

**Prerequisite Programs: Minimizing Food Safety
Hazards Along the Food Supply Chain**
Good Agricultural Practices (GAPs)
Good Manufacturing Practices (GMPs)
Sanitation and Hygiene

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Presentation Outline

- Introduction to Prerequisite Programs
- Good Agricultural Practices
- Good Manufacturing Practices
- Sanitation and Hygiene
- Exercise

Food Hygiene

CODEX Definition:

- All conditions and measures necessary to ensure the safety and suitability of food at all stages of the food chain.

Prerequisite Program

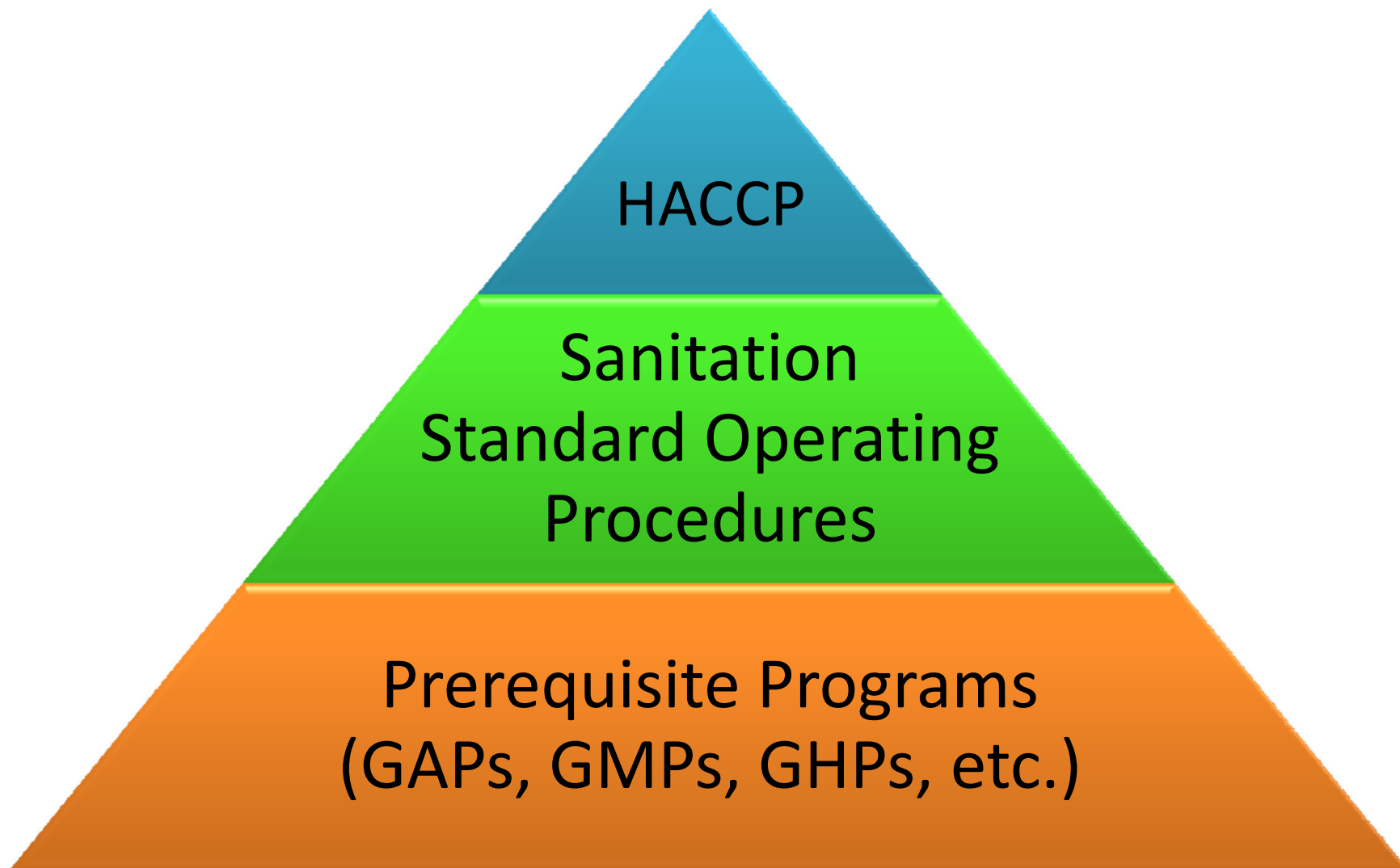
CODEX Definition :

- A program 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 Codex Principles of Food Hygiene, the appropriate Code of Practice and appropriate food safety legislation.

Prerequisite Programs

- Effective implementation of prerequisite programs (PRPs) is essential to establish a sound foundation prior to application of HACCP or other food safety management systems.
- Ineffective implementation of PRPs will likely lead to ineffective implementation of HACCP (Hazard Analysis and Critical Control Point) systems.

Prerequisite Programs are the Foundation of an Effective Food Safety System



Good Agricultural Practices

Good Agricultural Practices

- Recommended practices for primary production of foodstuffs (e.g. fruits and vegetables, cereals and legumes, livestock, fish and shellfish).
- Primary Production (defined)
 - Those steps in the food chain up to and including, for example, harvesting, slaughter, milking, fishing.

Normative Documents - GAPs

- Codex Alimentarius Commission – Code of Practice for Fish and Fishery Products (CAC/RCP 52-2003)
[Principle focus on harvest and post-harvest handling.]
- Codex Alimentarius Commission – Code of Hygienic Practice for Fresh Fruits and Vegetables (CAC/RCP 53-2003)
- Codex Alimentarius Commission – Recommended Code of Practice on Good Animal Feeding (CAC/RCP 54-2004)
- Several other Codex standards also apply to primary production.

Codex General Principles of Food Hygiene – Primary Production

- Primary production should be managed in a way that ensures that food is safe and suitable for its intended use. Where necessary, this will include:
 - avoiding the use of areas where the environment poses a threat to the safety of food
 - controlling contaminants, pests and diseases of animals and plants in such a way as not to pose a threat to food safety
 - adopting practices and measures to ensure food is produced under appropriately hygienic conditions.

Codex General Principles of Food Hygiene – Primary Production

- Rationale: To reduce the likelihood of introducing a hazard which may adversely affect the safety of food, or its suitability for consumption, at later stages of the food chain.
- Primary Considerations at Primary Production:
 - Environmental Hygiene
 - Hygienic Production of Food Sources
 - Handling, Storage and Transport
 - Cleaning, Maintenance and Personnel Hygiene at Primary Production

Seafood

- Areas noted under CAC/RCP 52-2003 – Code of Practice for Fish and Fishery Products
 - Fishing and Harvesting Vessel Design and Construction
 - Facility Design and Construction
 - Design and Construction of Equipment and Utensils
 - Hygiene Control Program
 - Personal Hygiene and Health
 - Transportation
 - Product Tracing and Recall Procedures
 - Training
- Focus primarily on harvest and post-harvest. Aquaculture is not really addressed.

Animal Feeding

- Areas noted under CAC/RCP 54-2004 – Code of Practice on Good Animal Feeding
- General Principles and Requirements
 - Feed ingredients
 - Labeling
 - Traceability/product tracing and record keeping of feed and feed ingredients
 - Inspection and control procedures
 - Health hazards associated with animal feed

Animal Feeding

- Production, Processing, Storage, Transport and Distribution of Feed and Feed Ingredients
 - Premises
 - Receiving, storage and transportation
 - Personnel training
 - Sanitation and pest control
 - Equipment performance and maintenance
 - Manufacturing controls
 - Recalls

Animal Feeding

- On-Farm Production and Use of Feed and Feed Ingredients
 - Agricultural production of feed
 - Manufacturing of feed on-farm
 - Good animal feeding practice
 - Stable feeding and lot/intensive feeding units
 - Aquaculture (refers only to CAC/RCP 52-2003)

GAPs for Fresh Fruits and Vegetables

- CAC/RCP 53-2003 – Code of Hygienic Practice for Fresh Fruits and Vegetables
 - Primary Production
 - Packing Establishment: Design and Facilities
 - Control of Operation
 - Packing Establishment: Maintenance and Sanitation
 - Packing Establishment: Personal Hygiene
 - Transportation
 - Product Information and Consumer Awareness
 - Training

USFDA Good Agricultural Practices

- 1998 FDA guidance document developed by the US Food and Drug Administration
- “Guide to Minimize Microbial Food Safety Hazards for Fresh Fruits and Vegetables”
 - Not a federal regulation – guidelines only
 - <http://www.fda.gov/food/guidancecomplianceregulatoryinformation/guidancedocuments/produceandplantproducts/ucm064458.htm>

USFDA Good Agricultural Practices

- The guide provides general advice for the fresh fruit and vegetable industry.
- Focus on **Risk Reduction** – Not Risk Elimination
- Elements of “The Guide”
 - Water
 - Manure and Municipal Biosolids
 - Worker Health and Hygiene
 - Sanitary Facilities
 - Field Sanitation
 - Packing Facility Sanitation
 - Transportation
 - Traceback

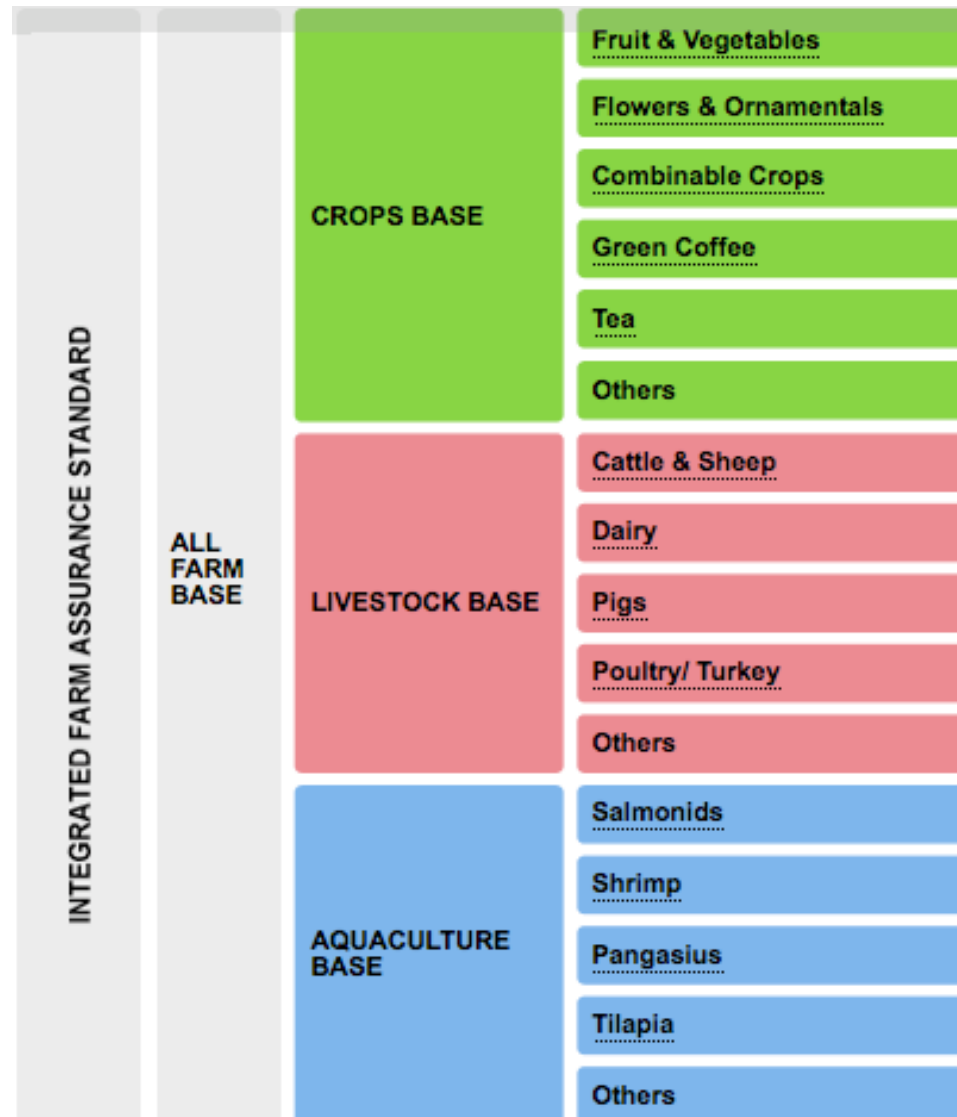
Commodity Specific GAPs Guidance Documents – US Examples

- Tomatoes
 - <http://www.unitedfresh.org/assets/files/Tomato%20Guidelines%20July08%20FINAL.pdf>
- Melons
 - <http://www.fda.gov/Food/GuidanceComplianceRegulatoryInformation/GuidanceDocuments/ProduceandPlanProducts/ucm174171.htm>
- Leafy Greens
 - <http://www.fda.gov/Food/GuidanceComplianceRegulatoryInformation/GuidanceDocuments/ProduceandPlanProducts/ucm174200.htm>
 - California Leafy Greens Marketing Agreement
 - <http://www.caleafygreens.ca.gov/>

Private Standards

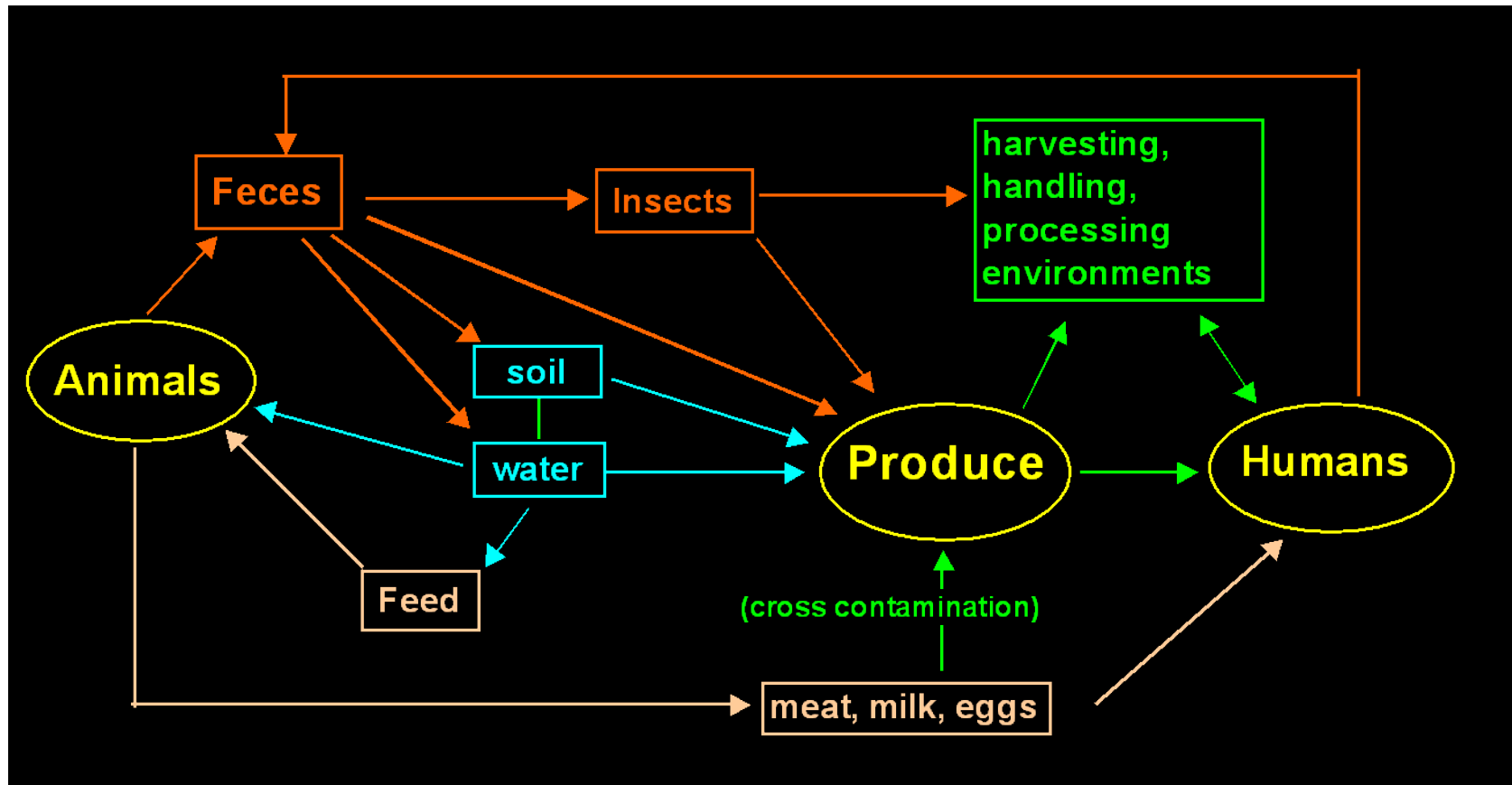
- Industry-led standards for food safety assurance
- Generally rely on third-party audits for monitoring
- Numerous private food safety schemes exist
- Several schemes have been benchmarked for equivalence by GFSI and other organizations
- Accredited schemes likely are more robust than non-accredited schemes
- The scope of several private standards extends beyond food safety (e.g. environment, social responsibility)

GlobalGAP – Integrated Farm Assurance Standard



PREVENTION is the Key to
Reducing Microbial Contamination
of Fresh Fruits and Vegetables

Potential Sources of Pathogen Contamination of Fresh Produce



Modified from Beuchat, 1996

Environmental Assessment

- Environmental assessments are intended to identify any issues related to the produce field, adjacent land uses, or intrusion by animals that might impact produce safety.
- Conduct assessments of:
 - Animal encroachment in produce fields
 - Adjacent land use (e.g. animal feeding operations)
 - Historical land use (e.g. hazardous wastes)
 - Flooding potential

Review Field Management Practices to Reduce Risks

- Manure Use
- Crop Selection and Management
- Water Quality
- On-Farm Planning and Documentation



Manure = Potential Source of Pathogens

- Human or animal manure: DO EVERYTHING you can to keep untreated manure off produce.
- Preventing contamination is the goal.



All Manure Can Carry Pathogens

- Livestock
 - cattle, swine, poultry, horse, sheep, etc.
- Dog and Cat
- Bird
- Rodent
- Deer
- Fly or other insect
- Human



Compost Manure Properly

- Appropriate composting can destroy pathogens present in manure.
- Manage piles to have active, uniform composting.
 - High temperatures, good moisture, proper aeration, and mixing.
 - Weed seeds killed means good composting conditions were achieved.
- Exclude animals from compost area to prevent recontamination.

Manure Application

- Less risk if manure is incorporated into soil.
- Top- or side-dressing = higher risk of contamination.
- If applying untreated manure in spring to fruit and vegetable fields, wait 120 days to harvest.
- Recommendations from different sources vary.



Exclude Animals

- Exclude livestock from production areas, especially in the months leading up to harvest.
- Keep wildlife out of production areas as much as possible.
- Don't allow dogs or other pets in the field.
- Manage rodents and birds in packing houses and storage areas.



Safety of Water Sources

- *E. coli* 0157:H7 (and other pathogenic strains), *Salmonella* spp., *Giardia*, *Cyclospora* and other pathogenic microorganisms are commonly associated with contaminated water sources.
- Carefully evaluate the safety of water used for irrigation, chemical applications, and post-harvest packing operations.



Water Management



- Select water source based upon agricultural use.
- Clean water quality is most important when in direct contact with edible portion of crop close to or at harvest.

Know Water Source Quality

- Best source (lowest risk) is drinking water, such as municipal.
- Ground water is less likely to have microbial contaminants than surface water.
- Surface water quality and pathogen levels are affected by watershed activities and season.

Surface Water Contamination Sources

- Livestock
- Sewage treatment facilities
- Wildlife



Well Water Contamination Sources

- Poorly maintained wells or pumps
- Livestock in active well recharge area



Irrigation Water Management

- Choose application method and treatment to reduce risk
 - Drip irrigation has a lower risk than overhead irrigation
- Test water sources at an appropriate frequency and maintain records of water tests.

Water Quality for Chemical Applications

- Use potable (drinking) water for pesticide sprays.
- When potable water is not available, test water quality and keep records.
- Using small volumes of water reduces risk.



Water Testing

- Research relating to field irrigation water quality and risks is still needed.
 - Fecal coliform count < than 100 per 100 mls is one recommendation
 - Fecal coliform as an indicator of water quality only partially useful, as coliforms are not always correlated to presence of pathogens.
- Leafy Greens Marketing Agreement standard (USA)
 - Generic *E. coli* used as indicator organism
 - Must be < 235 MPN / 100 mL for a single sample, and
 - < 126 MPN / 100 mL for a rolling 5-sample geometric mean.

Water Testing Frequency

General Advice:

- At least annually with municipal water
- Quarterly with groundwater
- Surface water quality is variable, particularly for flowing water
 - Test 3 times during growing season in temperate climates
 - at planting
 - at peak irrigation water use
 - at harvest
- Maintain good records of results

Harvest Considerations

- Teach workers about proper hygiene and provide appropriate hand-washing and toilet facilities.
- Utensils, totes, bins and other harvesting equipment must be clean and sanitary.
- Ideally – harvest fruits and vegetables when they are dry.
- Don't harvest produce that has bird droppings on it.
- Cool produce quickly to minimize growth of pathogens.



Harvest Considerations

- Handle produce carefully during and after harvest.
- Punctured or bruised produce provides points of entry for:
 - Plant Pathogens
 - Human Pathogens
- So proper harvesting/culling is important to both safety and quality.

Field Sanitation

- Clean and sanitize storage facilities prior to harvest.
- Clean fields daily
- Remove garbage, objects that harbor pests
- Avoid standing in harvest bins.
- Clean and sanitize harvest bins and totes daily.
- Clean and disinfect harvest aids
- Clean harvest and packing equipment
- Remove visible dirt and other contaminants



Harvest Totes and Containers

- When not in use, must be stored in a location that will prevent contamination.
- During use, must be cleaned and sanitized daily to prevent them from becoming a source of contamination.
- Dirt and organic load on containers can be detrimental to effectiveness of chlorine and other sanitizers used in water.



Bin and Tote Storage

Outside storage – bins must be washed and sanitized prior to use.

Proper storage of totes – protected from contamination (same for packaging materials)



Field Hand-Washing Stations and Toilets

- Clean and adequate hand-washing and toilet facilities encourage appropriate worker behaviors.
- Hand-washing facilities must have an adequate supply of potable water, soap, and single-use towels.
- Portable facilities can be used effectively in farm operations.



Agricultural Chemicals

- All chemical inputs (pesticides, fungicides, growth regulators, chemical fertilizers, etc.) must be used appropriately.
- Only use chemicals which are approved/registered for specific crops.
- Follow label directions.
- Use potable water for foliar spray applications.
- Make certain that application equipment is appropriately calibrated.
- Observe recommended time intervals from application to harvest.
- Applicators must use appropriate personal protective equipment.

Post-Harvest Water Quality

- A critical point capable of amplifying an error in sanitation or hygiene management during production, harvest, or postharvest.
- Water used in dump tanks, flumes and wash water should be chlorinated or otherwise treated to control microbial pathogens.



Pathogen Internalization in Fruits and Vegetables

- Clearly a risk for certain commodities:
 - Tomatoes
 - Melons (e.g. cantaloupe)
 - Mangoes
 - Citrus fruits
 - Apples
- Risk is greatest when warm produce is submerged in cold water (this can draw water inside the produce)

Wash Water Quality



- Use potable water for all produce washing, cooling, dipping, icing, and processing.
- Avoid water temperatures in dump tanks that are more than 10°F (~5°C) cooler than produce.

Farm Food Safety Records

If you did not RECORD IT,
you did not do it.

- Record keeping allows you to keep track of farming operations and worker training.
- Record keeping documents your activities should this information ever be required.

Farm Food Safety Records

- Manure storage and handling
- Animal exclusion (domestic & wild)
- Irrigation and drainage management
- Equipment sanitation
- Harvest and post harvest handling
- Employee training program
- Restroom & hand-washing facilities
- Crisis management strategy



Traceability Systems

- Lot identification aids in tracing back any problems that develop.
- If you do not have a system already established, consider ways to develop positive lot identification in your operation.



Spinach Case Study



MSNBC Home » Health » Infectious Diseases

FDA rushes to find E. coli outbreak source 2nd supplier recalls spinach for possible contamination

MSNBC staff and news service reports
Updated: 11:13 a.m. ET Sept 18, 2006

SAN FRANCISCO - The company whose fresh spinach was linked to an E. coli outbreak that's sickened at least 109 people said its organic products had been cleared of suspicion, while health officials continued working to pinpoint the bacteria source.

Natural Selection Foods LLC, the country's largest grower of organic produce, said late Sunday that manufacturing codes from packages of spinach that infected patients turned over to health officials all were from non-organic spinach. Natural Selection packages both organic and conventionally grown spinach in separate areas at its San Juan Bautista plant.

The company, however, did not immediately lift any recalls of 34 brands. Those brands include the company's own labels and those of other companies that had contracts with Natural Selection to produce or package its spinach.

NBC VIDEO



Launch

- **Spinach-related illnesses continue rise**
Sept. 18: The number of people sickened by an E. coli outbreak traced to tainted spinach rises to 109 as federal officials announce that more brands are recalling their products. NBC's Michael Okwu reports.

Today show

Health

Diet & Nutrition
Fitness
Women's Health
Children's Health
Men's Health
Sexual Health
America Unzipped
Low Blow
Aging
Cancer
Heart Health
Mental Health
More Health News
Pet Health
Health Library
Health Columns

Video

U.S. News

Politics

World News

Business

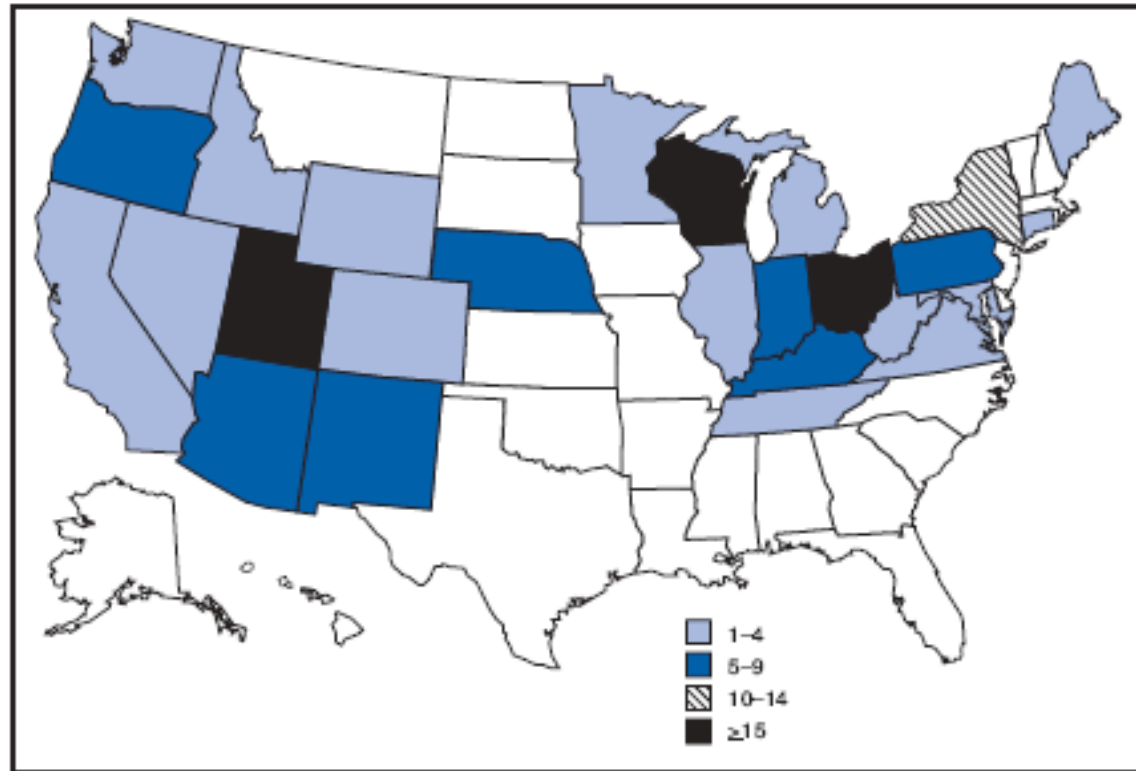
Sports

E. coli O157:H7 Outbreak with Pre-packaged Spinach – September 2006

- 204 confirmed illnesses
- 104 hospitalizations
- 31 cases of hemolytic uremic syndrome
- 3 deaths
- Illnesses confirmed in 26 US states
- 1 illness in Canada

Spinach Case Study

FIGURE 1. Number of confirmed cases (N = 183)* of *Escherichia coli* serotype O157:H7 infection, by state — United States, September 2006



* Confirmed cases reported as of 1:00 p.m. EDT on September 26, 2006.

Morbidity and Mortality Weekly Report 55(Dispatch):1-2. Sept. 26, 2007

Spinach Case Study

- 13 unopened packages of spinach were recovered from consumers who tested positive for the outbreak strain of *E. coli* O157:H7.
- These 13 packages all had the same lot code prefix “P227A” and were ultimately traced back to spinach grown on four separate farms in the Salinas Valley of California.

Spinach Case Study

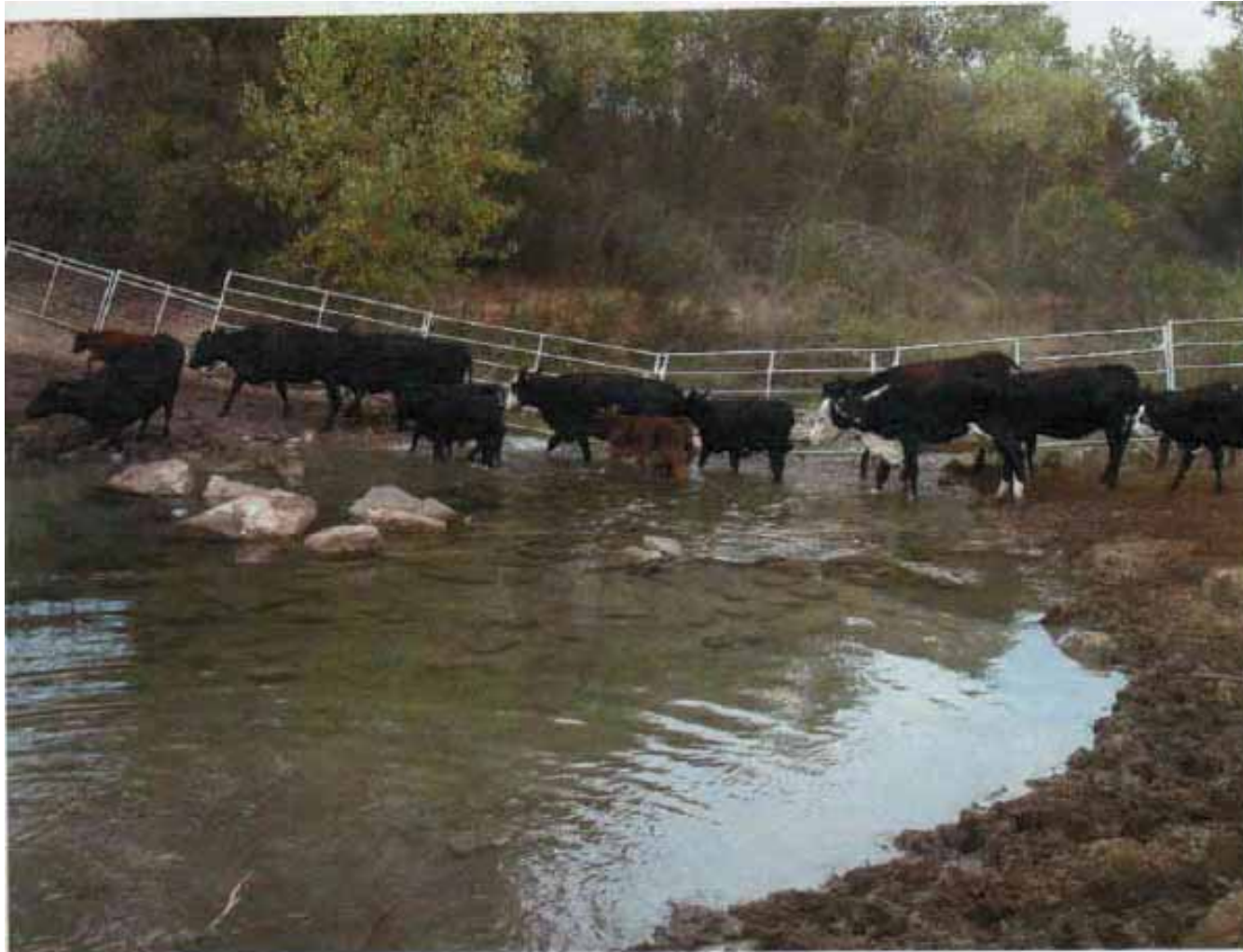
- Highlights of Farm Investigations:
 - All four farms used mechanical harvesters
 - Spinach harvested into plastic totes or bins
 - “Spotters” walked in front of harvesters to watch for hazards. Manual harvesting conducted around hazards.
 - Mechanical harvesters were washed daily
 - Abundant livestock and wildlife in the area
 - *E. coli* O157:H7 positive samples in environment

Spinach Case Study



Valley Fabrication Harvesting Machine Pictured With Empty Totes Prior to Harvesting and Packing

Spinach Case Study



San Benito River on the Paicines Ranch: Cattle Crossing

Spinach Case Study



Pig Rooting and Tracks, in Field Belonging to Neighboring Grower to Mission Organics

Spinach Case Study

- Microbial sampling at Paicines Ranch:
 - 351 samples including cow, pig and other animal feces, soil and water.
 - 45 samples positive for *E. coli* O157:H7
 - 26 samples had identical PFGE patterns compared to the outbreak strain
 - Cattle feces
 - Wild pig feces
 - Soil
 - River water

Good Manufacturing Practices

Normative Documents - GMPs

- Codex Alimentarius Commission – General Principles of Food Hygiene (CAC/RCP 1-1969, Rev. 4-2003)
- US Food and Drug Administration – Current Good Manufacturing Practice in Manufacturing, Packing, or Holding Human Food (21 CFR Part 110)
- PAS 220:2008 – Prerequisite Programs on Food Safety for Food Manufacturing

[Now adopted as ISO/TS 22002-1:2009 – Prerequisite Programs on Food Safety – Part 1: Food Manufacturing]

Good Manufacturing Practices

- Written for:
 - Personnel
 - Buildings and facilities
 - Equipment and utensils
 - Production and process controls
 - Warehousing and distribution
- GMPs guide the development of SOPs

Codex General Principles of Food Hygiene

1. Primary production *
2. Establishment: design and facilities
3. Control of operation
4. Establishment: maintenance and sanitation *
5. Establishment: personal hygiene *
6. Transportation
7. Product information and consumer awareness
8. Training

Establishment: Design and Facilities

OBJECTIVES:

- Depending on the nature of the operations, and the risks associated with them, premises, equipment and facilities should be located, designed and constructed to ensure that:
 - contamination is minimized;
 - design and layout permit appropriate maintenance, cleaning and disinfections and minimize air-borne contamination;
 - surfaces and materials, in particular those in contact with food, are non-toxic in intended use and, where necessary, suitably durable, and easy to maintain and clean;
 - where appropriate, suitable facilities are available for temperature, humidity and other controls; and
 - there is effective protection against pest access and harborage.

Buildings and Facilities

- Grounds:
 - Properly store equipment, remove litter and waste, and cut weeds or grass in the immediate vicinity of the plant (prevent attracting or harboring pests).
 - Maintain roads, yards and parking lots so they do not constitute a source of contamination in areas where food is exposed.
 - Provide adequate draining.
 - Systems for waste treatment and disposal should be operated in a manner that does not constitute a source of contamination in areas where food is exposed.

Buildings and Facilities

- Plant construction and design:
 - Provide sufficient space for equipment placement and material storage to facilitate maintenance and sanitary operations.
 - Take precautions to reduce the potential for contamination of food, food-contact surfaces, or packaging materials.
 - Adequate food safety controls and operating practices
 - Effective design – separate operations by location, time, partition, air flow, enclosed systems, etc.

Buildings and Facilities

- Plant construction and design:
 - Facilities should be constructed in a manner such that floors, walls and ceilings may be adequately cleaned.
 - Drip or condensate from fixtures, ducts and pipes does not contaminate food, food-contact surfaces, or food packaging materials.
 - Provide adequate lighting.
 - Provide adequate ventilation to minimize odors and vapors and in a manner to prevent contamination of food.
 - Provide adequate screening or other protection against pests.

Buildings and Facilities

- Sanitary operations:
 - Buildings, fixtures and other physical facilities shall be maintained in a sanitary condition and in good repair.
 - Cleaning and sanitizing chemicals shall be clearly identified, stored, and used in a manner that prevents contamination of food.
 - No pests shall be allowed in any area of a food plant.
 - All food-contact surfaces shall be cleaned and sanitized as frequently as necessary to protect against contamination of food.

Buildings and Facilities

- Sanitary facilities and controls:
 - Water supply shall be sufficient and derived from an adequate source.
 - Plumbing shall be of an adequate size and design.
 - Sewage disposal shall be into an adequate sewerage system or disposed of through alternative means.
 - Toilet facilities shall be adequate and readily accessible.
 - Hand-washing facilities shall be adequate and convenient and furnished with running water at a suitable temperature.
 - Rubbish and offal shall be stored and disposed in a manner to minimize its potential to contaminate food or attract and harbor pests.

Equipment and Utensils

- Equipment and utensils shall be designed to be adequately cleanable, and shall be properly maintained.
- Food-contact surfaces shall be corrosion-resistant and made of non-toxic materials.
- Seams on food-contact surfaces shall be smoothly bonded or maintained to minimize accumulation of food particles, dirt, and organic matter.
- Instruments and controls used for measuring temperatures, pH, water activity, etc. shall be adequate in number, accurate and adequately maintained.

Control of Operation

OBJECTIVE:

- To produce food which is safe and suitable for human consumption by:
 - formulating design requirements with respect to raw materials, composition, processing, distribution, and consumer use to be met in the manufacture and handling of specific food items; and
 - designing, implementing, monitoring and reviewing effective control systems.

Production and Process Controls

- Raw materials:
 - Shall be inspected and segregated to ensure they are clean and suitable for processing into food.
 - Shall not contain levels of microorganisms that may cause food poisoning or otherwise treated so that they no longer contain levels that would cause the product to be adulterated.
 - Raw materials must be received and stored in a manner that prevents contamination.

Production and Process Controls

- Manufacturing operations:
 - All food manufacturing, including packaging and storage, shall be conducted under such conditions and controls as are necessary to minimize the potential for the growth of microorganisms, or for the contamination of food.
 - Food that can support the rapid growth of undesirable microorganisms (i.e. potentially hazardous foods) shall be held in a manner that prevents the adulteration of the food.
 - Refrigeration, freezing
 - Hot holding

Production and Process Controls

- Manufacturing operations:
 - Effective measures shall be taken to protect finished food from contamination by raw materials, other ingredients, or refuse.
 - Effective measures shall be taken to protect against the inclusion of metal or other extraneous material in food.
 - Mechanical manufacturing steps (e.g. washing, peeling, trimming, etc.) shall be performed as to protect food against contamination.

Control of Operation – Warehousing and Distribution

- Storage and transportation of finished food shall be under conditions that will protect food against physical, chemical, and microbial contamination as well as against deterioration of the food and the container.

Establishment: Maintenance and Sanitation

OBJECTIVE:

- To establish effective systems to:
 - ensure adequate and appropriate maintenance and cleaning;
 - control pests;
 - manage waste; and
 - monitor effectiveness of maintenance and sanitation procedures.

Establishment: Maintenance and Sanitation

Sanitation

Rodent Control Methods



Glue board



Multi-use traps



Mouse and rat traps

Establishment: Maintenance and Sanitation



Establishment: Personal Hygiene

OBJECTIVES:

- To ensure that those who come directly or indirectly into contact with food are not likely to contaminate food by:
 - maintaining an appropriate degree of personal cleanliness;
 - behaving and operating in an appropriate manner.

Establishment: Personal Hygiene

Adequate, well-stocked facilities are essential!



Personnel – Cleanliness

- Wear clean outer garments
- Maintain adequate personal cleanliness
- Wash hands thoroughly and frequently
- Remove all jewelry and other objects that might fall into food, equipment or containers
- Maintain gloves (if used) in an intact, clean and sanitary condition
- Use hair restraints when appropriate
- Avoid eating, drinking, chewing gum, smoking, in the food processing facility

Transportation

OBJECTIVES:

- Measures should be taken where necessary to:
 - protect food from potential sources of contamination;
 - protect food from damage likely to render the food unsuitable for consumption; and
 - provide an environment which effectively controls the growth of pathogenic or spoilage micro-organisms and the production of toxins in food.

Transportation



Product Information and Consumer Awareness

OBJECTIVES:

- Products should bear appropriate information to ensure that:
 - adequate and accessible information is available to the next person in the food chain to enable them to handle, store, process, prepare and display the product safely and correctly;
 - the lot or batch can be easily identified and recalled if necessary.

Product Information and Consumer Awareness

OBJECTIVES:

- Consumers should have enough knowledge of food hygiene to enable them to:
 - understand the importance of product information;
 - make informed choices appropriate to the individual; and
 - prevent contamination and growth or survival of foodborne pathogens by storing, preparing and using it correctly.
- Information for industry or trade users should be clearly distinguishable from consumer information, particularly on food labels.

Training

OBJECTIVE:

- Those engaged in food operations who come directly or indirectly into contact with food should be trained, and/or instructed in food hygiene to a level appropriate to the operations they are to perform.

PAS 220:2008

- Prerequisite programs on food safety for food manufacturing.
- Designed to be used in conjunction with ISO 22000:2005
- PRPs recognized under the FSSC 22000 food safety management scheme.
- Covers many of the same issues as 21CFR110 and Codex GHP document.

PRPs covered by PAS 220:2008

- Construction and layout of buildings
- Layout of premises and workspace
- Utilities – air, water, energy
- Waste Disposal
- Equipment suitability, cleaning and maintenance
- Management of purchased materials
- Measures for prevention of cross contamination

PRPs covered by PAS 220:2008

- Cleaning and sanitizing
- Pest control
- Personnel hygiene and employee facilities
- Rework
- Product recall procedures
- Warehousing
- Product information / consumer awareness
- Food defense, biovigilance and bioterrorism

Sanitation and Hygiene

The Importance of Cleaning and Sanitation (Disinfection)

- Accumulated soils on food equipment and in the food environment can support the growth of pathogenic microorganisms that can contaminate foods and potentially harm consumers.
- Food contact surfaces must be cleaned and disinfected on a routine schedule to minimize this potential contamination.

The Importance of Cleaning and Sanitation (Disinfection)

- On shared equipment lines, effective cleaning procedures also are critical to reduce the risk of cross-contamination of foods with potential allergens.
- Examples
 - Shared processing lines for dairy products and juices.
 - Shared equipment for dry cereals containing nuts vs nut-free products.

The Importance of Cleaning and Sanitation (Disinfection)

- From Farm to Fork
 - Helps prevent transmission of human diseases by foods.
- Helps Prevent Pest Infestations
 - Food residues can attract and support pests.
- Improves the shelf life and quality of food products.

Definitions from Codex Alimentarius

General Principles of Food Hygiene

- Cleaning
 - The removal of soil, food residue, dirt, grease or other objectionable matter.
- Disinfection
 - 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.



Four Types of Food Soils

1. Those that dissolve in water:

- Simple carbohydrates - sugars
- Some simple mineral salts (NaCl)
- Some starches

2. Those that dissolve in alkali:

- Proteins
- Starches associated with proteins or fats,
- Bacterial films (biofilms)

Four Types of Food Soils

3. Those that dissolve in acid:

- Hard water hardness salts (calcium and magnesium salts)
- More complex mineral films, including iron & manganese deposits

4. Those that dissolve with surfactants:

- Fats, oils, and greases
- Many food residues
- Inert soils such as sand, clay, or fine metals
- Some biofilms

Types of Cleaning Compounds

- Basic- Alkalis
 - Soften the water (by precipitation of the hardness ions), and saponify fats (the chemical reaction between an alkali and a fat in which soap is produced).
- Complex Phosphates
 - Emulsify fats and oils, disperse and suspend oils, peptize proteins, soften water by sequestering, and provide rinsability characteristics without being corrosive.

Types of Cleaning Compounds

- Surfactant (Wetting Agents)
 - Emulsify fats, disperse fats, provide wetting properties, form suds, and provide rinsability characteristics without being corrosive.
- Chelating (Organic compounds)
 - Soften the water by sequestering, prevent mineral deposits, and peptize proteins without being corrosive.
- Acids
 - Good at mineral deposit control; and soften the water.

Factors That Influence Cleaning Efficiency (The 4 Ts)

Choosing the right cleaner for the task.

- Time
 - Increased time improves efficiency
- Temperature
 - Increasing the temperature of the cleaning solution decreases the strength of the bond between the soil and surface, decreases the viscosity, and increases the solubility of the soluble materials and the chemical reaction rate.

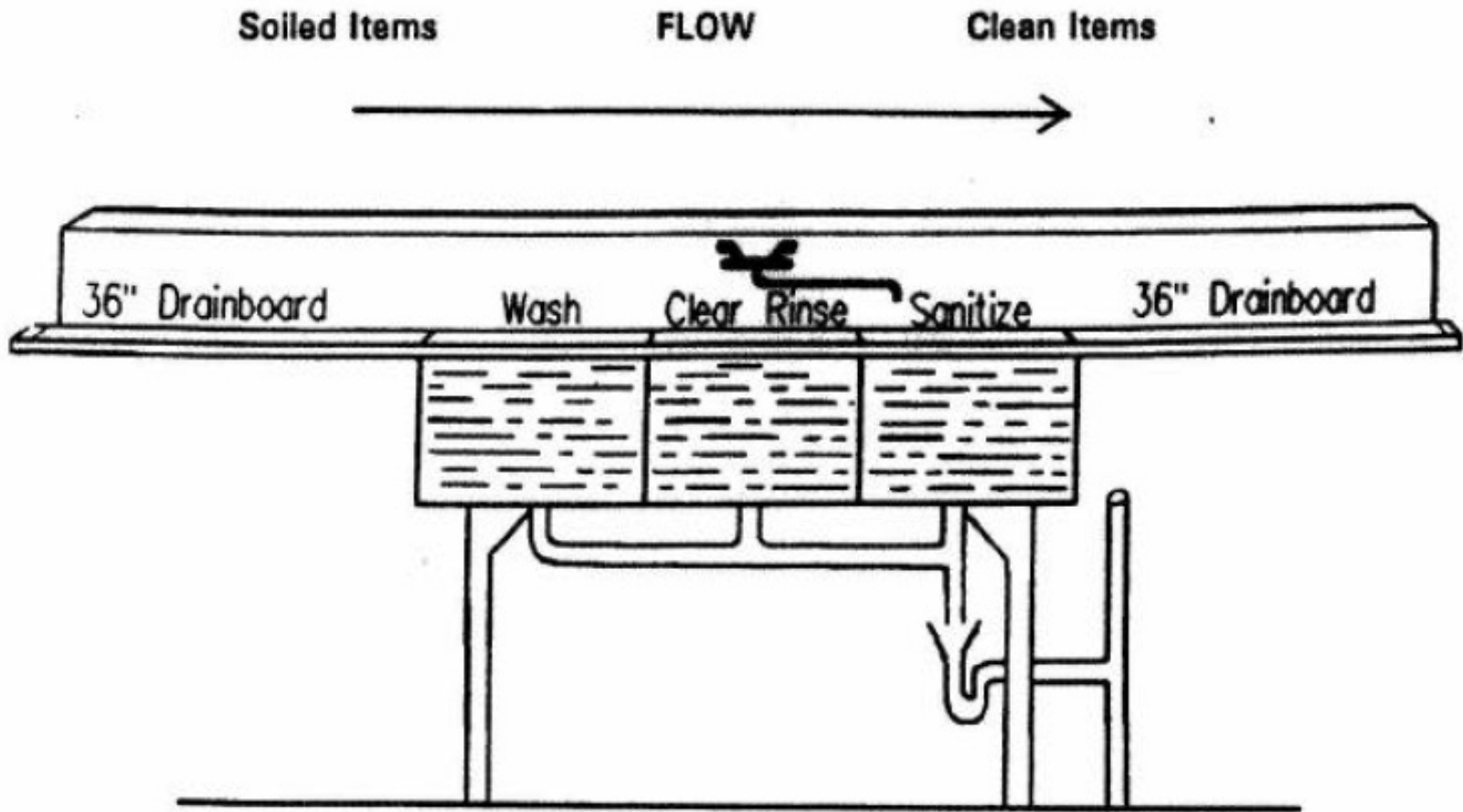
Factors That Influence Cleaning Efficiency (The 4 Ts)

- Velocity (Turbulence)
 - Increased velocity provides mechanical action to remove soil and filth (“elbow grease”).
- Concentration (Titration)
 - Increased cleaner concentration can improve efficiency, but this is the least effective variable to change in cleaning.

Standard Cleaning Procedure

1. Prewash
 2. Washing
 3. Rinsing
 4. Disinfection (Sanitizing)
- Clean first, then sanitize.
 - You cannot effectively sanitize a surface that is not clean!

Typical 3-Compartment Sink for Warewashing



Washing Methods

- Clean in Place Systems (CIP)
 - An automated cleaning system generally used in conjunction with permanent-welded pipeline systems or other systems that can not be broken down for cleaning.
 - Fluid turbulence in the pipeline is the major source of energy required for soil removal.
 - “Clean out of Place” (COP) refers to manual breakdown and cleaning of equipment.

Disinfection (Sanitizing)

- A process which destroys a disease causing organisms which may be present on equipment and utensils after cleaning.
- Two General Methods
 1. Heat Disinfection
 2. Chemical Disinfection

Heat Disinfection

- Hot water
 - An effective, non-selective sanitization method for food-contact surfaces.
 - However, spores may remain alive even after an hour of boiling temperatures.
 - The microbicidal action is thought to be the coagulation of protein molecules in the cell.
 - The use of hot water has several advantages in that it is readily available, inexpensive and nontoxic.

Pros and Cons of Heat Disinfection

Hot water

- Easy to apply
- Effective
- Non-corrosive.
- High energy costs
- Safety concerns

Steam

- Limited application
- Expensive
- Difficult to regulate
- Difficult to monitor contact time and temperature
- It is hazardous

Chemical Disinfectants

Most common chemical disinfectants:

- Chlorine (e.g. sodium hypochlorite)
 - Typically used at 50 – 200 ppm
- Quaternary ammonium compounds (Quats)
 - Typically used at 200 – 400 ppm
- Iodophores
 - Typically used at 12.5 – 25 ppm
- Peroxyacetic acid

Factors Affecting the Action of Chemical Disinfectants

1. Contact of the disinfection agent

- In order for a chemical to react with microorganisms, it must achieve intimate contact.

2. Selectivity of the disinfection agent

- Certain disinfectants are non-selective in their ability to destroy a wide variety of microorganisms while others demonstrate a degree of selectivity.
- Chlorine is relatively non-selective; however both iodophors and quaternary compounds have a selectivity which may limit their application.

Factors Affecting the Action of Chemical Disinfectants

3. Concentration of the disinfection agent

- In general, the more concentrated a disinfectant, the more rapid and certain its actions.
- Increases in concentration are usually related to exponential increases in effectiveness until a certain point when it accomplishes less noticeable effectiveness.
- More is not always better!
- Make certain you are using disinfectants in the correct range of concentration.

Factors Affecting the Action of Chemical Disinfectants

4. Temperature of solution

- All of the common disinfectants increase in activity as the solution temperature increases.
- This is partly based on the principle that chemical reactions in general are speeded up by raising the temperature.
- However, a higher temperature also generally lowers surface tension, increases pH, decreases viscosity and effects other changes which may enhance its germicidal action.
- It should be noted that chlorine compounds are more corrosive at high temperatures, and iodine tends to sublime at temperatures above 120°F (49 °C).

Factors Affecting the Action of Chemical Disinfectants

5. pH of solution

- The pH of the solution exerts a very pronounced influence on most disinfectants.
- Quaternary compounds present a varied reaction to pH depending on the type of organisms being destroyed.
- Chlorine and iodophores generally decrease in effectiveness with an increase in pH.

Factors Affecting the Action of Chemical Disinfectants

6. Time of exposure

- Sufficient time must be allowed for whatever chemical reactions that occur to destroy the microorganism.
- The required time will not only depend on the preceding factors, but on microorganism populations and the populations of cells having varied susceptibility to the sanitizer due to cell age, spore formation, and other physiological factors of the microorganisms.

Sources of Chlorine

- Sodium Hypochlorite (NaOCl)
 - Liquid (5.25, 12.75 or 15%)
- Calcium Hypochlorite [Ca(OCl)_2]
 - Solid (65 or 68%)
- Chlorine Gas (Cl_2)
 - Gas cylinders
- Chlorine Dioxide (ClO_2)
 - Generated on-site from sodium chlorite + acid

Chlorine as a Disinfection Agent

| Advantages | Disadvantages |
|---|--|
| <ul style="list-style-type: none">• Relatively inexpensive | <ul style="list-style-type: none">• Unstable during storage |
| <ul style="list-style-type: none">• Rapid action | <ul style="list-style-type: none">• Affected by organic matter content (loss of germicidal effect) |
| <ul style="list-style-type: none">• Wide action against many microorganisms | <ul style="list-style-type: none">• Viruses tend to be resistant |
| <ul style="list-style-type: none">• Colorless | <ul style="list-style-type: none">• Corrosive |
| <ul style="list-style-type: none">• Easy preparation and use | <ul style="list-style-type: none">• Efficacy is lowered when the pH of the solution increases |
| <ul style="list-style-type: none">• Easy to determine concentration | <ul style="list-style-type: none">• Irritating to skin; toxic at high levels |
| <ul style="list-style-type: none">• Not affected by water hardness | <ul style="list-style-type: none">• Dissipated by hot water |

Iodophores

- Soluble complexes of iodine in an organic polymer
- Used in combination with acid cleaning agents
- Highly effective against a wide spectrum of bacteria
- Short contact time

Iodophores as Disinfection Agents

| Advantages | Disadvantages |
|---|---|
| Rapid bacterial action in acid pH range in cold or hard water. | Slow acting at pH 7.0 above, vaporizes at 120°F (49°C) |
| Less affected by organic matter than chlorine. | Less effective against bacterial spores than hypochlorites. |
| Non-corrosive and non-irritation to skin. Generally spot free drying. | May stain some plastics and porous surfaces. |
| Stable - long shelf life. | Relatively expensive. |
| Visual control (color) | |

Quaternary Ammonium Compounds

- Type of cationic detergent which are poor detergents but excellent germicides
- Used widely in the food and meat industry
- Effective against a wide spectrum of bacteria
- Used on surfaces heavily contaminated with organic matter where chlorine will be corrosive

Quats as Disinfection Agents

| Advantages | Disadvantages |
|---|---|
| Non-corrosive. | Not compatible with hard water and most detergents. |
| Non-irritating to skin. | Forms film. |
| Stable to heat. | Produces foam in mechanical operations. |
| Forms bacteriostatic film on surface after treatment. | Selective in destruction or inhibition of various types of organisms. |
| Relatively stable in presence of organic matter. | Requires higher concentration for action than chlorine or iodine. |
| Active over a wide pH range. | Relatively expensive. |
| No taste or odor in use dilutions. | |
| Broad spectrum of activity. | |
| Long shelf life. | |

Peroxyacetic Acid

- Equilibrium mixture of acetic acid and hydrogen peroxide in an aqueous solution.
- Very strong oxidizing agent and has a stronger oxidation potential than chlorine.
- Pungent acetic acid odor.
- Used in CIP systems
- Used to sanitize surfaces of equipment, floors, walls, and indoor processing and packaging facilities.

Peroxyacetic Acid as a Disinfection Agent

| Advantages | Disadvantages |
|--|---------------------------------------|
| Non foaming. | Corrosive to soft metals. |
| Effective at low temperatures (5 to 40°C). | Concentration difficult to monitor. |
| Environmentally safe (Breaks down to O ₂ , CO ₂ , H ₂ O). | Rapidly decomposed by organic matter. |

Dry Cleaning

- Wet cleaning is not always possible.
- Dry cleaning entails the physical removal of filth by mechanical means. Generally no water or chemicals are used.
- Examples of dry cleaning methods:
 - Brushes, Brooms, Scrapers
 - Dry towels
 - Vacuum
 - Compressed air (difficult to control)

CLEANING AND DISINFECTION MANAGEMENT



What Should be Cleaned & Disinfected?

- All surfaces that may contact the food product:
 - Food bins, containers, totes
 - Equipment food contact surfaces
 - Utensils, knives
 - Tables, cutting boards, conveyor belts
 - Ice makers, ice storage bins
 - Hands, gloves, aprons
- Surfaces that do not directly contact the product - walls, ceilings, floors and drains
- Any surface that can have “drip” into food product.

What Should be Cleaned & Disinfected?

- Cleaning Tools:
 - Brooms, mops, squeegees, buckets, sponges, scrapers, foaming equipment, water guns, etc.
- Cleaning tools can be a major source of microbial cross-contamination if not cleaned.
- Cleaning tools should be washed and sanitized after every use.
- Stored clean, dried and secured.

Example - Recommended Cleaning Schedules

| 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 |

Sanitation Standard Operating Procedures (SSOPs)

- SSOP is a written document - an operations manual.
- Describes chemicals, concentrations, application methods and timing for every part of the plant.
 - **Master Sanitation Schedule:** What, When, Who?
 - **Cleaning & Sanitizing Procedures:** How?
- Cleaning and sanitation verification records show that procedures and schedules were followed.

USFDA SSOP Requirements

The SSOP shall address:

1. Safety of the water
2. Condition and cleanliness of food contact surfaces
3. Prevention of cross-contamination
4. Maintenance of hand washing, hand sanitizing, and toilet facilities

USFDA SSOP Requirements

The SSOP shall address:

5. Protection of food, food packaging material, and food contact surfaces from adulteration
6. Proper labeling, storage, and use of toxic compounds
7. Control of employee health conditions that could result in microbiological contamination
8. Exclusion of pests from the food plant

SSOP Monitoring Requirements

- Monitoring:
 - The processor must monitor the conditions and practices during processing with sufficient frequency to ensure conformance with those conditions and practices that are appropriate both to the plant and to the food being processed.
 - Each processor shall correct, in a timely manner, those conditions and practices that are not met.
- Records:
 - Each processor shall maintain SSOP records that, at a minimum, document the monitoring and corrections.

Monitoring Effectiveness

- Work with staff to make sure they understand the need for hygiene and cleanliness
- Record reviews.
 - Were procedures followed and conducted at the appropriate times?
 - Were corrective actions recorded?

Monitoring Effectiveness

- Regular pre-operational and inter-operational inspections.
 - Keep records of observations.
 - Inspection should be thorough, and use tools like flashlight (torch) checks, analytical monitoring procedures like ATP testing or swabs for microbial populations.
 - Note that properly cleaned and disinfected food contact surfaces will not be sterile, but should have low total counts of microorganisms.
- Adjust procedures if monitoring indicates potential for problems.

Summary

- Cleaning and disinfection are two distinct procedures.
- You must clean first, then disinfect.
- Choose the correct chemicals or processes for both steps.
- Develop a procedure for each operation and make certain these procedures are followed.
- Keep records of what you do.

PERSONAL HYGIENE



Codex GHPs – Health Status

- People 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 person so affected should immediately report illness or symptoms of illness to the management.
- Medical examination of a food handler should be carried out if clinically or epidemiologically indicated.

Many Food borne Illness Outbreaks are Caused by Infected Food Handlers

- Common Symptoms
 - ***Escherichia coli*** - diarrhea, vomiting, mild fever
 - ***Salmonella enteritidis* (and other *Salmonella* spp.)** - abdominal cramps, headache, fever, nausea, diarrhea
 - ***Listeria monocytogenes*** - flu-like, meningitis, encephalitis, spontaneous abortion
 - ***Campylobacter jejuni*** - diarrhea, vomiting, headache, fever, muscle pain
 - **Norwalk virus (norovirus)** - nausea, diarrhea, headache, mild fever

Codex GHPs – Illness and Injuries

- Conditions which should be reported to management so that any need for medical examination and/or possible exclusion from food handling can be considered, include:
 - jaundice
 - diarrhea
 - vomiting
 - fever
 - sore throat with fever
 - visibly infected skin lesions (boils, cuts, etc.)
 - discharges from the ear, eye or nose

Important Practices

- A person who has diarrhea or is a carrier of a communicable disease that can be transmitted is prohibited from working with food.
- That person must be excluded from working in receiving, inspection, washing, or other processing areas.



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Codex GHPs – Personal Cleanliness

- Food handlers should maintain a high degree of personal cleanliness and, where appropriate, wear suitable protective clothing, head covering, and footwear.
- Cuts and wounds, where personnel are permitted to continue working, should be covered by suitable waterproof dressings.

Sanitary Facilities

- Workers must have access to clean toilets and adequate hand washing facilities.
- Signs should be clearly displayed instructing workers to wash hands before returning to work.
- Provide suitable changing facilities.
- Lockable storage facilities.

Codex GHPs – Personal Cleanliness

- Personnel should always wash their hands when personal cleanliness may affect food safety, for example:
 - At the start of food handling activities
 - Immediately after using the toilet
 - After handling raw food or any contaminated material, where this could result in contamination of other food items; they should avoid handling ready-to-eat food, where appropriate

Important Practices

- Whenever personnel change from non-food contact or cleaning operation to food contact operation, the individual must replace gloves or wash hands thoroughly before resuming food-contact operations.



Handwashing Should Take Place

- Before starting work
- After any absence from a work station
- After blowing nose or touching face or hair
- After restroom use
- After breaks
- After handling dirty or raw materials
- After performing maintenance on equipment
- After picking up objects from the floor

Proper Handwashing Procedure

1. Wet your hands with clean running water and apply soap. Use warm water if it is available.
2. Rub hands together to make a lather and scrub all surfaces.
3. Continue rubbing hands for 20 seconds.
4. Remember to scrub between fingers, on the back of hands, wrists, and under fingernails.
5. Rinse hands well under running water.
6. Dry your hands using a paper towel or air dryer. If possible, use your paper towel to turn off the faucet.

Hand Washing

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20



Hand Washing Recommendations

- At least 20 seconds
- 2 rounds of “Happy Birthday”

Hand Sanitizers

- Typically use alcohol to kill microorganisms without water
- Usually contain a moisturizing component to counteract drying effect
- Most effective when used following hand washing with soap
- **ARE NOT A SUBSTITUTE FOR PROPER HANDWASHING**

Skin Protectants

- Includes creams and lotions to provide a protective barrier over the skin
- Helps to prevent skin shedding, which may lead to increased microorganism-shedding from skin
- Most effective when used in conjunction with handwashing with soap

Disposable Gloves

- If used, disposable gloves must be used correctly to ensure appropriate hygiene and safety.



Gloves

- Gloves must NOT be used in place of proper handwashing
- Be just as aware of what you touch
- Wash hands thoroughly before and after wearing gloves

Codex GHPs – Personal Behaviour

- People engaged in food handling activities should refrain from behaviour which could result in contamination of food, for example:
 - Smoking
 - Spitting
 - Chewing or eating
 - Sneezing or coughing over unprotected food

Codex GHPs – Personal Behaviour

- Personal effects such as jewellery, watches, pins or other items should not be worn or brought into food handling areas if they pose a threat to the safety and suitability of food.
- **Note:** This practice is important to prevent the incidence of physical hazards in foods.
- Common rule of thumb in food processing establishments is “No metal above the waist.”

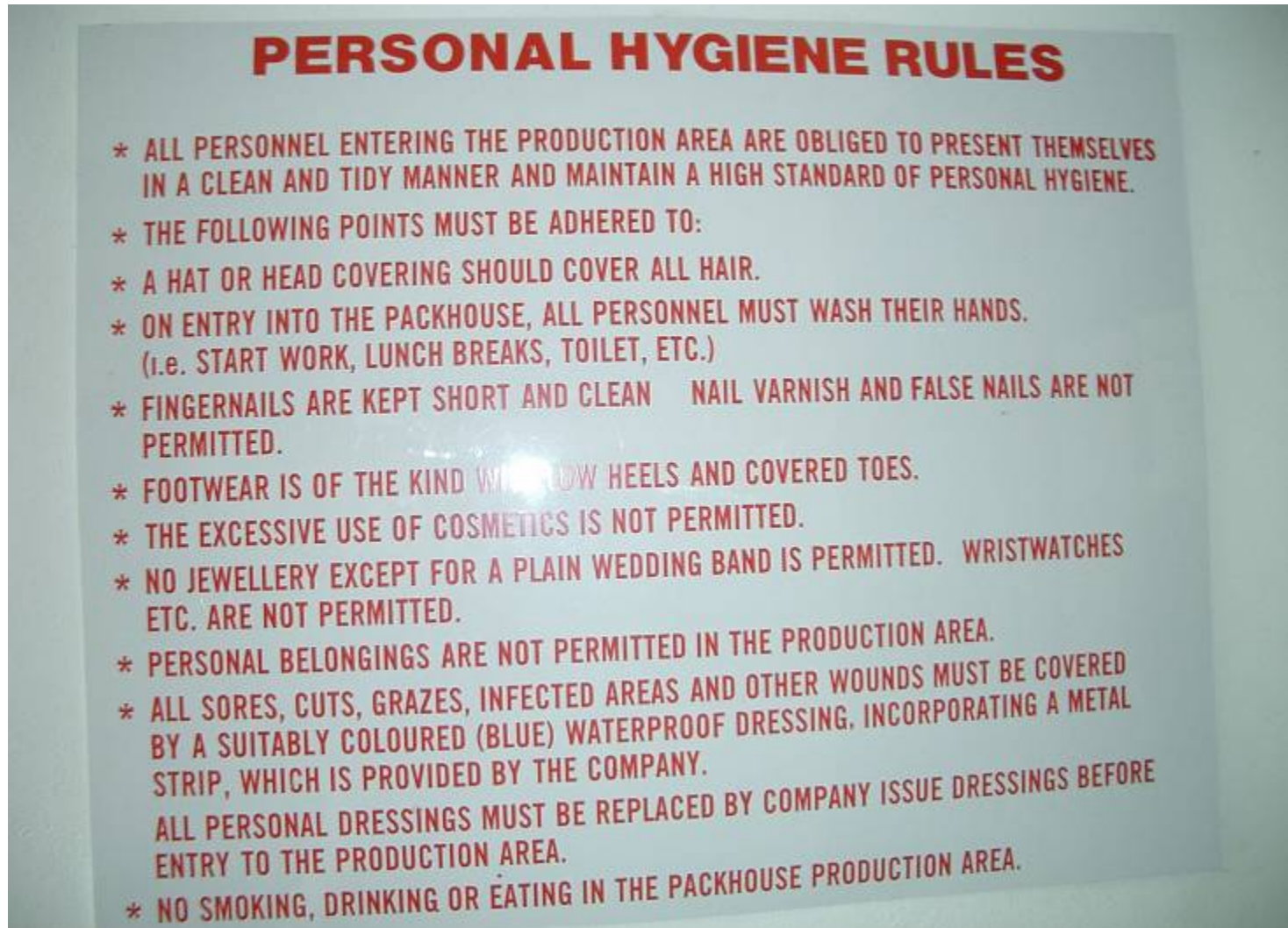
Jewelry Can Be a Physical Hazard



Fingernails

- Food employees shall keep their fingernails trimmed, filed, and maintained so the edges and surfaces are cleanable and not rough.
- Unless wearing intact gloves in good repair, a food employee may not wear fingernail polish or artificial fingernails when working with exposed food.

Proper Signage and Instructions for Workers is Important



Codex GHPs – Visitors

- Visitors to food manufacturing, processing or handling areas should, where appropriate, wear protective clothing and adhere to the other personal hygiene provisions in this section.



Exercise

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