

HACCP in *Changran Jeotgal*

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The HACCP (hazard analysis critical control point) concept becomes an important aspect of Good Manufacturing Practices (GMP) in safe food production. The HACCP plan was developed with food safety objective. The authors already carried out hazards analysis on *Changran Jeotgal* manufacturing process in a previous report. In this study we developed a HACCP plan on the manufacturing process of *Changran Jeotgal*. We could decide two CCPs those were salt concentration and eliminations of foreign materials before packaging. Foreign materials should be certainly checked out with laser detector just before packaging. Salt should be maintained more than 8% to inhibit pathogenic bacteria in end product. On the *Jeotgal* process free water is removed after salting and *Jeotgal* is seasoned with several subsidiary materials such as corn syrup. In result end products have 8% salt with water activity 0.82. Most bacteria are inhibited but some can live in this condition. Materials on the working may be contaminate by pathogens, chemicals or physical hazards. It will be decreased by SSOP (standard sanitary operating program). The SSOP needed in *Jeotgal* plants is nearly same as other general food manufacturing plants but essential to fulfill HACCP program.

Key words: *Changran Jeotgal*, HACCP (hazard analysis critical control point), GMP (Good Manufacturing Practices), CCPs (critical control points), SSOP (standard sanitary operating program)

Introduction

Potential hazards caused by food consumption are increasing year by year such as endocrine disruption chemicals, heavy metals, known and/or unknown microorganisms and other environmental contaminants. Sometimes we are faced with many questions about food safety such as "how safe is safe enough? or how to select the real safe food?" It is very difficult to give them correct answer. Frankly speaking, it is true that the food poisoning accidents are increasing in these years all over the world in spite of governmental emphasis on food sanitation.

The HACCP (hazard analysis critical control point) program is a tool to assess hazards and

establish control systems that focus on prevention rather than relying mainly on end product testing (Frazier and Westhoff, 1988; Notermans et al., 1994 a, 1994b; Loken, 1995; Gardner, 1997; Huggett, 2001; Mortimore, 2001; Taylor, 2001). The HACCP program can be applied throughout the food chain from primary production to final consumption and its implementation should be guided by scientific evidences of risks to human health. The HACCP program was first introduced to the fields of meat and meat products in 1996 in Korea, after that the program is extended to fish meat paste products, frozen sea foods, milk and milk products, ice cakes, general frozen foods and rice cakes in order. But till now, there is no item applied the HACCP system in the salted and fermented seafood industry.

Changran Jeotgal, a kind of Korean traditional seafood, is salt-fermented. The *Jeotgal* has pro-

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blems such as high salt concent, short shelf life, difficulties of sanitary control and determination of standard quality etc. Furthermore, it is difficult to induce the HACCP program in *Jeotgal* manufacturing plants because they has small financial scales except a few plants.

In this study, we attempted to develop a model HACCP program for safety *Changran Jeotgal*. We determined two critical control points (CCPs) and their critical limits (CLs) and could suggest the HACCP plan.

Model fomulation of HACCP plan

Generally the manufacturing process of *Changran Jeotgal* is composed orderly of purchasing of raw materials, subsidiary materials and packaging materials, thawing, pretreatment (parasite removal etc.), salting, draining, 1st seasoning, fermenting, 2nd seasoning, packaging and shipment (Fig. 1) (Lee et al., 2001a). To develop the HACCP plan first hazards must be analyzed on each process (Sperber, 2001; Panisello and Quantick, 2001). We could think many potential hazards on each step. Of them CCPs were determined by following subsequent questions (Fig. 2, Table 1). Do the hazards of the step affect human health? Are they most important to production of safety *Jeotgal*? What's the why? Do preventive measures exist at this step or subsequent steps for the identified hazard? Is control this step necessary for food safety? Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level? Could contamination with identified hazards occur in excess of acceptable levels or could these increase to unacceptable levels? Will a subsequent step eliminate identified hazards or reduce the likely occurrence to an acceptable level? Consequently they are keys to decide CCPs.

From hazards analysis through the whole steps of *Jeotgal*, we could determine the CCPs which were salting step and elimination step of foreign materials before packaging. The others should be managed by SSOP (standard sanitary operating program).

One of the CCPs is the elimination step of foreign materials before packaging. Foreign materials such as metal particles in end product may be fatal

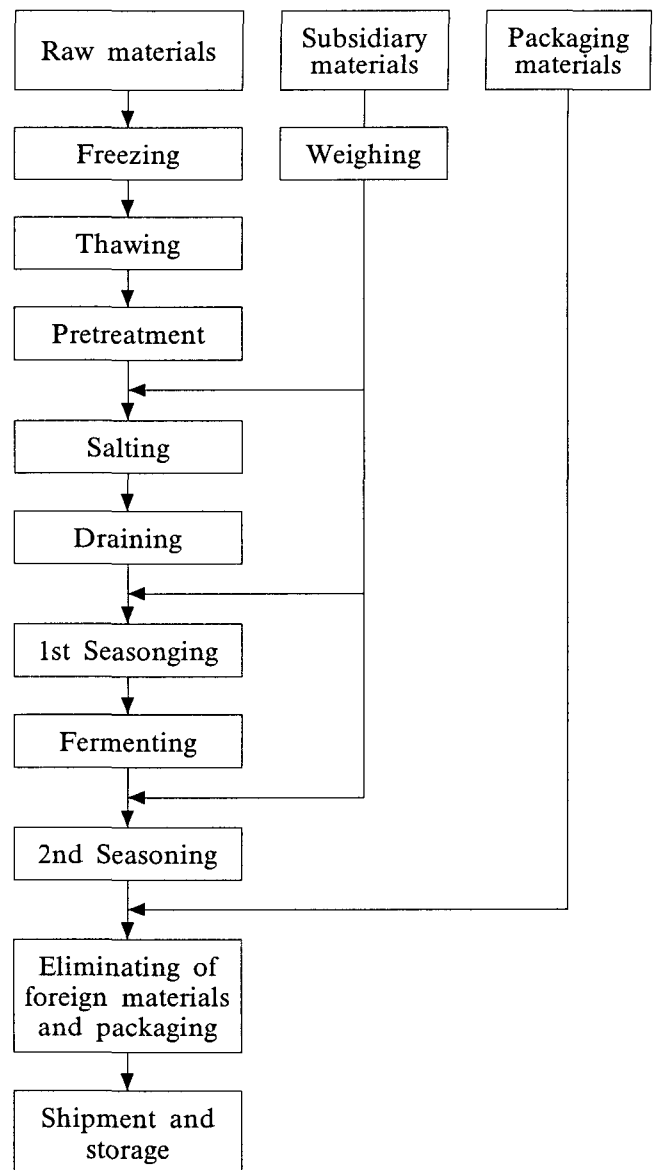


Fig. 1. The manufacturing process of *Jeotgal*.

to human. Metal particles must be eliminated by laser detector before packaging. The supervisor must regularly monitor the machine normal and keep its working diary. Products made under disorder will disuse or recirculate. If laser detector normally operate it is no problem at all (Table 2, Table 3).

The other CCP is the salting step. *Jeotgal* is salt-fermented seafood. Traditional *Jeotgal* have high salt concentration of 20~30% (Lee and Choe, 1974; Hur, 1996). Recently its process has been improved much (Lee et al., 2001a, b, c) especially it is made in low salt of 8% degree (Kim et al., 1999; Lee et al., 2001a).

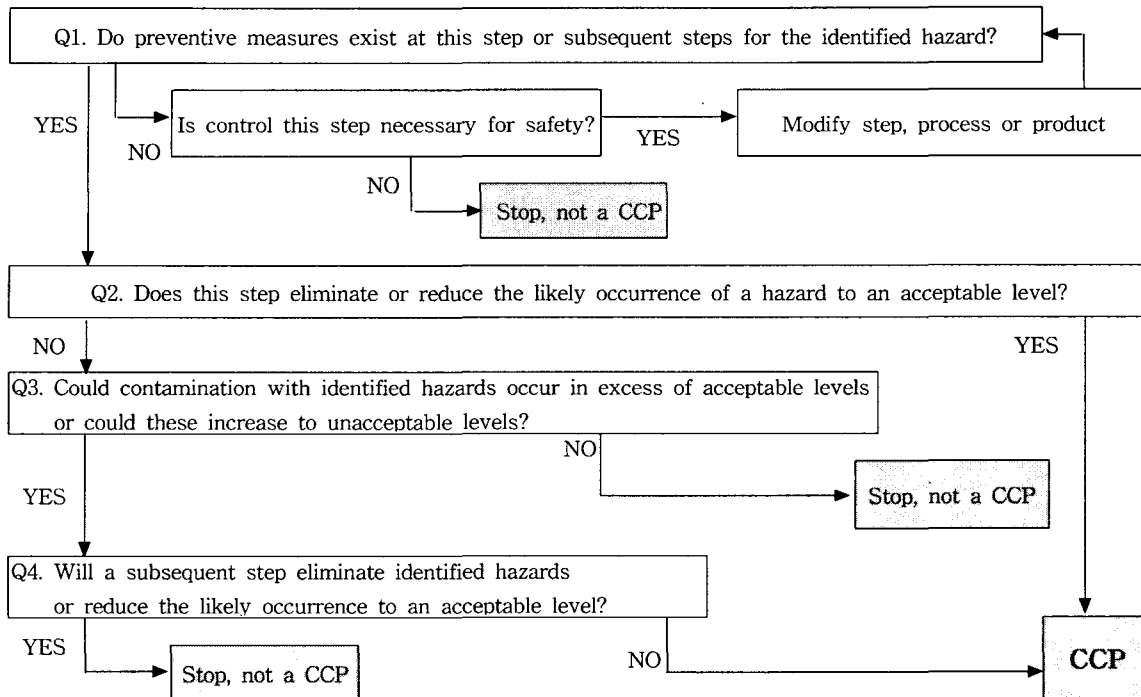


Fig. 2. The CCP (critical control point) decision tree by Codex.

Table 1. Determination of CCPs in the *Jeotgal* process

Process	Hazards	Q1	Q2	Q3	Q4	CP/CCP
Raw material	Pathogenic bacteria	Yes	Yes	No	No	CP
Thawing	Growth of pathogenic bacteria	Yes	Yes	No		CP
Salting	Growth of pathogenic bacteria	Yes	Yes	Yes		CCP
Elimination of foreign materials before packaging	Metal particles, hairs, stone etc.	Yes	Yes	Yes		CCP

CP, critical point; CCP, critical control point

Q1, Do preventive measures exist at this step or subsequent steps for the identified hazard?

Q2, Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?

Q3, Could contamination with identified hazards occur in excess of acceptable levels or could these increase to unacceptable levels?

Q4, Will a subsequent step eliminate identified hazards or reduce the likely occurrence to an acceptable level?

While some kinds of bacteria can grow even in high salt concentration. The maximum salt concentrations for growth are 6%, 8%, 10% for *Vibrio vulnificus*, *V. parahaemolyticus* and *V. alginolyticus*, respectively. What is worse *Staphylococcus aureus* can grow even at 15% salt (Lee, 1977; Sneath et al., 1984; Krieg and Holt, 1984).

Bacteria need water to grow. Because bacteria cannot take their food in a solid form, they must receive their nutrients in some kind of water solution. This solution is described as "water activity"

which means the amount of water available for growth. Salt decrease the available water and can reduce bacterial growth.

Today the *Jeotgal* in circulation market has 8~9% salt concentration (Kim et al., 1999; Lee et al., 2001 a). Only the 8% salt may not be sufficient to inhibit bacterial growth. But on the *Jeotgal* process there is a draining step after a salting step and released free water is removed and seasoned with several subsidiary materials. In result the *Jeotgal* has water activity 0.82 (A_w 0.82) with 8% salt (Lee

et al., 2001a) in end product. Most bacteria can not grow at lower than A_w 0.85 but some can live in this condition (Lee, 1977; Krieg and Holt, 1984; Sneath et al., 1984; Frazier and Westhoff, 1988; Loken, 1995).

We could suggest that some pathogens may cause food poisoning accident in *Jeotgal*. We examined the microbiological tests on *Jeotgal* from 2000 to 2001 (Park et al., 2002) and isolated *S. aureus* from a raw material but fortunately it was not pathogenic (coagulase negative). After that no pathogens have isolated from *Jeotgal* till now. Therefore we could decide that critical limit on salting step was at least 8% salt in end product (Table 2). Then salt 12% (w/w) must add to raw materials to salting step for making salt 8% end product (Lee et al., 2001a). When salt input is lower than 8% it must add to materials on the working and when it is excess it must remix with raw materials. All these works must keep in working diary (Table 3).

Pathogenic bacteria in end product are most principal hazards in most food, of all things (Giffel et al., 2001; Hoornstra and Notermans, 2001; Soboleva et al., 2001; Nissen et al., 2001; Brown et al., 2000; Kvenberg and Schwalm, 2000; Huss et al., 2000). Therefore microbiological test are essential for quality control.

Microbiological testing can be used for surveying the microbiological conditions of product, for deciding between acceptance or rejection of product, or for purposes related to the implementation and maintenance of HACCP system (Notermans et al., 1994b; Eisel et al., 1997; Brown et al., 2000; Nissen

et al., 2001; Hoornstra and Notermans, 2001; Soboleva et al., 2001).

Previously we reported the falling bacteria in working environment. Bacteria in air can rise and not fall during working time, but they fall materials on the working during break time and may contaminate materials on the working. Then we suggested that special measures to protect materials are needed during break times such as lunch time or exchanging working teams and if possible it is better to take a rest after working than on the working. In addition materials on the working may contaminate by several subsidiary materials, packaging materials, cross contamination and employee's etc. Then materials on the working may contaminate by pathogenic bacteria, chemicals and physical hazard (especially metal particles). These contaminations caused on working will reduce by employee training. Sanitary education for employee is essential for a successful food safety program. Therefore it should be prepared proper SSOP to prevent secondary contamination of materials on the working (Loken, 1995). The SSOP needed in the *Jeotgal* plant is nearly same as other general food manufacturing plants but essential for conducting of HACCP program. Basically SSOP is composed of facts like following things.

① Water for working must keep clean. ② All of equipments, instruments and tools should be easy design to cleaning, atoxic, a chemical-resisting and rustproof materials. ③ The surfaces of each instrument and tools contact with food must disinfect by chlorination and 70% alcohol before beginning of

Table 2. Justification on critical limits of CCPs

Process	Hazards	Critical limit	Justification	Validation
Salting	Growth of pathogenic bacteria	Maintenance of 12% (w/w) salt concentration to inhibit bacterial growth	The growth of most bacteria is inhibited in this condition*	No detection of pathogenic bacteria from end product
Elimination of foreign materials before packaging	Foreign materials	Normal operation of laser detector	Manual from company to make laser detector	Elimination of foreign materials with its operation

*The critical limit is proved by many references or research paper.

Salt must add 12% to raw material in salting step to make 8% salt in end product. Then *Jeotgal* has water activity 0.82 with 8% salt by recent improved process (Lee et al., 2001a). Most bacteria cannot grow in this conditions but some can live (Lee, 1977; Krieg and Holt, 1984; Sneath et al., 1984; Fraizer and Westhoff, 1988; Loken, 1995).

Therefore regular microbiological test are essential for quality control.

Table 3. HACCP plan for safety *Jeotgal*

Company name: ○○○○○○ Address: ○○○○○○○○○○		Product name: <i>Changran Jeotgal</i> / squid <i>Jeotgal</i> Storage and Circulation: chilling storage and circulation (below 10°C) Use: to eat itself							
CCP	Hazard	Critical limit	Monitoring				Readjustment	Validation	Recording
			What	How	Period	Who			
Salting	Growth of pathogenic bacteria	Maintenance of 12% (w/w) salt concentration*	Salt input	Confirmation by eyes for salt input that it has been measured and contained in designated container	Every 1 hr	A certain worker of quality control department	Salt supplement when the concentration is lower than 12% (w/w) Remixing with unsalted materials when salt is excess	Investigation of working diary	Salting monitoring diary Adjustment diary
Elimination of foreign materials before packaging	Foreign materials in end product	Normal operation of laser detector	Normal state of laser detector	Confirmation of the normal operation of laser detector	Every 4 hrs or just before beginning of working	A certain worker of quality control department	Disuse or recirculation of <i>Jeotgal</i> produced by disordered equipment fix of equipment	Investigation of working diary	Operation diary of laser detector

*Salt must add 12% to raw material in salting step to make 8% salt and 0.82 Aw in end product. Most bacteria cannot grow in this conditions but some can live (Lee, 1977; Krieg and Holt, 1984; Sneath et al., 1984; Fraizer and Westhoff, 1988; Loken, 1995).

Therefore regular microbiological tests are essential for quality control.

working and break time and after ending of working. ④ Sanitary uniforms and gloves made of waterproof cloth must keep clean and put on the appointed place after working everyday. ⑤ Workers must observe individual hygiene. For example every worker must take a shower before going to work and wear a sanitary uniform, a cap, gloves, boots and an apron on working. And they must wash their hands before beginning of working, after handling of other things or contaminants or when they return from a break time and at any time if necessary. They must not wear any accessories, eat or drink or smoke or talk with others or run in working environment. ⑥ Products must not contaminate by employee's hands or unsanitary instruments or others. Therefore disinfecting tanks must be placed surely at starting spot and ending spot in the production line. The vinyl for inner packing must hang it up and not put it down on the ground of working room. ⑦ Disinfect tanks for employee's hands or their boots and sanitarily fittings must get ready to observe good individual sanitary. ⑧ It must be prevented to contaminate products or packaging materials by chemicals. Then the worker in charge must label the chemical bottles well and put into

designated warehouse. ⑨ Products, the surfaces of instruments and packaging materials must be not contaminated by contaminated air, condensed water hung from the ceiling or water drops bounded from the ground. ⑩ The worker who have fever, diarrhea, nausea or hurts by a burn, inflammation or a cut must be exclude from production work and convert to other works. ⑪ Mice or noxious insects must not be in working areas. Therefore all doors must always close except when they are used and it is needed all windows with mosquito nets, drains with protection net against mice and sterilizing light like U.V. light. ⑫ The toilet must always keep clean, drain well and be well ventilated and should have a double door to open inside. ⑬ Materials on the working must not be left uncovered during break times because they may be contaminated and lose their freshness.

The employee must always record and keep all the above on daily sanitary inspection diaries.

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