelry, and should be aware of where you have placed personal belongings,
- be aware of ways in which injuries might occur and know what to do in the event of an injury that potentially impacts food safety.

Each of these requirements will be discussed in sequence.

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Food Safety in Post-Harvest and Processing Personal Behavior

A person's behavior and personal habits can have a significant effect on the safety of a food product they handle or produce. Staff should be trained and supervised to ensure certain behaviors are discouraged.

Wherever possible, you should promote a culture of personal professionalism and pride in working in a food production environment. Employees should reflect the behavior expected of them. They should be carefully supervised to ensure appropriate behavior.

Photo: www.bigstockphoto.com

Food Safety in Post-Harvest and Processing Improper Activities

To prevent contamination of the product, people working within a food production area must refrain from the following activities:

- smoking
- spitting
- chewing or eating
- sneezing or coughing over unprotected food, food packaging, or utensils that are used for food contact or cleaning
- licking fingers
- biting of fingernails

Preferably, drinking of any liquid should not be allowed in the production area. However, when drinking is allowed in the production area, it should be controlled and supervised to make sure safety of the product is not compromised. Any drink vessel should be disposed of in an appropriate manner.

Food employees also must keep their fingernails trimmed, filed, and maintained so the edges and surfaces are cleanable and not rough. Fingernail polish and artificial nails are discouraged as they may contaminate food products.

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Food Safety in Post-Harvest and Processing Jewelry and Personal Belongings

Jewelry, which often harbors dirt and bacteria, can contaminate food. Also, jewelry can be a potential physical contaminant if it falls off into the production stream. It is generally understood that certain jewelry (such as a wedding ring) may be worn, but it must not pose a risk of contamination to the product. A common rule of thumb in food facilities is to allow no metal above the waist of workers.

Other types of jewelry such as rings and earrings may be allowed in certain jurisdictions, but these must be of a design to ensure easy cleaning and not have any components that can fall off. Good examples of jewelry that may be acceptable are solid band rings and one-piece sleeper earrings. Watches cannot be worn in the production area.

You should defer to regulations and other applicable standards to determine policies with regard to jewelry in your location. For example, in the United States the 2009 FDA Model Food Code is particularly restrictive with regard to the wearing of jewelry in food establishments, stating: "Except for a plain ring such as a wedding band, while preparing food, food employees may not wear jewelry including medical information jewelry on their arms and hands."

Other personal effects, such as money, ink pens, and mobile telephones, must be stored away from any production area and are never allowed in the immediate vicinity of food production.

Food Safety in Post-Harvest and Processing

Food handlers who have an illness pose a direct hazard to food products because they might directly contaminate food with pathogenic microorganisms they shed. People who are known or suspected to be suffering from, or to be a carrier of, a disease or illness likely to be transmitted through food should not be allowed to enter any food handling area if there is a likelihood of their contaminating food. Any persons who are ill should immediately report illness or symptoms of illness to the management.

Any person working with food who exhibits any of the following symptoms must be excluded from the facility or production area until the illness has subsided and that employee has been given clearance to return to work by the person responsible for food safety :

- jaundice
- diarrhea
- vomiting
- fever
- sore throat with fever
- visible, infected skin lesions (boils, cuts, etc.)
- discharges from the ear, eye, or nose
- excessive coughing and sneezing

Photo: Public Domain

Food Safety in Post-Harvest and Processing Injury Exposure

Cuts and open skin lesions can be a source of microbial pathogens and must be treated appropriately. If a worker is injured action should be taken immediately. At the very least, wash the affected area, disinfect if necessary, apply a bandage, and cover with a barrier such as a glove. Water proof dressings may be necessary, and constant care must be taken to not allow injuries or dressings to contaminate foods. It is also essential that, in the event of an injury in a food facility, any food that was contaminated by blood or other tissues is discarded.

If there is any risk of food contamination, even with a companyissued dressing or barrier protection such as a glove, the individual must be relieved of duties and not allowed to resume activities until considered deemed fit to do so by the manager responsible for food safety.

For injuries that are covered, the dressing must be issued by the company and a record must be made of the issuing of this dressing. Supervisors need to be aware of the issuing of the dressing and be vigilant in ensuring that it is in place and that it poses no risk of product contamination.

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Food Safety in Post-Harvest and Processing Visitor Procedures

Visitors to a food facility are subject to the same personal hygiene requirements as permanent employees.

Visitors, such as contractors coming to work on equipment or to perform supply services such as pest control, may not be accustomed to working within a food production environment. This means that there could be an increased risk of food product contamination since these visitors may not be aware of appropriate procedures to minimize the risk of food contamination. For this reason, food facilities must implement effective procedures to ensure that visitors practice proper handwashing, wear appropriate protective clothing, properly manage personal effects, and follow other practices essential to food protection.

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Food Safety in Post-Harvest and Processing **Transportation**

A finished product can be compromised by inadequate handling procedures from factory storage areas to its transportation vehicle. It is good practice for there to be minimal distance between the finished product storage location and the transport vehicle loading dock. It is also good practice to have the transport vehicle pick up the product inside the facility to prevent outside atmospheric conditions from spoiling the product. The use of properly sealed loading docks is an example of effective practice in this regard.

Transportation vehicles, trailers and containers must not present a potential source of contamination for food products, and should be washed and sanitized as frequently as necessary to ensure potential food hazards are effectively controlled. You should be aware of the history of the vehicles, trailers and containers used to transport your food products, as some foodborne illness outbreaks have been caused by contamination resulting from prior loads.

Photo by Adrian and Janet Quantock

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Food Safety in Post-Harvest and Processing **Transportation**

Transportation vehicles should be designed and constructed:

- such that walls, floors and ceilings, where appropriate, are made of a suitable corrosionresistant material with smooth, non-absorbent surfaces. Floors should be adequately drained.
- where appropriate with chilling equipment to maintain chilled fish or shellfish during transportation to a temperature as close as possible to 0 °C or, for frozen fish, shellfish and their products, to maintain a temperature of -18 °C or colder (except for brine frozen fish intended for canning which may be transported at -9 °C or colder);
- so that live fish and shellfish are transported at temperatures tolerable for the species;
- to provide the fish or shellfish with protection against contamination, exposure to extreme temperatures and the drying effects of the sun or wind;
- to permit the free flow of chilled air around the load when fitted with mechanical refrigeration means.

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Food Safety in Post-Harvest and Processing Product Tracing and Recall Procedures

An effective system for tracing and recall of product, when necessary, is a necessary prerequisite program because no process is fail-safe. Product tracing, which includes lot identification, is essential to an effective recall procedure.

- Managers should ensure effective procedures are in place to effect the complete product tracing and rapid recall of any lot of fishery product from the market.
- Appropriate records of processing, production and distribution should be kept and retained for a period that exceeds the shelf-life of the product.
- Each container of fish, shellfish and their products intended for the final consumer or for further processing should be clearly marked to ensure the identification of the producer and of the lot.
- Where there is a health hazard, products produced under similar conditions, and likely to present a similar hazard to public health, may be withdrawn. The need for public warnings should be considered.
- Recalled products should be held under supervision until they are destroyed, used for purposes other than human consumption, or reprocessed in a manner to ensure their safety.

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Food Safety in Post-Harvest and Processing **Product Tracing Systems**

Product tracing and record keeping systems can range from manual systems (i.e. pen and paper) to sophisticated electronicbased systems. The level of sophistication implemented often is dependent on company size, with the larger companies having more sophisticated systems due to greater availability of resources. Effective systems that rely on manual record-keeping can be designed and effectively implemented, but electronic systems are much more conducive to rapid data sharing in the event of a food safety incident that requires such data communication.

In a recent study conducted by the Institute of Food Technologists in the USA, it was found that the most common types of data capture used for product tracing systems was pen/paper (alphanumeric notes), bar codes, radio frequency identification (RFID), and electronic systems.

Photo: Midnightcomm / Flickr

Food Safety in Post-Harvest and Processing **Product Tracing Requirements**

At a minimum, product tracing systems should be implemented in a manner that records on the immediate sources (1-step back) of incoming raw materials and ingredients and subsequent recipients (1-step forward) of finished food products are collected.

As a best practice, the lot number and name of the manufacturing facility should appear on each case of product, and the lot number(s), quantity and shipping location should appear on invoices and bills of lading.

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Food Safety in Post-Harvest and Processing **Training**

Appropriate hygiene training is of fundamental importance for production, packing, distribution and processing of safe fish or shellfish. All personnel should be aware of their role and responsibility in protecting fish or shellfish from contamination and deterioration. Handlers should have the necessary knowledge and skills to enable them to handle fish or shellfish hygienically.

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

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

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