USING HACCP FOR PROCESS CONTROL AND INNOVATION BY A CHEF IN RETAIL FOOD OPERATIONS

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Introduction
The current process control rules in the U.S. FDA Food Code are not based on hazard control science and published research studies, but based on the obsolete ideas that safe food can be assured if the kitchen is sanitized and there are no rats and insects. Because HACCP is not used to base process controls on specific hazards, it is impossible for chefs to innovate new processes.

This paper describes how to apply HACCP as a science base for retail food processes so that anyone, to include the chef, can innovate new processes and validate a new process as capable of achieving a specified Food Safety Objective (FSO). It describes how to do HACCP recipes, flow charts, and HACCP control documents.

The Science of HACCP
The National Advisory Committee on Microbiological Criteria for Foods (NACMCF), Codex, and training materials on HACCP provide a systematic documentation for the identification, risk evaluation, and control of food safety hazards, but they provide no technical detail as to how to apply this to the specific hazards and controls in a process. This paper reviews the documentation principles and then, provides food science details of the application of hazards and controls to retail food operations

The preliminary tasks in the development of the HACCP plan according to the NACMCF are:

1. Assemble the HACCP team.
2. Describe the food system and its distribution.
3. Describe the intended service (use) of the food and consumers of the food.
4. Develop flow diagrams that describe prerequisite and food processes to be analyzed in the food system.
5. Verify the flow diagrams.

The seven principles (steps) of HACCP, then, are applied to each step in the identified process to develop a HACCP plan for each process.

1. Is there a significant biological, chemical, or physical hazard at a step in a process?
2. If so, is this the best point to control the hazard(s) (CCP)?
3. If so, develop and validate a control(s) and critical maximum / minimum limits (process performance standards) based on scientific studies that prevent, eliminate, or reduce the hazard to a tolerable level [Food Safety Objective (FSO)].
4. Establish monitoring procedures.
5. Establish corrective actions to be taken if there is loss of control of the step.
6. Establish verification procedures that the process is being controlled.
7. Establish record keeping and documentation and incorporate in HACCP controls, monitoring, and verification.

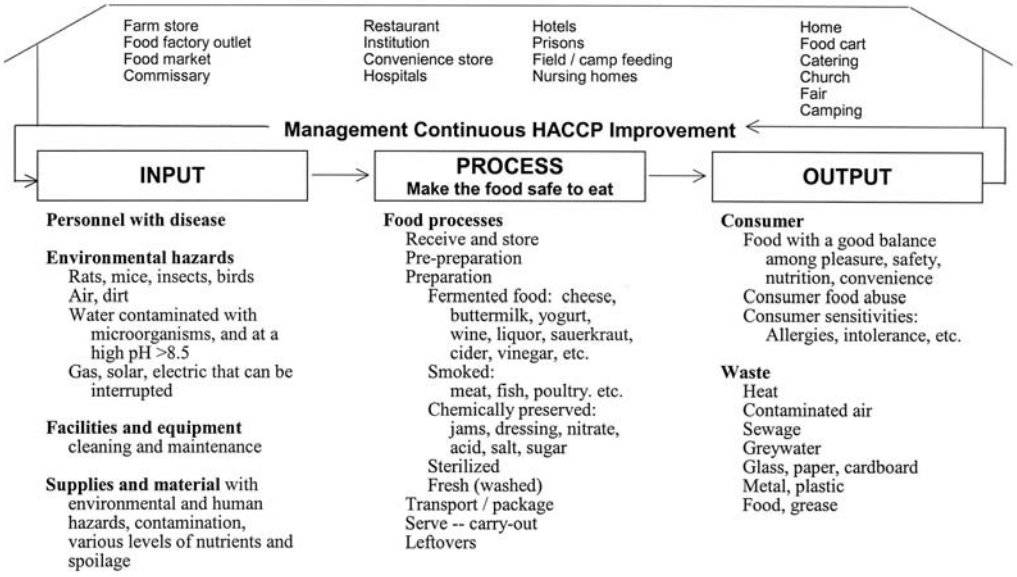
Background
Throughout the history of the world, humans have had to cook (pasteurize) their food in order to make it safe to eat. Spices and herbs have provided some medicinal effect, but they were used primarily to cover up the off-flavors associated with food that was beginning to spoil by the time it was prepared. Only in the last few decades has there been refrigeration to control spoilage. (Note, spoilage bacteria do not cause foodborne illness.)

Until the last few years, suppliers have not been held accountable for pathogenic contamination of food. Current government inspection methods, which are mostly visual, do a poor job of controlling hazards. With the implementation of HACCP by the U.S. Department of Agriculture (USDA), followed by the U.S. Food and Drug Administration (FDA) in Fish and Fishery plants, the application of HACCP is also being considered for application to land farmers and fish farmers.

Significant examples for the need for HACCP on the farm are the fruit and vegetable supplies worldwide. The regulatory system has not focused on the growing, harvesting, and distribution of safe fruits and vegetables, but rather, has relied on the cook to make these foods safe with washing or cooking. Fruits and vegetables have been, historically, a source of foodborne disease due to the use of animal manure as fertilizer, untreated irrigation water, and poor personal hygiene for field workers. It is now evident that washing fruits and vegetables to achieve any more than a 2-log reduction is a very difficult research challenge. Viruses and parasites are very difficult to inactivate with disinfectant chemicals. Fortunately, cooking / heating pasteurization to 158°F (70°C) for 15 seconds is at least a 5D reduction for vegetative organisms. The exception is hepatitis A virus, which requires about 185°F (85°C) for a couple of minutes to reduce the virus to a tolerable level.

The Retail Food System

HACCP begins with the formation of the HACCP team and description of the system. The chef is the person who develops and manages the catering kitchen. The figure below depicts the components of a typical retail food system; then, the inputs and outputs to the system; and the processes in the facility, which make the food safe.



The retail food operation is the final point at which the food is served directly to the customer. This includes a wide variety of settings such as formal dining, hotel restaurants, institutions such as hospitals and prisons, army field feeding, and camp feeding.

The inputs to the system are:

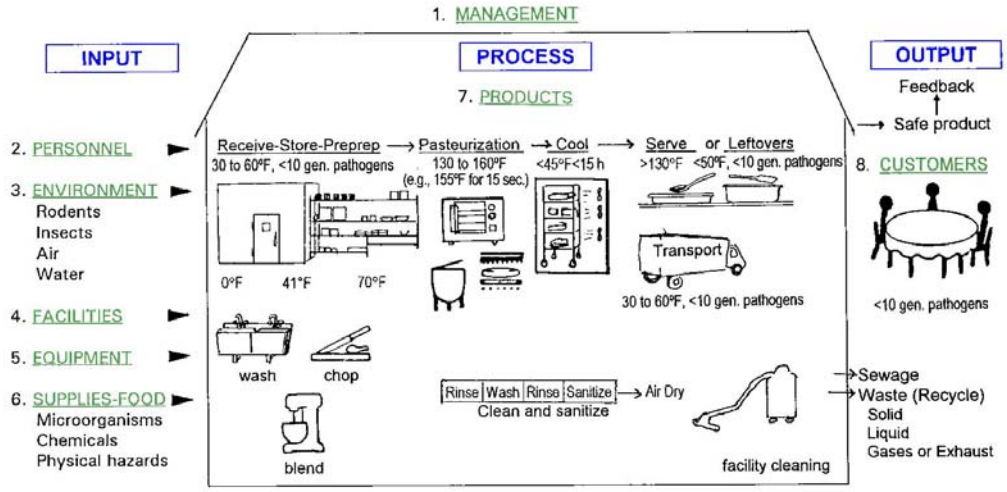
1. Personnel working in the kitchen, who can be colonized with disease bacteria and viruses.
2. Environmental hazards (e.g., vermin, air, water, etc.) around the kitchen, which must be controlled to prevent contamination of the food.
3. Facilities and equipment, which must be kept clean to control hazards and prevent cross-contamination.
4. Supplies. The chef must do his/her best to buy from suppliers who provide intervention strategies to assure that pathogens in ingredients are at a safe level. When the supplier cannot make such a guarantee, the chef must process the food to make it safe if it is to be sold.

The output from the system is the food served to customers and waste products from the kitchen. In providing food to customers, there is the problem of pathogen growth in take-out food. Therefore, if customers take out food, they must be given safe handling instructions for food that this not eaten on premise. The waste from the kitchen (e.g., leftover food, grease, etc.) must be recycled whenever possible. Waste food can be used, for instance, on hog farms or delivered to compost systems and used for fertilizer.

The Unit As a Food Process System
A more detailed presentation of the retail food system is shown below. Again, the kitchen is a system with inputs of hazards from personnel; the environment; facilities; equipment; and the supplies, which are contaminated with biological, chemical, and physical hazards.

The food enters the kitchen, where pathogen growth is controlled and chemical and physical hazards are prevented. Food is pasteurized for a 10^{-5} reduction of *Salmonella*. This is based on a possible 10^{3}-per-gram food contamination and the need to reduce it 10^{-5} so that it meets an FSO of ≤1 *Salmonella* per 100 grams of a menu item. Then, it is served at 130°F (54.4°C) or above so that the spores cannot germinate, or it is cooled so that there is less than a 3-log increase of *Clostridium perfringens* or *Bacillus cereus*.

Food handled with these controls is safe to serve to consumers. Waste is sent to the appropriate recycling system.



HAZARDS: Microorganisms [bacteria (vegetative cells and spores), viruses, parasites]; chemicals; hard foreign objects.

CONTROLS: Management involvement; hazard analysis and control; written procedures; employee training and empowerment; process measurement, control, and improvement; discipline and consequences.

Retail Food Process Controls that Assure that Hazards Are at a Tolerable Level
HACCP is a process control technology. The ingredients to a process have an expected level of pathogens, and the process prevents, eliminates, or reduces the hazards to a tolerable (FSO) level. The following are the retail food process control standards that assure that hazards are at a tolerable level.

To develop a process performance standard (PPS), the first step is to discuss validation of control in kitchen. *Listeria innocua* is a good surrogate bacteria to use to validate refrigerated processes, less than a 3-log increase of pathogen growth on raw food. Non-pathogenic *E. coli* ATCC 25922 can be brought into a kitchen and be used for validation of food contact surface cleaning. Using this non-pathogenic *E. coli*, one can show that a cleaning process gives a 10^{-5} reduction. As an alternative, one can simply use partly spoiled chicken to inoculate a surface. A surface count before and after cleaning will determine if a specific cleaning method gives a 10^{-5} reduction.

In order to organize the kitchen processes, they are grouped into eight functional groups, as previously presented, which make inputs to the system, the food processes, and the output. The input processes are called prerequisite HACCP processes, and controls are based on GMPs and SSOPs. The HACCP'd food processes begin with pre-preparation, preparation, package-transport-serve, and leftovers. Outputs are controlled by prerequisite processes. The columns below show the process and process controls that are applicable to food prepared anywhere worldwide. The biological, chemical, and physical hazards are the same everywhere, for all practical purposes.

RETAIL FOOD PROCESS CONTROLS
THAT ASSURE THAT HAZARDS ARE AT A TOLERABLE LEVEL

VALIDATION METHODS

To validate refrigerated processes, use non-pathogenic *Listeria innocua* and control to <3-log increase.

To validate pasteurization and washing surfaces, use non-pathogenic *E. coli* ATCC 25922 and control for a reduction of 10^{-5} or raw food such as chicken can be used with a surface APC of >5x10^6 CFU / 5 cm^2.

INPUT

[(HC) = hazard control; (QC) = Quality control]

PREREQUISITE / GMP / SSOP PROCESS HACCP

(HC) Employee fingertip nail brush washing and drying for a 10^{-6} reduction of bacteria and viruses on fingertips.

(HC) Water: Supplier HACCP; chemical and biological hazards at a safe level.

(QC) Insects, rodents, and birds excluded from the facility through construction and maintenance.

(HC) Equipment cleaning: 10^{-5} reduction of APC on the equipment surface; thermostat calibration and maintenance.

(HC) Environment and facility: Environment outside the facility is excluded with good construction, sanitation, and maintenance. There are emergency power sources.

(HC) Supplies and material: Contaminated with hazards; suppliers provide their intervention strategy; expected level of biological, chemical, and physical hazards.

PROCESSES

FOOD PROCESS HACCP

Receiving

(HC) Food to be eaten as received; suppliers must provide HACCP intervention strategy.

(QC) Just-in-time delivery of raw food: frozen or <50°F (<10°C) [fish <38°F(3.3°C)]. Pathogenic substances will be reduced to an acceptable risk by washing, pasteurization, or removal.

Target values for raw foods are:

Salmonella spp.: <10 / gram
Listeria monocytogenes: <10 / gram
Staphylococcus aureus: <100 / gram
Clostridium perfringens: <100 / gram
Bacillus cereus: <100 / gram
Clostridium botulinum: <1 / gram
Chemical: safe level
Physical: <<0.16 cm

(HC) Just-in-time delivery of ready-to-eat food <40°F (<4.4°C) [fish <38°F (<3.3°C)].

Food safety objectives for ready-to-eat foods are:

< 1 *E. coli* or *Salmonella* / 100 grams
<1,000 *S. aureus* /gram
<10,000 *B. cereus*, and *C. perfringens* vegetative cells / gram
<10 *C. botulinum* vegetative cells / gram
Undetectable viruses and parasites
Chemicals: safe level
Physical objects: <1/16 inch (1.6 cm)

(HC) Avoid biological, chemical, and physical contamination at receiving.

(HC) Damaged packages, cans, and infested packages stored separately for return to supplier.

Storage

(QC) Label food containers with receiving date; food 15 cm off floor.

(QC) Short-term frozen storage <10°F (<-12.2°C); long-term 0 to -20°F (-17.8 to -28.9°C).

(HC) Aerobic, refrigerated, raw food spoils safe or is made safe by washing 10^{-2} reduction, or by pasteurization, 10^{-5} reduction.

(HC) Spoilage bacteria inhibit *S. aureus*, *C. botulinum*, *B. cereus* toxin production in raw food.

(HC) Refrigerated, ready-to-eat food is used before there is time and temperature for 2-log increase of *L. innocua* or 3-log increase of *B. cereus* to multiply.

Pre-preparation

(QC) Use oldest ingredients first (FIFO).

(HC) Cook from the frozen state or thawing can be conducted at room temperature or colder until the center is 35 to 38°F (1.7 to 3.3°C).

(QC) Keep food temperature <55°F (12.8°C) during preparation.

(HC) Double wash fruits and vegetables in warm water 10^{-2} reduction, or use hot water blanching pasteurization 10^{-5} reduction.

(HC) Do not cross-contaminate raw, unprocessed and ready-to-eat foods.

Preparation

(HC) Ferment foods such as cheese, buttermilk, yogurt, wine, liquor, sauerkraut, cider, vinegar, etc. with controlled starter culture and validated HACCP procedures to exclude pathogens.

(HC) Chemically preserved: Nitrate, salt, sugar, etc.; according to Code of Federal Regulations (CFR).

Acid control: Jam, dressing, condiments.

(HC) Control salmonellae in unpasteurized food with pH <4.1.

(HC) Control *Clostridium botulinum* in pasteurized food with pH <4.6.

(HC) Smoking: to control growth of *S. aureus* to <3-log increase.

(HC) Heat to >130°F (>54.4ºC) quickly enough to prevent >3-log increase of *S. aureus*.

(HC) Pasteurize raw, high-water-activity meat, fish, and poultry: 5D salmonellae, where z = 10°F (5.56ºC); D_{140} = 1.73 minutes. The food safety objective for *Salmonella* is <1 per 100 grams.

(HC) Sterilize: 9D *C. botulinum*, z = 18°F (10°C); D_{210} = 400 minutes.

(HC) Hot hold surface and center >130°F (54.4°C) with surface controlled Rh >90%

(HC) Cool center 130 to 45°F (54.4 to 7.2ºC) with 38°F (3.3ºC) driving force, <15 hours, <3 generations *C. perfringens* or *B. cereus*.

(HC) Mix cold salads with ingredients precooled to 50°F (10°C) to prevent production of *S. aureus* toxin.

(HC) Allergen control: Do not add any ingredients that are not on the recipe ingredient list.

(HC) Cold hold ready-to-eat food at <40°F (<4.4°C) [fish <38°F (<3.3°C)] until spoiled or to <3-log increase of *B. cereus*.

Package -- transport -- serve

(HC) Pasteurized food hold >130°F or 40°F (>54.4ºC or <4.4°C), or at any time-temperature that limits vegetative outgrowth of spore pathogens to <3-log increase between production and consumption.

(QC) To retain nutrients, hot hold for service, <30 minutes.

NOTE: Hot liquids >170°F (>76.7°C) are physical hazards and will burn skin in 1 or 2 seconds.

(HC) Protect cold, ready-to-eat food from hazard contamination.

Leftovers

(HC) Do not add fresh food to old food for allergen control and prevention of cross-contamination.

NOTE: Reheating is not used as a hazard control, because it will not control toxins, poisons, and physical hazards. Once cooked / disinfected, the process must be controlled to prevent the ready-to-eat food from becoming hazardous.

OUTPUT

Consumer

(HC) Take-out package for the consumer <2 inches (<5 cm) thick for rapid cooling. Label, "Consume in 4 hours, or begin cooling as soon as possible to 45°F (7.2°C) in less than 15 hours. Do not cool food in a container in a bag. Remove the bag."

(HC) Label packages for allergenic ingredients. Answer consumer allergy questions about food ingredients.

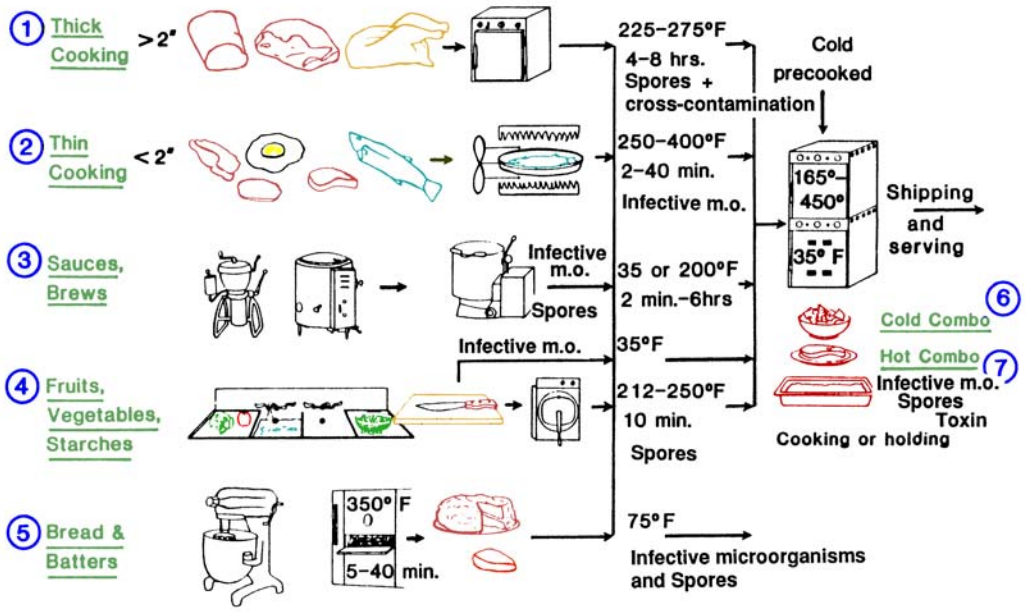
The Seven Cook-Then-Package / Serve Recipe Processes
There are two forms of processes: 1) the common cook-then-package / serve; and 2) package-then-cook, which is typical of sous vide food. (For information about package-then-cook, contact the author.) The figure below refers to the cook-then-package / serve process.

Recipes can be grouped by hazard and control into seven process groups. It is assumed that the prerequisite programs have taken care of the chemical and physical hazards. The two biological hazards, then, remain: 1) **vegetative cells**, of which *Salmonella* is the validation organism, because it is the most deadly of the pathogens; and 2) **spores** of *Clostridium botulinum*, *Bacillus cereus*, and *Clostridium perfringens*, which survive the cooking process and must be controlled until the food is consumed.

Recipe process hazard analysis does not concern itself with the flavor of food, although, if a food is acidic or has low water activity, that is a variable in terms of food safety, because it affects the critical control limits.

1. **Thick foods:** These foods are cooked for a long time; therefore, 10^{-5} *Salmonella* is assured. When the food comes out of the oven, the spores survive. Because thick foods often sit for hours in a kitchen as they are served, the control for thick foods is to prevent spore outgrowth after cooking until the food is used up.
2. **Thin foods:** This group includes pork chops, hamburger, pork sausage, fish, and eggs. It is assumed that the center of these foods is contaminated with vegetative pathogens. The center must get pasteurized for *Salmonella* control. A tip-sensitive digital thermometer is necessary for verifying pasteurization. The spores are not a problem. The food is single portion and should always be consumed in a safe 4 hours.
3. **Sauces and brews:** There are two groups of sauces and brews. The first is acidified sauces (e.g., Hollandaise, mayonnaise, fruit soups, etc.), with a pH less than 4.1. *Salmonella* that might be in an ingredient would be controlled by this pH. Hot sauces and brews are brought to a temperature >158°F (>70°C) pasteurization. The only pathogens left in hot sauces and brews will be the three spores. Therefore, the spores must be controlled after cooking by holding >130°F (>54.4°C), cooling for less than 3-log increase of *Clostridium perfringens*, and held at <40°F (<4.4°C) for *Bacillus cereus* control, until the food is consumed.
4. **Fruits and vegetables, starches:** There are two groups of fruits and vegetables: 1) cold items, which must be washed to reduce pathogens >10^{-2} to a safe level; and 2) hot items, in which the spores survive. The hot vegetables and starches must be kept >130°F (>54.4°C) or cooled for a less than 3-log increase in spore outgrowth. The food, then, must be kept at <40°F (<4.4°C) to prevent the outgrowth of *Bacillus cereus*.
5. **Breads and batters:** These foods, to be acceptable, get cooked to >180°F (>82.2°C) so that raw eggs and vegetative cell contaminants of baked products will be reduced to a safe level. The problem with this group is icings, where the baker's hands may contaminate the icings with vegetative pathogens during decorating. Also, *Bacillus cereus* could grow in custards because of the milk ingredients. So, cold hazardous pastries must be <40°F (<4.4°C).
6. **Cold combinations:** Salads and sandwiches, which are salads on bread, belong to this group. This group is really a combination of safe product from the first five processes. One HACCP plan can be used for this group of foods. A typical cold combination would contain a meat, a sauce, perhaps a vegetable and bread ingredient. The critical control points are correct cooling of ingredients and correct hand washing. The person making the cold combination must have scrupulously clean hands so that fecal pathogen contamination from the hands does not occur. If salads are made at a temperature <50°F (<10°C), *Staphylococcus aureus* from the skin touching food will not make a toxin, and the food can be made in a large batch and will be safe.
7. **Hot combinations:** The group includes foods that have been cooled and assembled for a casserole or hot sandwich. The problem is the control of the spores in the hot food so that they do not outgrow. If they are kept at >130°F (>54.4°C), the spores will not germinate.

THE SEVEN COOK-THEN-PACKAGE / SERVE RECIPE PROCESSES
Design for control of infective microorganisms and toxin-producing microorganisms



Chicken Cacciatore HACCP Plan

With these universal rules for recipe processing, one can apply them to the seven hazard-grouped recipes in the kitchen in a formal HACCP plan. The HACCP plan for a group is really a document that regulatory officials and auditors can read to verify that the food operation has an adequate intervention strategy for a group of foods. The example shown is of Chicken Cacciatore, which is from the hot combination group. The plan is used to show, generically, control of the hot combination group. This is based on the NACMCF documents and CODEX.

The Process Steps and Controls column (Column 1) shows a flow chart for the preparation of this food. At the bottom of each block / step, there is the food temperature into the step (Ti); the food temperature at the completion of the step (To); and the time it takes to do the step (t). This provides critical information that allows the auditor to verify that the HACCP plan will adequately control the process. In Column 2, the biological, chemical, and physical hazards are listed. The person analyzing the plan can determine if there is or is not a significant hazard at the step. A significant hazard is one whereby there is evidence of a hazard to human health from this source, there are hazards at an unacceptable level in the raw material, there is an unacceptable probability of human exposure and illness, and the illness is severe. If there is a significant hazard, and the step is the last step at which the hazard can be controlled, it is a Critical Control Point (CCP). Column 3 identifies the critical limit. For example, at Step 3, cooking to >71.1°C assures >5D reduction of *Salmonella*. Column 4 records monitoring: what is monitored, how it is monitored, how frequently it is monitored, and who monitors the step. Column 5, Corrective Action, explains what to do if the critical limit is not met. Finally, Column 6 explains how verification is carried out.

At the bottom is an approval section for the Quality Control / HACCP Team and Process Authority.

CHICKEN CACCIATORE HACCP PLAN

Process Steps and Controls: GMPs and prerequisites are in place	**B, C, P, Potential Hazards and Risk Analysis**	**Control** Critical Limit (CL) for each Hazard Control	**Monitoring & Record;** (What, How, Frequency, Who)	**Corrective Action & Record**	**Verification & Record** (Procedures and Frequency)
Preparation 1. Prepare sauce. Get chopped onions, mushrooms, green peppers, minced garlic. Sauté in oil. Add crushed tomatoes, juice, wine and seasoning. Bring to a simmer. Ti 40°F To 205°F t 20 min. Ti 4.4°C To 96.1°C t 20 min.	**B:** Not significant. **C:** None. **P:** None.	Supplies are obtained from reputable sources; sauce has low pH and is heated sufficiently to destroy vegetative pathogens.			
1a. Hold sauce in bain marie. Ti 205°F To 165°F t 20 min. Ti 96.1°C To 73.9°C t 20 min.	**B:** Not significant. **C:** None. **P:** None.	No pathogenic microbial growth in sauce at 130°F (>54.4°C).			
2. Get chicken quarters from refrigerator. Remove rib bones. Ti 40°F To 45°F t 10 min. Ti 4.4°C To 7.2°C t 10 min.	**B:** Not significant. **C:** None **P:** Not significant.	Vegetative pathogens and spores are con-trolled by low temperature. Inspect to assure that all bones are removed			
3. **CCP** Place quarters, one layer deep in shallow roasting pan. Bake (brown) in convection oven at 350°F (176.7°C). Ti 45°F To >45°F t 30 min. Ti 7.2°C To >7.2°C t 30 min.	**B:** Vegetative pathogens and spores **C:** None **P:** None	Cooking temperature >160°F (>71.1°C) assures a >5D salmonellae kill.	Assigned worker takes one temperature of center of food in each lot and records on production sheet for each lot.	If temperature is not >160°F (>71.1°C), continue to cook.	Supervisor initials the production log each shift.
4. Remove pan(s) of chicken from oven. Ti >160°F To 145°F t 15 min. Ti >71.1°C To 62.8°C t 15 min.	**B:** Not significant. **C:** None. **P:** None.	Temperature >130°F (>54.4°C) controls spores and kills vegetative cells..			
4a. **CCP** Pour off liquid from pans of chicken. Chill. Refrigerate liquid. (Save for chicken stock). Ti >150°F To 40°F t <4 hr. Ti >65.6°C To 4.4°C t <4 hr.	**B:** Pathogenic spores **C:** None **P:** None	Cooling chicken stock to 40°F (4.4°C) within 4 hours limits spore outgrowth.	Use clean, sanitized container and refrigerator that is validated for safe cooling	If refrigeration goes off, move stock to a working refrigerator. If cooling >15 hr. to 45°F (7.2°C), throw it out.	Supervisor initials the production log each shift.
5. Cover chicken quarters with sauce held in bain marie (Step 1a.). Ti >145°F To 145°F t <10 min. Ti >62.8°C To 62.8°C t<10 min.	**B:** Not significant **C:** None. **P:** None.	Temperature >130°F (>54.4°C) controls spores and kills vegetative cells..			

Process Steps and Controls: GMPs and prerequisites are in place	**B, C, P, Potential Hazards and Risk Analysis**	**Control** Critical Limit (CL) for each Hazard Control	**Monitoring & Record;** (What, How, Frequency, Who)	**Corrective Action & Record**	**Verification & Record** (Procedures and Frequency)
6. Bake at 300°F (148.9°C) in convection oven until chicken reaches a temperature of 175°F (79.4°C). Ti >145°F To 175°F t <45 min. Ti >62.8°C To 79.4°C t<45 min.	**B:** Not significant. **C:** None. **P:** None.	Temperature >130°F (>54.4°C) controls spores and kills vegetative cells..			
7. Check. Is the temperature >175°F (>79.4°C)? If not, continue to cook.	**B:** Not significant. **C:** None. **P:** None.	Temperature >130°F (>54.4°C) controls spores and kills vegetative cells..			
8. Cover and transfer to 150°F (65.6°C) hot holding unit. Ti >175°F To 170°F t 5 min. Ti >79.4°C To 76.7°C t 5 min.	**B:** Not significant. **C:** None. **P:** None.	Temperature >130°F (>54.4°C) controls spores and kills vegetative cells..			
Hold/Serve 9. Hold. Serve 1/4 chicken and 3 oz. sauce. Use within <2 hr. Ti 170°F To 150°F t <120 min. Ti 76.7°C To 65.6°C t <120 min.	**B:** Not significant. **C:** None. **P:** None.	Temperature >130°F (>54.4°C) controls spores and kills vegetative cells..			
Leftovers 10. **CCP** Cool to <45°F (<7.2°C) within 15 hr. Ti 150°F To 45°F t <15 hr. Ti 65.6°C To 7.2°C t <15 hr.	**B:** Pathogenic spores. **C:** None **P:** None	Cooling from 130 to ≤45°F (54.4 to ≤7.2°C) <15 hr. assures safety (Juneja et al, 1994). The presence of pathogenic microorganisms from cross contamination products is controlled by GMPs and SSOPs.	Assigned worker makes sure containers are the authorized sizes to cool to ≤45°F (≤7.2°C) in <15 hr. This is recorded on production sheet for each lot.	If refrigerator goes off, transfer to a functioning refrigeration unit. If containers are the wrong size, get the correct size.	The production schedule will be initialed by a supervisor once a shift, prior to transfer to refrigerator. The supervisor will initial that the CCP has been met.

B, C, P = Biological, Chemical, and Physical

CCP = Critical Control Point

Approved (QC) _____ Date _____

Approved (Process Authority) _____ Date _____

Quality-Assured HACCP Recipe Procedures

The HACCP plan is a good process analytical tool, but it does not, for instance, include the ingredients. The true total food hazard control document is the recipe. The recipe is actually a HACCP plan, but it is written in the language that the cook understands. The top of the recipe includes production specifications such as portion size, etc. The ingredient section lists ingredients and sources. The edible portion (EP) column in pounds and grams allows one to calculate the edible portion weight in order to do a nutrition analysis. The amount of additives (e.g., sorbate, benzoates, nitrates) is also shown so that critical limits can be verified.

The recipe procedure contains the same words, times, and temperatures used as the flow chart but in a standard recipe procedure format. This narrative recipe can be verified for safe critical limits the same way that a flow chart can. If the food gets above 149°F (65°C) for a minute or 158°F (70°C) instantly, the food has a 5D *Salmonella* reduction. If the food stays above 130°F (54.4°C), spores will not germinate. If the food cools so that there is less than 3-log increase of *Clostridium perfringens* or *Bacillus cereus*, the food is safe. *Clostridium botulinum* outgrows slower than the other two pathogens.

At the bottom of the recipe, there is a list of points that need to be made at each recipe step: Step number; start food center temperature; thickest food dimension; container size; whether it is covered or not, temperature on or around the food; end food center temperature; and time it took to do the step.

QUALITY-ASSURED HACCP RECIPE PROCEDURES

Recipe Name: **Chicken Cacciatore**
Production style: **Combination**
Written by: **O. P. S.** Date: 10/95
SA/QA by: **J. Bell** Date: 12/95

Portion size (vol./wt.): **1/4 (6 oz.) chicken + 3 oz. sauce**
Number of portions: **100**
Final yield (AS):100
Final yield:

Preparation time: 2 hours

Prepared by: **S. P.**
Supervisor:

Gp. #	Ingred. #	Ingredients and Specifications	Edible Portion (EP) (weight or volume)		EP Weight %	As served (weight)
I	1	Onions, chopped (1/2" x 1")	3.0 lb	1,360.00 g	13.26	
	2	Mushrooms, cut (1/2 ", caps & stems)	3.0 lb	1,360.00 g	13.26	
	3	Peppers, green, cut (1/2" x 1")	2.0 lb	907.2 g	8.84	
	4	Garlic, chopped	6 Tbsp.	85.05 g	0.53	
	5	Tomatoes, canned, crushed (2 - #10 cans)	13.25 lb	6,010.00 g	58.58	
	6	Oil, vegetable	1/4 cup	54.00 g	0.53	
	7	Wine, Marsala or Madeira	2 cups	472.00 g	4.60	
	8	Oregano, crushed	2 tsp.	3.00 g	0.03	
	9	Salt	1 tsp.	5.50 g	0.05	
	10	Pepper	1 tsp.	2.10 g	0.02	
		Total	22.6 lb	10,258.85 g	100.00	22.0 lb
		Approx. gallons	2.5 gal.			
II	11	Chickens, whole (25 - 2¼ to 2½ lb.)	62 lb			40.0 lb

Preparation

1. **Prepare sauce**. Get chopped onions, mushrooms, green peppers and garlic [40°F (4.5°C)] from refrigerator. Sauté the vegetables in vegetable oil for about 10 minutes. Add crushed tomatoes with juice, wine, and seasonings [72°F (22.2°C)]. Bring sauce to a simmering temperature [205°F (73.9°C), 10 min.]. Hold sauce in bain marie [165°F (73.9°C), 20 min.].
2. **Prepare chicken**. Get chicken quarters [40°F (4.4°C)] from meat and poultry refrigerated storage area. Remove rib bones. [45°F (7.2°C), 10 min.]
3. **CCP** Place quarters, one layer deep in shallow roasting pans. Brown chicken by baking it in a convection oven at 350°F (176.7°C) for 30 min. [>160°F (>71.1°C)]
4. Remove pans of chicken from oven [145°F (62.8°C), 15 min.].
   CCP Pour off excess liquid. Chill liquid. Save for chicken stock. [40°F (4.4°C), <4 hours].
5. Cover the chicken quarters with sauce [145°F (62.8°C), <10 min.].
6. Return the pans of chicken and sauce to convection ovens at 300°F and continue baking until all parts of the chicken reach a temperature of 175°F (79°4°C) (about 45 minutes).
7. **Check** temperature of chicken. If temperature is not 175°F (79.4°C), continue baking.
8. Cover chicken, transfer to 150°F (65.6°C) hot holding unit and serve within <2 hours.

Hold/Serve

9. Hold / serve chicken >150ºF (>65.6°C), <2 hours. For each portion, use either 1/4 quarter white or dark meat. Chicken should be accompanied by 3 ounces of sauce [about 3 tablespoons] [>140ºF (>65.6°C)].

Leftovers

10. **CCP** Cool to <45°F (7.2°C) in <15 hours, ≤2 inches deep.

Ingredients that could produce possible allergic reactions: Tomatoes, wine

Process step #	Start food ctr. temp., ºF (°C)	Thickest food dimension (in.)	Container size HxWxL (in.)	Cover Yes/No	Temp. on/ around food	End food ctr. temp., ºF (°C)	Process step time, hr./min.

Policies, Procedures, and Standards Manual Table of Contents

In order to have a complete hazard control program, the operator must write employee policies, procedures, and standards operating rules for all prerequisite processes and food processes. This policies, procedures, and standards manual becomes the training document for the personnel, because it describes the HACCP prerequisite and food process control procedures that management wants employees to follow in order to assure that the food is safe.

Preface: Description of the System and Products

1. AMC-HACCP Management (prerequisite)
- **A. Food Safety Policy**
- **B. Responsibility and Accountability**
  1) Evaluation of unit performance
  2) Food safety improvement program
  3) Holding subordinates responsible for safety results
  4) HACCP team
  5) Continuous improvement
  6) Coaching and skill development
  7) Setting the example
  8) Foodborne illness complaint
  9) Maintaining equipment

Enclosures:
1. Minnesota Department of Health form
2. Employee-customer report of quality or hazard problem and disposition
3. HACCP team monthly meeting report
4. Corrective action report
5. Foodborne illness information form
6. Analysis of an alleged foodborne illness

2. Organization and Personnel (prerequisite)
- **A. Organization Chart**
- **B. Personnel**
  1) Individual illness
  2) Cuts and abrasions
  3) Personal cleanliness
  4) Fingernails
  5) Hair restraint
  6) Jewelry and hard objects in pockets
  7) Handkerchiefs and facial tissues
  8) Chewing gum, smoking, and eating
  9) Hand washing
  10) Handling food, money, and dirty tableware

Enclosures:
1. Organization chart

3. Facility System Description (prerequisite)
1) Construction
2) Water
3) Leftover food
4) Layout
5) Production flow

Enclosures:
1. Facility picture
2. Facility floor plan

4. Food Operations Description (prerequisite)
1) Consumer
2) Menu
3) Menu items group HACCP (with example)

Enclosures:
1. Menu items group HACCP (blank)

5. Supplies (prerequisite)
- **A. Supplier HACCP**
  1) Inspection of incoming products
  2) Substandard products
- **B. Receiving**
  1) Prevent cross-contamination
  2) Chemicals separation
  3) Container disposal
  4) Stock rotation
  5) Proper storage procedures

6. Food HACCP Production and Distribution
- **A. Recipe Flow Charting and HACCP (with examples, Chicken Cacciatore**
- **B. Food Preparation**
  1) Food product thermometers
  2) Food thawing
  3) Food washing
  4) Serving raw foods
  5) Hard foreign objects
  6) Ingredient control
  7) Separate raw and cooked food preparation equipment
  8) Sauces, soups, and beverages
  9) Fruits, vegetables, legumes, and cereals
  10) Bread and pastry
  11) Hot combination dishes
  12) Cold combination dishes
  13) Pasteurization
  14) Food tasting
  15) Carry-out and banquet food
- **C. Food Service**
  1) Serving, packaging, transporting
  2) Beverage dispensing equipment
  3) Milk product dispensers
  4) Self-service food, dishes, and utensils
  5) Food exposed to the customer
  6) Ice
  7) Allergies
- **D. After Service**
  1) Returned food
  2) Leftovers / cooling food
  3) Storage time

Enclosures:
1. Recipe HACCP and flow charts

7. Cleaning and Sanitization (prerequisite)
1) Cleaning plan
2) Food sinks vs. hand and utility sinks
3) Knowing equipment is sanitized
4) Frequency of sanitizing food contact surfaces
5) Food contact surface wiping cloths
6) 3-compartment sink operation
7) Bussing tables
8) Equipment cleaning
9) Machine ware washing procedures
10) Food waste cans
11) Tableware
12) Work station cleanliness

Enclosures:
1. Cleaning and sanitizing schedule

8. Equipment and Maintenance (prerequisite)
1) Maintenance plan
2) Cooler-freezer temperatures

Enclosures:
1. Maintenance schedule

9. Pest Control (prerequisite)
1) Pest control plan
2) Pest control

Enclosures:
1. Pest control schedule

10. Training Program (prerequisite)
1) Training

Enclosures:
1. Employee food HACCP competencies (English)

11. Quality Assurance – Quality Control (prerequisite)
1) Thermometer calibration, verification

Enclosures:
1. Thermometer accuracy verification log

12. Food Safety Program (AMC-HACCP) Certification (prerequisite)

The AMC-HACCP Cycle

The policies, procedures, and standards have no value if they are not followed by every employee. They must be taught to the employee. The employee must be coached. There must be operation control and, finally, continuous improvement. The HACCP Team (Step 1) consists of the owner, the quality assurance director or consultant, and the kitchen staff (i.e., chef and kitchen department leaders). They are responsible for writing and then, enforcing the HACCP program. If they do not know the hazards and controls, the kitchen cannot produce safe food.

Step 1. The HACCP team plans, analyzes, does pre-control, and commits resources to the control and improvement of the operation. They continually revise the policies, procedures, and standards manual based on self-inspections and develop schedules for implementation.

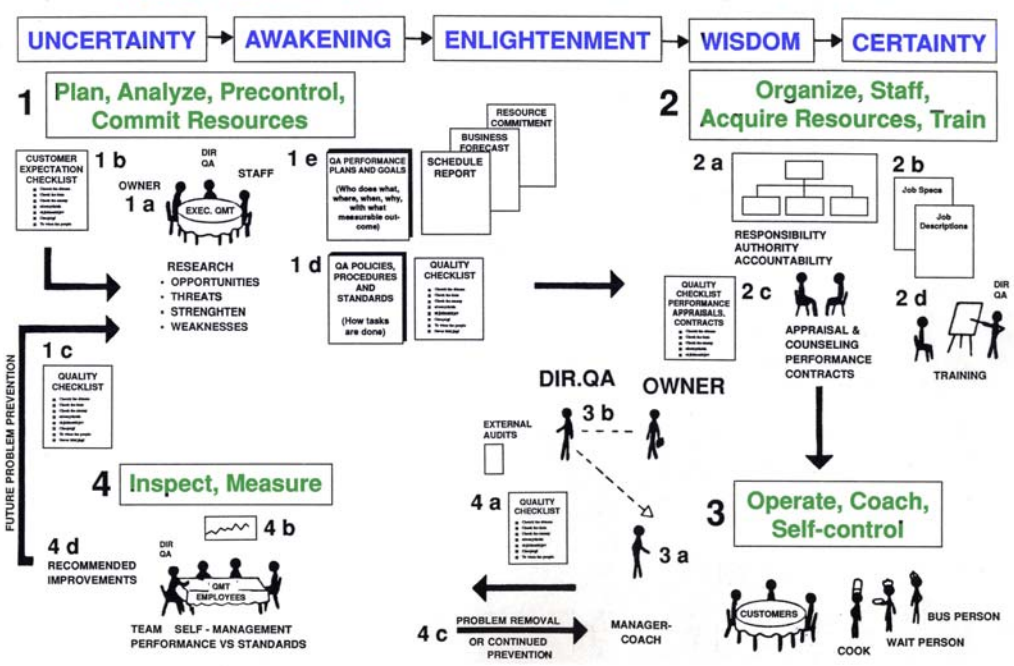
a. The chef develops a recipe with ingredients and procedures. The recipe is flow charted. It is converted to the six-column HACCP plan format.
b. At each step, the biological, chemical, and physical hazards are determined. The team decides if a hazard is significant.
c. If significant, the step is declared a Critical Control Point (CCP), and controls are proposed. Controls are tested until one is validated as being capable of achieving the Food Safety Objective, is doable by the kitchen and personnel, and is robust.
d. The HACCP team develops and validates a monitoring procedure so that the cook can maintain control of the process and CCP.
e. Corrective actions are developed for probable process deviations.
f. Self-inspection verification procedures are developed.
g. A final version of the HACCP'd recipe procedure is written; employees are trained and tested to verify that they can do the procedure as written; and the recipe is implemented. Employee monitoring finds opportunities to improve the stability / consistency of the recipe product; improvements are made; and a continuous quality improvement cycle is performed.

Step 2. The kitchen department leaders organize, staff, acquire resources, and train every employee in the kitchen to perform the procedures to meet the standards and critical limits that are necessary for hazard control.

Step 3. The owner and/or QA director or consultant oversee the operation, coaching, and self-control of the food operation by the cooks, wait staff, bus persons, cleaning staff, etc. They track their performance by using the HACCP checklist, which is also used for training and improvement. They make notes on the checklist as to what needs to be improved.

Step 4. The checklists are reviewed at the HACCP Team meetings. The team does self-control, analyzes improvement, makes plans for the next month, and then, cycles the analysis of performance back to Step 1 for improvement and a new improvement cycle.

THE AMC-HACCP CYCLE



Summary

This presentation illustrates how manufacturing HACCP can be adapted to a retail food operation with hundreds of recipes if the recipes are grouped by biological control into one of the seven process groups. The controls will be the same for *Salmonella*, for example, in a process plant or a restaurant.

The policies, procedures, and standards manual is the training and measurement document of employee performance. If all employees are trained and coached, and there is self-evaluation and self-control, there is high assurance that all hazards associated with the food operation will be controlled.