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steps showed that aerobic plate counts in the washing processes were decreased at 0.26~2.20 log CFU/g. The coliforms were very similar to those of aerobic plate counts. But these were increased after the salting and rinsing processes of Chinese cabbage. The contamination in salting processes were higher levels than other processes at aerobic plate counts and coliforms 1.00~2.10 log CFU/g, 1.03~4.81 log CFU/g. It is estimated that contaminations by work environment temperature or reuse of brine. The pathogenic microorganisms have been identified as a negative. In conclusion, the results of biological hazard analysis will be utilized the basic data to secure the hygiene and safety in *Baechu Kimchi* manufacturing processes, and to develop the technology for hazard reduction.

#### P05-16

##### Antagonistic Microorganisms Isolated from Various Environments to Inactivate *Staphylococcus aureus*, *Escherichia coli* O157:H7, *Aspergillus flavus*

Yeri Lee\*, Jihyun Bang, Jee-Hoon Ryu. Department of Biotechnology, Korea University, Seoul 136-701, Korea

We isolated antagonistic microorganisms from various environments and measured their inhibitory activities against *Staphylococcus aureus*, *Escherichia coli* O157:H7, and *Aspergillus flavus*. Ten microliters of microbial suspension (471 isolates) or extracts (extracted from ca. 2,200 isolates) were dropped on tryptic soy agar (TSA) or potato dextrose agar (PDA) plates, and then 10 ml of molten TSA containing ca. 5 log CFU/ml of *S. aureus*, *E. coli* O157:H7 or molten PDA containing ca. 5 log CFU/ml of *A. flavus* were poured onto the corresponding agar plates. TSA and PDA were incubated at 37°C and 30°C, respectively, for 24-48 h before measuring the size (diameter) of inhibition zone. As a result, 10 antagonistic microorganisms and 22 extracts showed the inhibitory activities against *S. aureus*. The largest size of inhibition zone of microorganism (isolate no. 03656) and extract (isolate no. 02906) were 32 mm and 24 mm, respectively. For *E. coli* O157:H7, 5 microorganisms and 4 extracts showed antimicrobial activities. The greatest antimicrobial activity was shown from isolates no. 03707 (14 mm) and no. 02078 (10 mm), respectively. Against *A. flavus*, 18 antagonistic microorganisms and 7 microbial extracts showed antifungal effects. The microorganism (isolate no. 03289) and extract (isolate no. 02694) showed 22 mm and 7 mm of inhibition zone, respectively. In the future studies, the synergistic effect of combined antagonistic microorganisms against *S. aureus*, *E. coli* O157:H7, and *A. flavus* will be investigated.

#### P05-17

##### Comparison of the Efficacy of Sanitizers Containing Alcohol, Chlorine, Iodine, or Quaternary Ammonium against *Escherichia coli* O157:H7 Contaminated on Stainless Steel Surface

Ayoung Hong\*, Jihyun Bang, Jee-Hoon Ryu. Department of Biotechnology, Korea University, Seoul 136-701, Korea

We compared the efficacy of various sanitizers with different ingredients (alcohol, chlorine, iodine, and quaternary ammonium) in killing *Escherichia coli* O157:H7 on stainless steel surfaces. For each type of sanitizers, two commercial products were purchased from supermarket and online stores. To compare the efficacy of sanitizers, *E. coli* O157:H7 in biofilms on stainless steel coupon or attached to the surface of stainless steel knives used in food processing facilities were prepared. The initial population of *E. coli* O157:H7 in biofilms on stainless steel coupon was 8.9 log CFU/coupon. When treated with alcohol type sanitizers, *E. coli* O157:H7 in biofilm on stainless steel coupon was eliminated within 5 min. However, when treated with sanitizers containing chlorine, iodine, and quaternary am-

monium for 10 min, the numbers of *E. coli* O157:H7 remained >0.4, >2.1, and >2.4 log CFU/coupon, respectively. On the stainless steel knives, the populations (ca. 4.9 log CFU/cm<sup>2</sup>) of *E. coli* O157:H7 attached were decreased to below detection limit after treatments with all types of sanitizers within 10 min. Based on these observations, we concluded that the most effective sanitizer against *E. coli* O157:H7 on stainless steel surface was the alcohol type sanitizers. These results will provide useful information to select proper sanitizers for decontamination of pathogenic *E. coli* on food processing, distribution, and preparation environment.

#### P05-18

##### Probiotic Properties of *Lactobacillus sakei* with Cinnamoyl Esterase Activity from Korean Traditional Fermented Food, Jangajji

Yong-Geun Yun\*, Sang-Ho Baik. Department of Food Science and Human Nutrition, and Fermented Food Research Center, Chonbuk National University, Jeonju, Jeonbuk 561-756, Korea

Caffeic acid is one of free hydroxycinnamic acid, exhibiting strong antioxidant and anticarcinogenic properties, which can be produced by cinnamoyl esterase (CE) existing intestinal microbial strains including lactic acid bacteria (LAB). To understand biological roles of LAB with CE as probiotics, we tried to obtain LABs with CE activity from Korean traditional fermented food, Jangajji. Among the 110 strains isolated from Jangajji, 92 strains were confirmed as CE producing LABs by TLC and HPLC. When the obtained CE producing strains were classified by ARDRA as a simple and accurate method for identifying species of LAB, it classified into five restriction patterns. Homology analysis of the 16S rRNA sequences from the five different profile groups revealed that the groupA (2 strains) belonged to *W. hellenica*, the groupB (87 strains) belonged to *L. sakei*, the groupC (1 strain) belonged to *Leu. mesenteroides*, the groupD (1 strain) belonged to *L. brevis*, and the groupE (1 strain) belonged to *P. pentosaceus*. Among the 87 *L. sakei* strains, that is the dominant species, the 11 strains were shown the higher antioxidants activity (ABTs method) and antimicrobial activity (paper disc method) than other strains. When the selected *L. sakei* strains were further examined on their tolerance to unfavorable conditions (acid and bile), most of the *L. sakei* strains were able to grow in MRS broth with pH 2.0 except *L. sakei* A99. Moreover, bile salts (3%) didn't show any killing effect in all strains.

#### P05-19

##### 가스상 이산화염소 방출 Gel을 활용한 미생물 살균효과

류아라\*, 조종락, 오태환, 김준용, 임선아, 김아현, 김정목. 목포대학교 식품공학과

식품의 비가열 살균처리 방법으로 이산화염소수를 이용한 방법이 있으나 액체 살균제의 사용범위 제한과 살균 효력의 한계를 극복하고자 gel 형태의 이산화염소 방출제를 개발하고 식품에서 살균 효과를 확인하였다. 이산화염소수 농도가 각각 200, 500, 800, 1000 ppm에 겔화제로서 agar 1%를 첨가하여 제조한 이산화염소 gel의 가스방출 농도는 0.06, 0.20, 0.28, 0.62 mg/L로 나타났다. 이산화염소수의 첨가 농도에 따라 제조된 gel의 색도 변화도 농도가 높을수록 a-value는 감소하였고, b-value는 증가하였으며 L-value는 유의적 차이를 보이지 않았다. Gel형 이산화염소를 이용하여 식품 표면의 병원성 미생물에 대한 살균효과를 확인하기 위해 *Salmonella* Typhimurium과 *E. coli* O157:H7을 각각 골과 사과 표면에 접종하여 살균효과를 확인하였다. 골에서 *Salmonella* Typhimurium 대조구의 경우 초기 균수는 6.5 log를 나타내었는데 Gel형 이산화염소의 방출에 따른 0.28 mg/L에서 노출시간 10, 30, 60, 90 min에 따라 초기 균수에 비해 각각 0.1, 0.6, 1.5, 3.9 log 감소하였다. 사과 표면에서 *E. coli* O157:H7의 대조구 초기 균수는 8.5 log에 대하여

처리시간에 따라 각각 0.6, 1.1, 2.8, 4.4 log 감소하였다. 따라서 비교적 낮은 0.28 mg/L에서 90분 이상 처리하였을 때 4 log 이상의 살균효과를 확인할 수 있었으며 식품의 표면 살균에 적용이 가능하리라 여겨진다.

#### P05-20

##### Acid Resistance of *Cronobacter sakazakii* in Media with the Compositions of Infant Formula

Sung-Ran Jang<sup>1\*</sup>, Hyun-Jung Chung<sup>2</sup>, Woo-Suk Bang<sup>1</sup>.  
<sup>1</sup>Department of Food and Nutrition, Yeungnam University, Gyeonsan 712-749, Korea, <sup>2</sup>Department of Food and Nutrition, Inha University, Incheon 402-751, Korea

*Cronobacter sakazakii* is a gram-negative, facultative anaerobe, motile, non-spore-forming, and rod-shaped bacterium. This pathogen has been associated with bacteraemia, meningitis, necrotizing enterocolitis, and sepsis in neonates and infants. The objective of this study was to determine the acid resistance of *C. sakazakii* in laboratory media. Stationary phase of standard strains (ATCC 12868, ATCC 29004, ATCC 29544, ATCC 51329) and wild strains (EB 1, EB 5, EB 7, EB 41) were used in this study. At pH 2.5 in TSB, acid shocked *C. sakazakii* exhibited increased optical densities at 260 nm (nucleic acid) and 280 nm (protein) with the passage of time. At pH 3.5 in TSB, all 8 strains were able to survive with 0.24-4.31 log CFU/mL reduction. Moreover, 7 of the 8 strains exhibited higher D-values at pH 2.5 in TSB when cells were adapted in TSB with 1% lactose monohydrate or casein hydrolysate than that not adapted. Three strains exhibited significant differences in survival ( $P<0.05$ ) between infant formula adapted and non adapted. Therefore, the compositions of infant formula may be able to enhance the survival of *C. sakazakii* in acid stress environments.

#### P05-21

##### Acid Tolerance Response (ATR) of *Cronobacter sakazakii* in Reconstituted Powdered Infant Formula, Powdered Skim Milk

Sung-Ran Jang\*, Woo-Suk Bang. Department of Food and Nutrition, Yeungnam University, Gyeonsan 712-749, Korea

*Cronobacter sakazakii* was isolated from foods with low water activity food such as infant formula. This pathogen was more endured in dry environments than other *Enterobacteriaceae* such as *Citrobacter*, *Enterobacter*, *Escherichia*, *Klebsiella*, *Pantoea*, *Salmonella* spp. The objective of this study was to determine the acid tolerance response (ATR) of *C. sakazakii* in reconstituted powdered infant formula (PIF) and, powdered skim milk (PSM). Stationary phase of standard strains (ATCC 12868, ATCC 29004, ATCC 29544, ATCC 51329) and wild strains (EB 1, EB 5, EB 7, EB 41) were used in this study. *C. sakazakii* were able to grow with 0.18-0.56 log CFU/mL increases in pH 4.5 PIF, and strains were able to grow with 0.26-0.68 log CFU/mL increases in pH 4.5 PSM for 5 hours. The D-values of all strains at pH 2.5 in TSB were higher when cells were adapted at pH 4.5 in reconstituted PIF and PSM than pH 4.5 TSB, and 7 of the 8 strains exhibited significant differences in survival ( $P<0.05$ ) between PIF adapted or PSM adapted and TSB adapted. Acid tolerance response of *C. sakazakii* has important implications for microbiological safety assurance and should be considered when food preservation measures are developed.

#### P05-22

##### Identification and Characterization of Lactic Acid Bacteria with Tannase Activity as Probiotics Isolated from Korean Traditional Fermented Foods, *Jangajji*

Nho Eul Song\*, Sang Ho Baik. Department of Food Science and Human Nutrition, and Fermented Food Research Center, Chonbuk National University, Jeonju 561-756, Korea

Tannase (tannin acylhydrolase, EC 3.1.1.20) catalyzes the hydrolysis of gallic acid esters and hydrolysable tannins which naturally occurring plant polyphenols and significantly affected the nutritive value on many foods by binding and precipitating with various nutritive components. Moreover, tannins induce a negative response such as toxicity increasing and digestibility reduction, etc. when consumed as foods. In this study, lactic acid bacteria with tannase activity were isolated from 5 types of *Jangajji* and incubated in M9 agar plate with 0.2% tannic acid as a single carbon source. From total 110 lab strains which showed tannase activity by halo assay, 11 strains were selected as lab with tannase activity. TLC analysis showed that JBCC M1, M3, M5, M6, D1, D4, D6, G3, G4, and G5 degraded tannic acid and gallic acid to pyrogallol in whole cell reaction, except JBCC M2. Selected eleven strains were identified as *Lactobacillus plantarum* with 100% homology by 16S rDNA sequence analysis. To understand physiological and biochemical properties, the selected strains was evaluated by probiotic parameters. Among them, isolate *L. plantarum* JBCC M1 exhibited high survival rate against low pH (62.26%), hydrophobicity (77.47%) and cell surface aggregation properties (33.83%). The tannase activity of the selected *L. plantarum* JBCC M1 was comparable with *L. plantarum* ATCC 14917 (145.03 unit/mg protein) which already known as most higher tannase activity lab strain at present, showing 147.87 unit/mg protein.

#### P05-23

##### Characteristics of Bacteriophages for Lactic Acid Bacteria during Kimchi Fermentation

Young-Duck Lee<sup>1,2\*</sup>, Bong-Ju Kim<sup>2</sup>, Jong-Hyun Park<sup>2</sup>.  
<sup>1</sup>Department of Food Science and Engineering, Seowon University, <sup>2</sup>Department of Food Science and Biotechnology, Gachon University

Lactic acid bacteria (LABs) is recognized world widely as a important microorganism. Recently, bacteriophages have been studied for the reduction of pathogenic bacteria in various fields and the control of microbial population in ecosystem. In this study, we demonstrated that the population and characteristics of bacteriophages for LABs from Kimchi during fermentation. *Kimchi* samples from the fermentation were collected on days. Each sample was divided into several portions for microbiological and for isolation of bacteriophages and their hosts. In screening of phage for LABs, approximately 180 bacteriophages were isolated from *Kimchi* during fermentation. In addition, these LABs were identified by 16s rRNA sequence and included mainly *Weissella* spp. and *Lactobacillus* spp. Isolated bacteriophages belonged to the *Siphoviridae* and *Myoviridae*, respectively. Also, bacteriophages for LABs were changed through the succession of *Weissella* spp. and *Lactobacillus* spp. during fermentation. These results showed that bacteriophages were correlated closely to succession of LABs in *Kimchi* fermentation.

#### P05-24

##### Efficacy of Electrolyzed Activated Water (EAW) as Sanitizer on Bacteria

Jeong-Min Lee<sup>1\*</sup>, Hyun-Jung Chung<sup>2</sup>, Woo-Suk Bang<sup>1</sup>.  
<sup>1</sup>Department of Food and Nutrition, Yeungnam University, Gyeongbuk 712-749, Korea, <sup>2</sup>Department of Food and Nutrition, Inha University, Incheon 402-751, Korea

Electrolyzed Activated Water (EAW) has been introduced for