

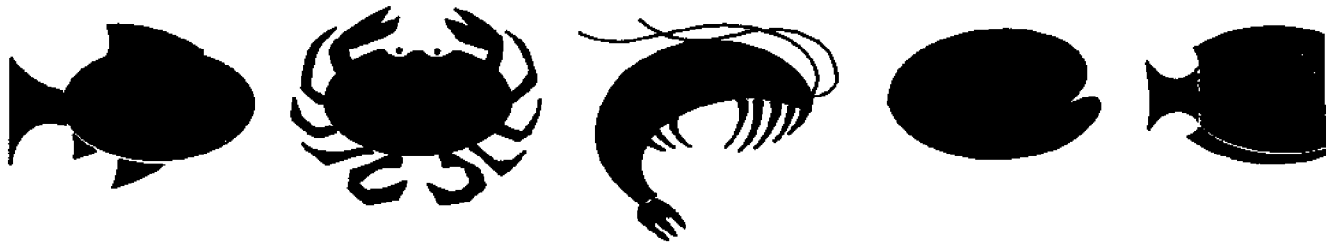
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Hazard Analysis and critical control point applications to the seafood industry

J. S. LEE

OREGON STATE UNIVERSITY
SEA GRANT COLLEGE PROGRAM
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Introduction

Federal legislation* will in the near future make adequate safety assurance programs mandatory for all food processors. It is none too soon that the seafood industry should be aware of this development and be prepared for it. While seafood is no more sensitive to processing hazards than other fresh foods, the particular methods used by seafood processors require individual attention in designing a safety assurance program that will match the industry's needs.

In order to comply with such proposed regulations, food processors SHALL set forth, IN WRITING, the procedures they use to identify the control points in the processing operations and the hazard associated with each point, and to establish adequate control measures and an adequate monitoring plan for each point. In short, it will require food processors to establish safety assurance programs based on the rational and systematic approaches of the Hazard Analysis and Critical Control Points (HACCP) concept.

This bulletin is intended to explain HACCP and explore its applications in the seafood industry of the Pacific Northwest. The process models given for fish smoking (Fig. 1), cooked and picked crab processing (Fig. 2), and cooked and peeled shrimp processing (Fig. 3) indicate suggested processing steps; other models of processing methods are also possible.

* The "Consumer Food Act of 1976" passed the senate in March 1976, but the house failed to act on it before its adjournment. A bill similar to above is expected to be introduced in the current congress.

What is hazard analysis?

The hazard analysis (HA) portion of HACCP requires the processor to estimate the degree of hazard associated with each commodity produced, the intended end use of the product, the processing modifications he might have incorporated, and the possibility and extent of abuses incurred during distribution and by the consumer.

Food and food ingredients are grouped according to the degree of risk inherent in the product. This classification is based on scientific and epidemiological data. The Pillsbury Company, which pioneered the development of HACCP, has grouped food ingredients into five hazard categories shown in Table 1. Unfortunately, no seafood ingredient is shown in this example.

Seafoods are basically protein foods that can be enjoyed by all age groups. Therefore, no seafood item would be classified as a category solely intended for infants or the elderly. Nevertheless, if a seafood processor is filling an institutional order that is for the nursing home or the hospital, he should be aware that this will increase the risk factor.

Most seafoods fall into hazard categories two or three of Table 1 where there is some degree of risk involvement. Table 2 lists seafood items in decreasing order of risk.

Thermally retorted products such as canned tuna and canned smoked oysters are excluded because they are already regulated under Good Manufacturing Practices Regulations, 21 CFR (Code of Federal Regulations, part 128 b) of the Federal Food, Drug and Cosmetic Act (Federal Register 3d, 2398, Jan. 24, 1973), which make safety assurance procedures mandatory for these items.

Seafood products may be divided into raw seafoods, processed raw foods, processed foods, and formulated products. Examples of raw seafoods are oysters in the shell, live crabs, and live fin fish. Processed raw foods include gutted salmon, fish fillets, and shucked oysters. Processed foods include peeled shrimp and picked crab meats. Examples of a formulated product are the fish sticks and breaded shrimp.

Seafood products may be frozen, refrigerated, or stored at ambient temperature. While no *fresh* seafood should be stored at ambient temperature, some products may be exposed to ambient temperatures for varying lengths of time during processing or packaging.

Seafoods may also be consumed after cooking or without further cooking.

Discounting environmental factors and the influence of harvest and onboard handling variables, which incidentally can not be ignored when formulating an individual HACCP program, the rule of thumb is as follows: the risk increases

1. with more handling
2. with higher storage temperature
3. and if the product is not to be cooked further by the consumer.

These considerations are incorporated into developing the hazard categories of seafoods shown in Table 2.

Foods and their ingredients may also be assigned a hazard classification that identifies the source of hazard (Table 3). Sources are broken into three areas and listed in order of the hazard inherent in a food or ingredient, the hazard that is introduced during processing, and the hazard that may be introduced by consumer abuse. The + denotes presence and 0 denotes the absence of a hazard. Thus, each

CATEGORY	DESCRIPTION	EXAMPLE
1	Special foods intended for special populations	Infant and geriatric foods
2	a. Sensitive ingredients	Eggs, milk products
	b. Compound ingredients (30% or more sensitive)	Spray-dried shortening with more than 30% milk products
	c. Ingredients stored in a plant where sensitive ingredients are processed	Chicken fat premix stored in an egg plant
	d. New ingredients	
3	Compound ingredients (30% or less sensitive)	Spray-dried flavor with 24% non-fat dry milk
4	Ingredients of agricultural origin not previously shown to be a source of harmful microorganisms or chemicals	Wheat, starches
5	Ingredients historically free of pathogens or residues	Citric acid, sugar, salt

Adapted from Bauman, H. E., Food Technol. 28:30, 1974 (1).

TABLE 1. Food ingredient hazard categories in order of decreasing risk

CATEGORY	DESCRIPTION	EXAMPLE
1	Heat processed foods usually consumed without additional cooking	Crabmeat, peeled shrimp & smoked fish
2	Non-heat processed raw foods often consumed without additional cooking	Shucked molluskan shellfish eaten raw
3	Formulated foods usually consumed after cooking	Fish sticks & breaded shrimp
4	Non-heat processed raw foods usually consumed after cooking	Fresh or frozen fish fillets & cooked molluskan shellfish
5	Raw seafoods usually consumed after cooking	Live crustacean & molluskan shellfish

TABLE 2. Seafood hazard categories in order of decreasing risk

food can be assigned a hazard classification as shown in the third column of Table 3.

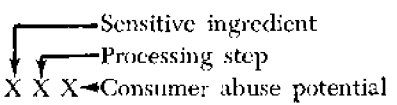
Some of the seafood products can be classified according to the hazard class assignment system as follows:

	sensitive ingredient ↓	processing step ↓	consumer abuse potential ↓
1. Smoked fish	+	+	+
2. Cooked and peeled shrimp	+	+	+
3. Fish stick	+	+	+
4. Salmon in round	+	0	+
5. Oyster in shell	+	0	+
6. Dried fish or jerky	+	+	0

In essence it is difficult to find any seafood product absolutely free of potential hazard as a raw material, or any that can be assumed to withstand the extreme abuse of the consumer. Even bone dry jerky containing sufficient salt could become hazardous if one imagines some extreme cases of abuse. Realistically, however, we have to determine the hazard on a relative rather than absolute scale. The International Commission on Microbiological Specifications for Foods (ICMSF) has addressed this problem and published its seafood risk categories (16).

What is critical control point?

The critical control point (CCP) is defined as a point

+	Hazard present (warning)		
0	Hazard absent (minimum risk)		
			
0	+	+	No sensitive ingredient
+	0	+	Heat processed product
0	0	0	No hazard present

Adapted from Peterson, A. C. and R. E. Gunderson. Food Technol. 28:37, 1974 (13).

TABLE 3. Food product hazard class assignment

in the processing steps where the failure to effectively control it may create an UNACCEPTABLE HEALTH RISK. The time and temperature specified for smoking fish is an example of this and the control here should never fail. The CCP should be under CONSTANT CONTROL by humans or by machines and the performance of the control step must be monitored and documented.

All other processing steps that involve the control of microorganisms are the control points. Failure to control these points might not result in a definite health hazard but it would indicate a potential risk not to be ignored. Many steps in seafood processing fall into this category. These will be discussed individually in conjunction with the model HACCP for smoked fish, pickled crab meat, and peeled shrimp.

Microbial hazards of seafoods

The microbial flora of seafood directly reflects the environment from which the seafood is extracted (14). Microorganisms come associated with the gill, intestine, and slime of the fish. The mud attached to bottom fish, crab, and shrimp is another source of microorganisms. If microbial buildup is allowed to occur in the fish hold it will further add to the microbial load of seafoods.

Since the microbial quality of seafood is so dependent on its environment the sessile shellfish is especially vulnerable to pollutants introduced into its growing waters.

The following list of pathogenic microorganisms are characteristically associated with seafoods. Their control should be considered critical. The important characteristics of these microorganisms discussed below are summarized in Table 4.

1. CLOSTRIDIUM BOTULINUM

This anaerobic, spore-forming bacterium is found in soil, sediment, fish intestines, and water. Seven different types of *C. botulinum* designated from A to G are presently recognized. Types A, B and E are most commonly implicated in human botulism. Types A and B spores are heat resistant and require heating at or above 250°F for over 15 minutes to destroy them. Salt (NaCl) in excess of 10%, acidity below a pH of 4.6, or a temperature below 50°F will prevent the growth of types A and B.

Type E, *C. botulinum* is found abundantly off the Alaskan, Washington, Oregon, and Northern California coasts in sediment, intestines, and gills of fish and shellfish. It is less resistant to heat than types A and B, and could be destroyed by heating at or above 180°F for over 30 minutes. Type E cannot grow in seafoods that contain salt (NaCl) in excess of 6% or acidity below pH 4.8, but it can grow and produce toxin at temperatures as low as 38°F.

2. VIBRIO PARAHAEMOLYTICUS

This marine bacterium, closely related to the Vibrios that cause mortalities in salmonids reared in saltwater, occurs naturally in the marine environment. *V. parahaemolyticus* is heat sensitive and can be destroyed by heating at or above 140°F for 30 minutes. It does not grow at temperatures below 41°F or at a pH below 5.0, but it can tolerate salt (NaCl) in excess of 10%. It can, however, grow so rapidly under favorable conditions that a moment's relaxation could invite a disastrous consequence. A more detailed account of this bacterium is given in an earlier publication (8).

Bacteria	Growth Temperature (°F)			Lowest pH for Growth	Max. NaCl (%) Toler- ated	Heat Inact. (°F/min.)
	Minimum	Optimum	Maximum			
<i>C. botulinum</i>						
types A & B	50	95	118	4.6	10.0	> 250/15'
type E	38	86	113	4.8	6.0	> 180/30'
<i>V. parahaemolyticus</i>	41-46	95-97	108-111	5.0	9-10	> 140/30'
<i>Salmonella</i>	42	99	115	5.0	8.0	> 140/30'
<i>S. aureus</i>	44	95	117	4.8	17.0	> 145/30'
<i>C. perfringens</i>	59	113	122	5.0	5.0	> 212/100'

Data compiled from Liston, J. *et al.*, 1969, FAO, Tech. Conf., Halifax, Can. (12) and Hobbs & Christian, 1973, The microbial safety of food, Academic Press, London (6).

TABLE 4. Growth and heat inactivation characteristics of food poisoning bacteria important in seafood processing

3. SALMONELLA INCLUDING S. TYPHI AND S. PARATYPHI

This group of organisms originates in diseased humans or other warm-blooded animals. They can be carried in apparently healthy individuals for varying time periods after recovery from the disease. Seafood can be contaminated directly or through polluted water.

The organisms are heat sensitive and destroyed by heat at or above 140°F for over 30 minutes. It will not grow at temperatures below 42°F but will persist in either frozen or refrigerated seafoods almost indefinitely. Since small numbers of this organism could initiate the disease, a stringent control measure must be employed.

4. STAPHYLOCOCCUS AUREUS

This organism resides on human skin and mucous membranes. Seafoods are usually contaminated with this organism by human handlers through nose and throat discharges and infected skin lesions. The organism is extremely salt tolerant and can withstand 17% NaCl. Because of its salt tolerance this organism can be concentrated in the brine and contaminate the rest of seafood dipped in that brine (10). It cannot multiply at temperatures below 44°F but the toxin it produces is heat stable and cannot be destroyed even by boiling for an hour.

5. CLOSTRIDIUM PERFRINGENS

Although this organism is related to *C. botulinum*, it does not produce the potent neurotoxin that *C. botulinum* does. It is widely distributed in soil and its presence in seafoods itself does not constitute a hazard. The organism

does not grow at temperatures below 59°F and is relatively easy to control by proper refrigeration. It also requires a massive growth in food prior to becoming toxic.

If a seafood dish is prepared from the contaminated seafood and left unrefrigerated, the spores of this organism, which can not be destroyed by heating at 212°F for less than 100 minutes, then germinate, multiply, and produce toxin.

6. VIRAL HEPATITIS

This disease is usually caused by ingestion of the raw or undercooked shellfish harvested from polluted water. The hepatitis virus originates in diseased humans and not in domestic or wild animals. Although the virus is unnatural to the marine environment, it could survive in the sediment for years. Besides shellfish, contaminated water used for seafood processing could spread this virus.

7. OTHERS

There are other pathogens that can be transmitted by seafoods. *Shigella* causes dysentery and can be transmitted via seafoods if a person suffering from this disease contaminates seafoods. The erysipeloid skin infection has long been known as an occupational hazard of fish handlers. There are nonmicrobial hazards as well, such as mercury and pesticides. Nematodes that cause eosinophilic enteritis in people through ingestion of pickled or smoked herring became known in Northern Europe. Ichthyosarcotoxins (puffer fish poison) that naturally occur in some fish, and scombroid fish poisoning due to histamine released by microbial action, are also of concern. However, these are

more isolated than the widely distributed and general hazards we have described earlier.

Table 5 lists the food pathogens and seafood items especially vulnerable to each pathogen. The table is constructed from the ICMSF recommended microbial sampling plan (16).

Table 6 lists the appropriate control measures for these pathogens as adapted from the United Nations Food and Agriculture Organization (FAO) booklet on Fish and Shellfish Hygiene (4). The tables are modified to accommodate specific needs of the Pacific Northwest seafood industry.

Model HACCP system

HACCP is not confined to microbiological monitoring. The processing plant layout, construction, proper operations of processing machinery and refrigeration systems, conveyers, chlorination system, the brine strength and temperatures, etc. all need to be monitored and their proper operations recorded.

Sometimes, microbial testing may be needed to monitor the above. For example, the microbial load of the conveyer belt should be known before establishing a proper cleanup schedule. On the other hand, the microbial control measure may not require microbial testing. For example, proper control of cooking time and temperature during smoking is a control step to ensure safety from *C. botulinum* in a fish smoking operation, which eliminates the need to test for *C. botulinum*.

I. HACCP FOR HOT SMOKING FISH

Regulations that govern fish smoking are quite specific. Sanitation regulations for manufacture, processing, packing, or handling of human food that include specifications for plant and grounds, equipment and utensils, sanitary facilities and controls including water supply, sanitary operations and processing controls are spelled out in Part 128, Title 21 of the CODE OF FEDERAL REGULATIONS (*Federal Register* 34:6977, April 26, 1969). Sanitation recommendations in more readable form can be found in Fisheries Facts-8 published by J. P. Lane (7) and another by J. D. Clem and S. Garrett (2).

Regulations that specifically govern smoked and smoke-flavored fish are spelled out in *Federal Register* (35:17401, Nov. 13, 1970). The HACCP program described here will aid the processors to produce wholesome smoked fish, as well as to meet the requirement of this regulation.

Fish smoking is a single-product process. The component is fish, the product is smoked fish. Smoked fish is in the seafood hazard category 1 (Table 2) because of its potential hazard of *C. botulinum*. The major components of the critical control points are: 1) smoking temperatures and time; 2) the water phase salt (WPS)* content of the

*WPS (water phase salt) =

$$\left(\frac{\% \text{ salt in finished product}}{\% \text{ salt} + \% \text{ moisture in finished product}} \right) \times 100$$

PATHOGEN	SENSITIVE SEAFOOD
<i>C. botulinum</i>	a. Smoked fish, including kippered and cold smoked, eaten uncooked
<i>V. parahaemolyticus</i>	a. Cooked picked crabmeat b. Frozen cooked shrimp, prawns, and lobster tail c. Fish eaten raw d. Frozen raw shrimp, prawns, and lobster tail e. Frozen raw breaded shrimp and prawns
<i>Salmonella</i>	a. Freshwater fish from warm waters b. Contaminated shellfish
Viral infections including hepatitis	a. Raw or undercooked shellfish from contaminated waters
<i>S. aureus</i>	a. Smoked fish eaten uncooked b. Frozen cooked shrimp, prawns, and lobster tails

Adapted from ICMSF sampling plans for fish and fishery products (16).

TABLE 5. Bacteria pathogens and the most sensitive seafoods

PATHOGEN	CONTROL MEASURES
<i>C. botulinum</i>	<ul style="list-style-type: none"> a. Correct processing b. Cooking just prior to eating food
<i>V. parahaemolyticus</i>	<ul style="list-style-type: none"> a. Sanitary handling and processing b. Adequate refrigeration or freezing c. Cooking just prior to eating food
<i>Salmonella</i>	<ul style="list-style-type: none"> a. Proper sewage disposal b. Sanitary handling and processing c. Adequate cooking d. Prohibit seafood harvesting from the polluted waters
Viral infections including hepatitis	<ul style="list-style-type: none"> a. Proper sewage disposal b. Adequate cooking c. Prohibit seafood harvesting from the polluted waters
<i>S. aureus</i>	<ul style="list-style-type: none"> a. Sanitary handling and processing b. Prohibit person suffering from cold or open infected wound from handling food c. Frequent brine change or adapt spray or injection system
<i>C. perfringens</i>	<ul style="list-style-type: none"> a. Rapid cooling of food after cooking

Adapted from FAO, Fish and Shellfish Hygiene (4).

TABLE 6. Control measures against seafood pathogens

smoked fish; and 3) the storage temperature of the smoked fish.

Two alternate smoking processes are permitted. Fish smoked at or above 180°F for not less than 30 minutes shall contain water phase salt level in excess of 3.5% and must be stored below 38°F. Or, fish smoked at or above 150°F for not less than 30 minutes shall contain water phase salt level in excess of 5.0% and must be stored below 38°F.

The smoking process diagram is shown in Fig. 1. The control measures for 3 CCPs (brining, smoking, and finished product storage) are described below:

CRITICAL CONTROL POINTS

A. BRINE

- Prepare brine in sufficient strength so that the brine level of fish will reach the desired level within 12 hours at 38°F. More specifically, measure and record the amount of salt added, the volume of water, the salometer reading and the temperature of the brine.
- A guide on brine preparation is available from the Oregon State University Sea Grant Office (5).
- The relationship between salt concentration and the brine concentration of smoked fish needs to be experimentally determined.

B. SMOKING

- Regulations specify that the internal temperature of fish and the oven temperature during smoking be continually monitored and recorded.
- The smoking process of not lower than 180°F for not less than 30 minutes is based on the coldest

part of the fish in the oven. At least a sample from each oven load should be analyzed for water phase salt (WPS) level and recorded.

C. STORAGE

- The smoked fish should be kept below 38°F and the storage temperature should be continually monitored.

OTHER CONTROL POINTS

a. RAW FISH

- Examine for freshness and wholesomeness.
- All eviscerated fish or fish in the round not being used immediately should be kept below 38°F.

b. FROZEN FISH

- Check for wholesomeness.
- Frozen fish should be kept frozen until use. Defrost at or below 45°F.

c. EVISCERATION, CLEANING AND FRESHWATER RINSE

- The entire gut content must be cleanly removed and the fish thoroughly rinsed with approved fresh water.

d. DRAIN

- Excess water should be drained at or below 45°F for no longer than 2 hours.

e. FRESHWATER RINSE AFTER BRINING

- Rinse to prevent salt crystallization on the skin of smoked fish and drain to facilitate proper drying in oven.

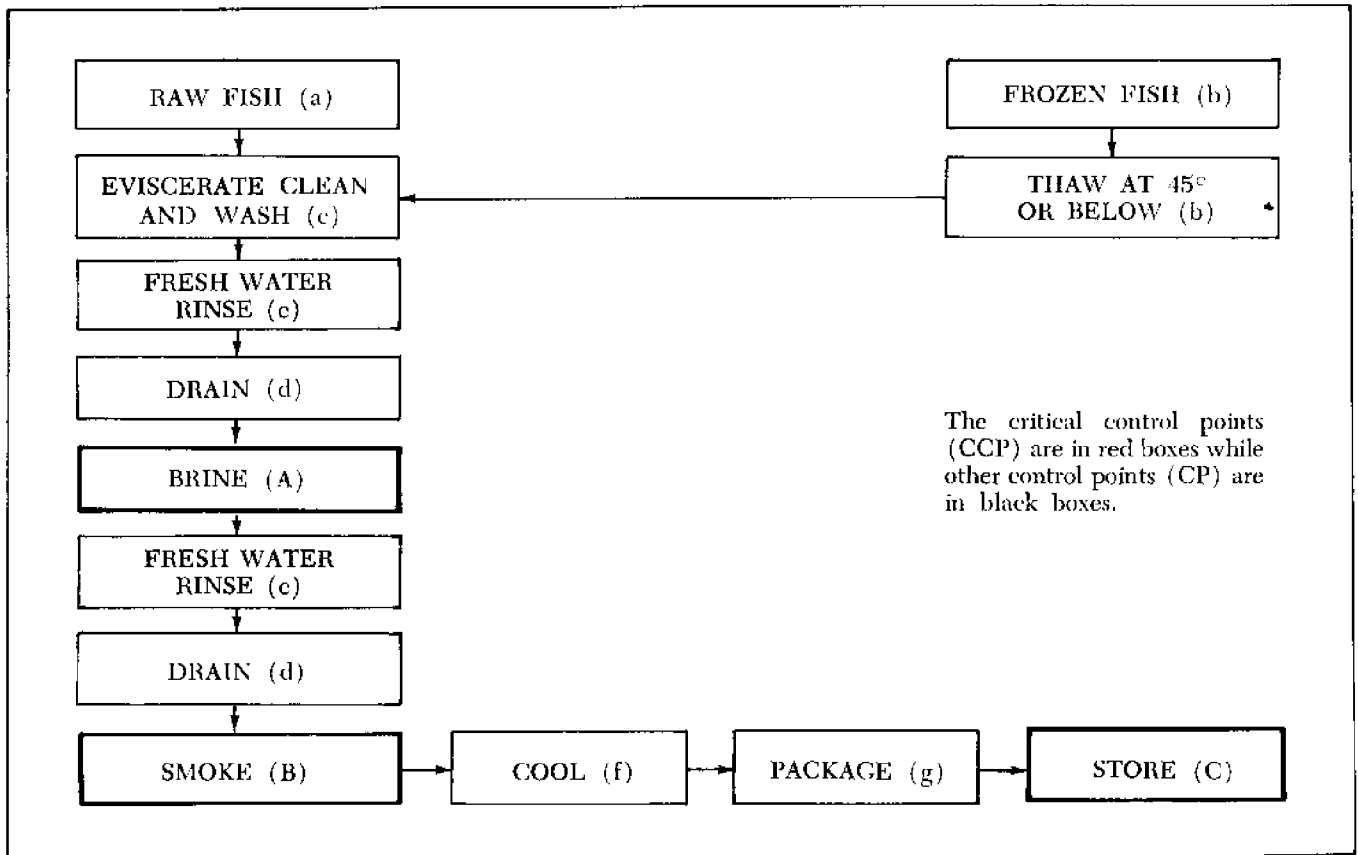


FIGURE 1. Fish smoking process

f. COOLING SMOKED FISH

- The smoked fish should be cooled to 50°F or below within 3 hours and subsequently cooled to 38°F or below within 12 hours after smoking.

g. PACKAGING

- Package should be labeled with plant name and location, the date of packaging and the oven load. Record should be kept to provide positive identification.

See Lane (7) and Clem and Garrett (2) for plant and equipment cleaning procedures.

2. HACCP FOR DUNGENESS CRAB PROCESSING (9)

Cooked and picked Dungeness crabmeat belongs to the seafood hazard category 1 (Table 2). Crabs are extracted from an environment known to harbor *C. botulinum* spores and the marine environment has to be assumed to contain *V. parahaemolyticus*. Crab processing requires excessive human handling, which increases the opportunity for contamination of the finished product with bacteria of the raw crab and those from the human handlers (*S. aureus*). In addition the picked crabmeat is usually consumed without further cooking.

When landed, crab is alive. The processor starts out with a raw product of microbiologically ideal quality. The flesh of the living animal is theoretically sterile. The processor, therefore, has full control over the microbial quality of the crabmeat that bears his label.

The key to proper crab processing is: 1) to avoid contamination of the picked crabmeat from the raw crabs; 2) to minimize contamination from the processing environment; and 3) to refrigerate promptly the picked crabmeat at temperatures below 38°F.

The crab processing diagram is shown in Fig. 2 and the control measures for CCP and CP are shown below:

CRITICAL CONTROL POINTS

A. PICKING

- Picking tables should be cleaned and sanitized with 50 ppm chlorine at each shift change.
- Pickers should wear clean clothes, apron, head cover, and gloves. Apron should be cleaned and sanitized with 50 ppm chlorine at each shift change.
- Cooked and cooled crab should be picked within an hour of cooking. Never pile up cooked crabs on picking table that cannot be picked in an hour.
- No picker should be allowed to handle raw crabs.

B. STORAGE

- Packaged crabmeat shall be stored at temperatures below 38°F at all times or quick-frozen.

OTHER CONTROL POINTS

a. LIVE CRAB

- To prevent active crabs from damaging each other, place the live crabs at 45°F for 12 hours before handling.

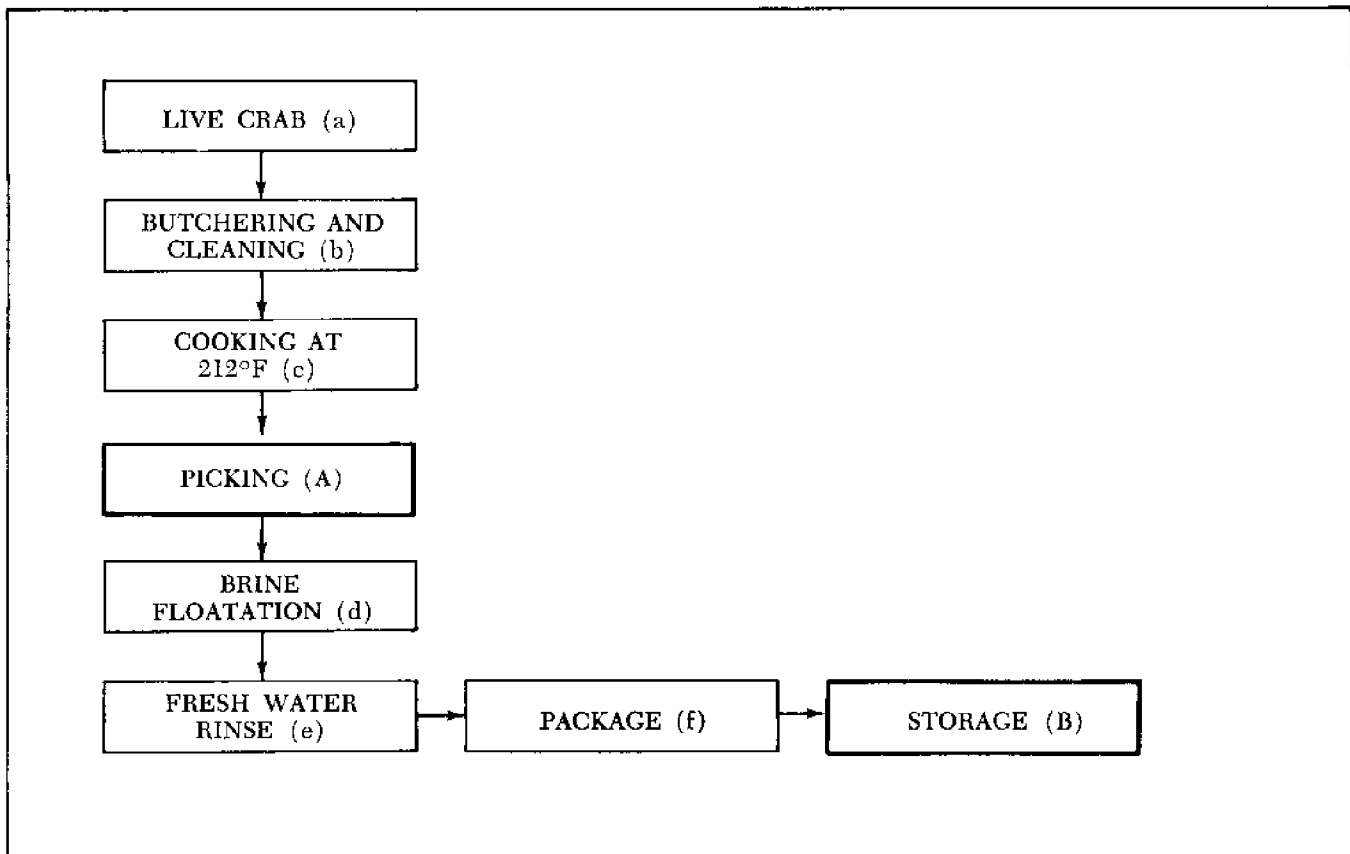


FIGURE 2. Cooked and picked crab processing

b. BUTCHERING AND CLEANING

- Check the condition and cleanliness of brush. Brush should be washed and sanitized at the end of each shift or every 2 hours.
- Remove carapace cleanly.
- Cut in halves.
- Brush off intestinal content as completely as possible.
- Wash and rinse the halves in running water or by spray.

c. COOKING

- Check water temperature at 2-hour intervals for the continuous cooker (before each load is added for batch system).
- Cook at 212°F for 15 minutes.
- Air-cool the cooked crab for an hour in an isolated location removed from raw crabs and heavy traffic.
- NEVER HANDLE COOKED CRAB WITH UTENSILS AND BASKETS USED FOR HANDLING RAW CRABS.
- Cooked crabs should not be handled by those who handle raw crabs.
- Do not cook more crabs than the pickers can handle in an hour after cooking.

d. BRINE

- Fresh and chilled brine should be prepared at each break or every 2 hours of operation.

e. FRESH WATER RINSE

- Brine should be rinsed off in fresh potable water spray within minutes of brining.

f. PACKAGING

- The packaging table should be cleaned and sanitized with 50 ppm chlorine at each break.
- Picked crab should be packaged within 10 minutes.
- Packaged crab shall be chilled immediately to temperatures below 38°F.
- Packaging should be done so that the package can not be mishandled. Each package should display "store below 38°F" warning.

See Lane (7) and Clem and Garrett (2) for plant and equipment cleaning procedures.

3. HACCP FOR PACIFIC SHRIMP PROCESSING (11)

The cooked and peeled shrimp belongs to seafood hazard category 1 (Table 2). Pacific shrimp comes from the same environment as the Dungeness crab. Therefore, *C. botulinum* hazard cannot be discounted. Shrimp, in contrast to Dungeness crab, is mostly harvested during the warmer summer months and this increases the *V. parahaemolyticus* risk. The mechanical peeler has largely replaced hand-picking and reduced the chance for human contamination to a degree. However, it has increased the chance for equipment-related contaminations.

The condition of the shrimp received at the plant can vary depending on the age of the shrimp out of water, on-board handling practices and the degree and care in icing.

Control of raw material and the proper care and sanitization of the processing equipment is even more critical for shrimp than for the crab due to seasonal and handling factors. The key to sound shrimp processing is: 1) to avoid contamination of the picked shrimp from the raw shrimp;

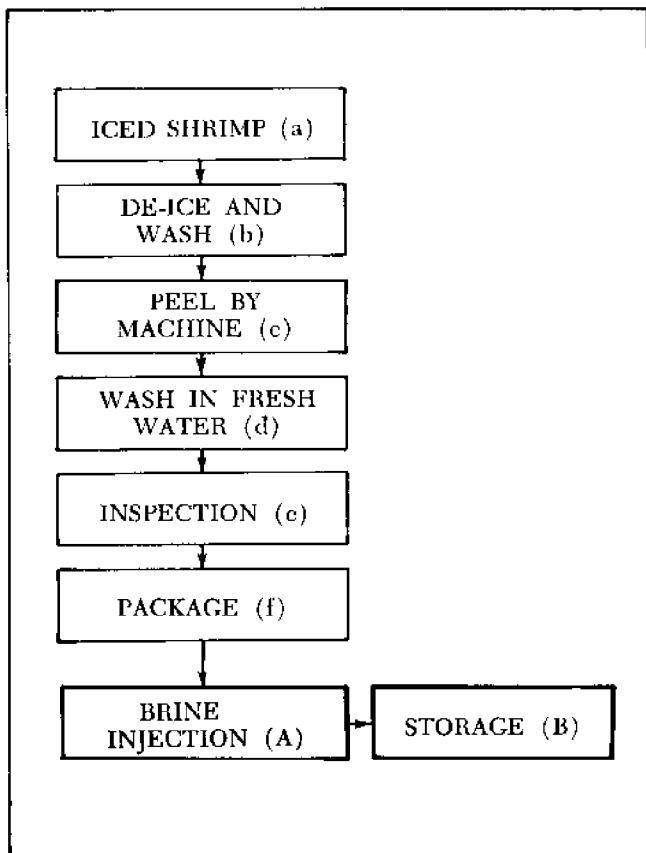


FIGURE 3. Cooked and peeled shrimp processing

2) to eliminate the microbial buildup in and on the processing machinery; and 3) prompt refrigeration of the peeled shrimp to below 38°F. Quick-freezing is preferable to refrigeration.

Shrimp peeling steps and the control measures for CCP and CP are shown in the diagram to the left and discussed in the following explanations.

CRITICAL CONTROL POINTS

A. BRINE INJECTION

- Brine is used to flavor the shrimp. It can best be done by injecting brine in the finished product. The brine tank quickly accumulates bacteria so the salt tolerant and rapid growing *V. parahaemolyticus* presents a special threat for shrimp dipped in old brine at ambient temperatures.

B. STORAGE

- Chill the packaged shrimp to below 38°F by 10 minutes after packaging.
- Never expose the peeled shrimp to above 38°F temperature. Quick freezing is preferable to refrigeration.

OTHER CONTROL POINTS

a. ICED SHRIMP

- The shrimp should have been well iced and the temperature of shrimp at any point should not exceed 40°F.
- De-ice the shrimp. Do not de-ice and re-ice.

b. **DE-ICE AND WASH**

- Iced shrimp should be de-iced just prior to peeling by immersion in potable tap water. Wash the shrimp as thoroughly as possible before cooking.

c. **MACHINE PEELING**

- Peelers and transport ducts should be cleaned and sanitized with 50 ppm chlorine at each break or every 2 hours of operation.
- Peelers and ducts should be inspected every 10 minutes during operation to ensure no peeled shrimp accumulates on the line.

d. **WASHING**

- Wash the peeled shrimp in a sufficient quantity of fresh water.

e. **INSPECTION**

- The inspector should wear clean clothes, aprons, and head cover. Inspection should be done along the conveyer belt with the running water. If table is used, the table top should be cleaned and sanitized with 50 ppm chlorine at each break, or every 2 hours of operation.

f. **PACKAGING**

- The packaging table should be cleaned and sanitized with 50 ppm chlorine at each break, or every 2 hours of operation.
- The peeled shrimp should be packaged within 10 minutes of peeling.

See Lane (7) and Clem and Garrett (2) for plant and equipment cleaning procedures.

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