

Safety Inspection on *Jeotgal*, Salt-Fermented Sea Food

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Jeotgal, salt-fermented sea food, is a kind of Korean traditional foods. We carried out hazard analysis on *Changran* (stomach and intestine of Alaska pollack) *Jeotgal* and squid *Jeotgal* through the whole processing procedures at H Co. located at Guryongpo from April 2000 to September 2001. During this studying period, we educated employee regularly and analyzed hazards on the whole process and then could conclude that pathogenic bacteria and metal particles were most important hazards in *Jeotgal*. Metal particles in end-product will be eliminated by laser detector before packaging. But bacteria must thoroughly manage through the whole process. Bacteriological qualities of the end products were much improved after education for the employees and by effort for HACCP (Hazard Analysis and Critical Control Point) program introduction. Pathogenic bacteria such as pathogenic *Escherichia coli*, *Salmonella* spp., coagulase positive *Staphylococcus aureus* and *Vibrio parahaemolyticus* were not detected from not only raw materials but also end products. The falling bacteria in the places such as thawing area, packaging area, seasoning area, fermenting room, subsidiary materials room and storage room were less than 30 CFU per plate for 30 minutes during working time. But those were increased more than 10 times during the resting time. It means that special measures are needed during the break time such as lunch time or exchanging working teams.

Key words: *Jeotgal*, HACCP program, Bacteriological quality, Falling bacteria

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. It is true that food poisoning accidents are increasing in these years all over the world inspite of governmental emphasis on food sanitation.

The hazard analysis and critical control point (HACCP) is a tool to assess hazards and establish control systems that focus on prevention against hazards rather than relying on testing with end-products (Fraizer and Westhoff, 1988; Notermans et al., 1994a, b; Loken, 1995; Gardner, 1997; Huggett,

2001; Mortimore, 2001; Taylor, 2001). Since 1996 Korean government has been trying to induce the HACCP program to many kinds of foods, meat products, fish-meat products, frozen seafoods, dairy products, the mass meal service and some fast foods etc. From this time forward, all kinds of foods will have to be under HACCP program. For adaptation of HACCP program, first we must carry out hazard analysis on objective food (Sperber, 2001; Panisello and Quantick, 2001).

Jeotgal, Korean traditional food, is salt-fermented and seasoned. Among numerous types of *Jeotgal*, *Changran Jeotgal* (salt-fermented stomach and intestine of Alaska pollack) and squid *Jeotgal* (salt-fermented squid) have been beloved by many consumers. But it has many problems such as high salt, short shelf life, difficulties of sanitary control and determination of standard quality by different manufacturing methods, while it is true that it has

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been improved recently (Lee et al., 2001a, b, c).

There are largely three kinds of hazards, chemical hazard, physical hazard and biological hazard (microbiological hazard). We inspected these hazards on *Changran* and squid *Jeotgal*, and examined falling bacteria in working rooms.

Materials and Methods

Sampling of *Jeotgal*

Jeotgal was submitted by Company H located at Guryongpo with 10 times from April 2000 to September 2001. The process of *Jeotgal* was reported Lee et al. (2001c).

Jeotgal was carried to our laboratory from the plant in two hours with chilling ice box.

Investigation of falling bacteria in working rooms

Sterilized nutrient agar (Difco) plate was placed for 30 minutes in working rooms, thawing zone, packaging zone, seasoning zone, fermentation room, food additives zone and subsidiary materials room, and incubated at 37°C for 24 hours.

Identification of bacteria from *Jeotgal*

We examined total viable cell counts, total or fecal coliforms, *Staphylococcus aureus*, *Salmonella* spp. and *Vibrio* spp. from *Jeotgal* in the making by manufacturing processes and using water.

Microbiological detection for total viable cells and pathogenic bacteria was basically conducted by Bacteriological Analytical Manual (USFDA, 1992). For detection of pathogenic bacteria, *Jeotgal* sample was enriched in BHI (Brain Heart Infusion) broth medium. Enriched culture was spreaded on each selective medium, TCBS (Thiosulfate Citrate Bile Sucrose) agar plate for *Vibrio* spp., SM 110 (*Staphylococcus* Medium 110) agar plate for *S. aureus* and SS (*Salmonella-Shigella*) agar plate for *Salmonella* spp. Detected single colonies on each agar plate were identified by biochemical test with API kits (bioMérieux).

Total coliforms or fecal coliforms were examined by one step preparation with Coli ID medium (bioMérieux). Sample mixed with Coli ID agar was incubated at 37°C for 24 hours. The Coli ID medium

contains two chromogenid substrates: one for β -D-glucuronidase giving a red colour for *Escherichia coli* colonies and one for β -galactosidase giving blue colonies for the other coliforms (Mioni et al., 1997; Sueiro et al., 2001). We could calculate total coliforms by counting blue colonies and fecal coliforms by counting red colonies.

All media used in this study was Difco except Coli medium.

Results and Discussion

Hazards analyses on *Jeotgal*

Jeotgal, salt-fermented sea food, has been loved by many Koreans but it still has many sanitary problems. Recently it is made with industrial scale but still small. It has difficulty on sanitary control.

Thus, food safety has become an important national issue as the public is better informed and more aware of foodborne diseases and is demanding better quality and safer food.

For making safety *Jeotgal* it is most important that raw materials are fresh. And it is very principal to eliminate contaminant from materials, to prevent contamination on materials and to educate sanitation for workers, too.

The manufacturing process of *Jeotgal* is composed orderly of thawing of raw material, parasite removal, salting, draining, 1st seasoning, fermenting, 2nd seasoning, packaging and shipment generally (Lee et al., 2001a, b, c). On the manufacturing process we could think biological, chemical, physical and quality hazard (Table 1). Biological hazards are pathogenic bacteria in end-product which result from unfresh raw materials or contamination on processing. Chemical hazards are adulteration of chemical agents such as disinfectants. Physical hazards are metal particles, pieces of stone or vinyl and hairs incoming in materials. Quality hazard is parasites in end-product. Parasite in *Jeotgal* will not become cause for disease but consumers dislike it. Therefore it should be controlled with the process to minimize them. Pathogens or chemicals in raw materials will prevent by purchasing from recognized seller. The other hazards will control by SSOP (sanitation standard operation procedure) which is a helpful tool for effective accomplishment of HACCP program.

Table 1. Hazard analysis on *Jeotgal* processing

Hazard factors	Kinds & sources	Prevention
Biological hazards	Pathogenic bacteria result from unfresh raw materials	Purchasing raw materials from recognized seller
	Pathogenic bacteria by contamination on processing	Management by SSOP
Chemical hazards	Chemical reagents incoming in material on handling	Management by SSOP
Physical hazards	Pieces of stone or metal in raw material	Elimination them on processing
	Particles of hairs or vinyls incoming in materials on processing	Management by SSOP
Quality hazards	Parasites in raw materials	Management with the process to minimize them

From above results, we could think that pathogens and metal particles are most important hazard factors in *Jeotgal*. Metal particles in end-product will be eliminated by laser detector before packaging. But bacteria must thoroughly manage through the whole process. Then we tried to investigate pathogenic bacteria on *Jeotgal* processing.

Microbiological hazards on *Changran* and squid *Jeotgal*

Pathogenic bacteria are most principal hazards in 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). It is true in case of *Jeotgal*, too. Therefore microbiological test is 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.

For microbiological hazard analysis on *Jeotgal* we tried to examine total viable cells, total or fecal coliforms and pathogenic bacteria in *Jeotgal*. Viable cells from raw materials of *Changran* was 4.0×10^2 CFU/g $\sim 2.5 \times 10^4$ CFU/g and the end products had 3.5×10^4 CFU/g $\sim 2.2 \times 10^6$ CFU/g. There were cells variation by the manufacturing processes from raw materials to the end products. The results from squid *Jeotgal* were similar to those of *Changran*

Jeotgal (data is not shown).

It was reported that *Jeotgal* products had about $10^5 \sim 10^6$ CFU per g of product at initial time by Lee et al. (2001b, c). These viable cells increase in number as time passed. Actually it's a natural conclusion that *Jeotgal* has many numbers of bacteria because it is fermented by bacterial enzyme and intestinal enzyme activities. These bacterial cells of *Jeotgal* is out of the serious question.

While pathogenic bacteria and fecal coliform bacteria are very important in final products because they make a threat against person's health. There was no detection of fecal coliforms from raw *Changran* but its detection rate from raw squid was about 25% in 2000. Fecal coliforms were detected up to 60% from end-product of *Changran* or squid *Jeotgal* in 2000, but they were not detected in 2001 (Table 2).

We have taught sanitary thought for workers in that plant since April 2000. From that result it had decreased detection cases of fecal coliforms as time passed (Table 2).

Staphylococcus aureus had detected from squid raw materials (data is not shown) but it showed coagulase negative reaction, then other pathogenic bacteria had never been detected during this studying period, too.

From these results we could suppose that the thorough sanitary concept could decrease detection cases of sanitary indicative bacteria or pathogenic bacteria. Then sanitary quality of food will be improved and food poisoning accidents caused by pathogenic bacteria will be decreasing gradually.

Table 2. Detections of total and fecal coliforms from *Jeotgal* processing

Processing	<i>Changran Jeotgal</i>				squid <i>Jeotgal</i>			
	2000		2001		2000		2001	
	TC	FC	TC	FC	TC	FC	TC	FC
Raw materials	2/4	0/4	4/5	0/5	3/4	1/4	2/2	0/2
Salting	2/2	2/2	5/5	1/5	1/2	1/2	2/4	1/4
Seasoning	2/2	1/2	4/5	0/5	0/2	0/2	3/4	0/4
Fermenting	2/2	0/2	3/5	0/5	2/2	0/2	2/3	0/3
End-product	5/5	3/5	4/5	0/5	4/5	3/5	5/5	0/5

Bacteriological detection was carried out 10 times during from April in 2000 to Sept. in 2001. Detection rates are showed by positive sample number per tested sample number. TC and FC mean the number of total coliform and fecal coliform bacteria, respectively.

While, some food poisoning bacteria can grow high salt concentration. *Vibrio vulnificus*, *V. parahaemolyticus* and *V. alginolyticus* can grow at 6%, 8%, 10% salt concentrations, respectively. And what is worse *S. aureus* can even live at 15% salt concentration (Lee, 1977; Sneath et al., 1984; Krieg and Holt, 1984). Therefore some pathogens may cause food poisoning accident in *Jeotgal* because *Changran* and squid *Jeotgal* in circulation market have 8~9% NaCl concentration (Lee et al., 2001a, c). We had isolated *S. aureus* from raw squid material, but it was not pathogen (coagulase negative).

Falling bacteria in working rooms

Falling bacteria in working room may contaminate and change food quality. Falling bacteria detection was carried out during lunch time and during working time in thawing zone, packaging zone, seasoning zone, fermenting room and food additives room and subsidiary materials room etc. (Table 3). During working time a few colonies were detected, but there were much more colonies during lunch time than those detected during working time. While a few falling bacteria was detected in fermenting room where it had been cool and a few workers come in for a while.

Table 3. Falling bacteria in working room

Position	During working time (CFU/plate)	During lunch time (CFU/plate)
Thawing zone	<30	1.5×10 ²
Packaging zone	<30	2.3×10 ²
Seasoning zone	<30	<30
Fermenting room I	<30	<30
Fermenting room II	<30	<30
Fermenting room III	<30	1.1×10 ²
Food additives room I	<30	1.1×10 ²
Food additives room II	<30	5.8×10 ¹
Subsidiary materials room	<30	1.4×10 ²

Sterilized nutrient agar plates were placed for 30 min in working rooms.

From these results we could suggest that bacteria in air could rise and not fall because many workers walk about the room during working time. But they could fall because there was nobody during a break time. Therefore it is not good that materials on working keep leaving uncovered. It means that special measures are needed during the break time such as lunch time or exchanging working teams.

When workers have a recess time on the job, they must cover the working table with something.

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