



**Hazard Analysis and Critical Control Point (HACCP)
Principles, and Application in Meat and Juice Industries**


AGSC 5540: Food Policies and Regulations
9-30-2021

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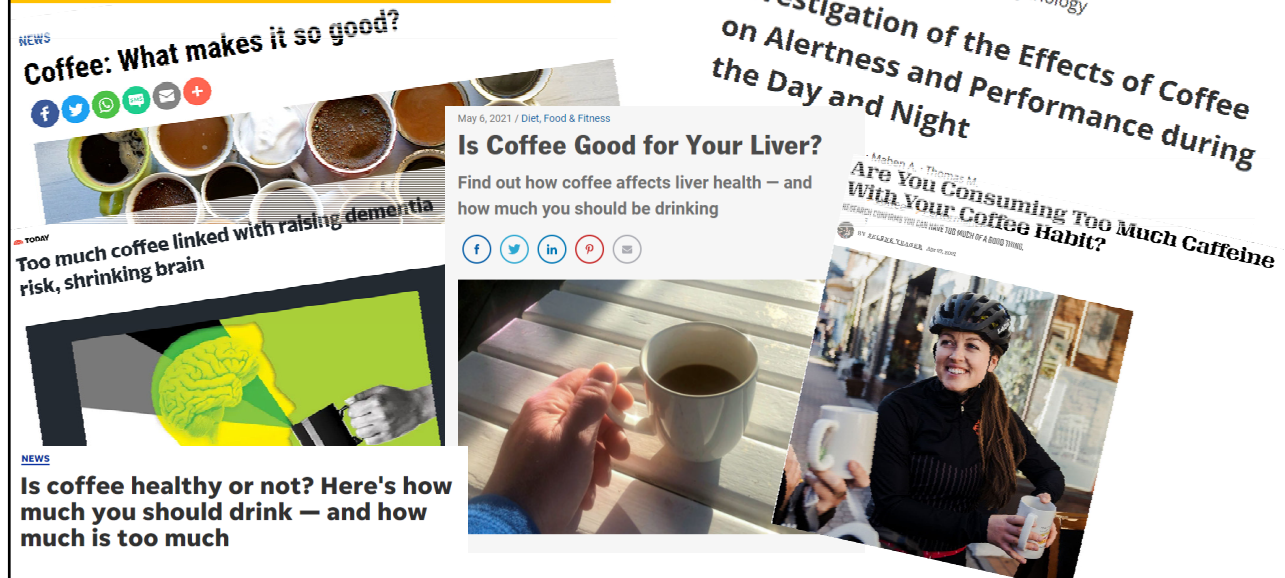
Week 7

- Tip for writing you term paper:
Advocacy and Analysis
- Discussion about Exam and
Certification
- HACCP and three exercises



2

Advocacy and Analysis



3

Evidence-Based Analysis of Literature Systematic Review and Meta-Analysis

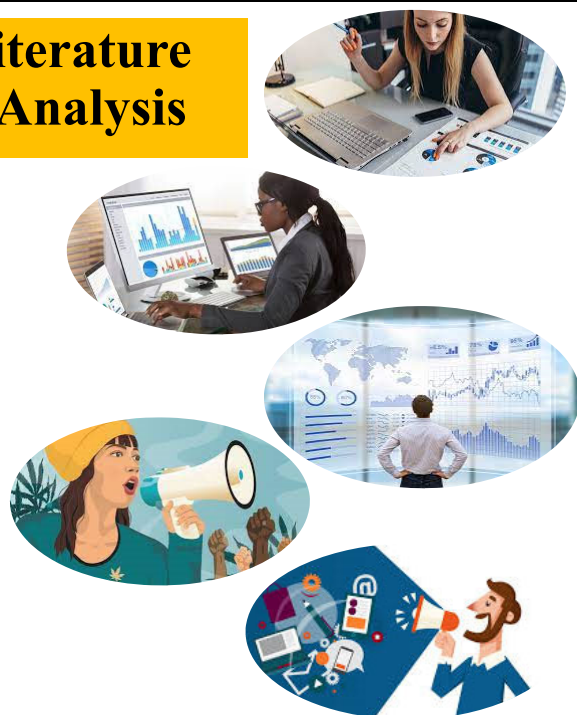
(Khan et al., 2013)

- STEP 1: FRAMING THE QUESTION
- STEP 2: IDENTIFYING RELEVANT PUBLICATIONS
- STEP 3: ASSESSING STUDY QUALITY
- STEP 4: SUMMARIZING THE EVIDENCE
- STEP 5: INTERPRETING THE FINDINGS

Publication Bias:

When research result is negative: inability or unwillingness to publish the results.

Negative results should be given appropriate weight



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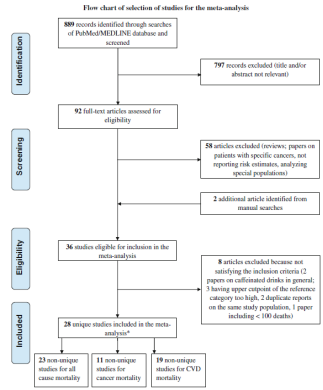
Eur J Epidemiol (2013) 28:527-539
DOI 10.1007/s10654-013-9834-7

META-ANALYSIS

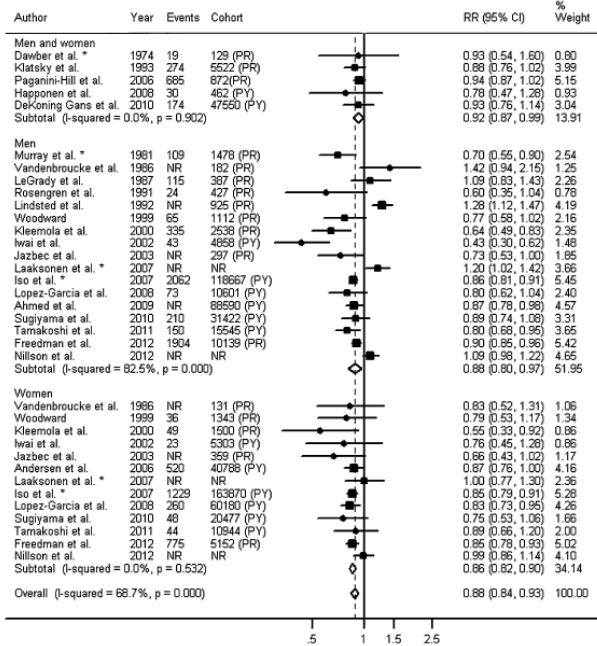
A meta-analysis of prospective studies of coffee consumption and mortality for all causes, cancers and cardiovascular diseases

Stefano Malerba · Federica Turati · Carlotta Galeone · Claudio Pelucchi · Federica Verga · Carlo La Vecchia · Alessandra Tavani

Fig. 1 Flow-chart of the selection of studies included in the meta-analysis. RR relative risk



TOTAL MORTALITY: HIGHEST VERSUS LOW COFFEE INTAKE

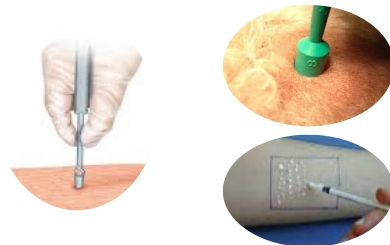


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Review article
Psychological stress and wound healing in humans: A systematic review and meta-analysis[☆]

Jessica Walburn^{a,*}, Kavita Vedhara^b, Matthew Hankins^a, Loma Rixon^a, John Weinman^a

^aInstitute of Psychiatry, Department of Psychology, King's College London, London, UK
^bInstitute of Work, Health, and Organizations, University of Nottingham, Nottingham, UK
Received 18 October 2008; received in revised form 3 March 2009; accepted 7 April 2009



J. Walburn et al. / Journal of Psychosomatic Research 67 (2009) 253–271

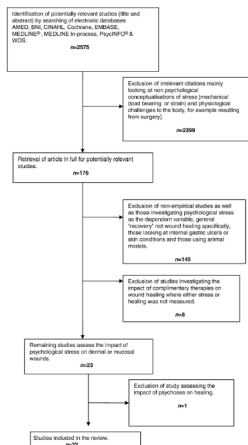
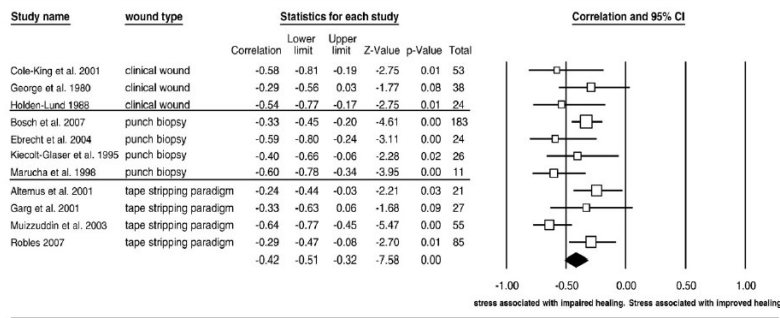


Fig. 1. Flowchart showing the process of selecting studies included in the review.



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Exam and PC QI Workshop

- Exam next week 10/7/2021
- In-person, closed book, in the class
- Starts at 4:40 to 6:00 pm

If you cannot join the exam for a justifiable reason, please let me know before the exam so we could arrange for an alternative time.

- Questions come from the packet (except for extra credit questions)
- 1 table, one multiple choice, 28 short answers and one extra credit point essay
- After a short break we will start the PC QI certification
- The curriculum is co-developed and recognized by the food and drug administration and **attendance in all sessions** are required to be able to obtain the certificate.
- A few members from the food industry will also join the session via Zoom.



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Food Safety Auditor Credentials

Stand Out in the World of Food Safety

The Food Safety Modernization Act (FSMA) has revolutionized the food safety landscape adding to the arsenal of required knowledge needed by those involved in any aspect of the food supply chain. Competent, Qualified Individuals are needed to carry out the functions described in the regulations. Equally, competent Qualified Individuals are needed for auditing the effectiveness of food safety programs internally, for supplier, and as an external third party observer.

The NEHA Certified in Food Safety Supplier Audits (CFSSA) credential has been developed to help build the global capacity of qualified, vetted professionals that will be needed to meet the requirements of FSMA. Upon successfully passing the exam, the CFSSA credential holder will be prepared to complete 1st and 2nd party audits. They will be accomplished in understanding and planning food safety audits, conducting an audit, verifying food safety and prerequisite programs, and conducting post-audit activities. It is also a career path to becoming a third party auditor.

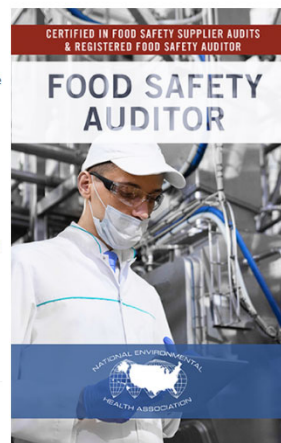
The NEHA Registered Food Safety Auditor (RFSA) credential enables individuals to complete third party audits. The RFSA is for more experienced food safety professionals who are one of the last lines of defense in the complex global food supply chain. If you're responsible for conducting risk-based facility audits (foreign or domestic) against internationally recognized food safety standards designed to mitigate risk, promote food safety, and enhance consumer confidence in the food supply, then the RFSA credential is the right choice for you.

Food Safety Magazine published two articles, [NEHA Credential Creates a Professional Pathway for Food Safety Auditors](#) and [New Food Safety Auditing Credentials](#), that outlined the work that went into creating this influential credential. The CFSSA credential with food sector specific auditing experience can lead to the Registered Food Safety Auditor (RFSA) credential for those who wish to become third party auditors.

Certified in Food Safety Supplier Audits (CFSSA)

If you're responsible for conducting risk-based facility audits (foreign or domestic) against internationally recognized food safety standards designed to mitigate risk, promote food safety, and enhance consumer confidence in the food supply, then the CFSSA credential is the right choice for you.

[APPLY NOW](#)



[View Interactive Brochure](#)

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What is HACCP?

- HACCP: Hazard Analysis and Critical Control Points

Systematic approach and a Food Safety Management system to:

- Hazard identification
- Assessment of risk
- Control hazard and risk
- Very common in food industry (meat packing and RTE meat products) to assure foods safety, and **prevent, eliminate, and/or reduce** hazards



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What is HACCP?

- HACCP originated in the 1960's, by:
 - National Aeronautics and Space Administration (NASA)
 - The Pillsbury Company
 - The U.S. Army Laboratories
- **Purpose:** Safe food for upcoming **space expeditions** to eliminate "critical failure areas"
- **Origin:** NASA's **engineering management requirements**, Critical Control Points, would be used as a guideline for this food safety initiative



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What is HACCP?

- HACCP had been a success in space expeditions' food preparation
- Shortly after implementation, **Pillsbury outbreak/recall (1970)**
 - **Farina with pieces of glass** (farina, carbohydrate rich food for infant/adults very rich in **iron**)
- A microbiologist at Pillsbury (**Howard Baumann**), who worked with **NASA initiative**:
 - Advocated adoption of HACCP in food industry because of the outbreak



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What is HACCP?

- **1971 Panel Discussion** in National Conference on Food Protection, Denver, CO:
 - *[Food Protection, International Association for Food Protection]*
- Conference Sponsored by:
 - *Food and Drug Administration (FDA)*
 - *American Public Health Association (APHA)*
- Examined concept of:
 - *Critical Control Points (CCP)*
 - *Good Manufacturing Practices (GMP)*
- After the conference:
 - **FDA requested Pillsbury** to establish/manage training program for **canned foods**
[b/c botulism concern by Clostridium botulinum]
[Botulism is now very rare and mostly occur as infant botulism associated honey]



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What is HACCP?

- The initial HACCP course (developed by Pillsbury):
- **Title:** Food Safety through the Hazard Analysis and Critical Control Point System
- First introduced: September 1972
- HACCP **was not** a regulatory requirement when established
- Since 1985 was **recommendation** for poultry and meat industry *[prevalence of pathogens, adopted by USDA FSIS]*
[Meat industry is the largest segment in food industry]



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What is HACCP?

- Jack-in-the-box outbreak: 1992-1993
- The outbreak strain of *E. coli* O157:H7
- Isolated from **11 lots of hamburger patties** produced on November 29 and 30, 1992,
- Jack-in-the-Box issued a recall of all ground beef produced on that day
- **73 Jack-in-the-Box restaurants** involved in outbreak



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What is HACCP?

- **Washington:**

- 144 people were hospitalized
- 30 developed HUS* (about 25-30%)
- 3 died (about 10%)

- **Idaho:**

- 4 people were hospitalized
- 1 developed HUS

- **California**

- 14 people were hospitalized
- 7 developed HUS
- 1 child died

- **Nevada**

- 9 people were hospitalized
- 3 developed HUS

More patients in IL, NJ, MI

Alex Donley
Chicago, IL
1987 - 1993

Katie O'Connell
Kearney, NJ
1990 - 1992

Scott Hinkley
Saranac, MI
1990 - 1993

Lauren Rudolph
Carlsbad, CA
1986 - 1992

E. coli O157:H7
kills more than one
victim each day.

WHO IS NEXT?

???? ???????
???????, ??
19__ - 19__

Picture
Your
Child
Here

*Hemolytic Uremic Syndrome (HUS)

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What is HACCP?

- After the jack-in-the-box outbreak and similar outbreaks in juices (*E. coli* O157:H7) and ready-to-eat products (*Listeria monocytogenes*)

- HACCP became **regulatory requirement** for :
- Meat industry, poultry industry, shelled egg and cat fish (USDA FSIS)
- Juices and seafood and intact egg (FDA, DHHS)

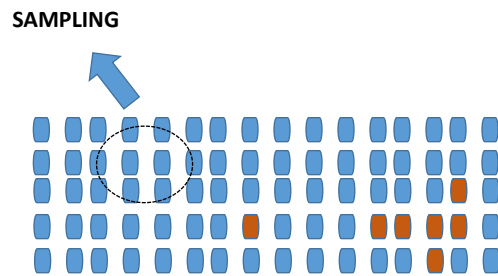
USDA
United States
Department of
Agriculture

United States
Department of
Agriculture
Food Safety
and Inspection
Service
April 1997

**Guidebook For
The Preparation
Of HACCP Plans**

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Understanding HACCP: HACCP and End Point Sampling



- Contamination in a food batch is **not homogeneous**
- Relying solely on sampling provides **false sense of security**
- HACCP is a systematic food safety management system to **prevent, eliminate, or reduce risk** of foodborne hazards

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Understanding HACCP

- Food Safety Management System
- Purpose is “prevention” ...



Table 1. HACCP Principles

Principle 1	Conduct a hazard analysis.
Principle 2	Determine the critical control points.
Principle 3	Establish critical limits.
Principle 4	Establish monitoring procedures.
Principle 5	Establish corrective actions.
Principle 6	Establish verification procedures.
Principle 7	Establish record-keeping and documentation procedures.

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HACCP Prerequisite Programs

GMP: Good Manufacturing Practices

Very specific requirements
 Specific forms
 Specific documentations

Production and Process Controls:

- Raw materials
- Manufacturing operations

Topics to Consider for GMP:

Internal characteristics of food (intrinsic factors)

- available nutrients [bioprotection in yogurt and wine]
- available water activity [<0.82, danger zone, 2 hours]
- pH (acidity or alkalinity) [>4.2 botulism concern]
- physical structure [moisture permeability]

External characteristics of processing (extrinsic factors)

- temperature
- atmosphere (presence or absence of O₂)
- packaging



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HACCP Prerequisite Programs

GMP: Good Manufacturing Practices

Building and Facilities

- Grounds and area outside [microbiologically cleanable]
- Cafeteria or lunch area [4 zones recommended]
- Entrances [Positive air flow, air curtain, footbath]
- Hand washing stations

Equipment and Utensils

- Design and construction of equipment [microbiologically cleanable]
- Instruments for control of temperature or pH must be accurate [calibration]



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HACCP Prerequisite Programs

GMP: Good Manufacturing Practices

Personnel Education [**>20% worker could carry *S. aureus***] [GMP violations, QC personal]

- Periodic training for all employees
- Diseases control [*Salmonella and Shigella positive*]
- Open lesions or infected wounds
- Personal cleanliness in production
- Clean outer garments
- Wash hands
- Remove jewelry
- Storage of personal belongings
- No chewing gum or smoking
- Hair nets and beard nets

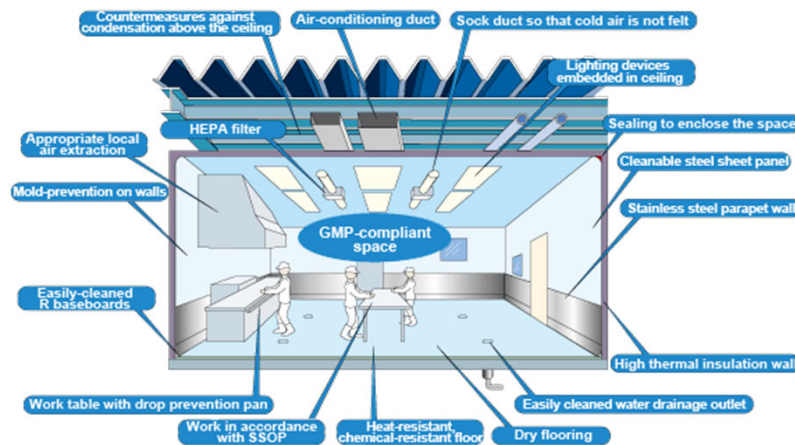


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GMP's in Manufacturing

[Chapter 3 of FSMA certification]

source: http://www.hitachi-hps.co.jp/en/product_site/food_chemical/haccp_sanitation.html



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HACCP Prerequisite Programs

SSOP: Sanitation Standard Operating Procedure

Specific documents, developed by the facility/company

Must address: pre-operational sanitation and operational sanitation (mid-shift) and Post-Operation

Plant needs to update SSOPs to reflect changes in equipment and facilities

SSOP: [Portfolia of products are available for planktonic cells and biofilms]

- Cleaning
- Disassemble and more cleaning
- Sanitizing
- Assembly and final rinse (or use of no-rinse sanitizer such as 200 ppm Sodium Hypochlorite)



- **Pre-operational checklist:** Inspection and regulatory compliance [Completed by QC]
- **Operational Sanitation:** Equipment cleaning during production
- **Post-operational sanitation:** Detailed descriptions of equipment disassembly and re-assembly

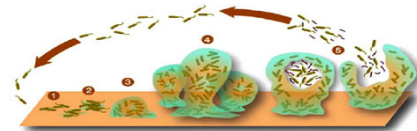


Photo Courtesy: <http://prometheus.mattse.illinois.edu/glossary/biofilms/>

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A Sample of SSOP and Sanitation Logs

SAMPLE – SANITATION STANDARD OPERATING PROCEDURE (SSOP)

XYZ Meat Packers, Inc. is a red meat processing establishment. This plant receives beef and pork for further processing. This plant cuts and grinds product and also packages it.

MANAGEMENT STRUCTURE

- Owner –
- Plant Manager –
- Team Captains –

The Team Captains are responsible for implementing and daily monitoring of Sanitation SOP and recording the findings and any corrective actions. The Team Captains are responsible for training and assigning specific duties to other employees and monitoring their performance within the Sanitation SOP. All records, data, checklists, and other information pertaining to the Sanitation SOP will be maintained on file and made available to inspection personnel.

- I. Preoperational Sanitation – Equipment and Facility Cleaning Objective
 - A. All equipment will be disassembled, cleaned, and sanitized before starting production.
 1. Establishment sanitary procedure for cleaning and sanitizing equipment.
 - a. All equipment will have product debris removed.
 - b. Equipment will be rinsed with water to remove remaining debris.
 - c. An approved cleaner will be applied to equipment and properly cleaned.
 - d. Equipment will be sanitized with approved sanitizer and rinsed with

Yogi Super Foods
Last revised: June 6, 2019

TOOLS, UTENSILS, AND PACKAGING CONTAINERS SANITATION LOG							
Please see the Food Safety Plan for Sanitation Standard Operating Procedures							
Date	Cleaning List (check each)				Treatment	Cleaned by Initials:	
	Knives and Utensils	Large Containers	Bottles and Caps	Product Line and Lead			Other
6-6-2019	CLN/ SW	CLN	N/A	CLN/ SW	N/A	Washed with dishwashing soap, rinse with hot water, sanitize with 100 ppm chlorine solution (pH for 10 seconds) exposed to UV for 10 minutes	MB

Reviewed by: _____ Title: _____ Date: _____

Food Contact Surfaces (Sodium Hypochlorite in organic operation, Vortex)
Non-food Contact Surfaces (Quaternary Ammonium Compounds)

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Understanding HACCP

- **Food Safety Management System**
- Purpose is “**prevention**”... unlike end point sampling
- **End product: HACCP plan**



Table 1. HACCP Principles

Principle 1	Conduct a hazard analysis.
Principle 2	Determine the critical control points.
Principle 3	Establish critical limits.
Principle 4	Establish monitoring procedures.
Principle 5	Establish corrective actions.
Principle 6	Establish verification procedures.
Principle 7	Establish record-keeping and documentation procedures.

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Exercise 1

- What HACCP stands for and what is it?
- What was the initial origin and purpose for HACCP? What Agencies developed the HACCP?
- What outbreak episode that resulted in introduction of HACCP in the food industry as a **recommended** food safety management system?
- What was the main outbreak episode that resulted in introduction of HACCP in the food industry as a **required regulatory** food safety management system?
- What are the products that are currently under the jurisdiction of mandatory HACCP? What regulatory agencies are overseeing the HACCP compliance?
- What is the difference between HACCP and End point sampling? What is the main limitation of end point sampling?
- What are the Prerequisite programs of HACCP?
- What are the seven principles of HACCP?

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Preparing a HACCP Plan

Two Prerequisite Programs for HACCP plan development:

- GMP: Good Manufacturing Practices
- SSOP: Sanitation Standard Operating Procedures



The **Five Preliminary Steps** to develop a HACPP plan:

- 1. Bring together your HACCP resources/assemble the HACCP team
- 2. Describe the food and its method of distribution [Defines regulatory path]
- 3. Identify the intended use and consumers of the food [RTE, RTH, frozen]
- 4. Develop a **process flow diagram**
- 5. **Verify the diagram** in the operation it is meant to represent

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Preparing a HACCP Plan

Application of **Seven Principles of HACCP**:

- 1. Conduct a **hazard analysis**.
- 2. Identify **critical control points**.
- 3. Establish **critical limits** for each critical control point.
- 4. Establish **monitoring procedures**.
- 5. Establish **corrective actions**.
- 6. Establish **recordkeeping** procedures.
- 7. Establish **verification procedures**.



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STEP 1 - BRING TOGETHER YOUR HACCP RESOURCES- ASSEMBLE THE HACCP TEAM

Small Company:

- One or two **employees**, one of whom has had HACCP training. [[HACCP International Alliance](#) or [equivalane](#)] [FSMA only PC QI]
- **Outside expertise:**
- Local Extension Office,
- Trade or professional association, or a
- Contractor of your choice.
- **Purpose:** **Cross-functional expertise** to adequately analyze all biological physical and chemical hazards.



Larger plant: [Standard outfit colors]

- Production managers
- Quality control manager
- Sanitation Manager
- Engineering/maintenance

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STEP 1 - BRING TOGETHER YOUR HACCP RESOURCES- ASSEMBLE THE HACCP TEAM

- **HACCP Team Would need to have knowledge of:**
- The **technology and equipment** used in your processing lines
- The practical aspects of **food operations and food policies**
- **Flow of the process in your plant**
- **Food microbiology** (could be supplemented by outside experts)
- **HACCP principles and techniques** (could be supplemented by outside experts)



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STEP 2 - DESCRIBE THE PRODUCT AND ITS METHOD OF DISTRIBUTION INCLUDING THE INTENDED USE AND CONSUMERS OF THE FOOD (defines the regulatory pathway)

- **1. Common name?** For example, a cooked sausage could be called franks/hot dogs/wieners.
- **2. How is it to be used?** Categories might include: Ready-to-eat, ready-to-serve, raw, frozen
- **3. The type of package?** For example, is it **modified atmosphere** packaging?
- **4. Length of shelf life?** In the cooked sausage example, the length of shelf life might be 30 to 50 days for modified atmospheric packaging. **[Accelerated shelf-life testing]**
- **5. Where will it be sold?** For example, will it be sold to wholesale, retail or institutions?
- **6. Labeling instructions?** "Keep Refrigerated" would be a common labeling instruction for meat and poultry products.
- **7. How is the product(s) distributed?** For instance, should the product be kept **refrigerated at or below 40 °F?**
- **8. Who is the consumer** and how will the product be used by the consumer? **YOPI? 30% of population**



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STEP 2 - DESCRIBE THE PRODUCT AND ITS METHOD OF DISTRIBUTION INCLUDING THE INTENDED USE AND CONSUMERS OF THE FOOD

PROCESS DESCRIPTION	
PRODUCT:	
THE FOLLOWING QUESTIONS NEED TO BE ANSWERED WHEN DEVELOPING THE PRODUCT DESCRIPTION:	
1.	COMMON NAME?
2.	HOW IS IT TO BE USED?
3.	TYPE OF PACKAGE?
4.	LENGTH OF SHELF LIFE, AT WHAT TEMPERATURE?
5.	WHERE WILL IT BE SOLD? CONSUMER? INTENDED USE?
6.	LABELING INSTRUCTIONS?
7.	IS SPECIAL DISTRIBUTION CONTROL NEEDED?

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STEP 3 - DEVELOP A COMPLETE **LIST OF INGREDIENTS AND RAW MATERIALS**

- **Written list of ingredients**
- **Written list of raw materials** for each process/product.
- **Basic FSIS forms suggest diving ingredients** to:
 - **Main Ingredients:** e.g. Meat (meat such as boneless beef or chicken parts with skin)
 - **Other Ingredients:** e.g. Such as spices and preservatives
- **Basic form** are recommended by FSIS, companies may elect to use more **elaborate form**
- **Example: Commercial Beef Stew**



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STEP 3 - DEVELOP A COMPLETE **LIST OF INGREDIENTS AND RAW MATERIALS**

LIST PRODUCT(S) AND INGREDIENTS
PROCESS CATEGORY: THERMALLY PROCESSED-COMMERCIALY STERILE
PRODUCT EXAMPLE: BEEF STEW
MEAT*
FROZEN COOKED DICED BEEF
INGREDIENTS*
FROZEN SLICED CARROTS FROZEN DICED POTATOES FROZEN SLICED CELERY REFRIGERATED ONION JUICE CONC. REFRIGERATED GARLIC PUREE VEGETABLE OIL STARCH HVP PLANT GUM DEHY. BEEF STOCK SALT SPICE MIX WORCESTERSHIRE SAUCE
* The dice size of the ingredients should be listed in a specific plan if it is a critical formulation factor. Amounts of each ingredient may also be included.

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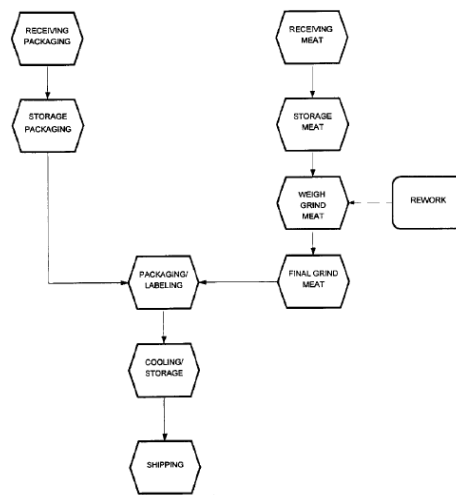
STEP 4 - DEVELOP A PROCESS FLOW DIAGRAM

- **Process flow diagram identifies:**
 - **All the steps** used to prepare the product from **receiving** through **final shipment** that are **directly under the control** of the establishment.
- The diagram **should not be so complex** that it is difficult to follow and understand.
- The diagram **must be complete** from the beginning of your process to the end.
- The flow diagram **may also include** steps that occur **before or after** the processing occurs in the establishment.
- The diagram **would need to be verified:** i.e. *walking through the plant to make sure that the steps listed on the diagram describe what really occurs in producing the product.*
- **Example: Ground beef Flow diagram**



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STEP 4 - DEVELOP A PROCESS FLOW DIAGRAM



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STEP 5 - MEET THE REGULATORY REQUIREMENTS FOR SANITATION STANDARD OPERATING PROCEDURES

- Perhaps, **good sanitation** is the **most important** way to ensure a safe product is produced.
- Pre-HACCP requirement (prerequisite programs) that **must be carried out** in all establishments.
- **Other prerequisite programs** for HACCP can be developed which are extremely useful (such as **GMP's**)
- SSOPs **must be microbiologically validated** for planktonic cells and biofilms:
 - Suppliers of the sanitizers
 - Challenge studies in the literature
- **Example: Validation of Sodium Hypochlorite in Planktonic and Sessile environment**



Food Contact Surfaces (Sodium Hypochlorite in organic operation, Vortex)
Non-food Contact Surfaces (Quaternary Ammonium Compounds)

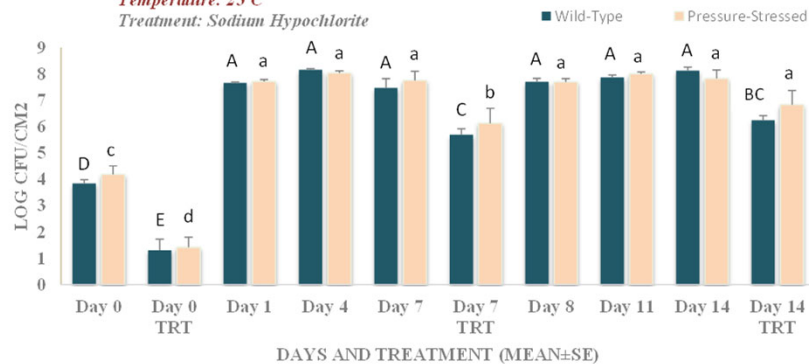
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STEP 5 - MEET THE REGULATORY REQUIREMENTS FOR SANITATION STANDARD OPERATING PROCEDURES

Biofilm Formation and Decontamination of Wild-Type and Pressure-Stressed *Cronobacter Sakazakii*

Temperature: 25°C

Treatment: Sodium Hypochlorite



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Development of a HACCP Plan

1. Conduct a hazard analysis.

2. Identify critical control points.
3. Establish critical limits for each critical control point.
4. Establish monitoring procedures.
5. Establish corrective actions.
6. Establish recordkeeping procedures.
7. Establish verification procedures.

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Development of a HACCP Plan

Conduct a hazard analysis

- **Hazard Identification.**

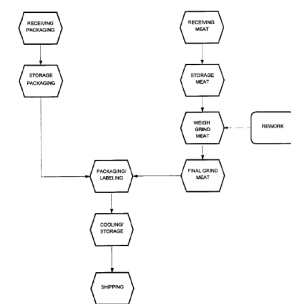
“Prepare a list of steps in the process where significant hazards occur and describe the preventive measures.”

- **HACCP definition of Hazard:**

“Any biological, chemical, or physical property that may cause a food to be unsafe for human consumption.”

- **HACCP definition of Preventive Measure:** (in FSMA called Control Measure)

“Physical, chemical, or other means that can be used to control an identified food safety hazard.”



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Development of a HACCP Plan

Conduct a hazard analysis

Biological Hazards

- **Biological Hazards in Foods:**

- *Bacterial*
- *Viral*
- *Parasitic*
- *Prions*

- (1) **Could directly infect human:** Parasites
- (2) **Zoonotic:** Transmitted from live animals
- (3) **Foodborne:** cause infection, intoxication, and toxicoinfection after ingestion
- During **production, processing, packaging, transportation, preparation, storage and service**, any food may be exposed to bacterial contamination.
- Major pathogens of concern in meat processing:

Salmonella, Clostridium perfringens, Listeria monocytogenes, Staphylococcus aureus, Campylobacter jejuni, Yersinia enterocolitica, Bacillus cereus, Clostridium botulinum, and Escherichia coli O157:H7.

Biological Hazards Associated with a product would need to be identified:

- *Literature*
- *Existing documents and company history*

Meat and Poultry Hazards and Controls Guide

Food Safety and Inspection Service
United States Department of Agriculture
March 2018



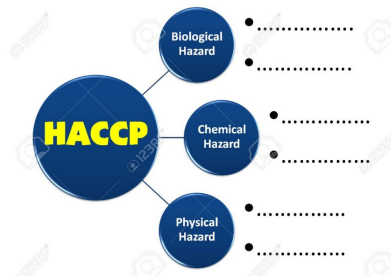
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Development of a HACCP Plan

Conduct a hazard analysis

Chemical Hazards

- **1. Naturally occurring poisons, chemicals, or deleterious substances:**
- Are natural constituents of foods
- Are not the result of environmental, agricultural industrial, or other contamination.
- **Examples:** aflatoxins, mycotoxins, and shellfish toxins. [*Secondary metabolites of molds*]



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Development of a HACCP Plan

Conduct a hazard analysis

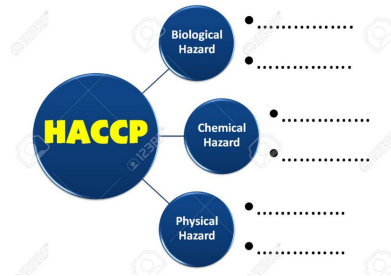
Chemical Hazards

2. Added chemicals or deleterious substances:

- Are **intentionally** or **unintentionally** added to foods at some point in growing, harvesting, storage, processing, packing, or distribution.

Examples:

- (1) **Agricultural additives:** pesticides, fungicides, insecticides, fertilizers, drug residues, and antibiotics
- (2) **Direct food additives:** preservatives, flavorings
- (3) **Indirect food additives:** lactic acid after rinsing carcass
- (4) **Others (accidentals):** lubricants, cleaners, paints, and coatings



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Development of a HACCP Plan

Conduct a hazard analysis

Chemical Hazards

Five Classes of Chemical Hazards in Meat Industry HACCP plan:

FSIS recommendation is placing **special emphasis on:**

- (1) **Drugs and pesticides** routinely used in raising the animals which are the source of your meat and poultry ingredients (e.g. **sub-therapeutic antibiotics**)
- (2) **Feeds and supplements** fed to the animals.
- (3) **Environmental contaminants**, (naturally occurring or added contaminants).
- (4) **Pesticides and other chemicals used in plant** that may end up as residues in the animal.
- (5) The **source of the water** for the animals [**heavy metals**]

• **Chemical Hazards Would need to be identified based on:**

- *Review of processing condition and company historical data*
- *Review of literature*
- *Review of regulatory guidelines*

Meat and Poultry Hazards and Controls Guide

Food Safety and Inspection Service
United States Department of Agriculture
March 2018



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Development of a HACCP Plan

Conduct a hazard analysis

Physical Hazards

- A **physical hazard** is any physical material **not normally found in a food** which **causes illness or injury** to the individual using the product.
- **Such as:** glass, metal, and plastic.
- **Foreign objects which cannot or do not cause illness or injury are not hazards**, even though they may not be aesthetically pleasing to your customers.

Sources of physical hazards:

- (1) **Contaminated raw materials:** *Pieces of metal or stone*
- (2) **Poorly designed or poorly maintained facilities and equipment.** *An example would be paint chips falling from overhead structures onto exposed product or pieces of metal from worn or improperly maintained equipment entering product. [Metal detector and keeping track of objects]*
- (3) **Improper procedures or improper employee training and practices.** *For example, broken glass jars, by improper loading on the line by employees or improper or inadequate condition examination, glass pieces from broken or chipped jars could be included when filling product containers.*



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Development of a HACCP Plan

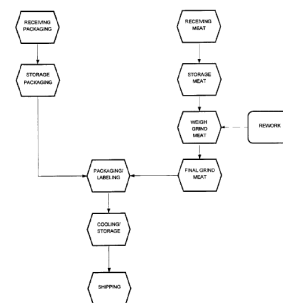
Conduct a hazard analysis

5 Steps in Conducting the Hazard Analysis:

(1) Assure that the prerequisite program (GMP's and SSOP's) are in place.

(2) **Hazard Identification:** For each **processing step** identified in the **process flow diagram**, determine if a biological, chemical or physical hazard(s) could exist at that step.

- **Tips for Hazard Identification: Ask questions (also software and paper-based decision trees exist)**
 - Could **contaminants** reach the product during this processing step?
 - Could any **pathogens multiply** during this process step to the point where they became a hazard?
 - Could this step create a situation where an ingredient, work in process, or finished product **became contaminated** with pathogens?
 - Could this step introduce a **chemical hazard** into the product?
 - Could this step introduce a **physical hazard** into the product?
 - Are the **hazards addressed in the SSOP's**?



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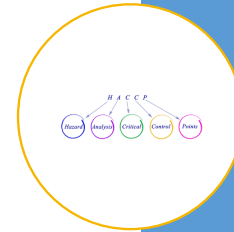
Development of a HACCP Plan Conduct a hazard analysis

(3) Fully describe the hazards identified for each step and describe in detail.

(4) Evaluate the **likelihood** and **severity** of occurrence of the hazard:

- Likelihood of occurrence: Frequency of disease (*Campylobacters*, Botulism)
- Severity of occurrence: How serious it could be (Norovirus, HUS)

(5) Identification of **Control Measures** for each hazards:
i.e. existing measures to control the hazard

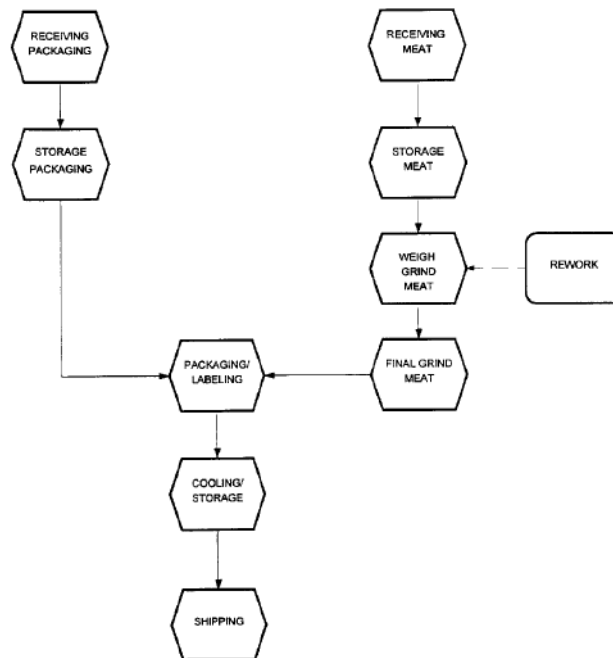


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In other words...

Each Step:

- Identification of Hazard
- likelihood and severity
- Identification of Preventive Measures
- How the hazard could be introduced



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HAZARD ANALYSIS/PREVENTIVE MEASURES

PROCESS CATEGORY : RAW, GROUND
PRODUCT EXAMPLE : GROUND BEEF

Process Step	HAZARDS Biological (B) Including Microbiological Chemical (C) Physical (P)	Preventive Measures	Examples of How Hazard Is Introduced *
RECEIVING - MEAT	<p>B (Microbial Growth) - Insufficient temperature control will result in unacceptable microbial growth. Ayers, J.C. 1979</p> <p>B (Mishandling) - The integrity of the immediate container is compromised such that microbial contamination could occur.</p> <p>P (Foreign Material) - Visible foreign material that could compromise product safety. Meat and Poultry Products Hazards and Control Guide.</p>	<p>Maintain product temperature at a level sufficient to preclude bacterial growth.</p> <p>Visual inspection of containers to ensure that immediate container is not compromised.</p> <p>Visual inspection of a sufficient representative sample to ensure no foreign material is present.</p>	<p>B-Transport refrigeration unit is not functioning properly (out of freon).</p> <p>B-The shipping container (the cardboard combo bin) was crushed by a forklift and the immediate container (the film wrapped around the individual trays) was torn and punctured introducing harmful microbes into the product.</p> <p>P-Pieces of glass found in product from a broken light bulb, metal clips, knives, plastic, etc.</p>
RECEIVING - NON-MEAT	<p>C (Deleterious Chemicals) - Chemicals/non-meat ingredients/packaging materials, are acceptable for intended use. Should be food grade material approved for intended use. Bean, N.H. and P.M. Griffin 1990.</p> <p>P (Foreign Material) - Visible foreign material that could compromise product safety; rodent droppings, insects, etc.</p>	<p>Verify that the letter of guarantee is on file and appropriate for product use.</p> <p>Visual inspection of a sufficient representative sample to ensure no foreign material is present.</p>	<p>C-The new tray pack "diapers" ordered came in and the letter of guarantee is present with the shipment, however the letter states that of the diapers are acceptable for industrial use and not food grade.</p> <p>P-Black material that resembles rodent droppings are found on the surface of the styrofoam trays.</p>
STORAGE - MEAT	<p>B (Microbial Growth) - Insufficient temperature control could result in unacceptable microbial growth. Internal product temperature and environmental temperature must be monitored. Ayers, J.C. 1979, Bryan, F.L., 1988, Palumbo, S.A., et.al. 1994</p>	<p>Monitor the internal product temperature and environmental temperature (ex. cooler or freezer) to ensure that the meat does not exceed a level sufficient to preclude bacterial growth for more than 1 hour, and the temperature of the cooler or freezer is maintained at or below 40°F.</p>	<p>B-Cooler generator breaks down and the ambient room temperature in the cooler increases above 50°F for 10 hours increasing product temperature above compliance permitting excessive bacterial growth.</p>

Chapter 8 of FSMA, we will conduct Hazard Analyses, would suggest choosing a product

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Development of a HACCP Plan

1. Conduct a hazard analysis.
- 2. Identify critical control points.**
3. Establish critical limits for each critical control point.
4. Establish monitoring procedures.
5. Establish corrective actions.
6. Establish recordkeeping procedures.
7. Establish verification procedures.

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Exercise 2

- According to “*Guidebook for Preparation of HACCP plan*” issued by FSIS, what are the five Preliminary steps before development of HACCP plan?
- What are the eight sections of the recommended form for describing a product and its method of distribution/consumption by consumers?

According to “*Guidebook for Preparation of HACCP plan*” issued by FSIS, a flow diagram of the operation would need to be developed before development of the HACCP plan. What a flow diagram identifies and what are the general recommendation for its development?

What are the four types of biological hazards in a HACCP plan for meat industry?

- According to “*Guidebook for Preparation of HACCP plan,*” what are the main pathogens of concern in meat processing?

What are the two main categories of Chemical hazards? Please name one example for each category?

What are the five steps of conducting hazard analyses?

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Development of a HACCP Plan

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Development of a HACCP Plan

Identify critical control points

- **Critical Control Point (CCP) is definition** "A point, step, or procedure in a food process at which control can be applied and, as a result, a food safety hazard can be prevented, eliminated, or reduced to acceptable levels."

Purpose of determining CCP: Prevented, eliminated, or reduced the risk to acceptable level

So far we have done:

- Identification of biological, chemical, and physical hazards
- Preventive measures for each hazard

Now, Determining Critical Control Points: [# of CCP a great question?]

- CCP decision tree
- Any other decision tree
- Or a logical process

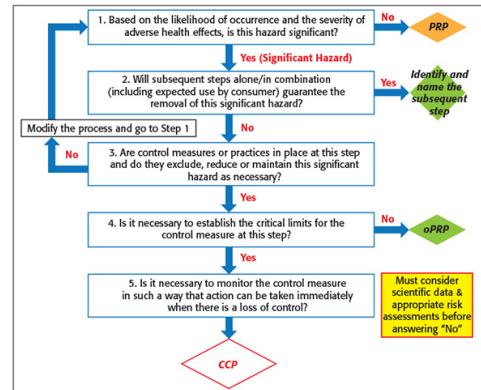
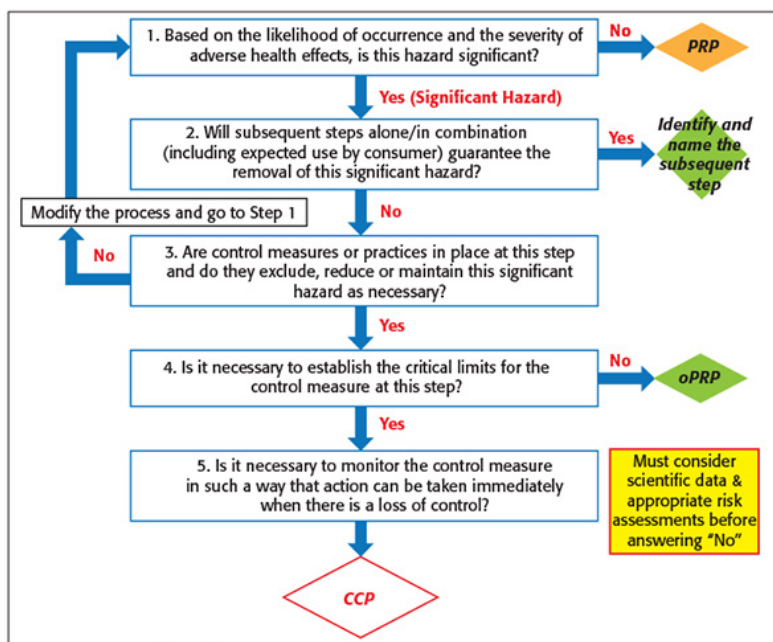


Figure 1: Coca-Cola/Michigan State Decision Tree

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Question #1 - Do preventive measures exist for the identified hazard?

Question #2 - Does this step eliminate or reduce the likely occurrence of the hazard(s) to an acceptable level? (is it a kill step?)

Question #3 - Could contamination with identified hazard(s) occur in excess of acceptable levels or could these increase to unacceptable levels?

Question #4 - Will a subsequent step eliminate identified hazard(s) or reduce the likely occurrence to an acceptable level?

CCP DECISION TREE

(Apply at each step of the process with an identified hazard.)

Q1. DO PREVENTIVE MEASURE(S) EXIST FOR THE IDENTIFIED HAZARD?
 YES NO MODIFY STEP, PROCESS OR PRODUCT
 IS CONTROL AT THIS STEP NECESSARY FOR SAFETY?- YES
 NO - NOT A CCP - STOP*

Q2. DOES THIS STEP ELIMINATE OR REDUCE THE LIKELY OCCURRENCE OF A HAZARD TO AN ACCEPTABLE LEVEL? - - - - -
 NO YES

Q3. COULD CONTAMINATION WITH IDENTIFIED HAZARD (S) OCCUR IN EXCESS OF ACCEPTABLE LEVEL(S) OR COULD THESE INCREASE TO UNACCEPTABLE LEVEL(S)?
 YES NO - NOT A CCP - STOP*

Q4. WILL A SUBSEQUENT STEP ELIMINATE IDENTIFIED HAZARD(S) OR REDUCE THE LIKELY OCCURENCE TO AN ACCEPTABLE LEVEL?
 YES - NOT A CCP - STOP* NO - - - - - CCP

* Proceed to the next step in the described process

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Development of a HACCP Plan
Identify critical control points

Typical Critical Control Points: [rule of thumb]

- **Chilling** when appropriate.
- **Cooking** that must occur for a specific time and temperature in order to destroy microbiological pathogens.
- **Product formulation** controls, such as addition of culture or adjustment of pH or water activity.
- Certain **processing procedures**, such as **filling and sealing cans**.
- Certain **slaughter procedures**, such as **evisceration or antimicrobial interventions**.

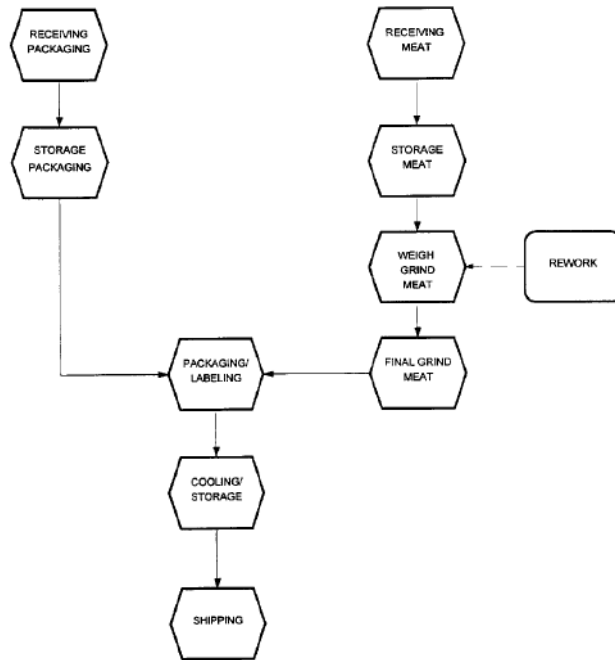
Figure 1: Coca-Cola/Michigan State Decision Tree

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In other words...

Identify "CCP's" after Hazard Analysis

A processing plant could have one or several CCP's



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RAW GROUND CCP DETERMINATION (A CRITICAL CONTROL POINT IS DEFINED AS A POINT, STEP OR PROCEDURE AT WHICH CONTROL CAN BE APPLIED AND A FOOD SAFETY HAZARD CAN BE PREVENTED, ELIMINATED, OR REDUCED TO ACCEPTABLE LEVELS)						
PROCESS STEP	HAZARD(S)	Q1. DO PREVENTIVE MEASURES EXIST FOR THE IDENTIFIED HAZARD(S)? *If no-not a CCP-Identify how and where this hazard will be controlled. *If yes-move to next question.	Q2. DOES THIS STEP ELIMINATE OR REDUCE THE LIKELY OCCURANCE OF A HAZARD(S) TO AN ACCEPTABLE LEVEL? *If no-move to the next question. *If yes-CCP	Q3. COULD CONTAMINATION WITH IDENTIFIED HAZARD(S) OCCUR IN EXCESS OF ACCEPTABLE LEVELS OR COULD THESE INCREASE TO UNACCEPTABLE LEVELS? *If no-not a CCP *If yes-move to the next question.	Q4. WILL A SUBSEQUENT STEP ELIMINATE HAZARDS(S) OR REDUCE THE LIKELY OCCURANCE TO AN ACCEPTABLE LEVEL? *If no-CCP *If yes-not a CCP.	#CCP
Receiving-Meat	B - Microbial Growth	YES	YES			CCP1B
	C - N/A (Not Applicable)					
	P - Foreign Material	YES	YES			CCP1P
Receiving-Non-Meat	B - N/A low risk					
	C - Deleterious Chemicals	YES	YES			CCP1C
	P - Foreign Material	YES	YES			CCP2P
Storage-Meat	B - Microbial Growth	YES	YES			CCP2B
	C - N/A					
	P - N/A low risk					
Storage-non-meat	B - Microbial Growth					
	C - N/A					
	P - Foreign Material Material/Addition	YES	YES			CCP3P
Assemble/pre-weigh/te-neck/final grind	B - Microbial growth	YES	YES			CCP3B
	C - N/A					
	P - Foreign Material	YES	NO	YES	YES	CCP4P

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Development of a HACCP Plan

1. Conduct a hazard analysis.
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Development of a HACCP Plan

Establish critical limits for each critical control point

• Main Critical Limits are:

- Time/temperature
- Relative Humidity
- Water activity
- pH
- Salt concentration
- Chlorine level

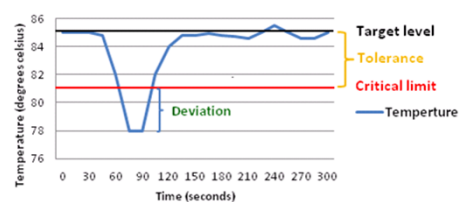
How to set the Critical Limits:

- Determine if there is a **regulatory critical limit** set for ensuring food safety
- If there are **no regulatory critical limits**, establishment of critical limits **based on literature** and other plans

• **Example:**

- Cooking RTE poultry products to **internal temperature of 165°F**
- The **pH of 4.2** for canned products (control of botulism)

A graph to show the temperature of sauce (recipe A) over time



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Development of a HACCP Plan

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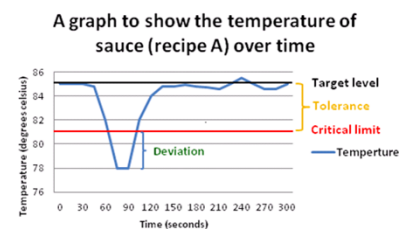
Development of a HACCP Plan

Establish monitoring procedures

- **Example of monitoring:** Measuring the pH of every 20 cans to assure it stays at 4.2 or below

FSIS 5 steps for successful development of monitoring:

- 1. For each CCP, **identify the best monitoring procedure.**
- 2. Determine the **frequency of monitoring** for each CCP.
- 3. If **random monitoring** needed, Determining a random monitoring plan
- 4. Determine **what testing procedures** need to be done for each monitoring function. For example, will you need to do a chlorine check or a temperature measurement?
- 5. **Identify and train the employee(s) responsible for monitoring.**



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HACCP PLAN						
PROCESS CATEGORY :		RAW, GROUND				
PRODUCT EXAMPLE :		GROUND BEEF				
PROCESS STEP	BIOLOGICAL CHEMICAL PHYSICAL HAZARD DESCRIPTION	CCP	CRITICAL LIMITS	MONITORING PROCEDURES/FREQUENCY/ PERSON RESPONSIBLE	CORRECTIVE/PREVENTIVE ACTION/PERSON RESPONSIBLE	VERIFICATION PROCEDURE/PERSON RESPONSIBLE
RECEIVING - MEAT	B - Microbial Growth. B - Container Integrity P - Foreign Material.	1 B 1 B 1 P	Temperature within plant specifications. ^a Immediate container is intact. No visible hazardous non-food material. ^a Carcasses or red meat must be received at 40° F or below. ^a Note: Insufficient scientific data exist regarding the growth of pathogens during chilling. However the chilling parameters provided above will control quality and limit the growth rates of even psychrotrophic spoilage organisms. Therefore, these parameters are more than sufficient to prevent growth of mesophilic enteric bacterial pathogens.	Internal temperature monitored when a shipment is received by the receiving personnel. Visual inspection of immediate container at the time a shipment is received and before processing by the receiving personnel. Record all findings in HACCP receiving log. Include lot #, date, condition, time of inspection and sign the record.	If product temperature is out of compliance, immediate container is compromised or foreign material is noted in/on the meat product, identify and control affected product for disposition; take corrective action to prevent reoccurrence. Notify plant designee. Receiving personnel documents actions taken in HACCP receiving log. Signs record and records time of observation.	Record all results and corrective action(s) in a plant specific log/record. Signs record and records time and date of observation. Corrective Action Log Audit to verify sampling techniques and accuracy of records; verify accuracy of temperature devices; determine in the Critical Limit corresponds to the plant records; check to see if Critical Limit is adequate for hazard; assure corrective actions are adequate; document findings. Weekly calibration of thermometers.

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Development of a HACCP Plan

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Development of a HACCP Plan

Establish corrective actions

- Corrective Action is needed when there is **departure** from critical limits
- **Example:** When pH of a batch is 4.4, higher than critical limit of 4.2: Corrective Action Needed

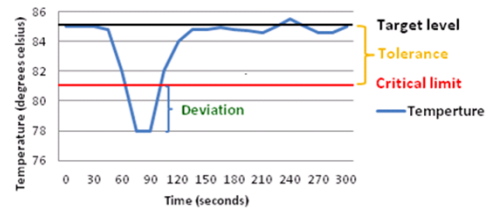
Corrective actions should include:

- Handling the non-complying product (discarding or rework)
- Correcting the cause of non-compliance
- Assure that CCP is under control
- Maintaining a record

Example of corrective action:

- Stopping the production
- Measuring the pH of main batch before canning
- Reworking products with high pH
- Documenting the incident and training the formulation staff

A graph to show the temperature of sauce (recipe A) over time



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HACCP PLAN							
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PRODUCT EXAMPLE :		GROUND BEEF					
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	B - Container Integrity	1 B	Immediate container is intact.	Visual inspection of immediate container at the time a shipment is received and before processing by the receiving personnel.	Receiving personnel documents actions taken in HACCP receiving log. Signs record and records time of observation.	Corrective Action Log	Audit to verify sampling techniques and accuracy of records; verify accuracy of temperature devices; determine in the Critical Limit corresponds to the plant records; check to see if Critical Limit is adequate for hazard; assure corrective actions are adequate; document findings.
	P - Foreign Material.	1 P	No visible hazardous non-food material.	Record all findings in HACCP receiving log. Include lot#, date, condition, time of inspection and sign the record.	Weekly calibration of thermometers.		
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Development of a HACCP Plan

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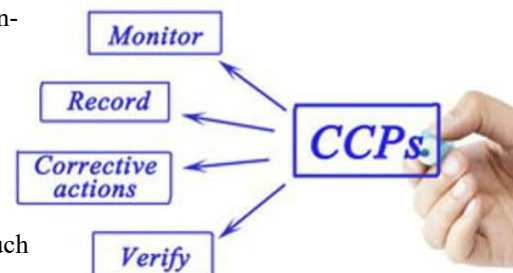
Development of a HACCP Plan

Establish recordkeeping procedures

Maintaining proper **HACCP records** is an important part of the HACCP system.

Benefits of Record Keeping:

- Records allow you to trace the **history of an ingredient**, in-process operations, or a finished product, should problems arise.
- Records help you **identify trends** in a particular operation that could result in a deviation if not corrected.
- If you were ever faced with a **product recall**, HACCP records could help you identify and narrow the scope of such a recall (**batch numbers, rework**)
- Well-maintained records are good evidence in **protection against legal actions** and **audits**.



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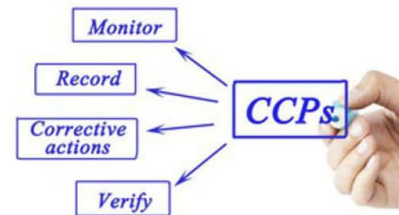
Development of a HACCP Plan

Establish recordkeeping procedures

FSIS 5 Steps for Successful Record Keeping:

Must be in **permanent ink** and available for **auditors**

1. Review **existing documentation to determine what other record keeping methods are needed**
2. **Develop forms for documentation** necessary to document corrective action deviations (*calibration log for pH meter, GMP violation form* etc.)
3. **Develop forms verification** to document your HACCP system verification
4. **Identify the employees responsible** for record keeping
5. **Incorporate the forms in appropriate HACCP Plan**



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Development of a HACCP Plan

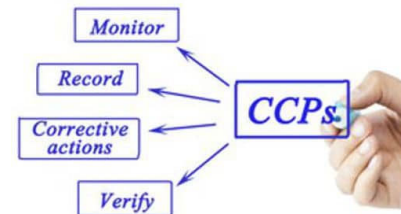
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- 7. Establish verification procedures.**

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Development of a HACCP Plan

Establish verification procedures

- **Verification in HACCP**
- "Establish procedures to verify that the HACCP system is working correctly."
- **Common Verification of HACCP system are:**
- Analytically **test or audit your monitoring procedures (metal detector)**
- *Calibrate your temperature/test equipment (calibration log)*
- Sample your product, including **microbiological sampling;**
- **Review your monitoring records**
- **Inspect and audit your establishment's operations** Sample for environmental and other concerns (**third party agencies**).



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Exercise 3

- What is CCP and what is the purpose of determining CCP's in a HACCP plan?
- What are some typical CCP's in an operation?
- Please name common Critical Limits in a HACCP plan and provide one example of Critical limit for a HACCP certified operation.
- When do we need to use corrective action in a HACCP certified operation?
- What is Verification in HACCP and what are some common examples of verification in a HACCP plan?

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Thank you

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